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ABBREVIATION AND ACRONYMS

$AgNO_3$	Silver tri oxo nitrate (V)
API	American Petroleum Institute
APHA	American Public Health Association
AQ	Air Quality
ASTM	American Society for Testing and Materials
BP	Bank Procedures
ACGIH	American Conference of Governmental Industrial Hygienists
BAT	Best Available Technology
BOD	Biochemical Oxygen Demand
Cd	Cadmium
cfu/ml	Colony forming unit per milliliter
Cl^-	Chloride ion
CH_4	Methane
Co	Cobalt
CEC	Cation Exchange Capacity
CO	Carbon ii oxide
HCO_3^-	Hydrogen trioxocarbonate (IV) ion
COD	Chemical Oxygen Demand
Cr^{3+}	Chromium (III) ion
Cu^{2+}	Copper (II) ion
CEDAW	Convention on the Elimination of All Forms of Discrimination against Women
CAP	Compensatory Afforestation Program
CDA	Community Development Association
CDS	Community Development Secretary
CSR	Corporate Social Responsibility
DO	Dissolved Oxygen
dB	Decibel
dB(A)	Aided Design and Drafting
ERGP	Economic Recovery and Growth Plan
EC	Electrical Conductivity
ECOWAS	Economic Countries of West African States
EAECL	Environmental Assessment and Evaluation Company Limited
EPZ	Export Processing Zones
EMP	Environmental Management Plan
EWE	East West East
ESE	East South East
E	East
EIA	Environmental Impact Assessment
EN	East North
ESE	East South East
EW	East West
EN	East North
EIS	Environmental Impact Statement
EU	European Union
EAR	Environmental Audit Report
Fe	Iron
FMEnv.	Federal Ministry of Environment
FNU	Formazin Nephelometric Unit
FMITI	Federal Ministry of Industry, Trade and Investment
FMEnv	Federal Ministry of Environment
FEPA	Federal Environmental Protection Agency

FRIN	Forestry Research Institute of Nigeria
FGN	The Federal Government of Nigeria
FOB	Free on Board
FRSC	Federal Road Safety Commission
GC	Gas Chromatograph
GDP	Gross Domestic Product
GDP	Gross Domestic Product
GFA	Gross Floor Area
GHG	greenhouse gas
HEMP	Hazards and Effects Management process
HAZID	Hazard identification and inventorization
ICT	Internet Communication Technology
ITGIP	Integrated Textile and Garment Industrial Park
ITGPS	Integrated Textiles and Garment Parks
IUCN	The International Union for Conservation of Nature
ILO	International Labour Organization
ISO	International Organization for Standardization`2
ITCZ	Inter-Tropical Discontinuity (ITD) or the Inter-Tropical Convergence Zone.
IUCN	International Union for Conservation of Nature and National Resources
LFTZ	Lekki Free Trade Zone
LASEPA	Lagos State Environmental Protection Agency
LAWMA	Lagos State Waste Management Authority
LASEPA	Lagos State Environmental Protection Agency
LASAA	Lagos State Signage and Advertisement Agency
LSWMO	Lagos State Waste Water Management Office
LASPARK	Lagos State Parks and Garden Agency
LMIP	Lekki Modern Industrial Park)
LUFASI	Lagos Urban Forest and Animal Sanctuary Initiative ()
LSMEnv	Lagos State Ministry of Environment
LFN	Laws of the Federation of Nigeria
LGAs	*Local Government Authority*
mg/l	Milligram per liter
MPH	Miles Per Hour
MINE	Made in Nigeria for Exports
ND	Not detected
Ni	Nickel
NS	Not Specified
NW	North West
NE	North East
NEPZA	Nigeria Export Processing Zones Authority
NESREA	National Environment Standards and Regulations Enforcement Agency
NBS	National Bureau of Statistics
NIMET	Nigerian Meteorological Agency
NEAQCR	National Environmental Air Quality Control Regulation
NPC	National Population Commission
NNW	North North West
NW	North West
OES	Office of Environmental Services
ODS	Office of Drainage Services
OP	Operational Policies

PIU	project implementation unit
QHSE	Quality, Health, Safety and Environment
Pb	Lead
pH	Hydrogen ion concentration
PM	particulate matter
S	South
SD	Standard Deviation
SSW	South South West
SW	South West
SE	South East
SSW	South South West
SW	South West
SW	South West
SES	South East South
SWE	South West East
SW	Surface Water
SO_2	Sulphur iv oxide
SPM	suspended particulate matter
SEZs	Special Economic Zones
SAP	Structural Adjustment Programme
SPL	Sound pressure level
SSS	Safe site selection
SCOPE	Scientific Committee on the Problems of the Environment
TDS	Total Dissolved Solids
THC	Total Hydrocarbon content
TS	Total Solids
TSP	Total Suspended Particles
TSS	Total Suspended Solids
ToR	Terms of Reference
TROBIT	Tropical Biome in Transition
TBA's	Traditional Birth Attendants
TVOCs	Total Volatile Organic Compounds
US EPA	United States Environmental Protection Agency
US	United Stated
UNFCCC	United Nation Framework Convention on Climate Change
UNEP	United Nations Environmental Programme
UGTL	Underground Transmission Lines
µS/cm	Micro Siemens per centimeter
VOCs	Volatile organic compounds
VES	Vertical Electrical Sounding
WEW	East West
WNW	West North West
WNW	West North West
WSW	West South West
WNW	West North West
WS	West South
WE	West East
WN	West North
WHO	World Health Organization
WSW	West South West
WSUDS	Water Sustainable Urban Drainage Systems
WTP	Construction of Water Treatment Plant

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EXECUTIVE SUMMARY
BACKGROUND INFORMATION

The Federal Government of Nigeria recently launched the Economic Recovery and Growth Plan (ERGP) to achieve greater economic diversification and promote long-term sustainable development. The trade and competitiveness agenda is at the heart of this strategy to restore growth and facilitate the economic recovery.

Developing Special Economic Zones has been identified as a key enabler and the Federal Ministry of Industry, Trade and Investment (FMITI) is eager to unlock the potential of these zones to diversify exports; boost manufacturing's share of Gross Domestic Product (GDP), create new jobs, leverage the country's endowments and maximize comparative advantages. Again, FMITI's thinking of why SEZs should be a key focus to diversify exports and enable an economic recovery:

The FMITI has set up the Project MINE (Made in Nigeria for Exports) to foster the development of world class export-oriented Special Economic Zones (SEZs) in the country by:

- Fast tracking the development of one export oriented SEZs;
- Bringing in PPP partners to help transform Government owned SEZs;
- Developing world-class greenfield SEZs across Nigeria; and
- Creating a supportive enabling environment for SEZs.

The Lekki Free Trade Zone has been identified as one of the model pilots and is set to become a manufacturing hub of South West Nigeria, serving a market of 30+ million consumers. Lekki Free Trade Zone is envisioned as a holistic industrial city acting as a gateway to regional Economic Countries of West African States (ECOWAS) and international markets via Apapa and planned Lekki and Badagry ports focused on Internet Communication Technology (ICT), agro-allied petrochemicals and textiles industries. It also aims at serving export markets in West Africa and beyond. The project's ambition is to create more than 300,000 jobs, generate USD 9.7 bn export value in 2027 and attract USD 60 billion in FDI.

Federal Ministry of Industry Trade and Investment (FMITI) considers that:

- The global textile sector is an attractive growth industry, expected to grow by 4-5%, with apparel and sportswear expected to grow by ~4% and ~7%, respectively.
- Nigeria is well positioned to take advantage of key trends in textile manufacturing, such as shifts to lower cost countries with greater proximity to raw material inputs and global markets.
- The Nigerian government has prioritized and is allocating resources to develop the textile and garment sector in order to leverage inherent Comparative Advantage and rebuild the sector into regional prominence.

In order to deliver the project, land covering 1,000 ha was acquired by the Federal Ministry of Industry Trade and Investment (FMITI). Dar has been commissioned by the FMITI as the pre-developer, responsible for preparing a master plan for the first phase, and a financial model. In order to enable this vision to succeed, a first concept framework has been developed for the overall Lekki Model Industrial Park. This provides the setting for the first phase (Phase 1) covering 150 hectares, for which the master plan has been developed.

The first phase is focused exclusively on the construction of Garment and Textile industries, where the desired industrial/manufacturing development is implemented in association with essential business offices, commercial, customs, recreation and required infrastructure developments to make it a state of the art Industrial Park.

In compliance with the Nigerian Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, the World Banks Operational Policy 4.01: Environmental Assessment (1999), revised April 2012) and the Equator Principles among others, an Environmental Impact Assessment (ESIA) study becomes an obligation for the approval of the proposed Textile and Garment Industrial Park project.

In view of the above, the Nigeria Export Processing Zones Authority (NEPZA) engaged Messrs: Environmental Assessment and Evaluation Company Limited **(EAECL)** - an Environmental and Technology Management consulting company duly registered and accredited by the Federal Ministry of Environment (FMEnv) to carry out a comprehensive Environmental and Social Impact Assessment (ESIA) for the proposed Textile and Garment Industrial Park in Lekki Free Trade Zone, Lagos State.

THE PROPONENT

The Nigeria Export Processing Zones Authority (NEPZA) is the proponent of the proposed Integrated Textile and Garment Industrial Park (ITGIP) as an industrial Complex exclusively Industries in the cluster format.

PROJECT LOCATION

The proposed Lekki Integrated Textile and Garment Industrial Park (Phase1) is located in the Lekki Free Trade Zone (LFTZ). LFTZ is in Lagos State, Nigeria. The site can be accessed through Yegunda earth road that T-off from Lagos – Epe Expressway by Alaro City Project site. It is situated on a parcel of land that is approximately 150 ha in size inside the 1000 ha Ultimate Phase within the North East quadrant which lies in the North East portion of the LFTZ located in Epe Local Government Area of Lagos State.

POLICY LEGAL AND INSTITUTIONAL FRAMEWORK

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

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

Policy Framework

National Environmental Policy

Some specific laws include:

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

National Land Policy

The legal basis for land acquisition and resettlement in Nigeria is the Land Use Act of 1978, modified in 1990.

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

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

Social Protection Policies

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

Federal government-led social protection includes three main programmes:

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

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

LEGAL FRAMEWORK

National Legislations

The national legislations include:

- The Environmental Impact Assessment (EIA) Act Cap E12 LFN, 2004
- National Resource Conservation Action Plan, 1992
- Land Use Rights Act No. 6, 1978
- Sea Fisheries ACT, CAP S4, LFN 2004
- Nigeria Maritime Administration and Safety Agency
- Nigerian Free Trade Zone Act No. 63, 1992
- Nigeria Export Processing Zones Act (CAP N107 LFN 2004)
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act, 2007
- The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004
- Water Resources ACT, CAP W2, LFN 2004

- The Inland Waterways Authority Act 13 of 1997
- Harmful Waste (Special Criminal Provisions) ACT CAP H1, LFN 2004
- The Forestry Act
- The Endangered Species Act, CAP E9, LFN 2004
- The Factories Act, 1987 (Factory Act cap 126, LFN, 1990)
- Labour Act - CAP. L1 L.F.N. 2004
- Wages Board and Industrial Council Act, 1974
- Workers' Compensation Act, 1987
- Standards Organization of Nigeria (SON) Act CAP 412 LFN 1990
- EIA Procedural Guidelines
- Environmental Impact Assessment Sectoral Guidelines (Manufacturing Industries)
- National Environmental Regulations

LAGOS STATE LAWS

The Lagos state laws include:

- Lagos State Environmental Protection Agency (LASEPA)
- Lagos State Ministry of Environment
- Lagos State Environmental Pollution Control Law Cap 46 of 1989
- Lagos Waste Management Authority 2008
- Lagos State Waterfront Infrastructural Development Law, 2008
- Road Traffic and Vehicle Inspection in Lagos State, 2012
- Construction Workers Safety Law, 2003

Institutional and Administrative Framework

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

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Environment (FMEnv)
- Federal Ministry of Industry Trade and Investment (FMITI)
- Nigeria Export Processing Zone Authority (NEPZA)
- NEPZA Project Implementation Unit (PIU)
- Lagos State Ministry of Environment
- Lagos State Environmental Protection Agency ("LASEPA")
- Lagos State Lands Bureau
- Epe Local Government Area
- Village Chiefs (Baale) of Affected Communities

International Guidelines and Conventions

In addition to the national laws/regulations, Nigeria is signatory or party to several international conventions and treaties that support the use of EIA as the key tool for achieving environmentally sustainable development. The EIA shall be guided by the international environmental and social regulations from IFC/World Bank where applicable. All other relevant international guidelines and conventions, and industry best management practices shall also apply, including the international financing community.

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

- African Convention on the Conservation of Nature and Natural Resources
- RAMSAR Convention on Wetlands of International Importance
- Convention on Biological Diversity
- Endangered Species (Control of International Trade and Traffic)
- Conservation of Migratory Species of Wild Animals (1973)
- Convention to Combat Desertification (1994)
- United Nation Framework Convention on Climate Change (UNFCCC) 1992.
- International Union for Conservation of Nature and National Resources (IUCN) Guideline, 1996.
- The “Equator Principle”
- World Bank Operational Policies.
- Public Health Legislations and Regulations.
- The Rio Declaration on Environment and Development
- The Kyoto protocol, Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.
- The African Convention on the Conservation of Nature and Natural Resources, 1968.
- Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)
- Human and Peoples’ Rights on the Rights of Women in Africa in 2005
- Civil and Political Rights Covenant
- Economic, Social and Cultural Rights Covenant
- Convention on the Elimination of All Forms of Violence against Women
- ILO Occupational Safety and Health Convention, 1981

ILO Conventions and Core Labour Standards

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

The core labour standards consist of five standards, laid out in eight conventions:

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

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

World Bank Safeguard Policies

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

IFC Performance Standards for Investment

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

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

Performance Standard 2: Labour and Working Conditions

Performance Standard 3: Resource Efficiency and Pollution Prevention

Performance Standard 4: Community Health, Safety, and Security

Performance Standard 5: Land Acquisition and Involuntary Resettlement

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

Performance Standard 7: Indigenous Peoples

Performance Standard 8: Cultural Heritage

World Bank Policies

The World Bank has 10 Environmental and Social Safeguard Policies to reduce or eliminate the adverse social and environmental effects of development projects, and improve decision making. Based on the general applicability of these policies to development projects, the proposed project will trigger four of these policies - Environmental Assessment, Natural Habitat, Involuntary Resettlement, and Forests.

Terms of Reference for the EIA

In November 2019, the Terms of Reference (ToR) for the EIA for this project was approved by FMEnv. It was agreed that the principal aim of the EIA process for the proposed Textile and Garment Industrial Park (Phase 1) was to determine any potential environmental impacts and to provide guidance to minimize or avoid any adverse impacts upon the environment (from baseline to construction and during operation), through appropriate mitigation and management recommendations. The preparation of an Environmental Management Plan (EMP) would ensure proper implementation of mitigation and monitoring measures. In addition, the EIA aims to inform decision making and to promote environmentally sound and sustainable development.

Need For the Project

It has been proven that the textile industry is, indeed, a driver of growth and employment globally.

The deployment of US $378.75 Million into the textile and garment manufacturing sector will certainly propel infrastructure development and in a way raise the standard of living of people in the host communities in particular and Nigeria in general.

Project's Sustainability

The important factors considered to reach project sustainability include – technical, economic, environmental and social. They are related to practical aspects related to economic profitability, technical resources, and all, with an efficient management. The project will be environmentally sustained by incorporating into project design, practical mitigation measures or controls proffered for the identified environmental impacts of the proposed project. The proposed Project is technically sustainable because of NEPZA's track record of strict adherence to Nigerian National (and International) engineering codes and standards. Only proven technologies that are economically viable with minimal environmental, social and health impacts readily available shall be utilised in the execution of the project and the project will attract a lot of improvements in the social wellbeing of communities neighbouring the project area.

Project Location Alternatives

The important factors that influence the site selection include:

- Proximity to the Lekki - Epe expressway, which links the Project Site to prominent activity hubs of the city.
- Situated adjacent to a proposed Lekki deep sea port and in vicinity of a proposed Lekki international airport, thereby expected to enhance future potential of the development
- Proximity to Dangote Refinery and Petrochemical industry, petrochemical feedstock for Man Made Fibre (MMF) production will be readily available.
- Site located on the Coastal Road, which runs along the southern part of the Lekki Peninsula (currently characterized by good congestion free access /connectivity.
- Presence of Lekki Lagoon south of the project site (the deepest natural lagoon in the state)
- Good access to other part of Nigeria
- Environmental considerations
- Land availability
- Acceptability of site from Environmental aspects like availability of areas for solid
- waste / liquid effluent disposal

PROJECT DESCRIPTION

The first phase of the proposed Textile and Garment Industrial Park is focused exclusively on the construction of Garment and Textile industries, where the desired industrial/manufacturing development is implemented in association with essential business offices, commercial, customs, recreation and required infrastructure developments to make it a state of the art Industrial Park. Accordingly, a summary of the classification of the major activities that will operate in the proposed Textile and Garment Industrial Park is given in table 3.1 Hence, in order to fully understand and propose an appropriate environmental management by way of the EIA, the nature and type of industries, proposed supporting facilities and businesses, land use and layout of all activities as well as the infrastructural development necessary need to be explained in order to arrive at a comprehensive EIA.

The description of the proposed Textile and Garment Industrial Park project is given here-under based on what has been provided by the feasibility and master plan studies for which the EIA is done.

Development Objective

A world-class industrial business park today requires an environment that strikes a balance between core industries and their supporting services and amenities. Current regional surveys show that a preferred industrial business environment is one that provides the following amongst numerous others:

- Electric Power ;
- Green area;
- Telecommunication services;
- Land and marine access;
- Security;
- Healthcare Facility
- Access roads
- Heliport

Strategic Plan Framework

In order to provide a setting for the detailed Phase 1 Masterplan (150ha), a strategic plan framework has been developed for the wider area, within the North East Quadrant.

This section sets out the vision, the principles, the development process and the detailed options that inform the steps taken in developing the masterplan.

Vision

The Lekki Model Industrial Park will be a high quality industrial site that provides employment and generates wealth for Nigeria. Set within the rapidly developing industrial complex of Lekki, the Model Industrial Park will become a landmark that sets a high standard and is an attractive place in which to invest and work.

Principles

In order to guide the development of the strategy, the following principles have been adopted in structuring the concept masterplan:

- Adding a passenger station on the rail line would promote the use of public transport for access of the workers to places of employment;
- The station would form an anchor to a new town centre, that provides local retail facilities and services;
- Residential development to be provided to the north, overlooking the Epe Creek and to take advantage of the attractive setting;
- Commercial development to stretch along the east-west road to the north;
- The industrial complex to contain units of a variety of plot sizes to promote flexibility;
- A green grid network to provide an interconnected system of open spaces;
- The green grid network to also provide a network for storm water drainage;
- Rail sidings to enable local use of the rail line for freight;
- A hierarchy of roads to direct traffic and manage vehicular flows;
- Streets and roads to be gently curved as a means to provide visual interest, work with the natural physical context and encourage slower traffic speeds;
- A green corridor extends along the east of the site to provide a buffer with the residential developments;
- The street network to be integrated and connected to the neighbouring areas as identified
- in the 2008 Lekki FTZ Master plan 2008

Phase 1 Masterplan

Master planning has a lasting impact on how an industrial park develops, operates and is integrated into surrounding areas and communities. It defines the connection between the topography, land use, infrastructure, public right-of-way, buildings, social settings, and their surrounding environments.

Design Approach

Figure 5.21 identifies the approach taken in developing the master plan. The following initiatives have been undertaken:

- The main east-west Primary Road is gently curved, so as to provide visual interest for moving vehicles, while also being a green route with planting either side;
- The Primary Road is to be heavily planted so as to create a greened visual environment;
- The building line is set back from the plot edges along the Primary Road to reinforce the visual setting of an open and greened environment;

- Few direct entrances are provided into plots from the Primary Road; entrances are primarily for the headquarter buildings which seek to provide an important and visible frontage along the Primary Road;
- Buildings fronting onto the Primary Road network are important as they form the public face of the overall development, and provide advertising opportunities for the businesses located there, while also being a visual indicator of the importance of the business;
- The streets that join onto the Primary Road are straight roads, with the vista terminating on an important building, usually an office headquarter building. This provides an opportunity for the relevant business to be located in a visually prominent location and mark out the entrance into the northern or southern industrial community;
- Plot entrances are primarily provided from the Collector Road, and in the case of larger plots, two entrances are provided as a means to separate cars from trucks and lorries;
- A linked green network connects the swale with the sports facility and park in the east of the site, as a means to provide a network of usable open space;
- Smaller units that are ideally suited to start-ups will be located opposite the sports facilities. These facilities will become the centre of the industrial area’s community life, around which events and inter-business sports events can be held. This will get the businesses to engage together and become a hub for exchange, benefitting both small and large businesses to grow and develop.

LANDSCAPE

A key focus of the landscape proposal is to create a robust and resilient framework that accommodates native habitats and harvests water runoff. To achieve this, the landscape strategy proposes the development of a smart Blue and Green infrastructure network comprising a series of productive and resilient landscape systems. These will provide a number of benefits including:

- Flood mitigation and protection;
- Rainwater harvesting;
- Wastewater remediation;
- Storage and reuse of rainwater;
- Increase in staff productivity;
- Micro-climate management;
- Improved air quality;
- Aesthetically pleasing spaces; and
- Improved accessibility and connectivity.

The Blue and Green infrastructure network forms a series of open spaces that fall into five main, functionally linked types. These are presented in the following detailed sections:

- Central Swale;
- Industrial Gardens;
- Nature Reserves;
- Street Drainage Channels;
- Urban Realm.

The spatial distribution of each type is identified in Figure 3.3.

The Central Swale

A dynamic landscape that accommodates rain and floodwater, treats gray water with the use of terraced gardens and provides recreational opportunities. The Central Swale is an interconnected drainage channel that crosses the whole Model Industrial Park north to south as a means to drain rainwater.

Industrial Gardens
These provide water management/filtration, flood protection, and a healthier environment for end users. Integrated as small-sized linear elements in response to the limited land availability, they are interconnected to larger local and regional networks.

Nature Reserves
Preservation of natural patches of forest

Street Drainage Channels
Street drainage channels will be integrated in the streetscape design and designed to function together with the conventional drainage infrastructure. The design will be based upon the street type:

Urban Realm
The drainage channels are integrated in the streetscape design and are designed to function together with the conventional drainage infrastructure. The design will be based upon the types of urban realm:

Landscape Systems and Typologies

The five typology areas are detailed as follows:-

- Central Swale
- Nature Reserves
- Industrial Gardens
- Street Drainage Channels
- Public Realm

LAND USE PLAN
This is explained under the following:

- Land Use Distribution
- Plot Distribution

INSIDE FENCE INFRASTRUCTURE
Under this we have Onsite Roads, Potable Water Supply, Security Fence, Storm Drainage, and Process Water

Onsite Roads
The road plan of the industrial park can be appreciated considering each of the following:

- Primary Road
- Collector Road
- Local Road
- Central Green Corridor
- Service Road

Potable Water Supply
Construction of Water Treatment Plant (WTP) of capacity 200,000 m^3/d and related works (intake works, pumping station, storage reservoir, etc.) are proposed at Oshun River to serve for both the demand of Lekki Sub Region and Lekki FTZ; however, for the Lekki Industrial park only 32,000 m^3/d is required. From WTP the water shall be conveyed through Transmission Mains to Distribution Centre within Lekki Industrial Park. The WTP will

- treat the water at WHO standards

- supply the water to consumer 24 hours a day as per intermittent demand with minimum required pressure
- decentralized water supply system so that inconvenience to the consumer is minimal

OUTSIDE FENCE INFRASTRUCTURE

Under this we have the following:

- Railway Station
- ICT Network
- Gas Supply
- Electrical Power
- Offsite Road

The project is further described under the following: Indicative utility consumptions, provision of facilities for community facilities, utilities for common area infrastructures, project waste and tentative project schedule.

PROJECT WASTES

A lot of wastes of different kinds are expected and generated during construction, decommissioning/dismantling, operation, and maintenance. Table 3.14 shows sources, disposal method, place of disposal and the responsible party.

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

- Leaves, branches, trunks, grasses from the clearing of the vegetation in the Project site.
- Kitchen wastes from human feeding and activities involving many workforces.
- Scrap metals – from cuttings, fittings, rods, nuts, bolts, and welding etc.
- Concrete waste – from foundations including building construction.
- Nylons/Plastics packaging materials – from textile and garment production, pieces of fabrics wrappings, water sachet, food etc.
- Oil spills from heavy duty machinery and equipment, vehicle engines during maintenance work.
- Human wastes – from activities of personnel involved in the work or secondary business group.

TENTATIVE PROJECT SCHEDULE

The actual activity from commencement of site preparation to decommissioning is expected to last approximately thirty-six (36 months) months

Procurement Period

The construction of the common infrastructure and buildings on serviced plots is to be procured on the basis of a detailed design. It is assumed that the procurement on this basis will take 6 months to complete.

Construction Period.

At the Workshop on 16 October 2018. FMITI identified the construction and commissioning period of the inside fence infrastructure and a similar period to build factories and hand them over to the future users for fitting out and commissioning. At the meeting with NEPZA on 1 July 2019, it was agreed that a construction period of 24 months expected to start on 1 January 2020 will be assumed.

NEPZA is strongly committed to the completion of the proposed Integrated Textile and Garment Industrial Park (Phase 1), and every effort is geared towards actualizing this goal. The proposed project execution schedule is presented in Table 3.16 and indicates construction period of 24 months expected to start on 1 January 2020.

The implementation schedule for the construction of the proposed Integrated Textile and Garment Industrial Park (Phase 1), would follow the under-listed duration.

BASELINE STUDIES

Baseline field sampling/ studies of the components described: the physic-chemical environment (Meteorology, geology, sediment, soil type and distribution, surface/groundwater characteristics), biological environment (location and distribution of benthos, plankton, fisheries, flora and fauna characteristics) as well as socio-economic and health status of the people and their environment was carried out.

CLIMATE AND METEOROLOGY.

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

Rainfall

The mean annual rainfall within Lagos State for the period 1987 to 2017 ranged from 13.8 mm in January to 282.6 mm in June. Rainfall distribution was observed to be highest in the months of June, followed by July, September and May. The lowest was in January and December.

Air Quality

Measured concentrations of TSP were within withing the FMEnV limit of 250 $\mu g/m^3$ at 28 points out of the 40 sampled points. The one hourly average concentration level of TSP, 355.93 $\mu g/m^3$, exceeded the FMEnV limit of 250 $\mu g/m^3$.This may be attributed to the dispersal and subsequent suspension ash remains from combustions.

The average of measured concentrations of SO_2, CO, CO_2 and VOC for wet and dry seasons, were less than their respective limits recommended of the National Environmental Air Quality Control Regulation (NEAQCR) 2014.

The minimum measured noise levels during the study were below both the sleep disturbance limit (Berglund et al, 1999) of 45 dB(A) and the WHO's limit of 55 dB(A) for ambient environment. The measured noise level in the location are attributable to the sound of sawing machine used for felling trees and turning logs to planks before transportation the nearby towns.

CLIMATE CHANGE STUDIES

Climate change impact/estimate of greenhouse gas emission from the proposed project were assessed in order to provide an indication of what amounts will be contributed through the project phases and to find ways to mitigate the impact. GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide N_2O. The various phase considered are: Construction Phase, Operation Phase and Decommissioning Phase.

Construction Phase

Total greenhouse gas emission associated with road construction is estimated to be 0.68 tCO_2e.

Operation Phase

Decommissioning Phase

It is expected that during the decommissioning stage, the `buildings would be retained and possibly converted for other functionary activities. The reclamation of the forest would ultimately serve as carbon sink for the project site.

REGIONAL GEOLOGY

The study area lies within Lagos State. Lagos State lies in Southwestern Nigeria and the formations found here occur within the sedimentary series. According to Jones and Hockey, (1964) the geology of Southwestern Nigeria reveals a sedimentary basin which is classified under five major formations. The state overlies the Dahomey basin which extends almost from Accra in Ghana, through the Republic of Togo and Benin to Nigeria where it is separated from the Niger Delta basin by the Okitipupa ridge at the Benin hinge flank. According to their geological formation age the five formations include: the Littoral and the Lagoon deposits, Coastal Plain sands, the Ilaro formation, the Ewekoro formation and the Abeokuta formation overlying the crystalline basement complex with their ages ranging from Recent to Cretaceous.

Four of these formations, excluding Ilaro, constitute aquifers in the Dahomey Basin, from which the geological section of Lagos was drawn. The Ilaro formation is composed predominantly of shaley clay (argillaceous sediments). Limestone forms the aquifer material in the Ewekoro formation while sands and gravels constitute the materials in aquifers of the recent sediments, Coastal plain sands and Abeokuta formations contain brackish water.

Groundwater

Ground water sample were typically collected from the discharge line of the borehole while for the shallow hand dug wells, samples were collected by directly dipping the sample bottles into the groundwater. In wet season only one borehole, named borehole 2, was located at 4° 0' 25.38" E, 6° 31' 38.1" N at the proposed project site and water sample was taken from it. In the dry season, borehole 1 and borehole 3 were located at 4° 0'39.91"E , 6°31'50.62"N and 4° 0'42.95"E, 6°31'26.29"N respectively but water sample could not be taken as the boreholes were closed and groundwater could not be accessed.

SURFACE WATER

In the course of this study, a total of nineteen (19 No) surface water samples, inclusive of two (2 No) Control, were collected from nine (9No) streams and ten (10) lagoon (Epe Lagoon and Lekki lagoon) within the proposed project area in the wet season while in the Dry Season, a total of ten (10 No) surface water samples, inclusive of two (2 No) control were collected from Epe lagoon (North of the proposed project site) and Lekki lagoon (South of the proposed project site). There was no water sample taken from the streams during the dry seasons they were all dried up.

Flora and Fauna

The results showed that majority of the plant species encountered do not fall to the categorization of IUCN Red lists while some are carrying Least Concerned (LC) recognition. *Raphia sudanica* is the only species that is listed as Near Threatened (NT). *Funtumia elastic, Albizia zygia* and *Sterculia oblongata* have not yet been assessed for the IUCN Red List, but is in the Catalogue of Life. *Albizia ferruginea* and *Terminalia ivorensis* flora species were vulnerable and this does not have much impact on the flora and fauna diversities in the area. Therefore the location of the Project in the study area will create little or no impact on flora and fauna in the vegetation belt of the project.

The fish composition of the project area include *Schilbe mystus, Tilapia guineensis, Sarotherodon melanotheron, Hemichromis fasciatus, Chromido tilapia guntheri guntheri . Pellonulla leonensis,* *Ethmalosa fimbriata* , *Mormyrus rume* , *Chrysichthys nigrodigitatus, Chrysichthys filamentosus,* Claridae *Clariasis heriensis* , *Clarias gariepinus* , *Heterobranchus longifilis, Brycinus longipinnis* , *Distichodus rostratus* , *Elop slacerta* , *Synodontis clarias, Synodontis nigrita, Sphyraena barracuda, Caranx hippos.*

Inventory of the site was conducted in plotless sampling points where fauna inventory was carried out. Both direct sighting, observation indices of presence. In addition, information was obtained through interviews with hunters, dealers in animal products,
The survey showed a total of 261 wildlife species including the mammals, birds and reptiles. The result of the survey showed that out of the 8 diurnal insect species listed, the largest number was observed in Hymenoptera Order accounting for 50%. This was followed by Diptera with 37.5% and Lepidoptera with 12.7%. The observed species of insect include: Spider (*Hysteroccrates laticeps*), ants (*Camponotus pennyslavanis*), Grasshopper (*Zonocerus variegatus*), (Caelifera), Wasps (*Polistes galicus*), termites (*Cryptotermes brevis*) and Butterfly (Lepidoptera).

Bush buck (1), Sitatunga (1) Grass cutter (18), were the most abundant of all the mammals found. Other mammals found include: Mona monkey, Palm squirrel, Fruit bat, but in low quantity. All the species encountered in the studies are common and are not listed in the IUCN Red list of endangered species.
Wood pecker, Laughing dove**,** Cattle egret, Village weavers etc. were the most abundant bird species in the area. Most of these species are classified as least concerned and are not threatened by the proposed project directly. Presence of some birds was as a result of farmlands within the project location. 23 species of bird have be reported identified at Murtala Mohammed Bontanical Garden 3.38 km west of the project location.

SOCIO-ECONOMIC AND HEALTH STUDIES

ETHNIC COMPOSTION

A high proportion (96%) of the communities' residents were of the Yoruba ethnic group and speak the Yoruba language with the Ijebu dialect. The inhabitants claimed that they were born in their communities and have lived all their life in the communities. The settlements are largely rural with few houses; predominantly hamlets and villages.

The communities also have the same culture and tradition of the Yoruba people in general. This is clearly demonstrated in their marriage, burial, traditional religious practices and in their general living habits and conditions. Religious festivals are celeberated regardless of the affliations of the people; confirming the rural nature of the communities. Only two respondents are from other ethnic groups apart from Yoruba.

Religion

The inhabitants in all the communities of study belong to three religious affiliations, namely: Islam, Christianity, and Traditional religion. Most of the respondents (87%) claim Islam as their primary religion, fewer people showed affiliation to Christianity. Among those that claimed traditional religion (3%).

Traditional style

All the communities studied claimed that their ancestors migrated from Ijebuland in Ogun State to settle in their present day communities. They claimed that their forefathers were great farmers and till date farming is still their main occupation. The quest to acquire more expanded land for farming and to acquire more independence and freedom influenced their forefathers' migrations. The migration thus afforded the people the opportunity to acquire the land on which they settled for agricultural, hunting and development purposes.

Traditionally, the first settler became the head of the community where they settled and in most cases the community is named after him. So most communities bear the name of the founder or first settler or the location in relation to the lagoon among others.

OCCUPATION

The major occupations of the people of the communities are fishing and farming, which accounted for 95.0% of all occupation categories. According to the respondents, these two occupations are done pari parsu on daily basis.

INDUSTRY

Only cottage industry is common in the project area apart from Yegunda that has more stable buildings. The industries included boat making from forest wood and cassava pressing machine. Due to the rural nature of the communities, there wre no standard industries in the area. Garri processing is done manually. This can be mechanized to achieve large production except that the women folk that are pre-occupied may be out of job if no alternative is provided.

INCOME

The average monthly income in the communities was poor and most people earned about ₦20,000 monthly. The breakdown of the income levels from respondents was as follows: between ₦5,000 and ₦15,00 per month (8.3%); ₦20,000 (55%) and ₦80,000 (1.7%). A good proportion of the residents were not able to estimate their monthly income (35%), these people are predominantly subsistent farmers who combine such with some craft making.

EDUCATION LEVEL

The Educational status showed that about 53% of respondents have had at least primary education and can speak (i.e. communicate orally) as well as read and write using Yoruba Language. Respondents that have had secondary and tertiary education were few (19%). About 30% of the residents had no formal education.

EDUCATIONAL FACILITY

Most communities do not have schools except Yegunda that has a primary and Secondary school. The children live and reside in epe town to attend schools, especially the primary and secondary.

WATER

Inhabitants of the impacted community obtain domestic water from rivers, streams and the Lagoon (98.3%) while only one person claimed the existence of borehole water in Yegunda. Further interaction showed that the borehole facility is dysfunctional. Hand dug hole which is less than a standard well exist in Oke-Egan, Idiroko and Idomu

Electricity

Most of the communities have no electricity supply from the National Grid of EKO Electricity. 95% of the respondents use energy from wood for the basic energy supplies. Less than 25 used kerosene to power lamps that will illuminate their residence.

Transportation facility

Apart from the major roads that linked Lagos and Epe, there is no tarred road in the project impacted area. There are untarred and narrow roads that meander through the forest cover across the communities. These roads are largely impassable during the wet season due to streams that cross the roads, hence it is a common experience to see vehicles sinking at such spots. Other oncoming vehicles must wait on such occasions for evacuation of the trapped vehicle for other users to use the road.

Health care facility
The communities had no Primary Health Care Centre nor private clinic for care provision to the people. All the communities' members visit Epe town for proper medical care. For Instance, Eyin Osa community is an island. Sick people are usually conveyed in paddled canoe to Epe General Hospital. Depending on the means of transport used, most residents will require not less than one hour to reach the nearest health care centre in Epe. This implies that only health conditions considered to be very serious will make the residents to visit hospitals; they will generally use self-medication, traditional herbal remedies for most of their health issues, which may aggravate or become irreversible before turning to hospitals for care.

Security facility
There were no police post or station across the length and breadth of the communities. The nearest point where police presence was seen was at an ongoing project site in Alaro City phase 1. As expected, the security personnel sighted there were to provide protection for the workers on-site. This type of privately arranged security will not accept to provide any cover for the community protection.

Waste management
Residents of the communities simply dump their refuse at specific designated places at the back of their homes for final disposal by burning or burying. Most of the people (99%) use open defecation in the bush while a few (1.0%) use the river water. There was no pit-toilet or modern day water cistern flush toilets in the communities

Needed Infrastructures in the Communities
Residents of the communities realizing the dare need of infrastructure in the communities expressed their desire for the provision of these basic facilities. A cursory look at the list of needed facilities in the project area depicts the crude nature of living and hardship faced by residents in the area. Recurring among the infrastructure needs are potable water, hospital, primary and secondary school, tarred road and employment. NEPZA and other companies that will site their projects in the area should consider these identified projects by the communities under the Corporate Social Responsibility (CSR).

POTENTIAL AND ASSOCIATED IMPACTS

The potential and associated environmental, social and health impacts of the proposed Textile and Garment Industrial Park and associated facilities project as well as the results from the entire process are described under the following phases: Construction Phase, Operational and Maintenance Phase and Decommissioning Phase.

Socioeconomic and Cultural impacts

The socio-economic and health assessment provided the baseline social profile of the study area. The proposed industrial plant will be located within the north-eastern quadrant of the Lekki Free trade zone in Epe local Government area of Lagos State. The baseline social profile of Epe LGA and affected communities are discussed in chapter four of this report.

Construction Phase
Demography
The inflow of workers who choose to reside along in Epe during the construction phase of the development may not have any impact on the demography of the area. The numbers of workers anticipated to be employed during the construction phase is estimated at about 500 workers who will be directly or indirectly employed in this phase. This number of workers will have an impact on demography on the communities which currently rural and sparsely

populated. There is no evidence of overcrowding; hence, no serious negative impact is envisaged on the demography of the area. No mitigation measure is proposed.

Employment Opportunities

Based on the results of the socio-economic assessment, the unemployment rate in the area is low to average. The local residents are however anticipating increase in job availability that the development of the industry will bring. Any available jobs will provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the regional and national levels. The impact is beneficial.

Employment of casual unskilled labour would occur, for short-term contracts or for the entire construction phase. This could result in a positive spin-off during the construction phase as any level of employment in this region of moderate unemployment and low wage levels will have a beneficial social spinoff. The impact is beneficial.

Contracting

During the construction phase, there will be provision for sub-contracting to local supplies. Supplies will include raw materials that meet standards as required for the construction of the industrial park facilities. Equal opportunities will be given to sub-contractors from the host communities and Epe LGA. This is a positive impact.

Information Dissemination

Improper dissemination of information about the project and its activities may pose a risk. This is because lack of information and improper sensitization of stakeholders such as men and women groups, religious groups, vulnerable groups (e.g. aged and widowed) youths, etc about the project may result in local agitation. This impact is assessed as medium.

Community Agitations

During labour recruitment and prior to full construction activities, there is potential for conflicts between neighbouring communities or individuals over employment quota systems, sub-contracting procedures or recruitment methodology. This will pose major significant impact on the project construction phase.

Socio-cultural Conflicts

Other potential socio-economic impacts are expected to arise from socio-cultural conflicts between the construction workforce and natives due to contrast in believes and religion. Particularly, the possible desecration of numerous traditional shrine/groves in the project area. Another challenge in this direction is increased demand on existing infrastructures due to influx of people to project area. These impacts have been ranked with a medium to major significance level.

Visual Effects

Erection of industrial (high rising) buildings and perimeter fence in the project area may create visual intrusion by altering the normal topographical view of the landscape. This impact has been ranked with a minor significance level.

Loss of Land

Utilization of land for the industrial textile/garment production and associated facilities may result in temporary and permanent loss of land, some of which are regarded as farmland. The impact was ranked with a major significance.

Loss of Income

Completion of the construction phase of the project will lead to loss of employment to construction workers and small business opportunities. This impact has been assessed with a medium significance level.

Operational and Maintenance Phase

Community Agitations

After the construction phase of the project there exist the possibility of community or groups of individuals or individual dissatisfaction with the conduct of the proponent regarding recruitment of labour as well as general conduct during the construction and extend to operation. This impact could result in strife thereby affecting the operations of the Textile and Garment industrial Park. This impact has been assessed to have a major significant level.

Unauthorized Access

Prior to the operation of the industrial complex (demobilization), unchecked and unauthorized encroachment by locals or individuals into the project premises may lead to land use conflict and possible accidents. This impact significant is ranked as medium.

Biodiversity Impact

It is expected that the project development activities will remove about 46.62 hectares of forest and its flora and fauna components. The development may have a major, long-term, irreversible negative impact on the floral composition.

Results from biodiversity studies conducted in the area shows the following ecological zones; secondary forest regrowth, degraded forest, riparian vegetation and cultivated farmlands. It is expected that the project development activities will remove about 46.62 hectares of forest and its flora and fauna components. The IUCN status of the plant resources for the studied area was evaluated using IUCN version 2017 .3 criterion. The results showed that majority of the plant species encountered do not fall to the categorization of IUCN Red lists. However, the identified species that are vulnerable are as follows; *Albizia ferruginea*. *Raphia sudanica* present in the project site is near threatened (NT).

Based on the vegetation and faunal investigations, the most sensitive ecological zones are considered to be the rivers/floodplain. In addition, the vegetation zones that were identified within the project area are well represented outside of the study area, and are thus not considered threatened ecosystems.

Data on the floristic composition and fauna assemblage in the project site and in the immediate vicinity within the project area indicate presence of a varied assemblage of forest resources and plant species, some of which are of economic and ecosystem services (ethno-botanical) importance (Table 4.38, chapter 4) to the people of the communities.

The main impacts of clearing the vegetation may however, be secondary and will affect the species that depend on the area for survival through habitat loss, fragmentation and the impacts of edge effects. This will be further discussed in the sections below.

Construction Phase:

The construction phase is the most destructive part of the planned development on vegetation. During the construction phase various impacts could cause loss and disturbance of vegetation and animal habitats.

Vegetation Clearing

Selective clearing will be combined with total clearance where necessary within the project area and access roads so as to the minimum ecological footprint during the construction phase. Total vegetal removal will be done only to allow for foundations of buildings and gutters, and placement of perimeter fence.

The impacts on vegetation and habitat loss due to vegetation clearing and other site preparation activities are put at a medium significant level.

Erosion

Erosion may take place when vegetation is removed, due to trampling of ground by vehicular and human traffic, and where vegetation is cleared for construction activities. Areas of particular concern would be along the access roads, areas in which the lay-down areas are place and disturbed areas around the buildings. Impacts resulting from erosion around building areas, access roads, etc have been ranked with a medium significance.

River Bank Disturbances

Damage to hydrological systems could occur where buildings are erected close or within the rivers, and/or when construction camps are placed within river banks. Water bodies/rivers are sensitive to disturbance and therefore should the afore-mentioned impacts occur, they would be on medium significance. Fortunately, rivers are relatively small in area except for the presence of Lagoon to the north and south of the project area. It is not anticipated that any facility will be erected on streams or lagoon beds at all. The industrial park is designed to ensure that it spans in-between the two lagoons (Epe and Lekki Lagoon). Similarly, if the construction camps are not built directly next to rivers, there will be no impact. However, specific mitigation measures have been included to ameliorate any possible impacts.

Wildlife Disturbance

During construction there is expected faunal disturbance along the entire length of the access road and the project site, in which sensitive ground dwelling animals like the ground squirrels, grass cutters, porcupine etc and those that render ecosystem services (Tables 4.46, 4.51 and 4.52 in chapter 4) will move out of the area during construction. This is likely short termed, and once construction is finished, some fauna will recolonize the area. The impact is anticipated to be medium.

In terms of birds, the migratory path may be obstructed and breeding site removed. The field study did not identify any peculiar bird breeding areas/migration routes within the project site. The impact is low and therefore no mitigation is provided.

Operational and Maintenance Phase:

During this phase, the impacts on the vegetation and habitat of the fauna would be relatively low.

Fauna Disturbance from Gaseous/Dust emission

Emission of particulates and noxious gases into the surrounding environment may result in some form of flora growth impairment and fauna disturbance. In the majority of situations, the fauna species will simply move into the large expanses of nearby forest vegetation. Impact significance on ecosystem is low.

Hydrology and Aquatic Systems

The activities involved in these phases of the development may cause a negative short to long-term impact on the surface hydrology and ground water quality in the project area. This will be as a result of activities which are capable of altering river course and possibly affect speed of water flow. The hydrological system of the project area includes seasonal river/stream and Lagoons. Water bodies are also exposed to anthropogenic impacts, including water pollution, and shoreline contamination by hydrocarbon and oil/grease.

Construction Phase

Sedimentation of streams/rivers

Clearance of existing vegetation will expose the upper layers of the soil horizon to soil erosion. The transport of eroded soil into the surface water resources, especially the rivers will impact on water quality. The movement of construction vehicles and personnel can also result in the onset of erosion and associated sedimentation of streams and rivers. The stockpiling of excavated earth and construction materials can result in contamination of runoff, through erosion of stockpiles. On the overall, impacts resulting to sedimentation problems as a result of soil erosion are adjudged to have a medium significance.

Aquatic Life disturbance

The riparian zone is an important corridor for the movement of wildlife, and as such the construction activities may impact on the movement of certain fauna species within the Riparian and wetlands. The construction related activities that will result in a deterioration of the water quality, will ultimately influence aquatic species such as macro-invertebrates, fish, amphibians and water-birds. This impact would however be limited in terms of duration and is ranked at a medium significance level.

Surface water pollution

Hydrocarbons-based fuels or lubricants spilled from construction vehicles, construction materials that are not properly stockpiled, and litter deposited by construction workers may be washed into the surface water bodies. Should appropriate toilet facilities not be provided for construction workers at the construction camps, surface water resources and surroundings will be contaminated by untreated sewage effluents, lubricants and other hazardous substances from accidental leaks and spillages. Depending on the nature of the contaminant the impact could range from either medium significance to major significance categories.

Operation and Maintenance Phase

The operation of the proposed industrial park and associated facilities would not result in a substantial increase in hydrological and aquatic systems disruption during the operational phase. Accidental discharge of untreated wastewater from industrial processing is capable of degrading the quality of nearby streams and Lekki Lagoon during this phase.

Air Quality and Noise Pollution

Air pollution is a major criterion for the design and citing of facilities within the industrial park. Pollution arising from the operation of the industrial facilities and the consequent environmental and health effects could lead to human health problems and environmental quality degradation. The baseline data on the level of noise and pollutant gases along the access road and project site has been assessed and found to be compliant to set regulatory limits for their natural environment (Tables 4.4.5 and 4.6 in chapter 4).

Gaseous Emission

Construction Phase

The construction of the proposed Industrial Park will generate some amounts of pollutant gases (SO_x, NO_x, CO, VOCs, etc) from fuel combustion (light fuel oil) used for supply trucks and heavy duty equipment. Such pollutants will include airborne particulates that would especially result during dry/windy conditions as a result of equipment movements and localized earthworks. Emissions during construction activities will be localized and short termed, impact will therefore be minor.

In addition, it is expected that there would be increase in dust particles (SPM) along earthed access roads and also during facilities construction activities. Increase in SPM levels will specifically result from vehicular movements and construction earthworks (excavations, trenching, etc). These are expected to last for a short term and have a minor significance ranking.

Operation and Maintenance Phase

It is known that data about emissions of air due to textile processes are not easily accessible, but many processes in textile cause air emissions. The secondary important pollutant in the textile after waste disposal is gaseous emissions. Air emissions include dust and lint, oil fumes, acid vapor, solvent mists, odor and boiler exhausts. In textile enterprises, sulfur and nitrogen oxides usually emerge due to the boilers operations. The other important air emission sources in textile processing are anti-crease finishing, drying, printing, dyeing and wastewater treatment facilities.

Dust and lint emissions associated with textile manufacturing occur during natural fiber and synthetic staple processing and yarn manufacturing. Fiber (especially cotton) handling and storage are sources of dust, particularly within work areas. The main sources are bale breakers, automatic feeders, separators and openers, mechanical conveyors, pickers, and cards.

Dust and emissions generation during operations is envisaged to be moderate and mitigation measure has been recommended.

Noise

Noise has the potential to damage health, to detract from the quality of life, and to disturb or affect wildlife. During the studies the baseline noise levels along the project area were within acceptable limits Results from measurements were within acceptable limits.

Construction Phase

The construction period could result in a temporary increase of the noise levels due to construction and delivery vehicles moving to and from the site as well as general installation activities. Noise and attendant vibration effects from fabrication and associated construction equipment. Increase in traffic flow within the study area could increase the nuisance levels in terms of noise generation.

The impact from increase in noise levels are evaluated and ranked to pose minor significance levels during construction period as they will be short termed.

Operation Phase

A one minute exposure to a sound level over 100dBA can cause permanent hearing loss. In a textile factory high noise level occurs in units where knitting and weaving are made and this can cause about 80% of hearing loss in people working there. The main sources of noise in textile plants are associated with yarn processing (e.g. texturizing and twisting and doubling) and woven fabric production. Some noise will also be generated from vehicles supplying raw material inputs and those taking away already finished products from the industrial park.

Noise impact during the operational phase of the project is expected to exceed the WHO/IFC regulatory limit of 70dB (A), but would be controlled by installing noise reducing devices, see Chapter Six, Noise impact is placed as minor significant at operation.

Waste Generation

Operation
Solid wastes
As discussed in Chapter Three, wastes from the project are grouped into solid wastes, liquid (wastewater) and air emissions. Most of the solid wastes originate from the dry process while the wet process yield only small amount of solid wastes. The majority of solid wastes are made of pieces of fabrics and packaging materials. Solid wastes are not found to be hazardous in general. However, the emptied chemical containers may contain traces of harmful substances. Solis waste generated would include; wood, metals, food remains, glass, refuse, spoil etc. Liquid wastes include sewage, waste chemicals and oily water.

Groundwater and Soil Quality
Operation Phase
The operational phase of the project is expected to have effect or bearing on the water aquifer of the area and soil over time. Water for drinking and domestic use may be sourced from the ground using constructed boreholes. Over time the recharge rate of the water level beneath the soil may be disrupted. Analysis shows that the depth to the groundwater table in the project site is shallow with the aquifer sand layer being very close to the surface. The depth to groundwater in the project area is between 2.8m and 4.4m.

Also diesel and oil leakage from vehicle movement, stored oil, maintenance workshops and from processing machines are likely to seep into the soil if not handled properly and may find its way into the ground water where they become nuisance. The possibility of this occurring is rather low, hence has been ranked medium.

Health, Safety and Security Aspects

Construction Phase

In any civil works, public as well as construction staff Health Safety and Environment risks can arise from various constructions activities such as earth works, operation, and movement of heavy equipment and vehicles, storage of hazardous materials, traffic, waste disposal etc. Because of the long duration of the construction phase, such activities need to be controlled and consequently the associated risks reduced to as low as reasonably practicable (ALARP).

Transportation Related Aspects
Construction and transportation activities will increase traffic congestion, risk of injuries, criminal attack as well as damage to assets. These impacts are expected to be of medium to major significance depending on the severity of the impact. Accidents arising from road trips (transport of materials and personnel) along mobilization routes may result in injury or loss of life of personnel as well as damage to company assets. The possibility of criminal attack on expatriate or local personnel during the construction of the project is likely. This may also result to injuries or fatality. These impacts are ranked from minor to medium significance.

Workplace Accidents
The probability of an accident occurring at the project site during the phases of the development is high. This is due to the intense use of machinery and other heavy-duty equipment used especially in the construction phase.

Work related incidents and accidents resulting from trips, falls, object at height during construction activities are likely to occur. These impacts pose a medium to major significance ranking all depending on the severity of the impact. In this project, the impact is ranked as a medium significant impact.

Communicable Diseases
Construction activities have the potential to create new malaria vector (mosquito) habitats. An influx of workers with no or partial immunity to malaria parasite (*Plasmodium sp*.) increases the risk of serious illness which may result to absenteeism or hospitalization/death. This impact if not managed is expected to pose a major significance characteristic.

Influx of resident and non-resident workers into the project area also increases the risks of sexually transmitted diseases (STDs) and could impact adversely on the spread of these illnesses especially relating to Acquired Immunodeficiency Syndrome (AIDS). This impact, if left unmanaged may result in long term health issues which may eventually lead to fatality. Impact arising from this is ranked as major.

Fires and Explosions
Fire and explosions may be described as technological hazards, which can cause serious injury or result in loss of lives and damage to properties and the environment. Flammable substances including diesel and motor oil may be stored or used on the project site for heavy-duty equipment. These substances are precursors for fires and explosions. Envisaged impacts from accidental explosions resulting in fire have been ranked with a medium significance level.

Waste Handling and Disposal
A significant amount of solid waste (including, wood, metal scarps, office and domestic wastes, etc.) will be generated in this phase of the project. The methods put in place for handling and disposing of these wastes to be generated play an important role in the significance of impacts expected from wastes management. Waste handling and disposal have been assessed to pose a medium impact to the environment.

Operation Phase
Collapse of Building and Electrocution
There exists the possibility of building collapse as a result of unsuitable geotechnical conditions of underlying geological structure. With the available geotechnical test done on the site, the possibility is low. Similarly, there is possibility of electrical accident which could range from shock and burns to fatality. This is a medium significant impact.

Workplace Accidents
The probability of an accident occurring at the project site during the phases of the development is high. This is due to the intense use of machinery and other heavy-duty equipment used especially in the construction phase.

Water Consumption
Water consumption in textile manufacturing has a significant environmental impact, in terms of freshwater needs, wastewater/sludge production, and energy used in heating. In the textile industry, used water is in each stage of the wet finishing to transport chemicals to textiles and to be washed the material before moving to the next step. Apart from these processes in textiles, there is also water consumption during cooling water, boiler, steam drying and cleaning. Average water spending of a medium sized textile factory producing around 8,000kg fabric/day is 1.6 million liters, approximately. Water consumption impact is rated medium to major due to seasonal variation of volume of water from the water intake source at Osun River that recharges Epe Lagoon.

Decommissioning Impacts

During the decommissioning phase, the demolition activities are likely to have similar impacts on the environment as was identified for the construction/demobilization phase. These include potential impacts such as sedimentation in surface water, visual impact, dust and noise pollution, loss of employment, a risk of fires and explosions, safety, security and traffic impacts etc. Impacts arising from decommissioning activities have been ranked with significance levels of minor to major.

Cumulative Impacts

Given the findings of impact assessment and distance (<5km) of the on-going Dangote Refinery project in the South East Quadrant and on-going Alaro City project in the North West Quadrant from the project site in the North East Quadrant, it appears likely that the cumulative impact on noise and air quality will be significant. Also the cumulative impact of the construction and operational phase of the proposed Lekki International Airport and the proposed Lekki Deep Seaport which are (<10km) from the project site will be moderately significant. It should however be noted that this statement is based on professional judgment only.

Project Specific Risks and Hazards

The potential risks and hazards associated with the construction and operation of the proposed Textile and Garment production plant are described below:

Security Threat and Attack

Occupational Hazards

Musculoskeletal disorders

Exposure to chemical agents

Exposure to dusts and fibres

Exposure to biological agents

Exposure to physical agents

Accidents in the textiles sector

Explosion

Heat

Psychosocial issues in the textiles sector

MITIGATION REQUIRED FOR SIGNIFICANT IMPACTS

Land Acquisition and Community Expectation
Construction Phase

The concerns of the neighbouring communities of cumulative effects of environmental and social impacts and their expectation of job provision within 5 km radius of the project site will need serious attention. By implementing a package of mitigation and enhancement measures, the concerns can be reduced to a manageable level for the majority of the community members. However, the Lekki Economic Trade zone has been previously acquired by the Lagos State Government, this will reduce/eliminate possible land tussle.

Notwithstanding, to reduce the effects which is largely limited to preparation/construction stage, a combination of the following measures should be applied to bring the impact to **minor**:

- Inform communities about details of construction activities (e.g. employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting
- Set-up and effectively monitor construction grievance mechanism
- Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this EMP.
- Engage communities in the monitoring activities to enhance transparency and involvement.
- Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities.
- Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan
- The cooperation of the community leaders and Epe LGA should be sought so as to avoid any complications.

Recruitment of Labour/Employment

Construction Phase

Recruitment of technical and non-technical workforce is a beneficial impact of the proposed project on Lagos State, Epe LGA and the host communities. Nevertheless, the following recommendations are necessary to help the communities to maximize the positive/**beneficial** outcomes.

- A Local Content Plan should be prepared and strictly adhered to in order to facilitate involvement of local labour.
- No hiring of short-term labour to be made at the site gate and be transparent to community leaders
- Only specialised professional workers will be recruited from outside the communities

Operation Phase

In the course of NEPZA recruiting industrial workers of different categories, there is the possibility of Community and individuals' dissatisfaction with the conduct of labour recruitment. This is a major impact which can be reduced to minor if the following measures are put in place:

- Engage communities in the recruitment of non-technical workforce so as to enhance transparency and involvement.
- Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities

Cultural and Traditional Heritage

Construction Phase

Considering the value placed on cultural and traditional milieu in the Yoruba context, project that will impact on society's values and traditional worship require huge community engagement in ameliorating the impacts. While Culture shock is rated as medium, land-take that will encroach on shrine location has major impact. The application of the following mitigation measures will reduce the impacts to minor.

- Avoid areas of cultural deity and shrine in the project area, where possible;
- The exact location and ceremony for relocation will be managed by the communities.

- Awareness and education campaign to be given to workers and also to community people on tolerance, coexistence of cultures
- Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.

Operation Phase

Arising from the rural and predominantly traditional nature of the host communities, conflict in respect of traditional festivals restraining human movement is a major issue and impact.

- The timing of operation/maintenance activities should be coordinated with the Communities to avoid interference between maintenance and the festivals.
- Accommodation should be provided for staff to forestall/ prevent movement on day when traditional festivals are held

The residual impact is negligible.

Community/ Workers' Health, Safety and Security

Construction Phase

It is extremely important to maintain health and safety of the host communities and workforce for sustenance of the proposed economic venture. The following mitigation measures should be implemented in order to reduce the potential adverse impacts and risks associated with construction activities on the community health, safety and security.

In order to mitigate work-place accidents:

- Develop an emergency response plan following NEPZA and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of Lagos State and Epe LGA
- Annual safety audit of facilities so as to minimize energy dissipation and material waste.
- Communicate safety awareness and risks of the electricity cables to communities and provide response measures. Put sign boards on high voltage areas.
- NEPZA should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height during maintenance and repair works, emergency prevention and management.
- Use personal protection equipment. Have medical emergency equipment at hand.

To minimize the occurrence of boat-mishap, the following should be engaged.

- Use of life-jacket by boat users should be made compulsory for workers.
- Arrange dedicated canoes for the workforce ferried by a professional sailor

Emergency for ill-health, malaria, STI/HIV and related health issues should be mitigated following these measures:

- Coordinate with medical posts and emergency services to prepare for water supply, waste management and incidents.
- Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.
- Aerial fumigation and use of Insecticide Treated Net should be promoted in the Workers camp

- Sex education in protected sex, risk of casual sex and counselling services should be provided.

  Provision should be made for workers to live off-site with their families

To address security of lives and properties, the following are appropriate mitigation measure:

- Make security plan and emergency response and contacts with security forces. Coordinate with NEPZA security measures for their site.
- Professional security outfit be engaged in protecting lives and properties within the park. This must be registered with the Nigerian Police/NSCDC etc.
- A Local Content Plan should be prepared to facilitate involvement of locals in the security network.
- Develop a code of behaviour for workers. All workers to receive training on community relations and code of behaviour.

Construction Phase

In order to minimize incidences during the plant operation, the following are mandatory to bring the impact to minor:

- A comprehensive HSE Policy of NEPZA must be displace openly, and enforced through monitoring within the Park;
- All staff must be trained and retrained on regular basis for HSE compliance;
- Develop a training program including a code of conduct for all workers;
- Well-equipped Clinic should be put up for emergence attention, while referral system should be arranged with a Secondary Hospital

Infrastructures

Construction Phase

With the influx of workers, there will be pressure on housing and other related facilities around the project area, including Epe town. The following mitigation measures are necessary to bring the impact to minor, except the damage to existing road that will remain medium:

- Coordinate with relevant agencies such as the Nigeria Police, NSCDC, etc. for traffic control.
- Schedule the movement of heavy-duty vehicles to off rush-hours in the area.
- Materials and manpower that could be conveyed through the Lagoon should be explored to reduce road traffic congestion.

Operation Phase

Although this impact is minor, the use of the following measure will reduce it to negligible:

- Engage the services of NPF/NSCDC for traffic controller if necessary;
- Schedule the movement of heavy-duty vehicles to off rush-hours.

Air Quality

Construction Phase

Impact due to Air pollutant emission

Regarding impacts of emissions from vehicles, equipment engines and power generator, the following mitigation measures are recommended:

- Cover properly loose materials and keep top layers moist

- Use binder material for erosion and dust control for long term exposed surfaces. Regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt. Spray surfaces prior to excavation
- Use covered trucks for the transportation of materials that release dust emissions.
- Speed limits on-site of 15 k/hr should be recommended and enforced
- Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations
- Stationary generators should be well maintained and located to facilitate dispersion

If the above measures are implemented accordingly, the residual air quality impacts can be considered to be negligible to minor.

Operation Phase

Air pollution by dust emission from cotton yarning, ammonium from cotton soaking and bleaching; and automobile activities will be mitigated as follows:

- Preference for usage of clean fuel like LPG, low sulphur diesel should be explored;
- Energy conservation should be adopted by opting the alternate energy options like solar power;
- Odour should be managed at the site using odour suppressant and planting flowering trees with fragrance

The mitigation measures and control methods for sources of dust emissions during textile production include:

- Enclosure of dust producing equipment,
- use of local exhaust ventilation;
- Use of dust extraction and recycling systems to remove dust from work areas;
- Installation of fabric filters to prevent outdoor emissions.

Green House Gas Emission

In consideration of the Climate Change under the construction phase, the impact of vegetation clearing and soil disturbance resulting to reduction of carbon sink ability of the environment and the use of equipment and vehicles during the construction has been computed to be negligible (Chapter 4). In addition, employing the following to mitigate the release of GHG gases shall further reduce the impact.

Use good international practice:

- Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations
- Use experienced drivers and fuel-efficient equipment, vehicles and machineries during construction activities.
- Restrict vegetation clearing and soil disturbance within and around project area.

Operation Phase

Accidental significant leaks from aging equipment, and gas losses occurring during equipment usage and servicing could be mitigated through the following:

- Machines using GHGs and ODS should be avoided and replaced with those using environmentally compliant or friendly gases
- Regular checking with auto-gas leak detector and maintenance of all plant and equipment to minimize the risk gas leakage

Noise/Vibration

Noise nuisance from construction activities and vibration arising from fabrication and associated welding equipment. The following measures are recommended to mitigate their negative impact:

- Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health and safety briefings
- Select ‘low noise’ equipment or methods of work
- Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources).
- Workers to wear hearing protection PPE (Ear plug and muff)
- Maintain and operate all vehicles and equipment’s in accordance with manufacturers recommendations.
- Avoid mobile plant clustering near residences and other sensitive land uses.
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events
- Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO.
- Noisy activities should be restricted to day-time working hours

Operation phase

Noise from vehicular movement and power generator will be reduced to negligible level by applying the following:

- Machineries to be used should comply with the noise standards prescribed by FMEnv.
- Workers shall be given PPE (ear plugs) and enforce compliance;
- Temporary noise barriers should be provided near the high noise generating areas;
- Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings;
- Select ‘low noise’ equipment or methods of work;
- Regular maintenance/servicing of production machines and generators

Water Resources

Construction Phase

Construction of access roads to projected swamp and marshy areas for performing investigative field work, construction and installation facilities will impact the water resources. These impacts that ranged from medium to major will reduced to minor and negligible categories by engaging the following measures:

- Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas.
- Install oil/water separators and silt traps before effluent, leaves the site.
- Minimize bare ground and stockpiles to avoid silt runoff.
- Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).
- Ensure that processed wastewater is treated before discharging to nearby water bodies.
- Ensure that treated waste water is reused to minimize its discharge volume.

  put in place a dedicated waste management system to account for generated waste.
- Ensure an inventory of waste is developed and maintained

- Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains.
- Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages.
- Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques.

Operation Phase

Impact of accidental leaks from generator and storage facilities can be minimised to minor by engaging the following:

- Install oil/water separators and silt traps before effluent, leaves the site.
- Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).
- Conduct bioremediation of polluted soil immediately to inhibit further spread

Water Consumption

Water consumption in textile manufacturing has a major significant environmental impact, in terms of freshwater needs, wastewater/sludge production, and energy used in heating.
Impacts can be minimized to minor by

- Reuse of dye baths;
- Adoption of continuous horizontal washers and vertical spray washers or vertical, double-laced washers; ·
- Adoption of countercurrent washing (e.g. reuse the least contaminated water from the final wash for the next-to-last wash);
- Use of water flow–control devices to ensure that water only flows to a process when needed;
- Reuse of preparation and finishing water.

Vegetation/ Ecosystem services

Construction Phase

Vegetation clearance during construction leading to disturbance of animal habitat and fauna displacement/migration which is rate as medium impact will require mitigation measures as stated below for a reduction to mino**r** impact category.

- Site clearance activities to be restricted to the minimum required area.
- Avoid the use of heavy equipment that could cause siltation of the aquatic habitats
- Restrict removal of vegetation and trees to the boundary of project site only;
- Retain all native vegetation;
- Protect all vegetation not required to be removed against damage;
- Undertake quick re-vegetation of exposed soils with indigenous plant species; and
- Use erosion protection structures such as sediment traps, riprap and gabions.

Operation Phase

Arising from change in Land Use of nearby areas and the buffer zone during operation phase, which has major impart, the following measures will reduce it to minor:

- Maintain the industrial park in orderly condition and do not distribute material or vehicles over open spaces.
- Procure and distribute seedlings of local plant species for community members to grow in replacement of cleared plants

Waste generation and management

Construction phase

Waste generation in form of wood, sand, paper; domestic waste, metal scraps from steel elements, during construction phase is rated medium. A reduction to minor impact category will require the following measures:

- Develop and implement a site-specific Waste Management Plan (WMP) to prevent unregulated dumping of waste;
- Ensure that solid/hazardous wastes are stored in properly labelled and sealed containers, and placed away from direct sunlight, wind and rain; and
- Engage waste disposal managers (PSP) that are accredited by LAWMA
- Proper sorting and collection of metals for recycling and monetary gain should be encourage

Operation Phase

Industrial waste emanating from replacement of machine parts, retrofitting and routine servicing should be handled as follows so as to minimize the impacts:-

- Recyclable materials should be sorted and sold to scrap metal converters
- Put in place a dedicated waste management system to account for generated waste.

Soils, geology and land-use

Construction Phase

Soil compaction leading to erosion and the subsequent accumulation of the sediment in surface water bodies can be reduced from medium impact to minor and negligible impact categories. The following are required to achieve these:

- Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers.
- Protect excavated soil materials from erosion.
- Ensure that the land is physically restored (include revegetation where possible) during the rainy season subsequent to the construction activities.
- Use of existing track for transport of man and material to the extent possible.
- Construction of foundations to be undertaken in the dry season.

Operation Phase

Soil contamination resulting from accidental leakages and spill of hazardous substances from generator can be mediated as follows so as to reduce the medium impact to minor.

- Install oil/water separators and silt traps before effluent, leaves the site.
- Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).
- Conduct bioremediation of polluted soil immediately to inhibit further spread

Visual/Aesthetics

Construction Phase

Disruption of the natural view of the local space due to erection of buildings should be mitigated so as to reduce the medium impact to minor category. This is largely an impact that will not progress into the operation stage of the industrial park lifecycle.

- Maintain construction site in orderly condition and do not distribute material over many sites before usage.

Local plant species should be used for beautification and lawn establishment.

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The ESMP has been developed to meet international standards on environmental and social management performance, specifically those set out by the FMEnv, AfDB, World Bank/IFC, Equator Principles.

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

DECOMMISSIONING

The project proponent (NEPZA) does not expect to close and terminate the operation of the Textile and Garment industrial Park for at least 50 years. On the other hand, in case closing and termination of the industrial will occur in the future the decommissioning will be done in accordance with a plan and standard procedures that meet local regulatory requirements and international standards. This section describes the activities that will be completed to restore the project location to an acceptable condition for its intended use. The incorporation of remediation plans into the overall project planning is essential because it allows proponents to understand the need for restoring the environment into its original, or near its original status when abandonment plans are being conceptualized.

CONCLUSION

This EIA has identified and assessed both positive and negative impacts of the proposed project and accordingly evaluated the associated and potential negative effects on the environment (biophysical), socio-economic and health characteristics of the project area in detail and mitigation measures have also been prescribed for significant negative impacts. For effective implementation of the recommended mitigation measures, an Environmental Management Plan (EMP) has been developed to ensure environmental sustainability during the construction and operation phases of the proposed Garment and Industrial Park project. .

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

1.1.1 The Project.

The Federal Government of Nigeria recently launched the Economic Recovery and Growth Plan (ERGP) to achieve greater economic diversification and promote long-term sustainable development. The trade and competitiveness agenda is at the heart of this strategy to restore growth and facilitate the economic recovery.

Developing Special Economic Zones has been identified as a key enabler and the Federal Ministry of Industry, Trade and Investment (FMITI) is eager to unlock the potential of these zones to diversify exports; boost manufacturing's share of Gross Domestic Product (GDP), create new jobs, leverage the country's endowments and maximize comparative advantages. Again, FMITI's thinking of why SEZs should be a key focus to diversify exports and enable an economic recovery:

The FMITI has set up the Project MINE (Made in Nigeria for Exports) to foster the development of world class export-oriented Special Economic Zones (SEZs) in the country by:

- Fast tracking the development of one export oriented SEZs;
- Bringing in PPP partners to help transform Government owned SEZs;
- Developing world-class greenfield SEZs across Nigeria; and
- Creating a supportive enabling environment for SEZs.

The Lekki Free Trade Zone has been identified as one of the model pilots and is set to become a manufacturing hub of South West Nigeria, serving a market of 30+ million consumers. Lekki Free Trade Zone is envisioned as a holistic industrial city acting as a gateway to regional Economic Countries of West African States (ECOWAS) and international markets via Apapa and planned Lekki and Badagry ports focused on Internet Communication Technology (ICT), agro-allied petrochemicals and textiles industries. It also aims at serving export markets in West Africa and beyond. The project's ambition is to create more than 300,000 jobs, generate USD 9.7 bn export value in 2027 and attract USD 60 billion in FDI.

Federal Ministry of Industry Trade and Investment (FMITI) considers that:

- The global textile sector is an attractive growth industry, expected to grow by 4-5%, with apparel and sportswear expected to grow by ~4% and ~7%, respectively.
- Nigeria is well positioned to take advantage of key trends in textile manufacturing, such as shifts to lower cost countries with greater proximity to raw material inputs and global markets.
- The Nigerian government has prioritized and is allocating resources to develop the textile and garment sector in order to leverage inherent Comparative Advantage and rebuild the sector into regional prominence.

In order to deliver the project, land covering 1,000 ha was acquired by the Federal Ministry of Industry Trade and Investment (FMITI). Dar has been commissioned by the FMITI as the pre-developer, responsible for preparing a master plan for the first phase, and a financial model. In order to enable this vision to succeed, a first concept framework has been developed for the overall Lekki Model Industrial Park. This provides the setting for the first phase (Phase 1) covering 150 hectares, for which the master plan has been developed.

The first phase is focused exclusively on the construction of Garment and Textile industries, where the desired industrial/manufacturing development is implemented in association with essential business offices, commercial, customs, recreation and required infrastructure developments to make it a state of the art Industrial Park.

In compliance with the Nigerian Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, the World Banks Operational Policy 4.01: Environmental Assessment (1999), revised April 2012) and the Equator Principles among others, an Environmental Impact Assessment (ESIA) study becomes an obligation for the approval of the proposed Textile and Garment Industrial Park (Phase 1) project.

In view of the above, the Nigeria Export Processing Zones Authority (NEPZA) engaged Messrs: Environmental Assessment and Evaluation Company Limited **(EAECL)** - an Environmental and Technology Management consulting company duly registered and accredited by the Federal Ministry of Environment (FMEnv) to carry out a comprehensive Environmental Impact Assessment (EIA) for the proposed Textile and Garment Industrial Park in Lekki Free Trade Zone, Lagos State.

1.1.2 The Proponent

The Nigeria Export Processing Zones Authority (NEPZA) is the proponent of the proposed Integrated Textile and Garment Industrial Park (ITGIP) as an industrial Complex exclusively Industries in the cluster format. NEPZA is the nodal agency of the Federal Government of Nigeria responsible for promoting and facilitating local and international investments into the 34 licensed Free Export Processing Zones (EPZ) in Nigeria. It administers EPZs, ensuring the establishment of customs, police, immigration, and all necessary legal posts. It works to streamline processes for businesses, and serves as a dispute-resolution mechanism in the case of conflict.

1.1.3 Project Location

The proposed Lekki Integrated Textile and Garment Industrial Park (Phase1) is located in the Lekki Free Trade Zone (LFTZ). LFTZ is in Lagos State, Nigeria (Figure 1-1). The site can be accessed through Yegunda earth road that T-off from Lagos – Epe Expressway by Alaro City Project site. It is situated on a parcel of land that is approximately 150 ha in size inside the 1000 ha Ultimate Phase within the North East quadrant which lies in the North East portion of the LFTZ located in Epe Local Government Area of Lagos State. (Figure 1.2). The site extends towards the western-most part of the North- East Quadrant of LFTZ and runs along the proposed North-South Expressway that is projected to connect Epe with the prosed deep sea port (Figure 1.2). The geographical coordinates of the site boundaries are given in (Table 1.1).

At present, the site is largely covered by trees especially Raphia Palm, and contains many scattered farm steads. The location has some pockets of wetlands, firm grounds and coastal mangrove forest. The settlements within 5km radius of the proposed location include Idiroko, Idomu, Gere, Eyin-Osa, Jaguna, Ijayo, Yegunda, Oloso, Imafo, Mausa, Agbon, Ofin, Ita-Aja and Oke-Egun.Idiroko is located very close to the project site boundary at the west side (Fig 1.3).

Table 1.1: Proposed Textile and Garment Industrial Park Phase 1 Boundary Coordinates

Coordinate No	Easting	Northing
1.	3.999577	6.519894
2.	4.002014	6.526829
3.	4.003092	6.527694
4.	4.003453	6.528651
5.	4.003306	6.529818
6.	4.002589	6.530357
7.	4.002846	6.531635
8.	4.003787	6.532858
9.	4.004248	6.533891
10.	4.007844	6.532199
11.	4.008017	6.532658
12.	4.013794	6.530579
13.	4.012347	6.525107
14.	4.013476	6.524664
15.	4.012793	6.522035
16.	4.012908	6.521999
17.	4.012532	6.52078
18.	4.009405	6.521834
19.	4.009246	6.521382
20.	4.006298	6.522407
21.	4.005915	6.521116
22.	4.003956	6.521787
23.	4.003089	6.518623

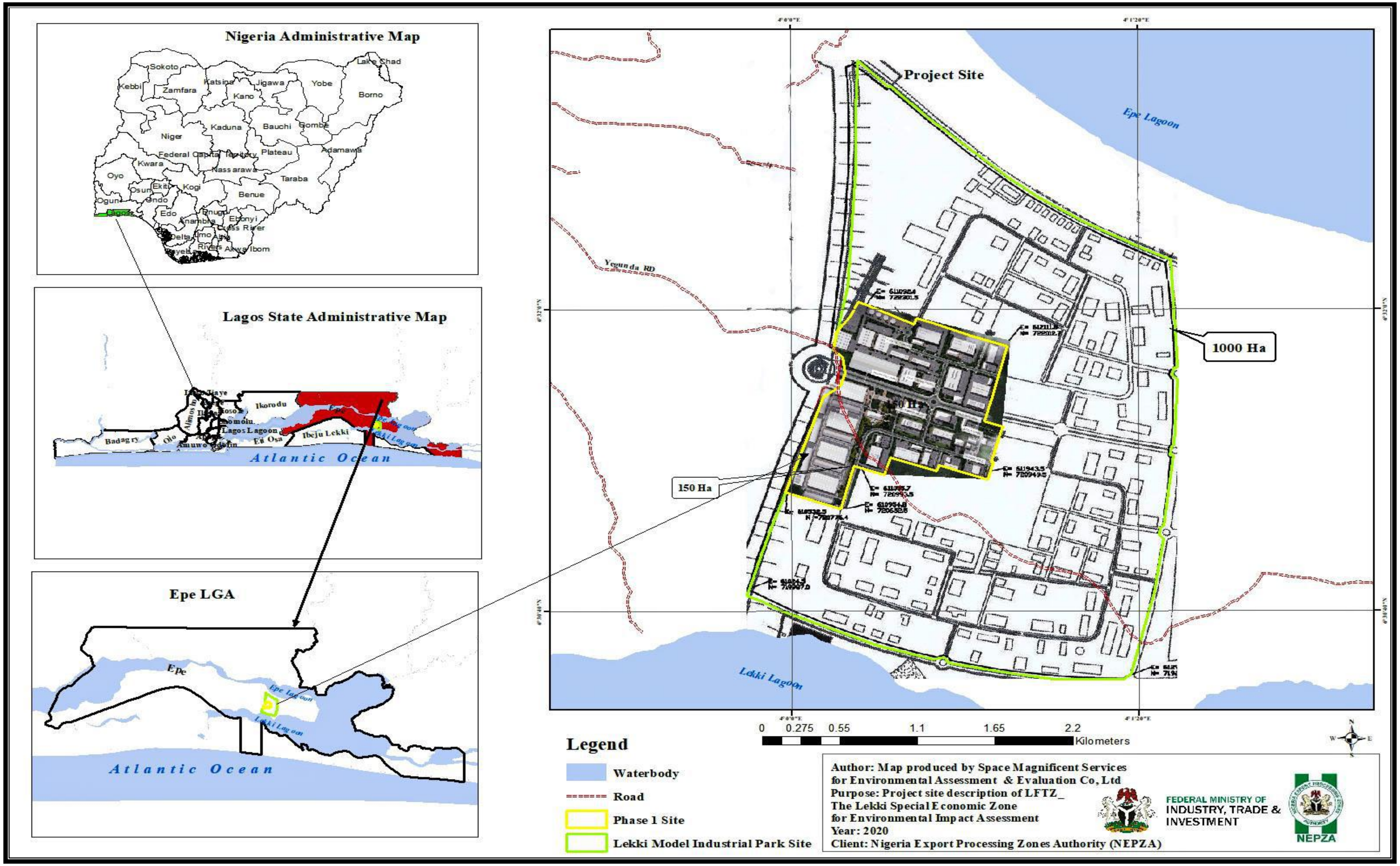


Figure 1.1: Map of Nigeria showing Lagos State, Map of Lagos State showing Epe LGA, Map of Epe LGA showing the Lekki Textile and Garment Industrial Park Phase 1

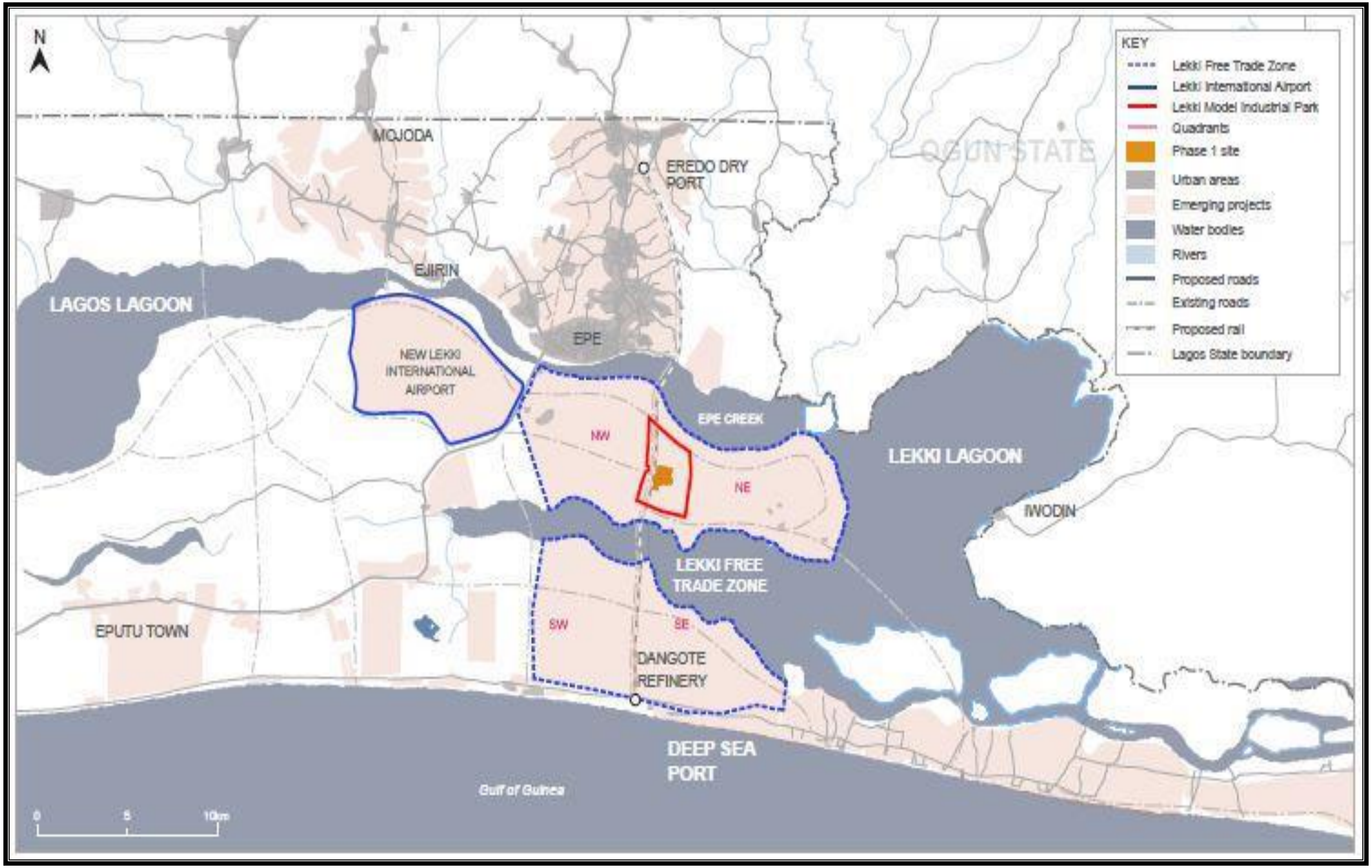


Figure 1.2 Map showing the location of the proposed Lekki Textile and Garment in the North East Quadrant of LFTZ

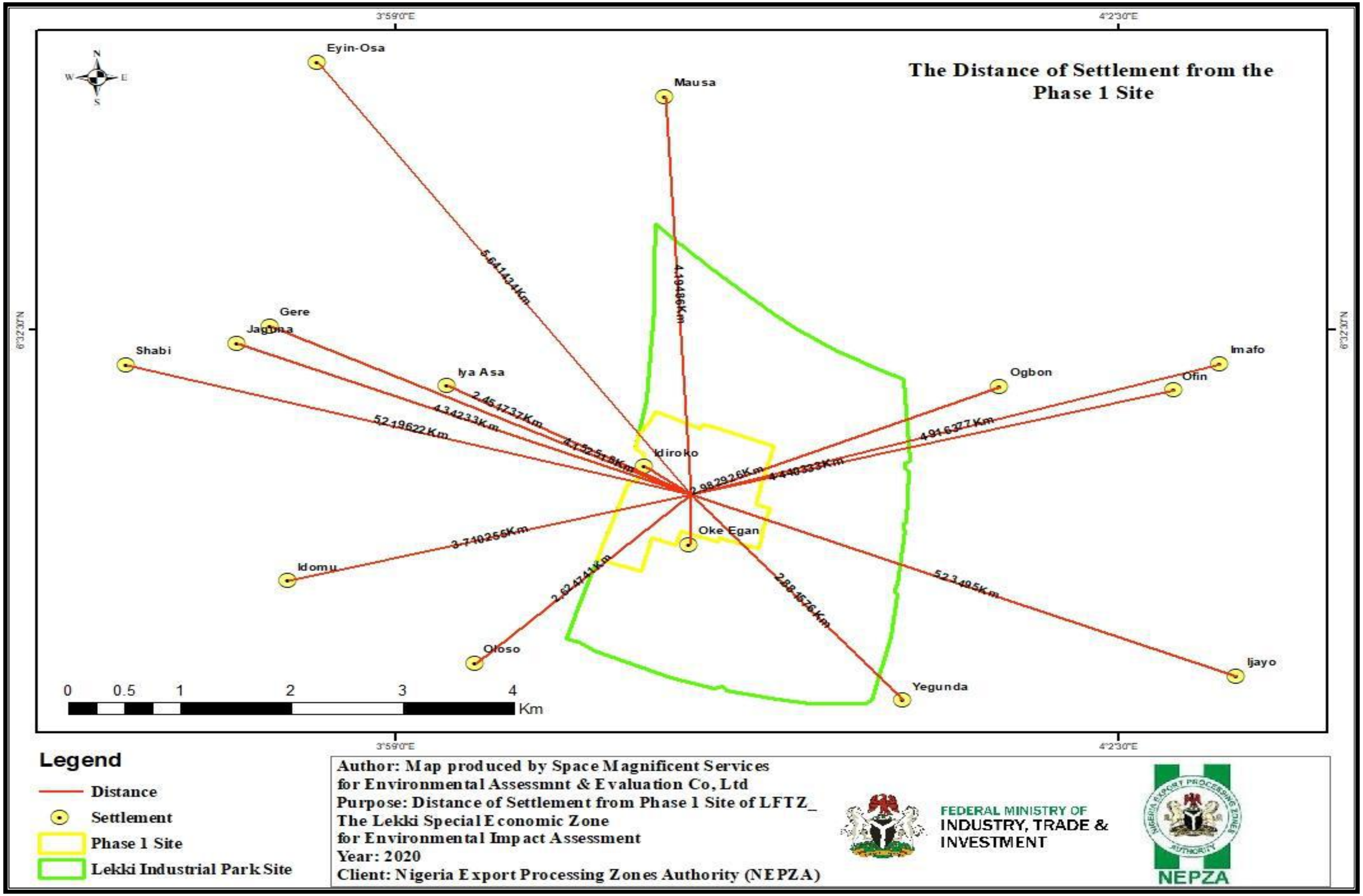


Figure 1.3: Map illustrating the distances of the host communities from the centre of the Project site

1.2 EIA OBJECTIVES

In line with statutory requirements for environmental protection in Nigeria, the proposed EIA study has been carried out to:

- Satisfy Federal, State and Local Governments as well as stakeholders, that proactive environmental actions shall be incorporated in project design, installation, construction and operation phases of the project;
- Provide all necessary answers to stakeholders, assessors, host community, regulators, financiers, pressure groups and other interested parties;
- Ensure all environmental components (baseline) from the project site are established and documented;
- Identify all environmental aspects of the proposed project that may interact positively or negatively with the environment;
- Make appropriate recommendations to prevent, reduce or control identified potential and associated impacts;
- Develop Environmental Management Plan (EMP) and procedures for effective and proactive environmental management of the environment throughout the project life cycle;
- Include a proposed institutional structure to govern the implementation of the EMP;
- Provide all necessary data/ evidence that will form basis for the preparation of the Environmental Impact Statement (EIS) of the project.

1.3 EIA SCOPE OF WORK

The scope of study includes:

- Project screening and site visit;
- Preparation of Terms of Reference (ToR) in accordance with regulatory guidelines;
- Review of national and international environmental regulations guiding the project;
- Consultations with regulators and other relevant stakeholders concerned with the proposed project;
- Extensive and comprehensive literature review specific to the project site to obtain background information on the environmental characteristics of the area;
- A two-season field data gathering exercise and survey of the area in order to establish environmental baseline information specific to the study area;
- Impact identification, prediction, interpretation and evaluation from project activities;
- Development of an effective mitigation/ ameliorative measures and monitoring programmes for significant impacts;
- Development of comprehensive Environmental Management Plan covering the project life cycle;
- Development of best conceivable plans for restoring the environment after decommissioning of the proposed project
- EIA reporting following Federal Ministry of Environment (FMEnv) guidelines and procedures as well as public disclosure.

1.4 EIA METHODOLOGY

The Environmental Impact Assessment study was carried out in line with the FMEnv EIA procedure. **Figure 1.4** is a methodology flowchart of the EIA process. The study involved combination of multidisciplinary studies (science, engineering, law and social sciences).

Information on the project area, project design as well as past project experience were used for impact identification and evaluation as well as to establish mitigation and enhancement measures.

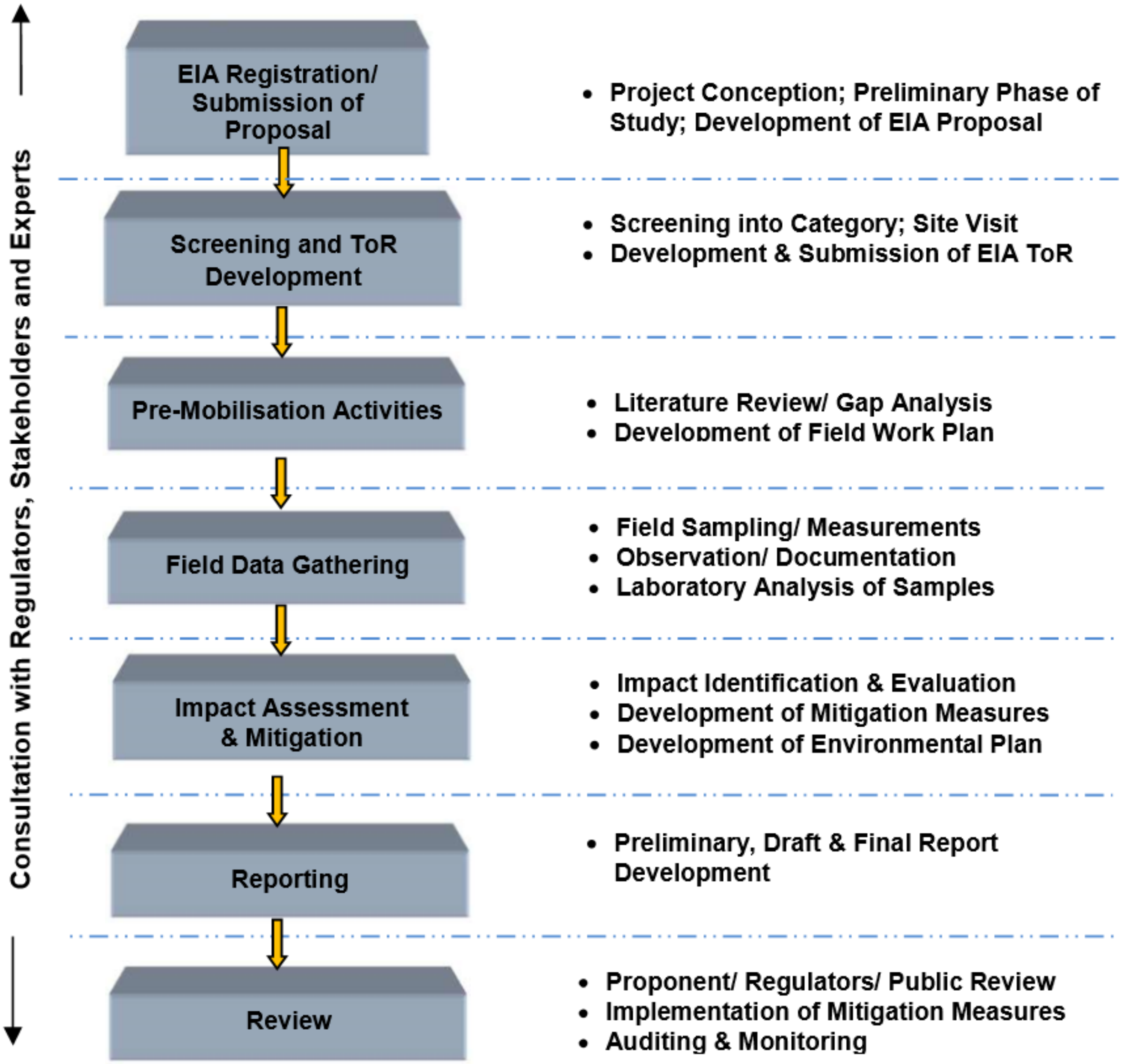


Fig 1.4 EIA Methodology Flow Chart

EIA Registration and Screening

An EIA registration form for the project was filled and forwarded to the FMEnv on the30th of September, 2019 by NEPZA. Subsequently, a screening process was conducted by FMEnv and the EIA placed in Category One (1), equivalent to Category A for World Bank.

Site Visit and EIA Terms of References

The EIA terms of reference (ToR) was defined and prepared in line with the EIA Procedural Guidelines (FEPA, 1995). It was submitted to the FMEnv for approval after site visit carried out on the October, 2019. **Appendix A** outlined the general scope of the EIA study and requirements for data collection.

Field Data Gathering

The EIA study provides a description of the existing environmental and socio-economic conditions as basis against which the impacts of the proposed project can be assessed. The main objective of the baseline description is to identify environmental and socioeconomic resources and conditions in areas potentially affected by the project (such as air quality, groundwater, surface water, fauna and flora etc.) and other key receptors. Data gathering also involved desktop studies of climatic conditions as well as obtaining information from journals on the project area. Project engineering studies were also obtained for quantitative information on environmental elements. Field data gathering campaign was carried out in two seasons (dry and wet) to acquire information on the baseline condition of the area. Field survey was conducted within FMEnv guidelines and standards. Field survey was carried out in the presence of FMEnv representatives for dry season between 27th and 30th November, 2019) and wet season between (25th and 29th February, 2020). Sampling requirements investigated include air quality and noise, surface water, soil, sediment, groundwater as well as socioeconomic and health profile of host community.

Data Analysis and Interpretation

Samples collected from the field visit were transferred to LACH Consult and Scientific Support Limited laboratory, Block D6 Small Scale Industrial Estate, Fatai Atere Way, Matori Mushin, Lagos State for physicochemical and biological analyses. Results obtained were interpreted and used to describe the existing baseline of the study area as documented in Chapter Four of this report.

Impact Assessment and Mitigation

The potential/ associated adverse and beneficial impacts of the proposed power plant project on the existing environment were identified at this stage of the EIA. The EIA Procedural Guidelines and the World Bank Environmental Assessment Source Book among other references were used in the identification process. Evaluation of the identified impacts were carried out and compared using specific criterion such as legal/regulatory requirements, magnitude of impact, risk posed by impact, public perception and importance of affected environmental component. Results of identification and evaluation are presented in **Chapter Five** of this report.

Mitigation measures designed to prevent, reduce or control the adverse impacts of the environmental aspects of the proposed project to as low as reasonably practicable were considered and documented in **Chapter Six** of this report.

Environmental Management

An Environmental and Social Management Plan (ESMP) was developed, which would be an environmental management tool to ensure that all mitigation measures are implemented and adhered to during the duration of the power plant operation. The EMP also enables a rapid rescue/ response if an unforeseen environmental impact occurs. It is found in **Chapter Seven.**

Consultation Process

Consultation is a tool used to assess stakeholders' concerns and expectations of pertinent issues on environmental, social and health concern for integration into the impact prediction, assessment, evaluation and mitigation. Consultation involved information dissemination and interactions/ dialogues with various stakeholders concerned in the proposed project including professionals/ experts in relevant fields relating to the power project. Consultation was carried out all through the study i.e .during screening, reconnaissance (site) visit, field survey/ data collection, public disclosure, expert review meetings. Consultation shall continue even through construction and operational phases of the project.

1.5 POLICY LEGAL AND INSTITUTIONAL FRAMEWORK

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

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

1.5.1 Policy Framework

1.5.1.1 National Environmental Policy

Launched by Government in November 1989, this document prescribed guidelines for achieving sustainable development in fourteen vital sectors of the nation's economy, namely: Human Population; Land Use and Soil Conservation; Water Resources Management; Forestry, Wildlife and Protected Natural Areas; Marine and Coastal Area Resources; Sanitation and Waste Management; Toxic and Hazardous Substances; Mining and Mineral Resources; Agricultural Chemicals; Energy Production; Air Pollution; Noise in the Working Environment; Settlements; Recreational Spaces, Green Belts, Monuments, and Cultural Property.

It also contains Nigeria's commitment to ensure that the country's natural and built environment is safeguarded for the use of present and future generations. This commitment demands that efficient resource management and minimization of environmental impacts be the core requirements of all development activities. Accordingly, this Policy seeks to promote good environmental practices through environmental awareness and education.

Some specific laws include:

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

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

National Land Policy

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

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

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

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

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

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

Social Protection Policies

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

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

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

- the conditional cash transfer In Care of the People (COPE) (funded initially through the DRG fund) targeted at households with specific social categories (those with children of school-going age that are female-headed or contain members who are elderly, physically challenged, or are fistula or HIV/ AIDS patients
- the health fee waiver for pregnant women and children under five (financed through the DRG fund)
- the community-based health insurance scheme, which was redesigned in 2011 because the previous scheme had design challenges Other social assistance programmes are implemented in an ad hoc manner by various government ministries, departments, and agencies at state level, and some are funded by international donors. These include conditional cash transfer programmes for girls' education (in three states), child savings

accounts, disability grants, health waivers, education support (such as free uniforms) and nutrition support. HIV and AIDS programming at state level also include social protection sub-components (although not as the primary objective), including nutrition, health and education support labour market programmes include federal-and state-level youth skills and employment programmes, and Nigeria also has agricultural subsidies/inputs.

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

1.5.2 Legal Framework

1.5.2.1 National Legislations

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

The EIA Act 86 makes it mandatory for any person, authority, corporate body private or public, to conduct EIA prior to the commencement of any new major development or expansion that may likely have significant effect on the environment. The Act sets the EIA objectives and the procedures for consideration of EIA of certain public or private projects.

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

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

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

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

promoting the scientific value of natural ecosystems, the study of which is required to enhance conservation itself, to improve the management of man-made systems, and to provide clues to technical innovations in agriculture, medicine and industry;

regulating environmental balance in such factors as carbon dioxide and radiation levels and the bio- geo chemical cycles;

maintaining ecological services through the protection of catchment's areas in order to enhance water resources and check soil erosion and flooding, protection of grazing lands against desert encroachment and the stabilization of coastal zones and;

enhancing the amenities values of natural resources, including aesthetic, heritage, religious, sentimental, ethical and recreational values on which tourism may be built.

iii Land Use Rights Act No. 6, 1978

The Land Use Act No. 6 was enacted in 1978. The Act vests all land in the urban areas of each state under the control and management of the governor of the state. The governor of the state holds the land in trust for the people of the state and is solely responsible for the allocation of land in all urban areas to individuals who reside in the state and to organizations for residential, agricultural and commercial purposes. Allother land in the state subject to conditions under the Land Use Act is under the control and management of the local government. The Act divests traditional owners of land and vests such land in the state governor for the benefit and use of all Nigerians. It provides the processes through which land maybe acquired by the federal government.

iv Sea Fisheries ACT, CAP S4, LFN 2004

The Sea Fisheries Act makes it illegal to take or harm fishes within Nigerian waters by use of explosives, poisonous or noxious substances. Relevant sections include the following:

- Section 1 prohibits any unlicensed operation of motor fishing boats within Nigerian waters.
- Section 10 makes destruction of fishes punishable with a fine of N50,000 or an imprisonment term of 2 years.
- Section 14 (2) provides authority to make for the protection and conservation of sea fishes.

v Nigeria Maritime Administration and Safety Agency

The Nigerian Maritime Administration and Safety Agency (NIMASA) is an Agency of the Federal Ministry of Transport with a mandate to protecting the coastal territorial waters and the Exclusive Economic Zone (EEZ) of Nigeria from pollutants like oil and others.

vi Nigerian Free Trade Zone Act No. 63, 1992

In 1992, the Nigerian Free Zone Act (Act No. 63 of 1992) was passed establishing the Nigerian Export Processing Zone Authority (NEPZA). As proposed, free trade zones (FTZ), are expanses of land with improved ports and/or transportation, ware housing facilities, uninterrupted electricity and water supplies, advanced telecommunications services and other amenities to accommodate business operations. Under the FTZ system, enterprises are exempt from customs duties, local taxes, and foreign exchange restrictions, and qualify for incentives—tax holidays, rent-free land, no strikes or lockouts, no quotas in European Union (EU) and United Stated (US) markets, as long as end products are exported (although some portion can be sold in the domestic market). The NEPZA is responsible for the regulation of FTZ operations. Its tasks involve policy formulation, licensing and monitoring. The zones are governed by the FTZ Act which stipulates that an extensive EIA must be carried out before the commencement of any major projects.

Under Section 8 of the Act [Nigeria Export Processing Zones Act 63, 1992], approved enterprises operating within Free Zones shall be exempt from all Federal, State and Local Government taxes, levies and rate. Section 18 (1) further provides that all legislative provisions pertaining to taxes shall not apply within Free Zones.

vii Nigeria Export Processing Zones Act (CAP N107 LFN 2004)

The institutional framework that governs the establishment of Lekki Textile and Garment Industrial Park falls under the jurisdiction of Nigeria Export Processing Zones Authority. “In exercise of the power conferred upon it by section 27 of the Nigeria Export Processing Zones Act, CAP N107 LFN 2004 and of all other power enabling it in that behalf, Nigeria Export Processing Zones Authority with the approval of the Honorable Minister of Industry Trade and Investments”.

The objectives of these regulations will apply to the Lekki Textile and Garment Industrial Park

- Complement and enhance the provisions of the Nigeria Export Processing Zones Act, 2004
- Provide details of regulatory and supervisory requirements necessary to promote efficient and profitable operations in Nigeria’s Free Trade Zones
- Facilitate the attainment of goals for which Free Trade Zones are established in Nigeria.
- These regulations shall take precedence over the Investment Procedures, Regulations and Operational Guidelines for free zones in Nigeria, 2004

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

Administered by the Ministry of Environment, the National Environment Standards and Regulations Enforcement Agency (NESREA) Act of 2007, repealed the Federal Environmental Protection Agency (FEPA) Act. It is the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources. The following sections are worth noting:

- Section 7 provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitory and regulatory measures.
- Section 8 (1)(K) empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation.
- Section 27 prohibits, without lawful authority, the discharge of hazardous substances into the environment. This offence is punishable under this section, with a fine not exceeding, N1, 000,000 (One Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of N 50,000, for every day the offence persists.

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

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

The Urban and Regional Planning Act is aimed at overseeing a realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions. In this regard, the following sections become instructive:

- Section 30 (3) requires a building plan to be drawn by a registered architect or town planner.
- Section 39 (7) establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
- Section 59 makes it an offence to disobey a stop-work order. The punishment under this section, is a fine not exceeding N10, 000 (Ten thousand naira) and in the case of a company, a fine not exceeding N50, 000.
- Section 72 provides for the preservation and planting of trees for environmental conservation.

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

x Water Resources ACT, CAP W2, LFN 2004

The Water Resources Act is targeted at developing and improving the quantity and quality of water resources. The following sections are pertinent: Section 5 and 6 provides authority to make pollution prevention plans and regulations for the protection of fisheries, flora and fauna. Section 18 makes offenders liable, under this Act, to be punished with a fine not exceeding N2000 or an imprisonment term of six months. He would also pay an additional fine of N100 for everyday the offence continues.

xi The Inland Waterways Authority Act 13 of 1997

This act gives the statutory backing to the National Inland Waterways Authority. This authority is concerned with the regulation of activities in the inland waterways within the territorial boundaries of Nigeria.

xii Harmful Waste (Special Criminal Provisions) ACT CAP H1, LFN 2004

The Harmful Waste Act prohibits, without lawful authority, the carrying, dumping or depositing of harmful waste in the air, land or waters of Nigeria. The following sections are notable:

- Section 6 provides for a punishment of life imprisonment for offenders as well as the forfeiture of land or anything used to commit the offence.
- Section 7 makes provision for the punishment accordingly, of any conniving, consenting or negligent officer where the offence is committed by a company.
- Section 12 defines the civil liability of any offender. He would be liable to persons who have suffered injury as a result of his offending act.

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

xiii The Forestry Act

The principal legislation in force for the regulation of the forest sector is the Forestry Act 1958. The Forestry Act CAP 51 LFN of 1994 prohibits any activity that may lead to the destruction of or cause injury to any forest produces, forest growth or forest property. The project area does not fall within any protected or reserved forest.

xiv The Endangered Species Act, CAP E9, LFN 2004

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

- Section 1 prohibits, except under a valid license, the hunting, capture or trade in animal species, either presently or likely, in danger of extinction.
- Section 5 defines the liability of any offender under this Act.
- Section 7 provides for regulations to be made necessary for environmental prevention and control as regards the purposes of this Act.

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

xv The Factories Act, 1987 (Factory Act cap 126, LFN, 1990)

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

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

xvi Labour Act - CAP. L1 L.F.N. 2004

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

xvii Wages Board and Industrial Council Act, 1974

The Act provides for the establishment of a National Wages Board and Area Minimum Wages Committee for States and for Joint Industrial Councils for particular industries. It empowers the Minister to order or direct that an industrial wages board be established to perform, in relation to the workers described in the order and their employers, the functions specified in the provisions of this Act, including minimum wage. The minimum wage is currently NGN 30,000.00 per month, and all workers employed for this project shall not earn less than the minimum wage. Hence, all workers engaged by the project shall be paid a minimum of N30, 000 per month.

xviii Workers' Compensation Act, 1987

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

xix Standards Organization of Nigeria (SON) Act CAP 412 LFN 1990

This organization was established to do the following:

- to organize tests and do everything necessary to ensure compliance with standards designated and approved by the Council;
- to undertake investigations as necessary into the quality of facilities, materials and products in Nigeria, and establish a quality assurance system including certification of factories, products and laboratories;
- to ensure reference standards for calibration and verification of measures and measuring instruments;
- to comply an inventory of products requiring standardization;
- to comply Nigerian standards specifications;
- to foster interest in the recommendation and maintenance of acceptable standards by industry and the general public;
- to develop methods for testing of materials, supplies and equipment including items purchased for use of departments of the Government of the Federation or a State and private establishments;
- to register and regulate standards marks and specifications;
- to undertake preparation and distribution of standards samples;
- to establish and maintain such number of laboratories or other institutions as may be necessary for the performance of its functions under this Act;

xx EIA Procedural Guidelines

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

The EIA Process in Nigeria: The Federal Ministry of Environment (FMEnv) developed guidelines to be used by project proponents in conducting EIA, in compliance with the EIA Act. Accordingly, the EIA process, illustrated in **Figure 1.5**, shall follow the following steps sequentially as outlined in the procedural guideline.

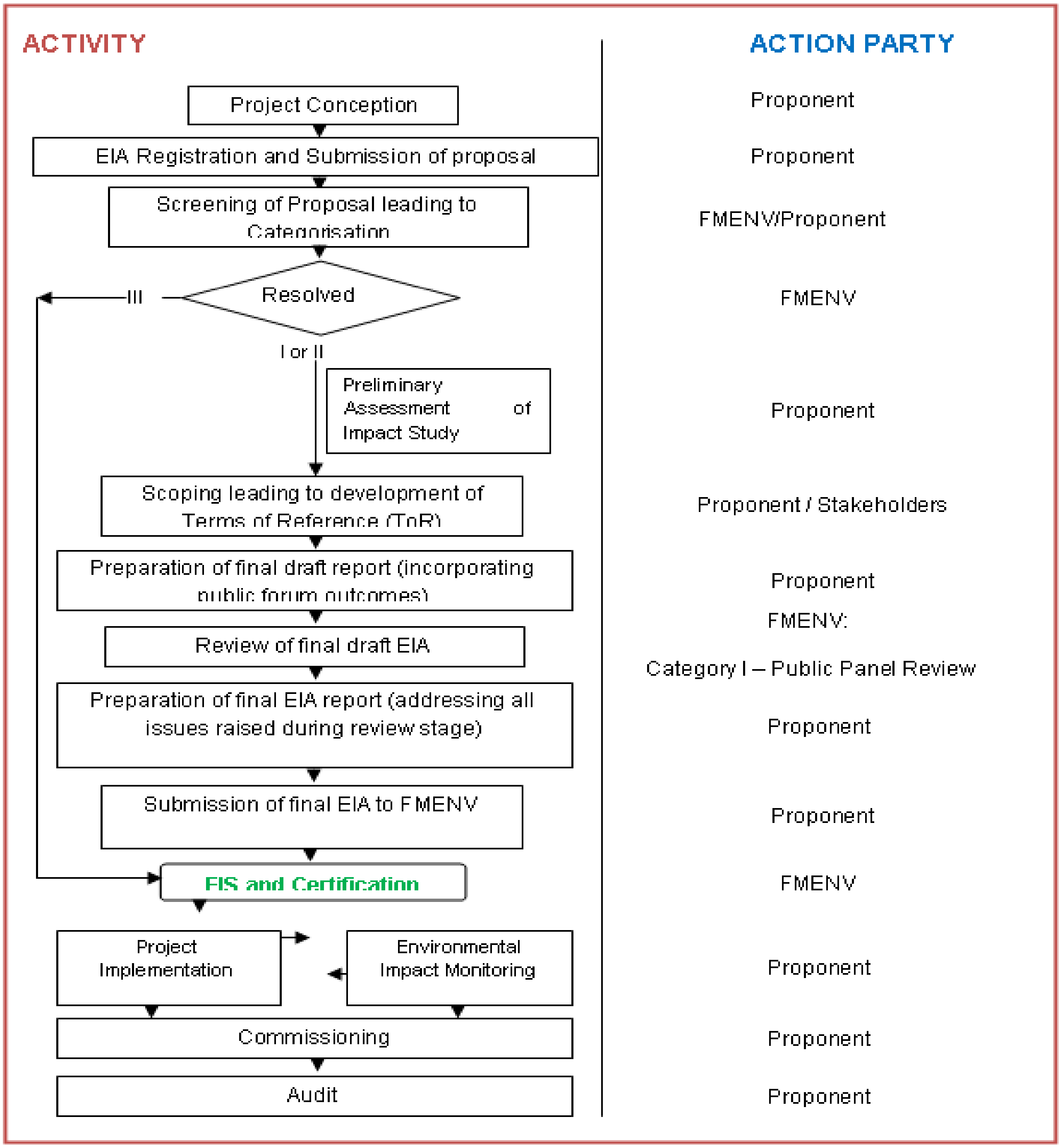


Figure 1.5: The EIA Process of Federal Ministry of Environment Nigeria

xxi Environmental Impact Assessment Sectoral Guidelines (Manufacturing Industries)

This provides general guidelines for EIA of projects in Manufacturing industries sectors of Nigeria, with specific details for sub-sectors. The manufacturing textile and leathersub-sector applies to this project.

xxii National Environmental Regulations

Section 34 of the NESREA Act, 2007 empowers the Minister of Environment to make regulations for safe and sustainable environment. In exercise of this power, the minster issued the national environmental regulations covering all sectors of development. The regulations relevant to the project are as follows:

- National Environmental Protection (Effluent Limitation) Regulations, 1999, makes it mandatory for industries to install anti-pollution and pollution abatement equipment on site. The regulation is specific for each category of waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the environment.
- National Environmental Protection (Management of Solid and Hazardous Waste) Regulations, 1999, defines the requirements for groundwater protection, surface impoundment, land treatment, waste piles, and landfills. It describes the hazardous substances tracking program with a comprehensive list of acutely hazardous chemical products and dangerous waste constituents. It also states the requirements and procedure for inspection, enforcement and penalty.
- Pollution Abatement in Industries Generating Wastes Regulations imposes restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency planning by industries, submission of lists and details of chemicals used by industries to FMEnv, permits for the storage and transportation of harmful or toxic waste and the waste generator's liability.

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

1.5.2.2 Lagos State Laws

i. Lagos State Environmental Protection Agency (LASEPA)

The Lagos State Environmental Protection Agency is responsible for the oversight of the environment in Lagos State. The Agency registers and monitors development projects throughout the state, and also manages matters relating to waste generated within the State. The Agency is the key in the development of governmental policies for environmental sustainability, and regulation and enforcement of Federal and State policies/regulations. Specific functions of LASEPA include:

- Advising the State Government on all environmental management policies;
- Giving direction to the affairs of the Agency on all environmental matters;
- Preparing periodic Master plan to enhance capacity building of the agency and for the development and natural resources management;
- Carrying out public enlightenment and educating the general public on sound methods of environmental sanitation and management;
- Carrying out appropriate test on insecticides, herbicides and other agricultural chemicals;
- Monitoring and controlling disposal of solids, gaseous and liquid wastes generated by both government operations;
- Setting, monitoring and enforcing standards and guidelines on vehicular emission;
- Surveying and monitoring surface underground and potable water, air land and soil environments in the state to determine pollution level in them and collect baseline data;
- Promoting co-operation in environmental science and technologies with similar bodies in other countries international bodies connected with the protection of the environment;

- Cooperating with the federal, state and local Governments, statutory Bodies and Research Agencies on matters and facilities relating to environmental protection.

ii Lagos State Ministry of Environment

The Lagos State Ministry of the Environment was established in 1979 by the first elected Governor of Lagos State, Alhaji Lateef Jakande when it was carved out of the then Ministry of Works and Transport. It was later merged with Ministry of Physical Planning and became Ministry of Environment and Physical Planning. In 2003, the administration of the former Governor of Lagos State, Asiwaju Bola Ahmed Tinubu separated the office of the Environment from Physical Planning and upgraded the present Office of the Environment to a full-fledged Ministry. The mandate of the Ministry was primarily to secure a clean, healthier and sustainable Environment which will be conducive for tourism, economic growth and well- being of its citizenry.

In the year 2005, two offices were created under the Ministry namely: Office of Environmental Services (OES) and Office of Drainage Services (ODS) with the following responsibilities:

- Waste Management;
- Environmental Sanitation and Protection Services;
- Pollution Control;
- Ecological and Conservation matters;
- Control and regulation of Outdoor Advertisement;
- Drainage services;
- De-flooding;
- Sewage Management;
- Coastal and Hinterland Erosion control;
- Evaluation of Environmental Impact Assessment (EIA), and
- Environmental Audit Report (EAR)

Parastatals under this Ministry include:

- Lagos State Waste Management Authority (LAWMA)
- Lagos State Environmental Protection Agency (LASEPA)
- Lagos State Signage and Advertisement Agency (LASAA)
- Lagos State Waste Water Management Office (LSWMO)
- Lagos State Parks and Garden Agency (LASPARK)

One key function defined for the Ministry as highlighted above is to monitor the implementation of EIA guidelines and procedures on all development policies and projects within the State. In this regard EIA is a regulatory requirement in the State.

iii Lagos State Environmental Pollution Control Law Cap 46 of 1989

Lagos State has also enacted the Environmental Pollution Control Law to provide for the control of pollution and protection of the environment from abuse due to poor waste management. In Section 25(1) transgressors were subject to pay a fine. The law also prohibits the discharge of Gamalin 20 or any herbicide or insecticide or other chemicals to kill or whatever purpose in rivers, lakes, or streams within the State, without first obtaining written approval from the Ministry of Environment and Physical Planning. Section 15(i) of the Edict prohibits the discharge into the air of any inadequately filtered and purified gaseous waste containing substances injurious to life and property whilst subsection 2 provides that persons not burn any type of refuse, bush, weed, grass, tyres, and cables on the Lagos Metropolis without obtaining a written permission from the State Ministry of Environment. Environmental Pollution Control Law Section 12 of this law under the

Laws of Lagos State makes it an offence to cause or permit a discharge of raw untreated human waste into any public drain, water course, or onto any land mass or water body. This offence is punishable with a fine not exceeding N100, 000 (One hundred thousand naira) and in the case of a company, a fine not exceeding N500, 000.

iv Lagos Waste Management Authority 2008

In an attempt to evolve an environmentally safe and clean environment, Lagos state established a law to establish State Waste Management Board. The Board was charged with the following responsibilities:

- Clean street, remove, collect and dispose of domestic commercial and industrial waste;
- remove and dispose of abandoned and scrapped vehicles;
- remove and dispose of carcass of dead animals from public places
- prepare and update from time to time the master plans for waste collection and disposal in the cities, towns, and villages in the State and control resultant waste system within the State;
- approve and monitor all waste disposal systems in the State;
- make provision for waste management services to state agencies, local governments, industries, business entities, private persons within the State by receiving waste at the Authority's facilities pursuant to contract agreement between the Authority and such other party;

v Lagos State Waterfront Infrastructural Development Law, 2008

The Law confers the following functions on the Authority managing the waterfront development in Lagos State. They include:

a) Ensure balance between economic development and preservation that will permit the beneficial use of waterfronts while preventing the diminution of open space areas or public access to the waterfront, shoreline erosion, impairment of scenic beauty, or permanent adverse changes to ecological systems;
b) Facilitate public access to waterfronts for recreational purpose;
c) Develop infrastructure along waterfronts for recreational purposes;
d) Minimize damage to natural resources and property from flooding and erosion, protection of waterfronts, beaches, dunes, barrier islands, bluffs and other critical coastal and inland waterway features;
e) Initiate and develop waterfront restoration and revitalization programs.
f) Enter into contracts with any person, firm, corporation, or governmental agency

vi Road Traffic and Vehicle Inspection in Lagos State, 2012

This law was enacted without prejudice to the provisions of Section 11 of the Lagos State Traffic Management Authority Law. The Authority's control and management of vehicular traffic in the Lagos State include:

a) Prohibition of restriction of the use of specified highway by vehicles;
b) Prohibition of driving or propelling vehicles on any specified highway by vehicles of specified class or description;
c) Prohibition of vehicles parking or waiting on any specified highway;
d) Prohibition or restriction of the use of sirens, and the sound of horns or other similar appliances either in general or during specified hours or in respect of specified areas;

e) Regulation of the conduct of persons driving, propelling, being in charge of or handling any vehicle or animation on a highway
f) Application of breath testing, blood and urine specimen testing devices on any driver to detect whether he is driving under the influence of alcohol, or drugs;
g) Demand of a psychiatric evaluation of any person who drives against the normal flow of traffic or who fails to comply with any of the provision of this Law, if in the opinion of any officer of the Authority such an evaluation is necessary for the purpose of determining the person's ability to operate a motor vehicle provided that such shall be at the driver's cost;
h) General regulation of traffic on public highways.

vii Construction Workers Safety Law, 2003

This law provides for the safety of workers in construction and allied industries in Lagos state. Essentially, the law is to guarantee safety of health and environment. It strives to protect workers health. In addition, the law mandates all employers to compulsorily insure their workers against occupational risks:

Other relevant Lagos State Laws that are expected to guide the construction, operation and decommissioning of the plant include but not limited to the following:

- Lagos State Environmental Sanitation Law 2001
- Lagos State Pollution Control Law Cap 46 Laws of Lagos
- Road Traffic Law Cap 172 of Lagos State of Nigeria 2000
- Lagos State Safety Commission Law, 2011
- Transportation of Employees Law, 2000
- Lagos State Infrastructure Maintenance and Regulatory Agency Law 2004
- Lagos State Urban and Regional Planning and Development (URPD) Law 2010

1.5.2.2 Institutional and Administrative Framework

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

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Environment (FMEnv)
- Federal Ministry of Industry Trade and Investment (FMITI)
- Nigeria Export Processing Zone Authority (NEPZA)
- NEPZA Project Implementation Unit (PIU)
- Lagos State Ministry of Environment
- Lagos State Environmental Protection Agency ("LASEPA")
- Lagos State Lands Bureau
- Epe Local Government Area
- Village Chiefs (Baale) of Affected Communities

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

The Federal Government of Nigeria

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

Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the Country. It has the responsibility for EIA implementation and approval, in accordance with the EIA Act. It has developed certain guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures, when the project commences. And they can issue directives to the project on specific actions related to the environment in the project area. The Ministry normally involves the states and sometimes local governments in this responsibility depending on the specific activity.

Federal Ministry of Industry Trade and Investment

The ministry plays a decisive role in the diversification of the resource base of the economy by promoting trade and investment with special emphasis on increased production and export of non-oil and gas products that will lead to wealth and job creation, poverty reduction, supervise the FEC Trade Zones and ensure enhanced service deliver on a manner that will aid growth of the Nigerian economy.

NEPZA Project Implementation Unit (PIU)

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

Furthermore, the PIU shall ensure:

- The EIA studies are conducted in line with legal requirements as well as requirements of the lender
- Proper implementation of the EMP
- Supervise the EPC contractor in conjunction with the Owner Engineers in Project Department to ensure implementation of management measures.
- Ensure proper information and participation of affected communities.
- Implementation of community-approved projects financed through the EPC contractors.

Lagos State Ministry for Physical Planning and Urban Development

The Lagos State Ministry of Physical Planning and Urban Development is the state government ministry, charged with the responsibility to plan, devise and implement the state policies on Physical Planning and Urban Development. The ministry is headed by a commissioner, who is assisted by the Permanent Secretary.

Local Government Authority (LGA)

The project site at the Northeast quadrant of Lekki Free Trade Zone is located in Epe LGA. Epe LGA will be involved in the EIA approval process. According to the EIA act, the LGA will have representative in the panel that will review the report and advise the Minister to make decisions on the project.

The Customary District Councils

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

Contractors

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

NEPZA HSE Department

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

1.5.2.4 International Guidelines and Conventions

In addition to the national laws/regulations, Nigeria is signatory or party to several international conventions and treaties that support the use of EIA as the key tool for achieving environmentally sustainable development. The EIA shall be guided by the international environmental and social regulations from IFC/World Bank where applicable. All other relevant international guidelines and conventions, and industry best management practices shall also apply, including the international financing community.

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

- African Convention on the Conservation of Nature and Natural Resources
- RAMSAR Convention on Wetlands of International Importance
- Convention on Biological Diversity
- Endangered Species (Control of International Trade and Traffic)
- Conservation of Migratory Species of Wild Animals (1973)
- Convention to Combat Desertification (1994)
- United Nation Framework Convention on Climate Change (UNFCCC) 1992.
- International Union for Conservation of Nature and National Resources (IUCN) Guideline, 1996.
- The “Equator Principle”
- World Bank Operational Policies.
- Public Health Legislations and Regulations.
- The Rio Declaration on Environment and Development
- The Kyoto protocol, Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.
- The African Convention on the Conservation of Nature and Natural Resources, 1968.
- Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)
- Human and Peoples’ Rights on the Rights of Women in Africa in 2005
- Civil and Political Rights Covenant
- Economic, Social and Cultural Rights Covenant

- Convention on the Elimination of All Forms of Violence against Women
- ILO Occupational Safety and Health Convention, 1981

ILO Conventions and Core Labour Standards

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

The core labour standards consist of five standards, laid out in eight conventions:

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

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

1.5.2.5 World Bank Safeguard Policies

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

1.5.2.6 IFC Performance Standards for Investment

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

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

Performance Standard 2: Labour and Working Conditions

Performance Standard 3: Resource Efficiency and Pollution Prevention

Performance Standard 4: Community Health, Safety, and Security

Performance Standard 5: Land Acquisition and Involuntary Resettlement

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

Performance Standard 7: Indigenous Peoples

Performance Standard 8: Cultural Heritage

1.5.2.7 World Bank Policies

The World Bank has 10 Environmental and Social Safeguard Policies to reduce or eliminate the adverse social and environmental effects of development projects, and improve decision making. Based on the general applicability of these policies to development projects, the proposed project will trigger four of these policies - Environmental Assessment, Natural Habitat, Involuntary Resettlement, and Forests.

OP 4.01: Environmental Assessment [IFC Policies-P.S.1]
This policy is triggered by any project that is likely to have potential adverse environmental impacts in its area of influence. Projects that trigger this policy are classified as Category A, B, or C according to the nature and magnitude of potential environmental impacts.
A Category A project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect and area broader than the project site.
A Category B project is likely to have potential adverse environmental impacts on human populations or environmentally important areas – including wetlands, forests, grasslands, and other natural habitats. The impacts are site specific and in most cases, mitigation measures can be designed readily. The assessment for this category examines the project's negative and positive environmental impacts and recommends measures to prevent, minimize, mitigate or compensate for adverse impacts and recommend environmental enhancement measures.
A Category C proposed project is likely to have minimal or no adverse impacts on the environment and thus requires no Environmental Assessment.
The proposed project is be classified as a Category A project and thus triggers this policy.

OP/BP 4.04: Natural Habitat [IFC Policies-P.S.6]
This policy supports the protection, conservation, maintenance and rehabilitation of natural habitats and their functions. The policy aims to prevent significant conversion or degradation of critical natural habitats, and requires implementation of conservation and mitigation measures to minimize habitat loss.
The proposed project triggers this policy as the operational area will include areas of natural habitats. The ESMP proposes mitigation measures to avoid degradation of the natural habitat within and around the project site.

OP 4.09: Pest Management [IFC Policies-P.S.6]
This policy necessitates an environmental assessment for projects that raise potential pest management issues. Such projects include the manufacture, use, or disposal of pest control products.
The proposed project does not involve pesticide use or other pest management practices and as such does not trigger this policy.

OP 4.12: Involuntary Resettlement [IFC Policies-P.S.5]
This policy addresses the direct socio-economic impacts arising from projects which could result in disruption of livelihoods, involuntary land take and restriction of access to land. Proponents of such projects are required to prepare a resettlement plan or policy framework addressing the following issues:
Measures to ensure that displaced persons are duly informed of their rights, resettlement alternatives, and replacement costs for loss of assets;
Provision of assistance to aid displaced persons in relocating; and ensure that displaced persons are supported after displacement.

OP/BP 4.10: Indigenous Peoples [IFC Policies-P.S.7]
This policy is aimed at poverty reduction and sustainable development by ensuring that developmental projects fully respect the dignity, human rights, economies and cultures of Indigenous Peoples. Indigenous Peoples are defined as people of a distinct, vulnerable, social and

cultural group possessing self-identification, attachment to a geographically distinct habitat, customary institutions different from dominant society and culture, and an indigenous language different from the official language of the region. The proposed project does trigger this policy

OP 4.11: Physical Cultural Resources [IFC Policies-P.S.8]

This policy seeks to avoid or mitigate adverse impacts of development projects on physical cultural resources which are objects, sites, structures and natural features and landscapes that have archeological, paleontological, historic, architectural, religious, aesthetic or other cultural significance.

Project proposed project does not trigger this policy if there are discoveries of cultural resources during pre-construction (chance finds). The ESMP in this assessment will proposes measures to mitigate adverse impacts on physical cultural resources.

OP 4.36: Forests

This policy addresses the management, conservation and sustainable development of forest ecosystems and their associated resources. It applies to projects that have the potential to impact on the health and quality of forests, the rights and welfare of people and their level of interaction with forests. A forest is defined as an area of land of not less than 1 hectare with tree crown cover of more than 10 percent that have trees with the potential to reach a minimum of 2 meters at maturity in situ. This definition does not include areas dominated by agriculture, grazing or settlements.

The proposed project triggers this policy as it will affect a natural forest area.

BP/OP 4.37: Safety of Dams

This policy applies to projects that include a new dam or rely on the performance of an existing dam or a dam under construction.

The proposed project does not trigger this policy as it does not affect the performance or functioning of a new or existing dam.

BP/OP 7.50: Projects on International Waterways

This policy applies to projects that involve the use or potential pollution of international waterways. International waterways include any body of surface water that flows through or forms a boundary between two or more states. The policy aims to ensure the efficient use and protection of international waterways by ensuring cooperation and good will between the Bank and its borrowers and between states.

BP/OP 7.60: Projects in Disputed Areas

This policy applies to projects sited in a location where there is a dispute over the area. Through this policy, the Bank aims to mitigate potential problems that may affect relations between the Bank and its member countries and between neighboring countries where such project is located.

The proposed project does not trigger this policy as it is not located in a disputed area.

1.6 TERMS OF REFERENCE

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

- Define the relevant framework of legal and administrative requirements for EIA of the proposed project;
- Outline the general scope of the ESIA study including the overall data requirements on the proposed project and affected environment; and.

- Define the procedures and protocols for identification and assessment of associated and potential impacts and for selecting appropriate prevention, reduction, and control as well as enhancement measures for such impacts; and eventually developing an effective Environmental and Social Management Plan (ESMP) for the project.

The ToR has been approved by the FMEnv.

1.7 STRUCTURE OF THE EIA REPORT

The ESIA Report is presented in Nine chapters.

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

- **CHAPTER TWO** presents the project justification, the need/value and its envisaged sustainability, options considered as well as site selection criteria;

- **CHAPTER THREE** contains detailed description of the proposed project including its location, overall layout, basis for design, type and specifications of equipment/facilities to be installed and operation/maintenance and waste streams and project timeline.

- **CHAPTER FOUR** the baseline, ecological and socio-economic status of the study area
- respectively is described. Information on consultation with stakeholders is presented in this chapter.

- **CHAPTER FIVE** discusses the identified potential and associated environmental impacts of the proposed project.

- **CHAPTER SIX** presents the various mitigation measures NEPZA is committed implement against the identified significant impacts.

- **CHAPTER SEVEN** provides a cost-effective environmental and social managemental plan that would be adopted throughout the project's lifecycle. It also enumerates the

- environmental monitoring programme, the waste management programme and the project's decommissioning/remediation plan.

- **CHAPTER EIGHT** presents the procedure for the decommissioning and closure of the project

- **CHAPTER NINE** concludes the report and requests approval for project implementation.

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

CHAPTER TWO

2.0 PROJECT JUSTIFICATION

2.1 INTRODUCTION

In this chapter, the need for and benefits of the proposed project are presented. It also presents a number of project alternatives that were considered during the project design.

2.2 NEED FOR THE PROJECT

The now comatose Nigerian textile industry was one of the booming sub-sectors of the nation's economy post-independence years. Fed by locally grown cotton, with huge demand for clothing by a fast-growing population, it provided direct and indirect employment to hundreds of thousands of Nigerians and some expatriates for several decades. For so long the textile and apparel industry played a dominant role in the manufacturing sector of the Nigerian economy. With a record high of over 140 companies, Nigeria witnessed a boom in the textile manufacturing industries in the 1960s to 1970s with companies such as Kaduna Textiles, Kano Textiles, United Nigeria Textiles, Aba Textiles, Texlon Nigeria Limited, First Spinners Limited, among others, employing about a million people, contributing about 15 percent of the manufacturing sector earnings to the Gross Domestic Product (GDP) of the Nigerian economy and accounting for over 60 percent of the textile industry capacity in West Africa.

The story, however, changed for the industry in the 1980s. Following the discovery of oil and the subsequent oil boom, the government became reliant on oil and abandoned agriculture. The neglect of the agricultural sector had an adverse effect on the textile industry. The production of cotton, the basic raw material used for the manufacture of clothes regressed rapidly as its production capacity declined by 50 percent.

In addition, the economic regression meant that manufacturers could not afford to import sophisticated modern equipment which could have facilitated the production processes. Similarly, textile manufacturers and fabric designers who could afford to import raw materials procured these at astronomical costs which had effects on their businesses. This meant the textile industry had insufficient and, at times, no raw material to work with.

Also, the trade liberalization polices adopted in 1986 following the implementation of the Structural Adjustment Programme (SAP), saw the flooding of imported fabrics and finished goods, thereby degenerating the manufacturing capacity of the industry. By the 1990s, the degradation of infrastructure, especially the lack of stable electricity supply, affected textile manufacturers as they could not keep up with the strains of production and this led to the closure of a number of textile companies, with hundreds of workers rendered helpless. By 1998, the industry was operating at a capacity of just 28 percent.

The abysmal performance of the textile industry and, indeed, the entire manufacturing sector is, indeed, a sad tale. The sector, which played a major role in boosting of nation's economy and development, is suddenly a shadow of itself as the country's manufacturing capacity, especially the textile industry, is at an all-time low and its poor performance is having a bearing on the Nigerian economy. Despite the fact that oil, Nigeria's major source of income, is in a declining state and its overall contribution to the economy has reduced drastically, analysis of data by Daniel Workman, 2020 showed Nigeria shipped US$53.6 billion worth of goods around the globe in 2019. That dollar amount reflects a 10.7% increase since 2015 and a 1.3% uptick from 2018 to 2019.

The following export product groups represent the highest dollar value in Nigerian global shipments during 2019. Also shown is the percentage share each export category represents in terms of overall exports from Nigeria.

1. Mineral fuels including oil: US$46.7 billion (87.1% of total exports)
2. Ships, boats: $3.2 billion (5.9%)
3. Other base metal goods: $2.1 billion (3.9%)
4. Cocoa: $311.1 million (0.6%)
5. Oil seeds: $299.7 million (0.6%)
6. Fertilizers: $151.7 million (0.3%)
7. Fruits, nuts: $113.4 million (0.2%)
8. Tobacco, manufactured substitutes: $103.7 million (0.2%)
9. Raw hides, skins not fur skins, leather: $75.3 million (0.1%)
10. Aircraft, spacecraft: $69.8 million (0.1%)

The analysis shows that textile was not among the top 9 non-oil exports in the year 2019. The analysis also showed that crude and petroleum exports constituted over 87.1% of total value of Nigerian exports to the rest of the world in 2019. Obviously, this is not good for Nigeria. The fact that the value of Nigeria's exports is small and even declined is not surprising because it is noted that developing countries do not export as much as developed countries and as a result, countries do not benefit equally from trade. More worrisome is the poor export performance of local textiles in the region. Internet World Stats, 2015 estimated the population of Africa, as at June, 2014, at over 1.1 billion people. Besides, "exporting to, and/or importing from the Far East, such as: China, Japan, and Korea are both physically and psychologically distant".
The manufacturing sector unfortunately lacks the capacity to provide relief to Nigeria's ailing economy as it only contributes a paltry seven percent to the GDP of the economy, with the textile, apparel and footwear industry contributing about N1.8 billion of that in 2015, according to the National Bureau of Statistics (NBS) report.
It has, however, been proven that the textile industry is, indeed, a driver of growth and employment globally. For example, the exports of the textile industry in Hungary edged up to 3.88 percent in 2019 to $57 Million with Nigeria one of the top 10 export destination share of 4.52% (2.62 million US$). With a strong labour population of over 43,000 in the textile industry, the involvement of medium-size enterprises in the industry and a robust export of textile products to countries such as Germany, Italy, Austria, France and Romania, a tremendous improvement has been forecasted for Hungary's economy.

The influence of the textile industry is bigger in China with more than 100,000 manufacturers employing over 10 million people. The industry is estimated to contribute about 47 percent to the country's GDP, with its value of garment export believed to be around US $ 151.37 billion as at 2019. With its percentage of the global garment market at 38 percent, China is the world's largest manufacturer, exporter and consumer of garments. The Chinese textile industry remains competitive due to the continued investment in the domestic industry.
Given the importance of the high productivity of the textile industry in boosting economic growth and the standard of living of the people, as evident in the examples stated above, the glowing success of the country's fashion designers today as seen in both local and international fashion

shows and according to the United Nations data, it is projected that the global apparel consumption will increase to USD 2.6 trillion annually by 2025, it is apparent that Nigeria must give priority to the textile industry and, indeed, the entire spectrum of the manufacturing industry to improve the fortunes of the Nigerian people and the economy.

The government must provide the enabling environment for textile manufacturers and fashion designers to thrive. Provision of critical infrastructure such as electricity and a good transport system needed by the manufacturers and designers should be made available to help them become truly productive. Also, the recently formulated policy road map for the creation of fashion clusters, the Integrated Textiles and Garment Parks (ITGPS), as formally adopted by the present government and ensure it implements the policy provisions to the letter

2.3. VALUE OF THE PROJECT

The proposed Lekki Textle and Garment Industrial Park will be built at an estimated cost of about US $378.75 million. The deployment of US $378.75 Million into the textile and garment manufacturing sector will certainly propel infrastructure development and in a way raise the standard of living of people in the host communities in particular and Nigeria in general. Table 2.1 shows the breakdown of the estimated project cost.

Table 2.1: Project Cost and Financing

Uses	USD'000	NG N'bn	Sources	USD'000	NG N'bn
Project Site (Phase 1)	7,500	2.70	LWIL- Land Equity	7,500	2.70
Phase 1 roads and services	9,375	3.38	NSEZCO-Cash-Equity	74,250	26.73
Phase 1 Other external facilities	7,875	2.84	Total Equity	81,750	29.43
Factory and other buildings and services	354,000	127.44	Afrexim bank FUND FAED-mezzaanine Afrexim bank and BOI –project debt	74,250 222,750	26.73 80.19
Total Investment	**378,750**	**136.35**	**Total Financing**	**378,750**	**136.35**

Source: DAR Project Feasibility Report and Masterplan, 2019

NOTES

- Conversion rate is N360/USD1.
- The preliminary cost estimate of S378.75 Million is based on professional estimates subject to refinement of project specifications and prior to competitive bidding.
- A nominal land value has been has been calculated on the basis of the proposed cost of **S**5/m^2. This translates to approximately 9% of project company equity, which has been rounded to 10%
- The final project financing structure will be determined based on final construction cost and negotiation of financing.

2.4 BENEFITS OF THE PROJECT

There are several significant benefits to gain from the construction of the project. The beneficiaries include the project proponent, the State and Federal Governments, the local community and importantly the local economy.

Socio-economic Benefits

The development is expected to benefit the location by creating an economic hub thereby creating local employment and raising the standards of living. The employment in turn is expected to train manpower towards skilled and un-skilled job requirements. Employment opportunities generated by the project have also been estimated. Based on UNIDO and NBS data, an average employment per industrial unit ratio was applied for each sector to derive total direct industrial employment. Indirect and induced employment has then been derived from direct employment figures by applying a ratio of 2 indirect/induced jobs per direct job.it is estimated that the project will employ around 12,300 workers

Additionally, it would create an ecosystem for training, learning and development. Based on these considerations, the following benefits have been considered: direct and indirect employment; value of industrial output generated and contribution to Nigeria's manufacturing output; and capital investment from industrial activity.

The production of textiles is also integrated with the chemical; rubber, plastic, skin, hide and leather industries. All these industries will benefit from the project development

Environmental Benefit

General contribution to climate change through overall reduction of the used of personal power generating sets.

Incentives as per the Nigerian FTZ policy:

- 100% tax holiday from all Federal, State and Local Government taxes, rates, duties
- One stop approval for permits, operating licenses and incorporation papers Duty-free and tax-free import of raw materials and components for goods destined for re-export
- Duty-free introduction of capital goods, consumer goods, machinery, equipment, and furniture
- Permission to sell 100% of manufactured, assembled or imported goods into the domestic Nigerian market with import duty calculated on the basis of the value of the raw materials or components used in assembly not on the finished products
- 100% foreign ownership of investments 100% repatriation of capital, profits and dividends
- Waiver of all expatriate quotas, and import and export licenses
- Prohibition of strikes and lockouts (10 years)
- On-site customs office, immigration and police station One-stop-shop services through NEPZA capital

2.5 PROJECT'S SUSTAINABILITY

Some factors are important to consider to reaching project sustainability. They are related to practical aspects related to economic profitability, technical resources, and all, with an efficient management.

2.5.1 Technical Sustainability

The proposed Project is technically sustainable because of NEPZA's track record of strict adherence to Nigerian National (and International) engineering codes and standards. Only proven technologies that are economically viable with minimal environmental, social and health impacts readily available shall be utilized in the execution of the project. Also, the technology to be employed shall be readily available.

2.5.2 Economic Sustainability

Four key industry drivers, namely the abundance of labour, government thrust, linkage with other industries and a large consumption base. Owing to a large raw material base and availability of cost effective labour,

Project Site strategically situated as part of the most populous and economically important city of Nigeria and West Africa with presence of adequate industrial, real estate and support infrastructure being located as part of Lekki region (having proximity to Lekki Deep Sea Port), which is deemed to be a natural extension to Lagos and an upcoming industrial and real estate corridor, the subject property has potential to draw industrial players. The country's large consumption base is also considered to be a crucial asset to drive the industry's growth.

Lekki Region is characterized as a well-planned satellite city of Lagos with proper allocation and demarcation of various land uses envisioned as a 'Blue-Green Environment City. Multiple transport, industrial and other initiatives are operational and under various stages of implementation – key ones include:

- Largest Refinery of Nigeria – Dangote Refinery
- Lekki International Airport
- Rendeavour Africa Free Zone
- Other initiatives such as Lekki Labor City, etc.

Above initiatives are expected to significantly transform the opportunity dynamics and enhance investor interest to the Project Site going forward.

Value Added Developments

As a result of the proposed project, several value added developments are likely to spring up in the immediate vicinity. Banks, schools, hospitals, etc. are likely to be established around the project location. In addition, other ancillary facilities that deal in materials that are routinely used in the construction and manufacturing sectors, including stationeries, household items that are required by project workers, clients etc. will spring up and engender an economic boom within host communities.

2.5.3 Environmental Sustainability

The project will be environmentally sustained by incorporating into project design, practical mitigation measures or controls proffered for the identified environmental impacts of the proposed project (see **Chapter Six**). Also by implementing the environmental monitoring and management programmes as recommended in the EMP (**Chapter Seven**). Implementing these actions would also ensure that the project meets and/or exceeds the requirements of the Nigerian FMEnv and World Bank/ IFC regarding minimizing the environmental and social impacts.

NEPZA has full department that handles environmental matters. The HSE department Hence, they have the technical skills needed to manage the mitigations that are determined for the identified impacts of this project.

2.5.4 Social Sustainability

The project has secured its first social license – the host communities' acceptance of the proposed project their eagerness to see it succeed. The project will attract a lot of improvements in the social wellbeing of communities neighbouring the project area. Some category of jobs including some sub-contracting services shall be employed from the communities, resulting in financial upliftment and reduction in the number of unemployed indigenes and Nigerians. Lagos holds a comparative advantage in terms of availability of labour.

In addition, NEPZA is committed to effective and continuous stakeholders' engagements and consultations and compliance with applicable national social laws, relevant international conventions and World Bank social safeguard policies.

2.6 SITE SELECTION AND ALTERNATIVES

There are usually several alternatives to a project design and in this sub section, a number of alternatives are considered. In assessing alternatives, there are often many influencing factors including economic feasibility, level of political support for the Project (in line with Government policies) and social-environmental feasibility and sustainability

2.6.1 Project Options

2.61 No project option

It is essential that the "no project option" be considered as a first step in mitigation. The "no project" option implies that the proposed Lekki Textile and Garment Industrial Park development project is suspended or cancelled, and this will mean that the textiles/garments importation currently being carried out by Nigerians will continue. This will result in depletion of our economy through continued demand for foreign exchange to meet our textile and garment importation need; about 12,300 Nigerians that will be employed by the Textile and Garment project will remain unemployed. The Federal Government agenda to diversify the Nigerian economy of which this project is key will be hampered. Moreover, the anticipated socioeconomic benefits derivable from this project will not be realized.

2.6.2 Delayed Project Option

This option implies postponing the planned construction and operation of the development of the Lekki Textile and Garment Industrial Park project to a much later date. Such options are usually taken when prevailing conditions are unfavourable to project implementation, such as during a war, political position, when host communities are deeply resentful of the project, or if the economics of the project are unacceptable or unattractive. But none of these conditions are applicable; on the contrary, both the economic and the political environment are favourably disposed towards the project. The implication, therefore of delaying the project will mean that all processes that have been put in place for the project design and implementation, contractors and/or workers that have been mobilized for this project will have to be demobilized. Also, because of the inflationary trends in the economy, such a delay may result in unanticipated increases in project costs, leading to perhaps the inability to proceed further giving the socio-economic benefits or even decrease in final profit accruable from the project. These, and other related problems make it impossible to adopt the delayed project option.

2.6.3 Project Implementation Option

The third option considered was the execution of the proposed project as planned. This option was accepted because the project will uplift the socio-economic activities of the host communities through its Corporate Social Responsibility (CSR). Further, it will generate employment opportunities for thousands of Nigerians and stimulate the springing up of ancillary industries that will also provide more job opportunities to the teeming unemployed youth in the country thereby increasing their standards of living. The Federal Government's Cotton, Textile and Garment (CTG) development scheme for the revival of ailing CTG sector will be actualized and the diversification of the economy from oil sector will be on course. These prospects will elude Nigerians if the project is not encouraged.

2.6.4 Project Location Alternatives

In accordance with the requirements of Nigeria's EIA procedures together with international best practice, a number of alternatives have been considered during the formulation of the proposed Project design. Location alternatives the present location of the free trade zone was identified as the preferred location taking into consideration the following location alternative factors. The important factors that influence the site selection include:

- Proximity to the Lekki - Epe expressway, which links the Project Site to prominent activity hubs of the city.
- Situated adjacent to a proposed Lekki deep sea port and in vicinity of a proposed Lekki international airport, thereby expected to enhance future potential of the development
- Proximity to Dangote Refinery and Petrochemical industry, petrochemical feedstock for Man Made Fibre (MMF) production will be readily available.
- Site located on the Coastal Road, which runs along the southern part of the Lekki Peninsula (currently characterized by good congestion free access /connectivity.
- Presence of Lekki Lagoon south of the project site (the deepest natural lagoon in the state)
- Good access to other part of Nigeria
- Environmental considerations
- Land availability
- Acceptability of site from Environmental aspects like availability of areas for solid waste / liquid effluent disposal.

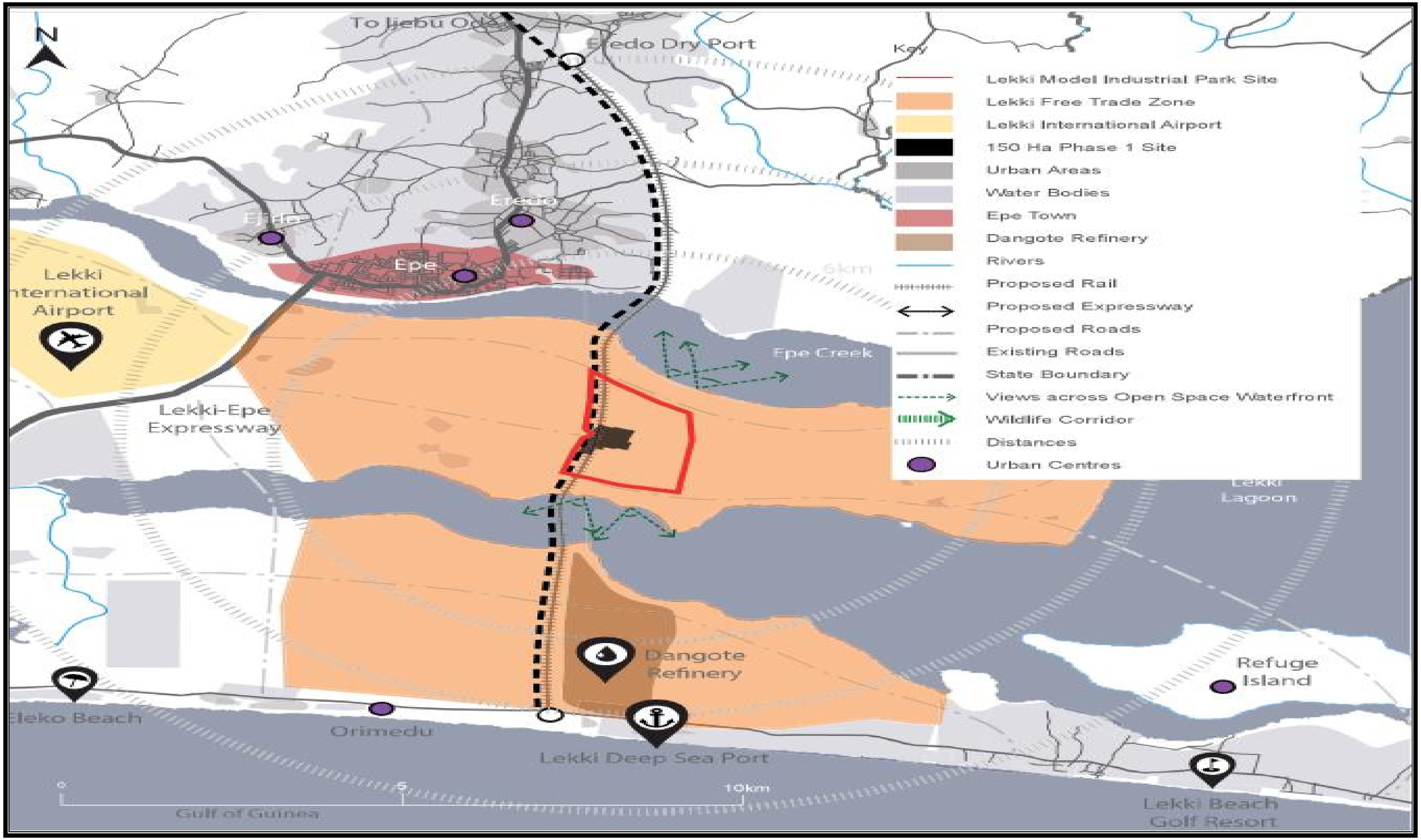


Figure 2.1: Map of project Area showing some on-going and proposed projects

Lekki Lagoon
Closeness of the site to Lekki Lagoon and availability of networks of rivers/streams will ensure regular water supply. The site is actually between Lekki lagoon at the south and Epe lagoon at the north. Wastewater will be discharged to the lagoon after needful treatment.

Lekki Deep Seaport
The master plan of the Lekki Free Zone includes a state of the art deep sea port which will be constructed in several phases up to -18 m water depth. The offshore area located adjacent to this port quickly reaches depths in excess of 15m allowing access by appropriate vessels for export of the finished product.

Existing Port Facilities
There is an all-weather, operating port at Apapa, Lagos which can meet the requirement for bringing most of the project cargo during construction.

Local Industries

Enabling environment has been provided for the proposed refinery in the zone as reflected in LFZ master plan that several small and medium sized companies including a refinery will be established in the Zone. In addition, a number of maintenance and fabrication workshops will also be set that could meet the requirements of the industry.

Local Transport
The road network between LFTZ, Lagos Metropolis and Apapa Port is adequate for mass transit and the delivery of land based machinery and parts for the plant at present. Again, as the majority of the equipment will be unloaded at a jetty to be developed along the coast and delivered by road to the site, the preferred site has been selected on the basis of being as close to the main trunk road as possible. It is also anticipated with the growth of the LFTZ, critical transport infrastructure would be improved in and around the area to support the increase in capacity load. Air transport will also be facilitated following the completion of Lekki International Airport which less than ten kilometers from the site.

Proximity to the Main Road

As the majority of the equipment will be unloaded at a jetty to be developed along the coast and delivered by road to the site, the preferred site has been selected on the basis of being as close to the main trunk road as possible.

Environmental Considerations
The development is not within any officially designated protected Area. Some patches of mangroves are observed within the proposed site. However, they are in a degraded state.

Availability of Infrastructure and Peaceful Environment
The project is being located in a Lekki Free Trade Zone that assures massive infrastructure including transportation infrastructure (road, rail and air), energy infrastructure, water infrastructure, waste infrastructure, waste water infrastructure and other municipal infrastructure. Apart from developing her own infrastructure network, NEPZA shall also leverage on these general infrastructure for enhance delivery.

The prevailing environment is peaceful as there is no recorded case of rift among the host communities, LFTZ and NEPZA. In additional, no inter-communal crises is reported among the host communities. Interaction with community members showed a high desire for the establishment of the Textile and Garment Industrial Park as they are convinced the project will enhance their socio-economic status through provision of jobs and infrastructure improvement.

2.6.5Lekki Textile and Garment Industrial Park Analysis (Phase 1) Site Selection Analysis
NEPZA recognizes the importance of selecting appropriate sites for its project proposals and that the identification of those sites should include consideration of technical and commercial feasibility, environmental impact and stakeholder concerns.

2.6.5.1. Selecting the Phase 1 Area
Three options were subsequently developed to identify the siting of the Phase 1, which would trigger the development of the Lekki Model Industrial Park. Option 2 is taken forward as it provides the opportunity to separate agro-industry from the garments industry into two district communities either side of the east-west Primary Road when compared with Option 1 and Option 3.
The following identifies the characteristics of each option:

Option 1

- Close to new road and railway infrastructure;
- Optimises the need for infrastructure development;
- Flexibility for plot configuration.

Figure 2.2: Site Option 1

<u>Option 2.</u>

- Provides opportunity to cluster agro-industry and garment industries into two separate industrial areas either side of the main east-west Primary Road.

Figure 2.3 Option 2

Option 3

- Part of the east-west primary road is completed;
- Direct industrial plot access to the Primary Road;
- Greatest demand for infrastructure development.

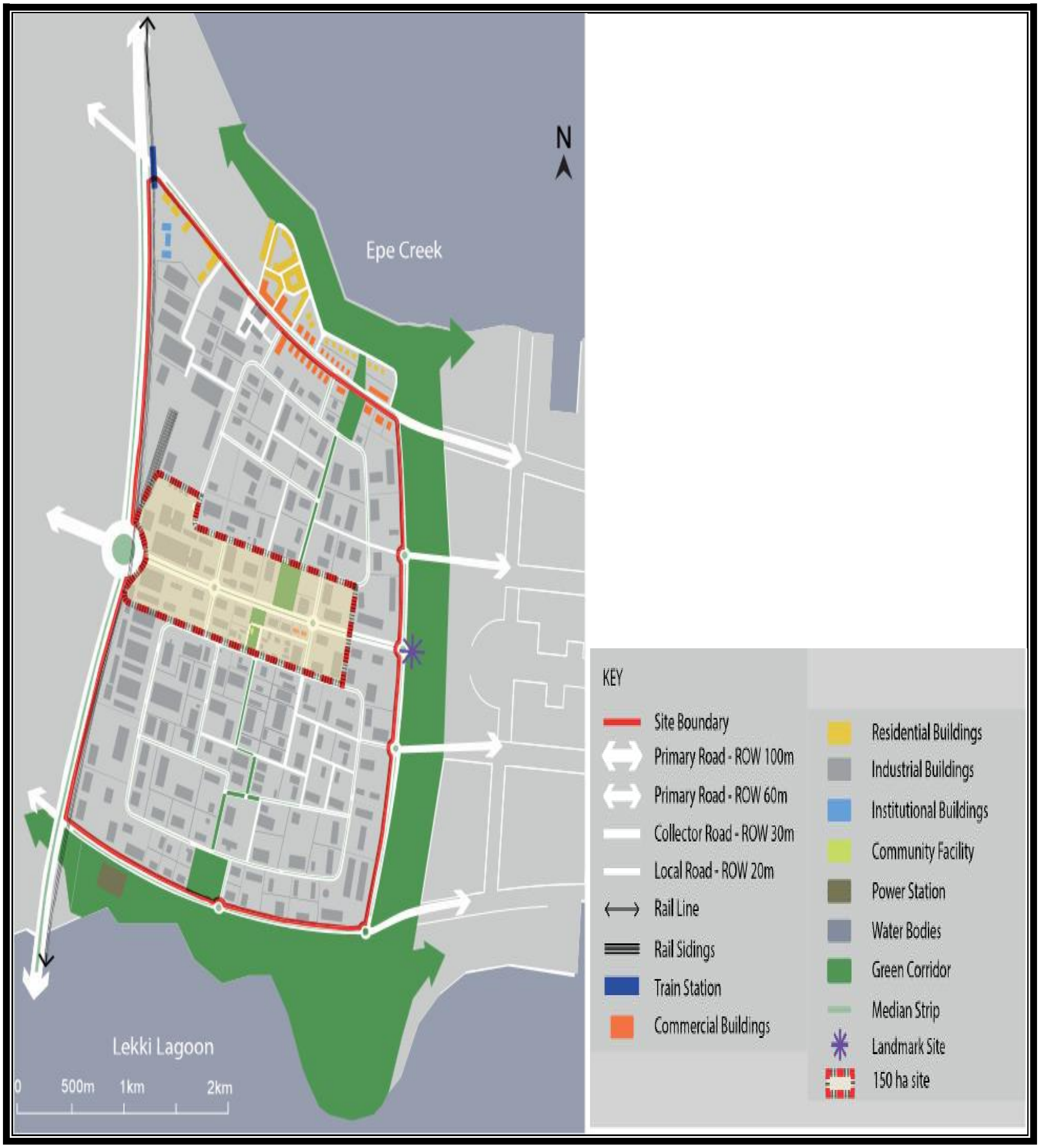


Figure 2.4. Option 3

2.6.5.2 Option Evaluation

A series of criterion have been used to provide an assessment of the most favourable approach in selecting the area of Phase 1. An evaluation has been undertaken to score these options against one another, as presented in Table 2.2.

The following ranking has been used in assessing the merits of each option against the criteria set out in Table 2.2:

- 1 - Inadequate
- 2 - Low
- 3 – Medium
- 4 - Good
- 5 – Excellent

Table 2.2. Phase 1 Options Evaluation Matrix

	CRITERIA	OPTION		
		1	2	3
1.	**NEED FOR UPFRONT INFRASTRUCTURE -** requires limited investment in infrastructure to allow for delivery of the initial phases of the development.	2	5	4
2.	**LEVEL OF ACCESS TO THE INDUSTRIAL PLOT -** there is good vehicular access to the plots.	2	5	3
3.	**FLEXIBILITY FOR PLOT CONFIGURATION -** permits flexibility in the potential layout of plot uses.	2	4	5
4.	**RAILWAY ACCESS –** provides easy and direct access to the railway.	3	5	5
5.	**NORTH-SOUTH ROAD ACCESS –** there is good vehicular access to the north-south Primary Road.	2	5	4
6.	**ACCESS TO THE PROPOSED RESIDENTIAL AREA –** the residential accommodation is easy to get to.	4	5	3
7.	**CLUSTERED INDUSTRIES –** industrial processes and types are grouped together	4	5	2
TOTAL \		**19**	**34**	**26**

2.6.5.3 Assessment of Site Options

An evaluation was undertaken to score these options against one another, as presented in Table 2.2. Option 2 is assessed as the preferred option.

Need for Upfront Infrastructure

This criterion assesses the required infrastructure to allow for delivery of the initial phases of the development. Option 2 scores better than the other two options due to its compact form and therefore less intensive need for the delivery of infrastructure. The main clusters will be developed along the primary road making the best use of the required upfront infrastructure.

Level of Access to the Industrial Plot
Option 2 scores better than the other two options due to its proximity to the north-south road, taking advantage of the railway connection. This option also includes a good mix of primary, collector and local roads that will provide a good level of access to the industrial plots.

Flexibility for Plot Configuration
Option 2 and Option 1 score highly against flexibility for plot configuration. The reason is that in both options the industrial complex contains units of a variety of plot sizes which are intended to provide flexibility for industrial operators.

Railway Access
Both Option 2 and 2 share the western boundary with the railway. However, Option 2 includes the optimal access for rail freight especially in the northern part of the site.

North-South Road Access
Option 2 and Option 3 score highly against this criterion. Both options share their western boundary along the north-south road. However, Option 2 includes a primary road that functions as a spine of the development. This primary road creates a junction with the north-south road making the best use of this link.

Access to the Proposed Residential Area
Option 2 scores better than the other two options due to its proximity to the residential area which means it will be easier to reach for the commuters.

Clustered Industries
Option 2 scores better as it provides 4 clusters of industrial development which are regrouped by specialism. The agro-industry and garment clusters will be pooled together by specialism and served by the central primary road.

Conclusion
Option 2a scores more highly than the other two options under almost all the criteria. The better results are due to the siting of Option 2.a which will be adjacent to the railway and north-south Primary Road. This will therefore require minimal infrastructure provision upfront and provide the opportunity to cluster agro-industry and garment industries into two separate industrial areas either side of the main east-west Primary Road. In conclusion, Option 2.a is taken forward as the preferred option.

2.6.6 Internal Phase 1 Area Configuration
As two industry types are proposed, different internal spatial configurations are possible. Three configurations of option 2 are presented as follows:

Option 2a
Option 2a includes agro-industry plots to the northern side of the east-west road and garment plots on the southern side.

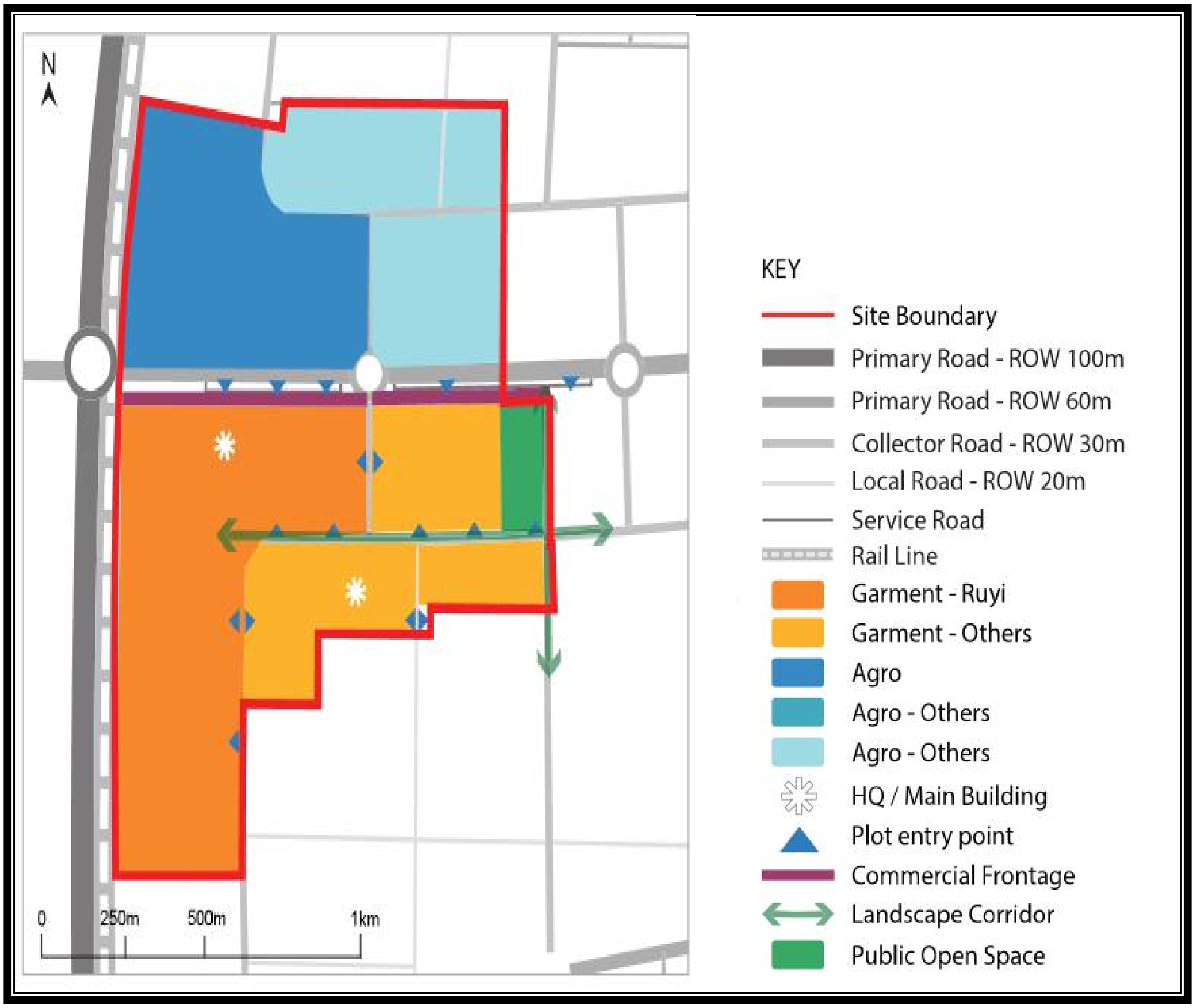


Figure 2.5 Configuration Option 2a

Option 2b

Option 2b includes agro-industry plots on the southern side of the east-west road and garment plots on the north side.

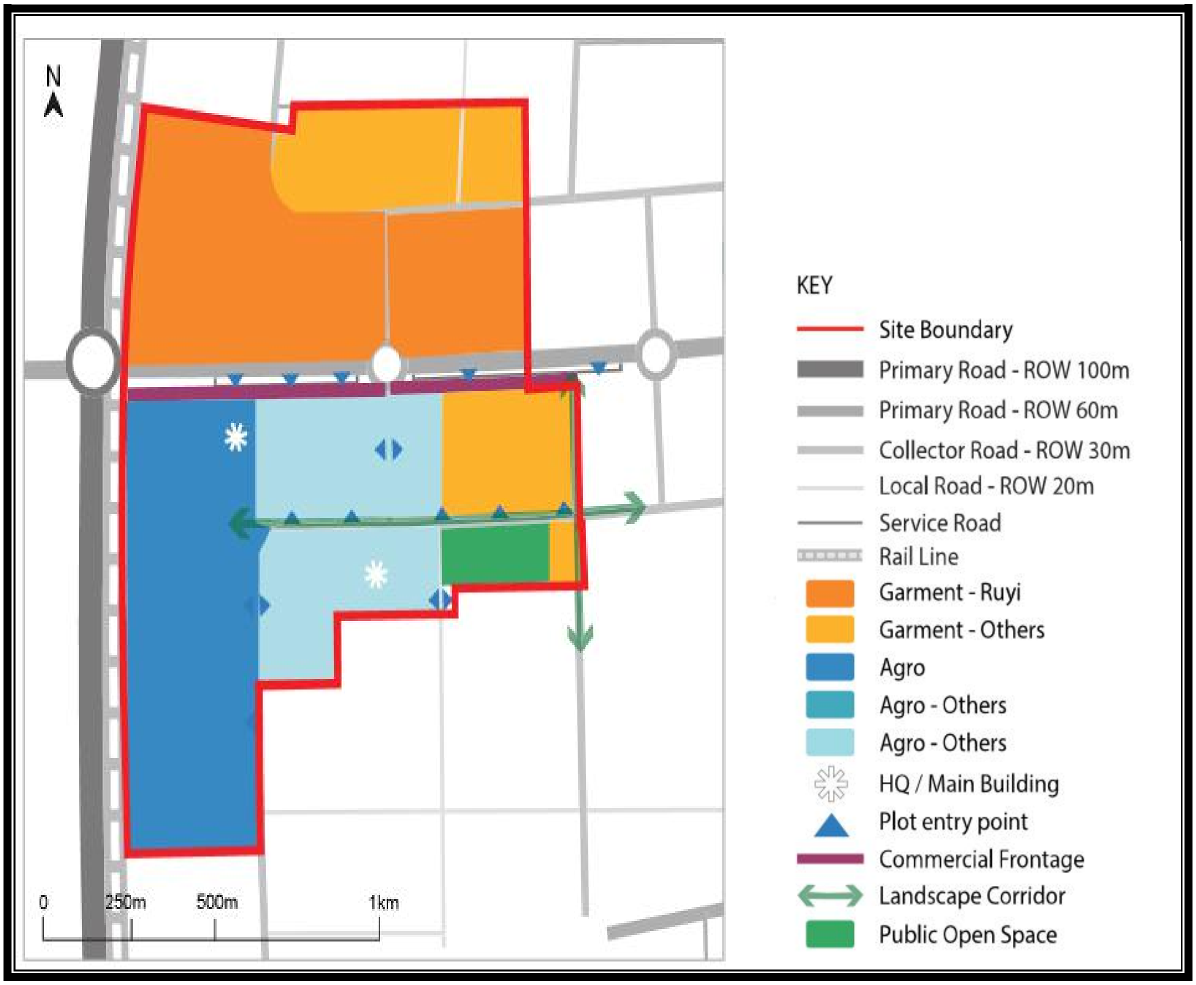


Figure 2.6: Configuration Option 2b

Option 2c

Option 2c includes garment plots that abut the railway and agro-industry plots in the eastern part of the site.

Figure 2.7: Configuration Option 2c

2.6.6.1 Preferred Configuration Option

Option 2a is the preferred option considering that it provides both Ruyi and Flour Mills Nigeria with good access to the infrastructure network, while also providing them with efficient site layout opportunities. Splitting the two industrial types into separate communities is also preferred.

After careful consideration and analysis, it has been identified that option 2.a.1 will be best suited to promote an efficient use of the land area available for industrial development.

The masterplan provides the opportunity to split agro-industry from garments and textiles into two distinct communities either side of the east-west Primary Road. This enhances the management of security into and out of the site but also eases the flow of traffic. Plots are intended to be flexible for all operators, including Ruyi and FMN, with good access to the infrastructure network, while also providing them with efficient site layout opportunities. Option 2 provides the optimal formula to achieve a sustainable socio-economic development generating economic (21,800 new jobs), ecological (Sustainable Urban Drainage) and social (residential and sports facilities) benefits.

CHAPTER THREE

PROJECT DESCRIPTION

3.1. PROJECT OVERVIEW

The first phase of the proposed Textile and Garment Industrial Park is focused exclusively on the construction of Garment and Textile industries, where the desired industrial/manufacturing development is implemented in association with essential business offices, commercial, customs, recreation and required infrastructure developments to make it a state of the art Industrial Park. Accordingly, a summary of the classification of the major activities that will operate in the proposed Textile and Garment Industrial Park is given in table 3.1 Hence, in order to fully understand and propose an appropriate environmental management by way of the EIA, the nature and type of industries, proposed supporting facilities and businesses, land use and layout of all activities as well as the infrastructural development necessary need to be explained in order to arrive at a comprehensive EIA.

The description of the proposed Textile and Garment Industrial Park project is given here under based on what has been provided by the feasibility and master plan studies for which the EIA is done.

Table 3.1: Classification of activities and major components

S/N	Classification	Major components
1.	Industrial /Manufacturing	Garments and Textiles factory, Flour Mill Factory, Agro-Processing: factory, Warehouses
2.	Business Support / Public offices	Zone Administration Offices, Workshop ·Business Support Center ·Public Office / Exhibition hall ·Police Station, Fire Station
3.	Commercial / Business	One - Stop Shop / Stores services (laundry, Canteen, Plaza etc.)
4.	Recreation / Leisure	·Parks, green areas (buffer zones) ·Pedestrian roads The Sports and Community Centre
5.	Infrastructure (On-site and Offsite)	Roads, Street Lights, Storm Drainage, Plants & Machinery, ICT Ducts, Security Fence, Sewers and STP, TSE Supply, Potable Water Supply, Gas Supply, Electrical Power Supply. Process Water

3.2 DEVELOPMENTOBJECTIVE

Aworld-classindustrialbusinessparktodayrequiresanenvironmentthat strikes a balance between core industries and their supporting services and amenities. Current regional surveys show that a preferred industrial business environment is one that provides the following amongst numerous others:-

- Electric Power;
- Green area;
- Telecommunication services;
- Land and marine access;
- Security;
- Healthcare Facility
- Access roads

3.3 STRATEGIC PLAN FRAMEWORK

In order to provide a setting for the detailed Phase 1 Masterplan (150ha), a strategic plan framework has been developed for the wider area, within the North East Quadrant. This section sets out the vision, the principles, the development process and the detailed options that inform the steps taken in developing the masterplan.

3.3.1. Vision

The Lekki Model Industrial Park will be a high quality industrial site that provides employment and generates wealth for Nigeria. Set within the rapidly developing industrial complex of Lekki, the Model Industrial Park will become a landmark that sets a high standard and is an attractive place in which to invest and work.

3.3.2. Principles

In order to guide the development of the strategy, the following principles have been adopted in structuring the concept masterplan:-

- Adding a passenger station on the rail line would promote the use of public transport for access of the workers to places of employment;
- The station would form an anchor to a new town centre, that provides local retail facilities and services;
- Residential development to be provided to the north, overlooking the Epe Creek and to take advantage of the attractive setting;
- Commercial development to stretch along the east-west road to the north;
- The industrial complex to contain units of a variety of plot sizes to promote flexibility;
- A green grid network to provide an interconnected system of open spaces;
- The green grid network to also provide a network for storm water drainage;
- Rail sidings to enable local use of the rail line for freight;
- A hierarchy of roads to direct traffic and manage vehicular flows;
- Streets and roads to be gently curved as a means to provide visual interest, work with the natural physical context and encourage slower traffic speeds;
- A green corridor extends along the east of the site to provide a buffer with the residential developments;
- The street network to be integrated and connected to the neighbouring areas as identified in the 2008 Lekki FTZ Master plan 2008

3.4 PHASE 1 MASTERPLAN

Master planning has a lasting impact on how an industrial park develops, operates and is integrated into surrounding areas and communities. It defines the connection between the topography, land use, infrastructure, public right-of-way, buildings, social settings, and their surrounding environments.

3.4.1 Design Approach

Figure 3.1 identifies the approach taken in developing the master plan. The following initiatives have been undertaken:-

- The main east-west Primary Road is gently curved, so as to provide visual interest for moving vehicles, while also being a green route with planting either side;
- The Primary Road is to be heavily planted so as to create a greened visual environment;
- The building line is set back from the plot edges along the Primary Road to reinforce the visual setting of an open and greened environment;
- Few direct entrances are provided into plots from the Primary Road; entrances are primarily for the headquarter buildings which seek to provide an important and visible frontage along the Primary Road;
- Buildings fronting onto the Primary Road network are important as they form the public face of the overall development, and provide advertising opportunities for the businesses located there, while also being a visual indicator of the importance of the business;
- The streets that join onto the Primary Road are straight roads, with the vista terminating on an important building, usually an office headquarter building. This provides an opportunity for the relevant business to be located in a visually prominent location and mark out the entrance into the northern or southern industrial community;
- Plot entrances are primarily provided from the Collector Road, and in the case of larger plots, two entrances are provided as a means to separate cars from trucks and lorries;
- A linked green network connects the swale with the sports facility and park in the east of the site, as a means to provide a network of usable open space;
- Smaller units that are ideally suited to start-ups will be located opposite the sports facilities. These facilities will become the centre of the industrial area’s community life, around which events and inter-business sports events can be held. This will get the businesses to engage together and become a hub for exchange, benefitting both small and large businesses to grow and develop.

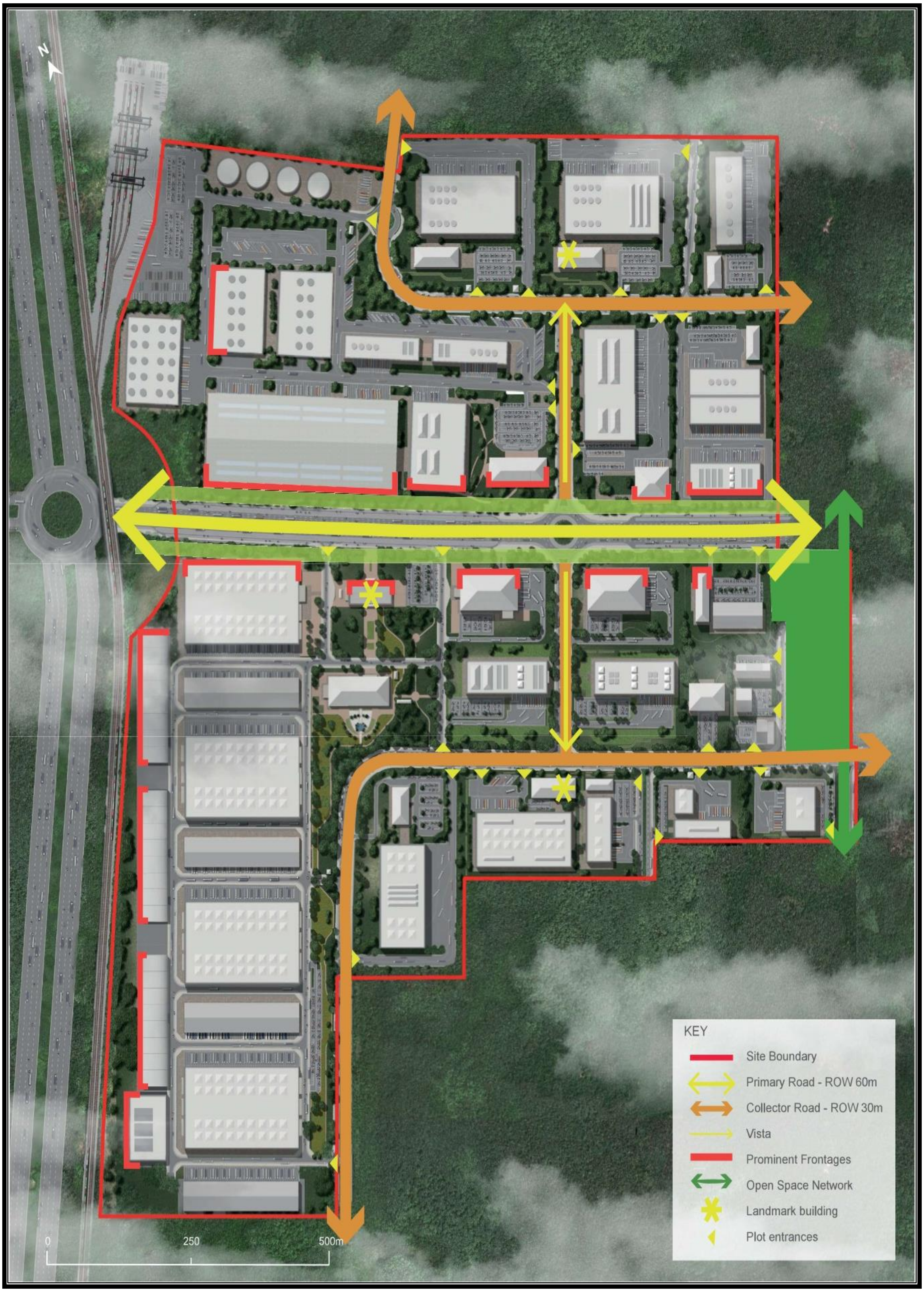


Figure 3.1. Analysis Diagram

3.4.2 Masterplan Illustration

Figure 3.2 shows the illustrative master plan. The east-west primary road (60m) will provide the main access to the site from the north-south primary road (100m) via a roundabout.

Garment manufacturer Ruyi's buildings are located to the south side of the east-west road. They will benefit from the transport opportunities offered by the nearby railway on the western side of the plots.

Access to this part of the site is gained via a Collector Road heading south that will also provide access to the rest of the garment/ textile buildings.

Adjacent to the eastern boundary of the site, a sports and community centre will include a football pitch, gym and a wide public open space. This area is envisaged to act as a catalyst for the commercial and industrial activities, offering the opportunity for business networking while providing a shared space for local employees to meet and socialize.

The facility will be a valuable asset to the local business community, and in particular start-ups, which can benefit from getting to know neighbours and find opportunities offered in the local business environment. The Sports Community Centre will be a unique local business proposition. In order to maximize the benefits, the smallest units in the Phase 1 are be home to start-up businesses, are located around the facility.

To the north side of the east-west Primary Road, plots will be allocated for Flour Mills Nigeria and other agro-industry units. Access will be provided by a Collector Road. Street within the development will be attractively landscaped, including along vegetated corridors which will improve the appearance of the industrial complex.

Figure 3.2: Illustrative Masterplan

3.5 LANDSCAPE

A key focus of the landscape proposal is to create a robust and resilient framework that accommodates native habitats and harvests water runoff. To achieve this, the landscape strategy proposes the development of a smart Blue and Green infrastructure network comprising a series of productive and resilient landscape systems. These will provide a number of benefits including:

- Flood mitigation and protection;
- Rainwater harvesting;
- Wastewater remediation;
- Storage and reuse of rainwater;
- Increase in staff productivity;
- Micro-climate management;
- Improved air quality;
- Aesthetically pleasing spaces; and
- Improved accessibility and connectivity.

The Blue and Green infrastructure network forms a series of open spaces that fall into five main, functionally linked types. These are presented in the following detailed sections:

- Central Swale;
- Industrial Gardens;
- Nature Reserves;
- Street Drainage Channels;
- Urban Realm.

The spatial distribution of each type is identified in Figure 3.3.

The Central Swale

A dynamic landscape that accommodates rain and floodwater, treats gray water with the use of terraced gardens and provides recreational opportunities. The Central Swale is an interconnected drainage channel that crosses the whole Model Industrial Park north to south as a means to drain rainwater.

Industrial Gardens

These provide water management/filtration, flood protection, and a healthier environment for end users. Integrated as small-sized linear elements in response to the limited land availability, they are interconnected to larger local and regional networks.

Nature Reserves

Preservation of natural patches of forest

Street Drainage Channels

Street drainage channels will be integrated in the streetscape design and designed to function together with the conventional drainage infrastructure. The design will be based upon the street type:

Urban Realm

The drainage channels are integrated in the streetscape design and are designed to
function together with the conventional drainage infrastructure. The design will be based upon the types of urban realm:

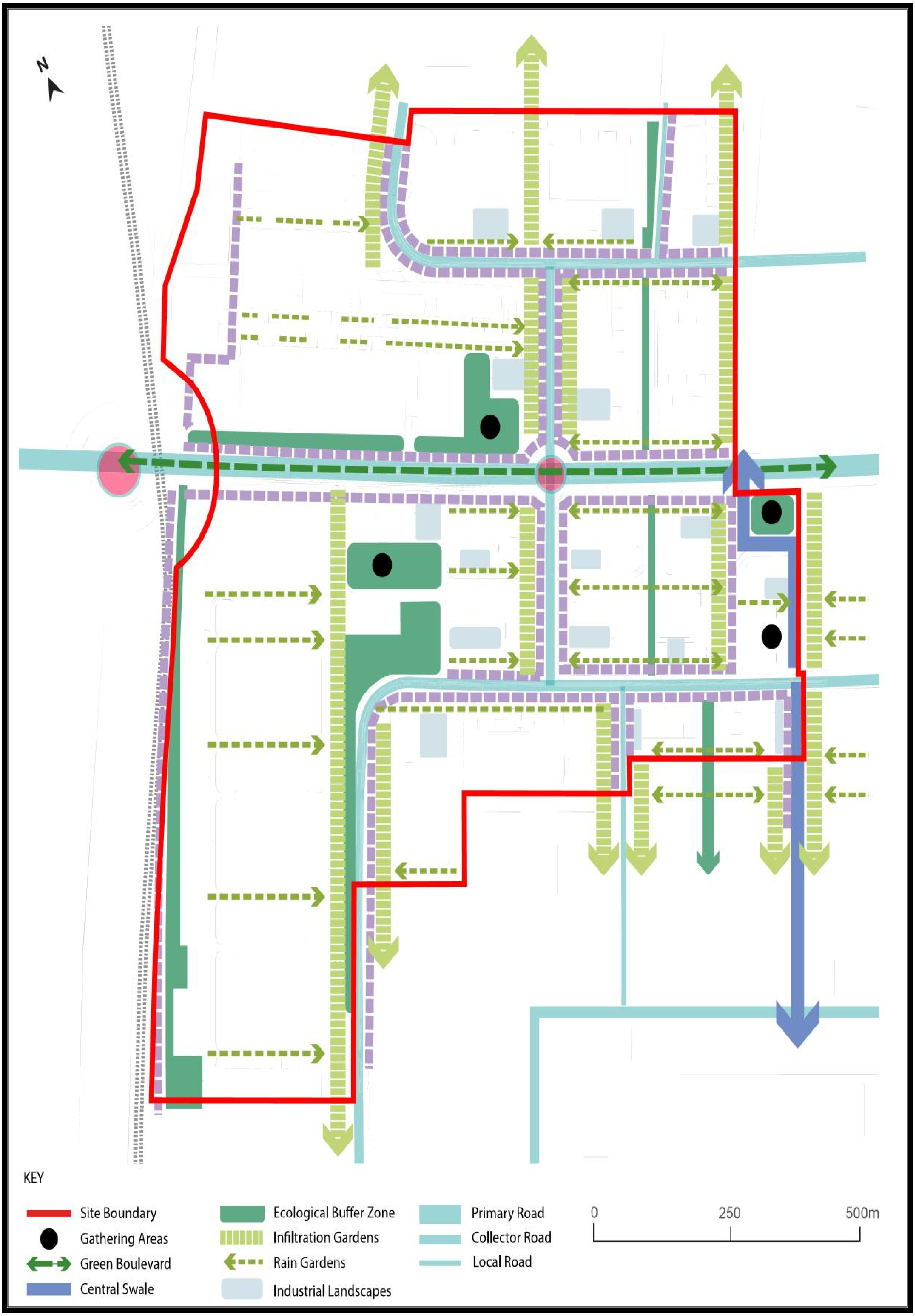


Figure 3.3: Rain and Infiltration Strategy

3.5.1. Landscape Systems and Typologies

The five typology areas are detailed as follows:-

3.5.1.1 Central Swale

Figure 3.4 shows the Central Swale in a road section which serves as a flood mitigation channel where excess flood water is collected and managed, while also providing recreational and ecological value. A network of walking and cycling paths and a series of seating areas are located within the zone of the swale. Flood water and wastewater from the industrial gardens will be treated through the use of remediation gardens before flowing into the swale

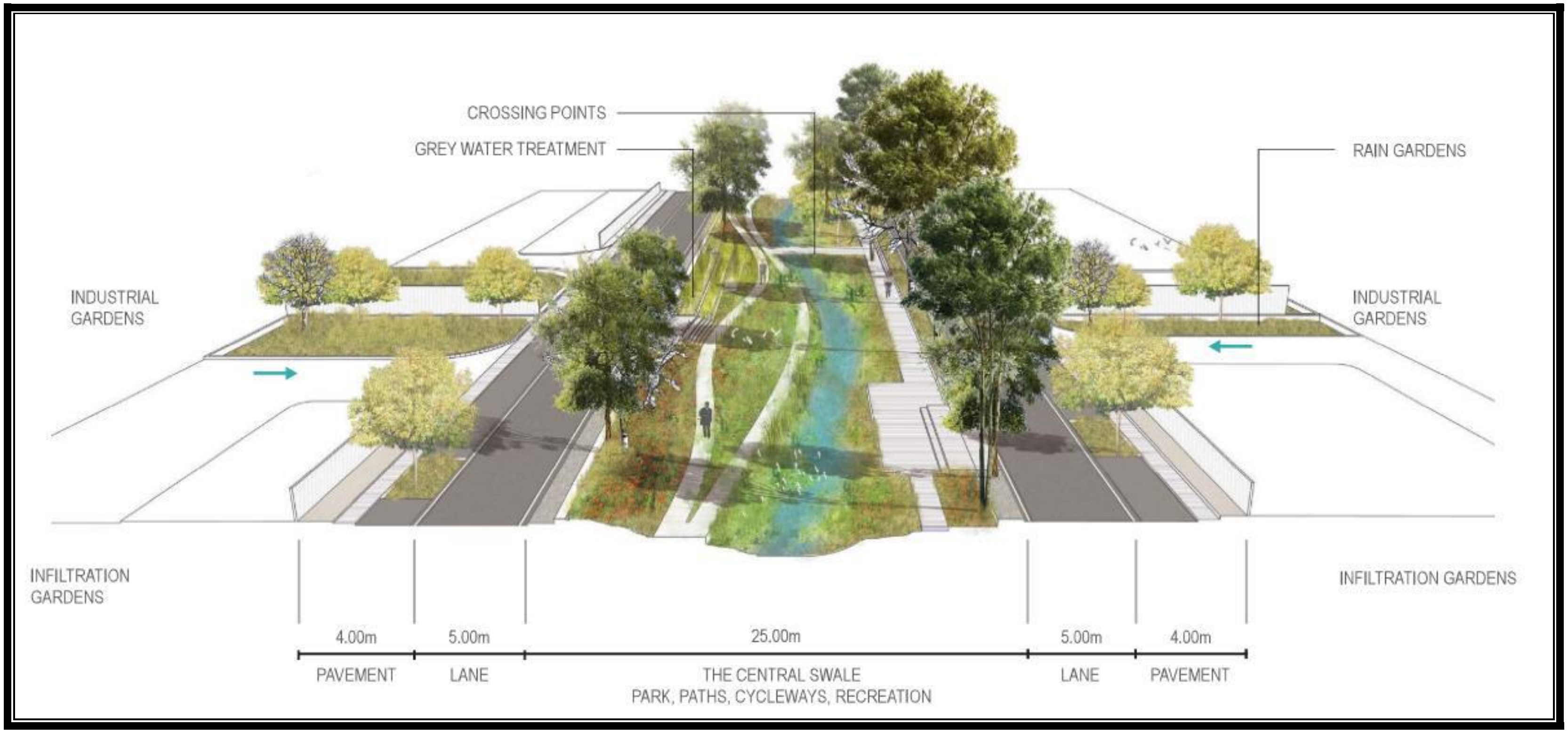


Figure 3.4: Road Section - Central Bio-retention Swale

3.5.1.2 Nature Reserves

The primary focus of the forest reserves is to create a robust landscape setting, optimize recreational opportunities and improve the aesthetic quality of them interface between the proposed industrial park and the public realm. Landscape interventions include the following:

- Protect and preserve native habitats and create ecological corridors across the industrial park.
- Strengthen the buffer zones with native tree planting to enhance biodiversity **(Plate 3.1).**
- Screen views and complement the setting of the proposed Industrial Park.

Plate 3.1: Examples of native planting

3.5.1.3 Industrial Gardens

The industrial plots will adopt sustainable and low cost landscape principles. They are designed as a robust green infrastructure network which treats wastewater, provides rainwater management and are connected to the site-wide street drainage network.

Industrial gardens (figures 3.5 and 3.6) form a series of landscape elements which collect and filtrate rainwater and grey water. This water is distributed to the general drainage network (green roofs, rain gardens, infiltration gardens, industrial gardens, break areas and front of plot landscaped gardens) and the street drainage channels. These double as integrated lunch break areas which provide water management/filtration and flood protection while also creating a healthier local setting and environment. They are integrated as small-sized linear elements, even where land availability is limited, and are inter-connected to larger local and regional networks.

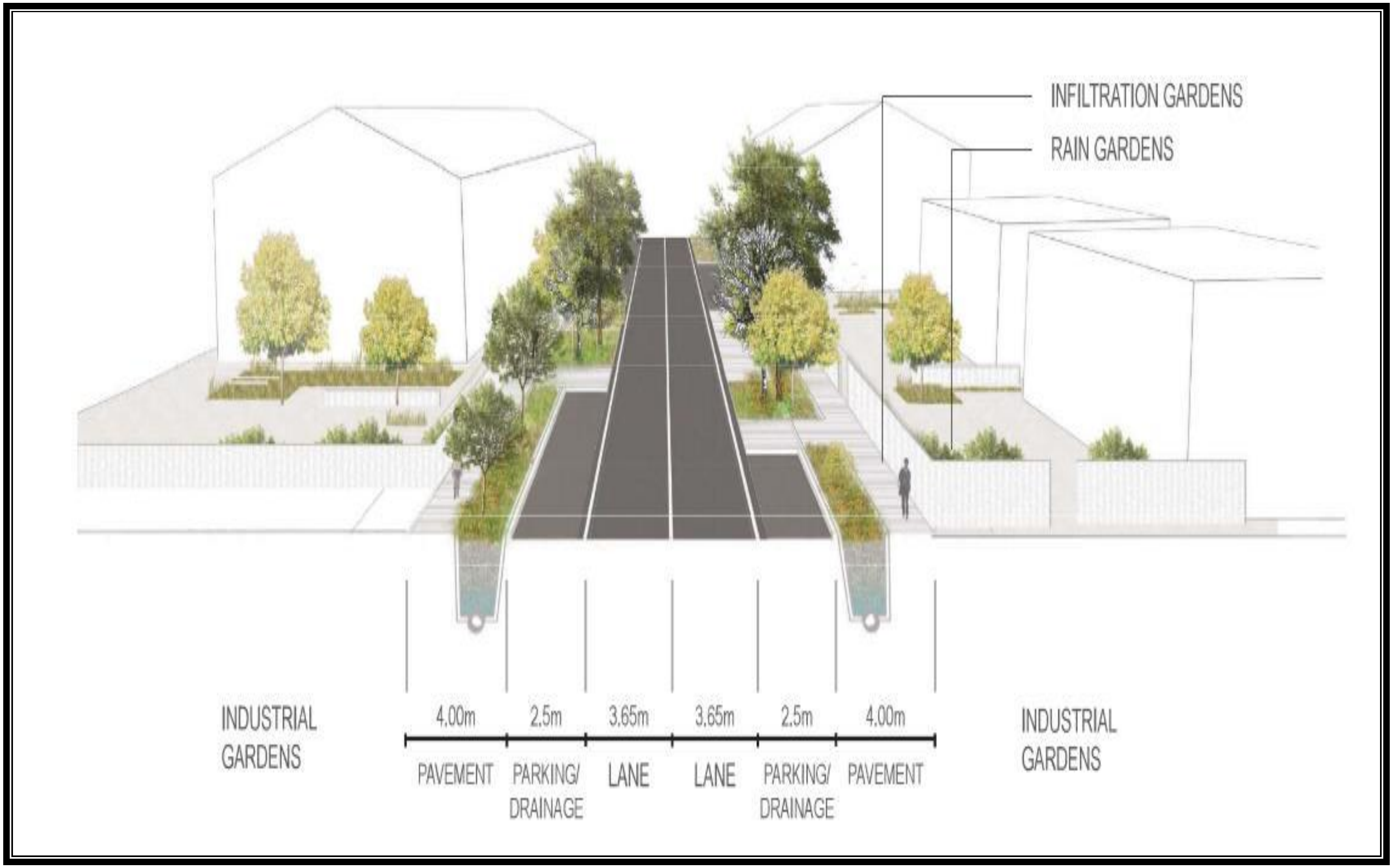


Figure 3.5. Section through a Typical Local Road showing the Industrial Gardens

Figure 3.6: Industrial Gardens - Image Precedents

3.5.1.4 Street Drainage Channels

Figure 3.7 shows street drainage channels which form a network of pedestrian and cycle friendly streets that include swales, drainage channels and flood retention areas. Flood retention is integrated within the streetscape design and will function alongside the conventional drainage infrastructure. The channels are integrated within all the roads within the proposed hierarchy: Primary, Collector, Local and Service. This network of streetscape swales, drainage channels and water retention areas are connected to the concrete lined channels within each plot drainage network. This network will be designed to be pedestrian-friendly including cycle ways and shading strategies.

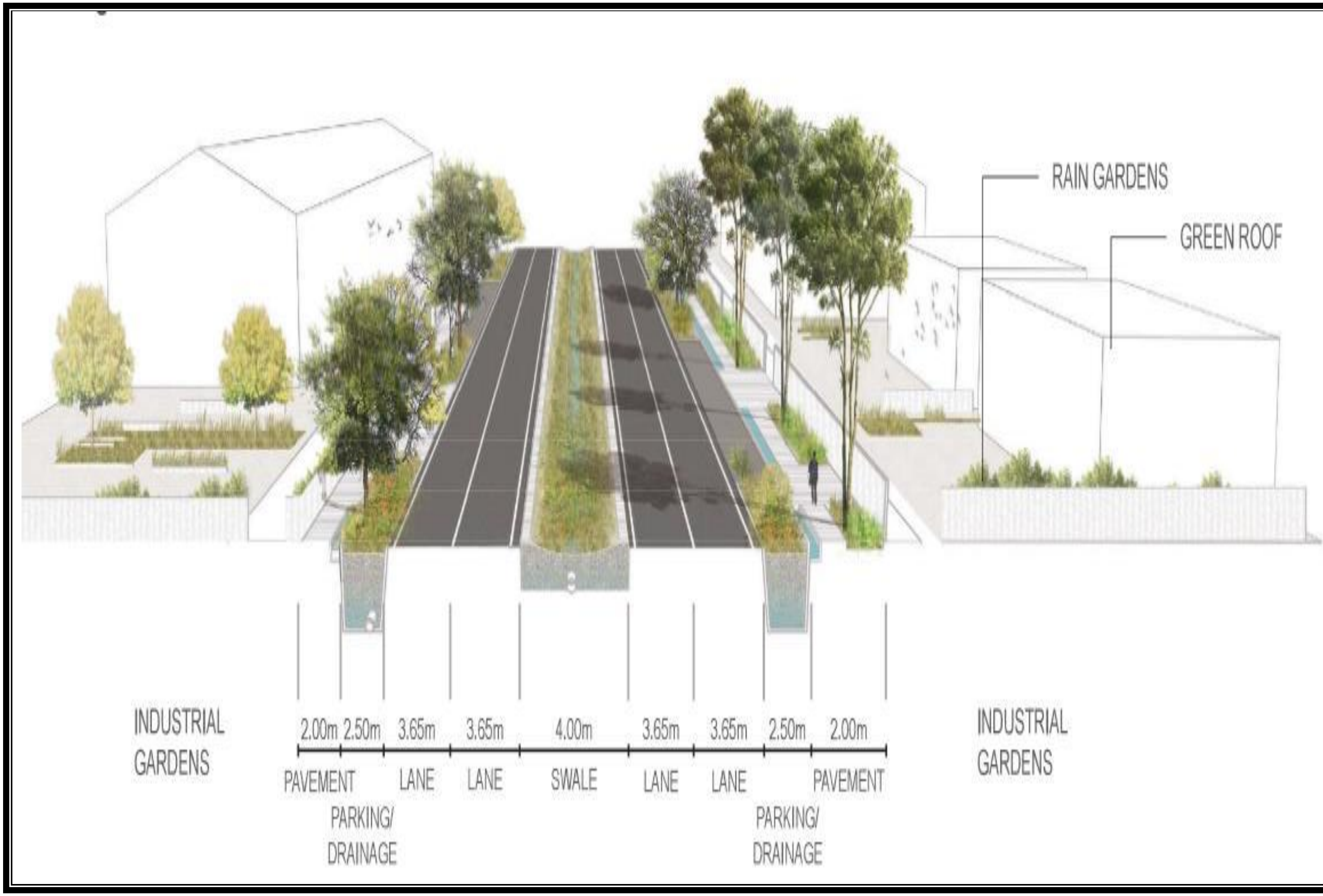


Figure 3.7: Section through a Typical Collector Road showing Street Drainage Channels

3.5.1.5 Public Realm

The public realm will include a series of quality, human-scaled, interesting places that define the identity of the Lekki Model Industrial Park as follows:

- Pedestrian priority including well-defined, continuous pedestrian routes, wide clutter free pavements, off-road pedestrian and cycle connections to areas of open space.
- A clear legibility to the street network, including a strong hierarchy and way finding strategies to improve accessibility, orientation and connectivity of spaces.
- A unique identity that is designed to be safe, adaptable, resilient and climate responsive.
- The public realm will meet the cultural needs of the community while contributing to the visual quality of the urban environment.
- Streetscapes will reflect the scale, character and function of adjacent urban character areas and integrate with the surrounding natural and built environment.
- Gathering areas for employees and communities to meet and interact will be included.

Figure 3.8: Street Planter **Figure 3.9: Parking Landscape**

Figure 3.10: Section through the Primary Road

3.6 LAND USE PLAN

3.6.1 Land Use Distribution

Table 3.2 identifies the breakdown and distribution of land uses. Figure 3.11 details the split of industries when not accounting for the Ruyi and Flour Mills Nigeria sites. Figure 3.11 and Figure 3.12 also illustrate the land use distribution within the masterplan, including:-

- in orange the garment (Ruyi) area (43ha);
- the garment area also includes 6ha for future expansion for Ruyi;
- in light orange, the other garment plots cover almost 25ha;
- in green, the sports and community centre area including open space (1.5ha);
- in blue, the Flour Mills Nigeria area (30ha); and
- in light blue the other agro-industry plots covering a total of 26ha

Table 3. 2: Land Use Distribution

Plot	Plot area (sqm)	Building footprint	GFA (sqm)	Tarmac (sqm)	Landscape (sqm)
Garment-Ruyi	490,162	190,425	316,225	186,592	113,145
Garment-Other	247,076	74,987	159,405	64,510	107,579
Agro-Flour Mills Nigeria	308,518	111,386	217,048	118,427	78,704
Agro-Others	259,076	81,285	179,545	93,571	84,220
Park and Open Space	15,469	1,125	2,250	1,433	12,910

Source: DAR Feasibility Studies and Master plan, 2019

Figure 3.11: Area View of the Land Use Distribution.

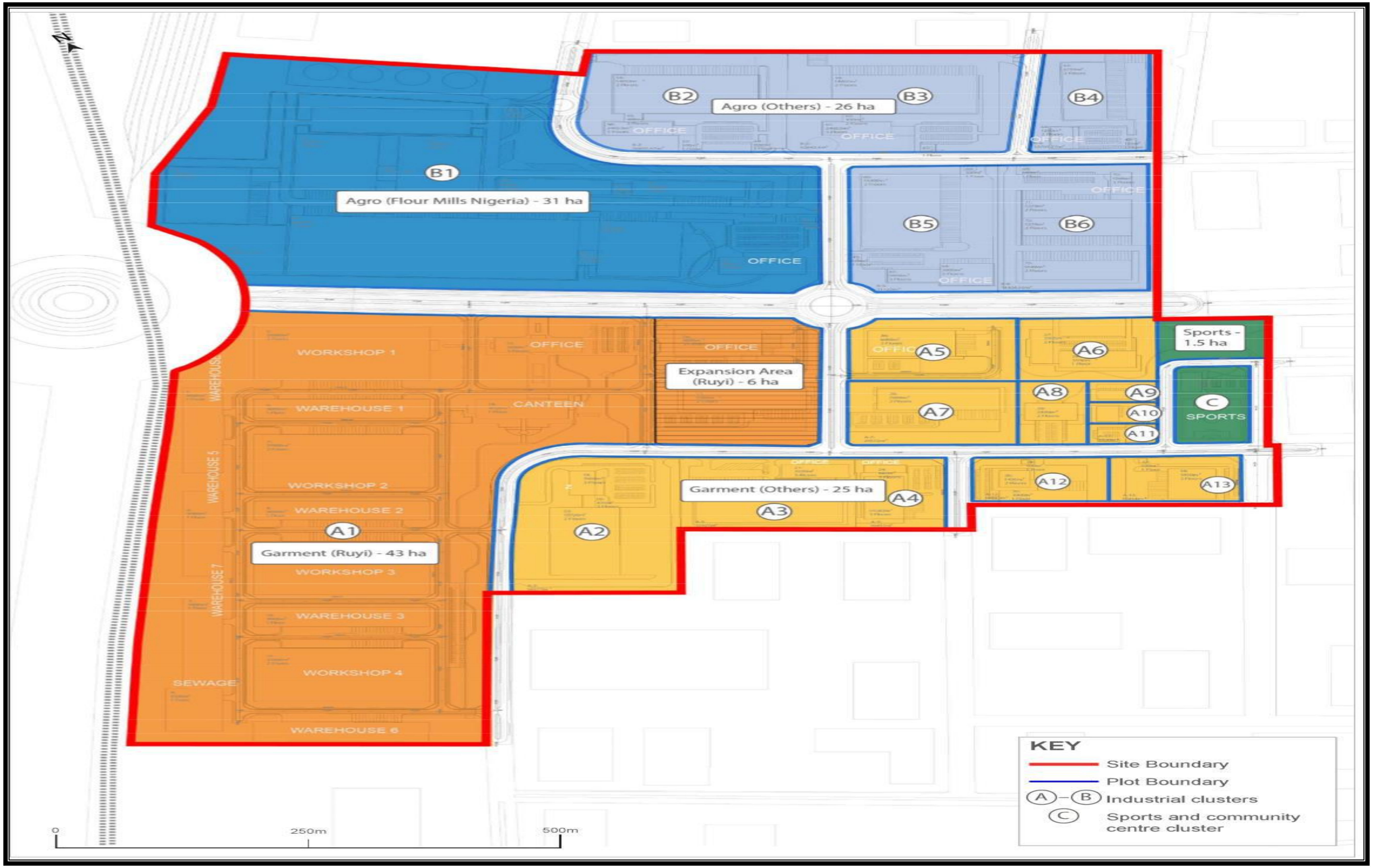


Figure 3.12: Land Use Distribution

3.6.2 Plot Distribution

The figure 3.13 illustrates the plot distribution plan which identifies the spatial distribution of the site development opportunities. Plots are intended to be flexible and can be combined or split according to the needs or demand of individual operators.

38 Garment buildings are located to the south side of the east-west road. They will benefit from the nearby railway on the western side of the plots. 17 out of the 38 will be allocated for Ruyi Garment industrial buildings which will be accessed from the east-west road and from the Collector Road (30m) surrounding the plot on the southern side.

The Ruyi plot will also include an expansion area bounded by the Primary Road (60m) and the Collector Road (30m) heading to the south of the site.

The remaining 21 Garments buildings will be distributed across the area covering the southern and eastern part of the site. Adjacent to the eastern boundary of the site, a Sports Community Centre will include the Sports Centre and a large area of public open space. To the north of the east-west road, 34 agro-industry buildings will be developed.

15 out of 34 of these will be used by Flour Mills Nigeria which will benefit from proximity to the adjacent railway on the western side of the plots.

The remaining 16 agro-industry buildings will be located in the eastern part of the site. Access for the agro-industry buildings will be provided by the Collector Road heading towards the north part of the site

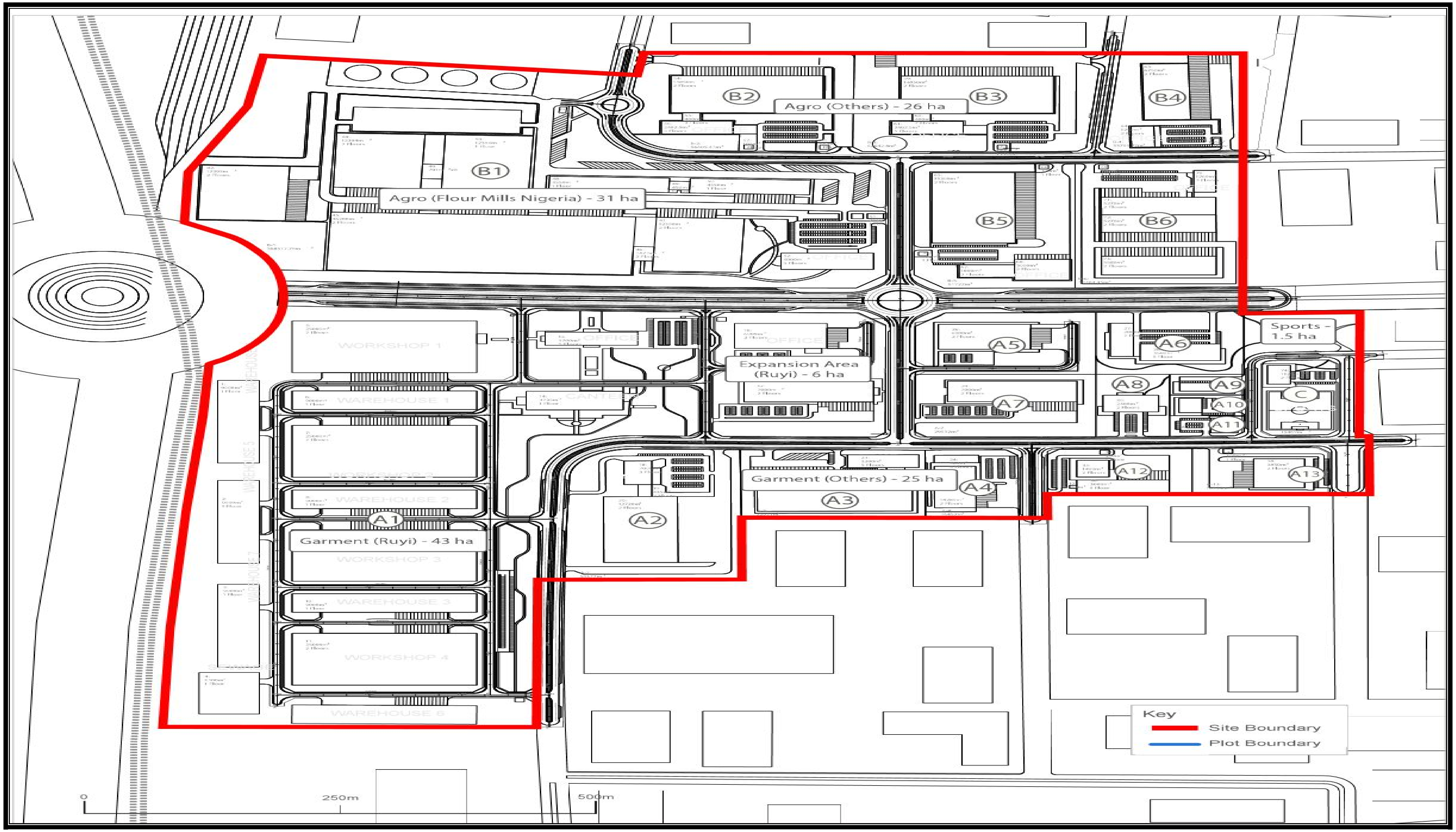


Figure 3.13: Plot Distribution

Development Assumptions

The Table 3.3 provides a breakdown of the spatial configuration of each plot and the development assumptions.

The 6 Flour Mills Nigeria plots include a total of 396,593 sqm Gross Floor Area (GFA) which it is estimated will provide over 10,000 new jobs.

The 13 textiles and garment plots include a total of 467,830 sqm GFA which it is estimated will provide over 11,800 new jobs. A Sports and Community Centre includes one building (2,250 sqm GFA) which will offer the opportunity for networking and shared facilities for local employees (approximately 20 new jobs).

In accordance with the employment density matrix published in the Employment Density Guide 2015, a standard of 39.6 sqm GEA per job for industrial and manufacturing facilities and 110 sqm GEA per job for the fitness centre has been considered.

Table 3.3: Plot Spatial Configuration

	Plots	**Plot Area(sqm)**	**Building ref**	**Building footprint (sqm)**	**No. of Floors**	**Groos Floor Area (sqm)**	**Tarmac (sqm)**	**Landscape (sqm)**	**Employment**
Textile /Garment	A-1(Ruyi)	490,161.9	1	9,000	1	9,000	186,591.6	113,145.2	227
			2	9,000	1	9,000			227
			3	9,000	1	9,000			227
			4	6,500	1	6,500			164
			5	25,000	2	50,000			1,263
			6	9,000	1	9,000			227
			7	25,000	2	50,000			1,263
			8	9,000	1	9,000			227
			9	25,000	2	50,000			1,263
			10	9,000	1	9,000			227
			11	25,000	2	50,000			1,263
			12	9,000	1	9,000			227
			13	3,200	5	16,000			404
			14	4,725	1	4,725			119
			15	6,000	2	12,000			303
			16	7,000	2	14,000			354
	A-2	58,110.2	17	7,010	3	21,030	15,800.4	22,144.8	531
			18	435	2	870			22
			19	12,720	2	25,440			642
	A-3	32,637.6	20	2,402.5	5	12,013	7,323.4	8,231.7	303
			21	400	2	800			20
			22	14,280	2	28,560			721
	A-4	16,384.2	23	864	3	2,592	7,085.3	3,934.9	65
			24	4,500	2	9,000			227
	A-5	28,533.7	25	6,000	2	12,000	7,054.5	15,479.2	303
	A-6	24,091.4	26	2,000	2	4,000	3,823.3	14,768.1	101
			27	3,500	1	3,500			88
	A-7	29,512.1	28	7,000	2	14,000	7,276.1	15,236.0	354
	A-8	12,013.6	29	2,400	2	4,800	1,876.8	7,736.9	121

	A-9	3,988.3	30	1,100	2	2,200	913.8	1,974.5	56
	A-10	3,988.3	31	875	2	1,750	1,399.1	1,714.3	44
	A-11	3,920.1	32	1,050	3	3,150	1,188.3	1,681.6	80
	A-12	16,981.8	33	100	1	100	5,276.3	7,205.5	3
			34	1,400	2	2,800			71
			35	3,000	1	3,000			76
	A-13	16,914.2	36	100	1	100	5,493.0	7,471.2	3
			37	3,850	2	7,700			194
Agro-Industry	B-1(FMN)	308,517.8	38	105	1	105	118,427.1	78,704.2	3
			39	791	8	6,326			160
			40	100	1	100			3
			41	12,394	2	24,788			626
			42	105	1	105			3
			43	12,394	2	24,788			626
			44	46,200	2	92,401			3
			45	787.5	2	1,575			626
			46	12,350	2	24,700			2,333
			47	4,550	1	4,550			40
			48	450	1	450			624
			49	4,550	1	4,550			115
			50	216	1	216			5
			51	4,000	5	20,000			505
			52	12,394	1	12,394			313
	B-2	56,605.5	53	14,850	2	29,700	21,994.1	16,758.9	750
			54	400	2	800			20
			55	2,402.5	5	12,012.5			303
			56	100	1	100			3
			57	100	1	100			3
	B-3	62,642.4	58	14,850	2	29,700	19,845.0	25,044.9	750
			59	400	2	800			20
			60	2,402.5	5	12,012.5			303
			61	100	1	100			3
	B-4	33,701.8	62	6,750	2	13,500	12,541.6	13,160.1	341
			63	1,250	2	2,500			63
	B-5	51,722.0	64	15,300	2	30,600	17,747.9	13,774.2	773
			65	100	1	100			3
			66	1,800	3	5,400			136
			67	3,000	2	6,000			152
	B-6	54,404.5	68	100	1	100	21,442.8	15,481.7	3
			69	1,260	3	3,780			95
			70	5,270	2	10,540			266
			71	5,270	2	10,540			266
			72	5,580	2	11,160			282
Sports Hub	C	15,468.7	73	1,125	2	2,250	1,433.2	12,910.5	57
TOTAL		**1,320,300**		**459,208**		**874,472**	**464,533**	**396,559**	**22,083**

Source: DAR Feasibility Studies and Masterplan, 2019

3.7 INSIDE FENCE INFRASTRUCTURE

3. 7.1 Onsite Roads

Road Plan

The road plan of the industrial park can be appreciated in Figures 3.1 and 3.3.The east-west primary road (60m) will provide the main access to the site from the north-south primary road (100m) via a roundabout. Sub-road is planned also, as access road for small-scale plots and mid-scale plots from the main road.

Table 3.4: Description of Road Network

Category of Road	Road reserve Width (m)	Length (km)	Pavement Width (m)	Road reserve Landscaping width (m)	Number of Lanes
Primary	60	1.03	30	30	4/Direction
Collector	30	2.93	10	20	2/Direction
Local	20	0.57	7.5	12.5	2
Central Green Corridor	20	-	-	-	1/Direction
Service	13	-	-	-	-

Source: DAR Feasibility Studies and Masterplan, 2019

3.7.1.2 Primary Road

The 60m wide Primary Road (Figure 4.8) includes pavement 30m in width, swale and car parking on both sides of the road. The Primary Road contains 4No lanes per direction divided by an 8m wide bioretention landmark boulevard. The total length of the road is 1.03km

Figure 3.14: Primary Road (ROW 60m)

3.7.1.3 Collector Road

The 30m wide Collector Road include pavement 10m in width is used for the two inner loop roads. As illustrated in Figurec3.15, each Collector Road includes 2 lanes per direction including car parking on each side and a 4m central swale. The total length of the road is 2.9km.

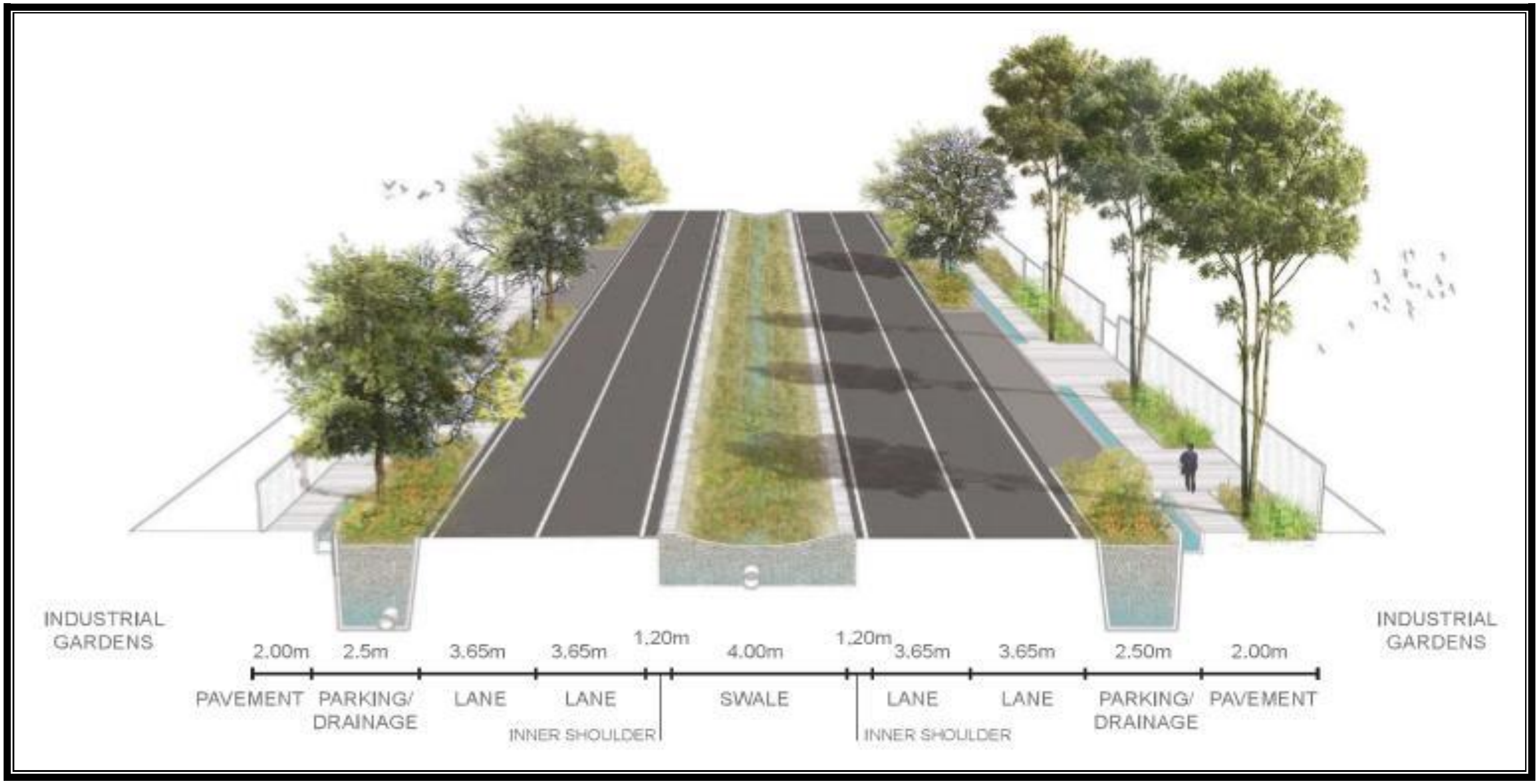


Figure 3.15: Collector Road (ROW 30m)

3.7.1.4 Local Road

The Local Road (Figure 4.11) is 20m wide and provides access to the industrial plots. The Local Road includes two lanes with side parking, pavement (7.5km) and drainage on both sides. The total length of the road is 0.57kkm

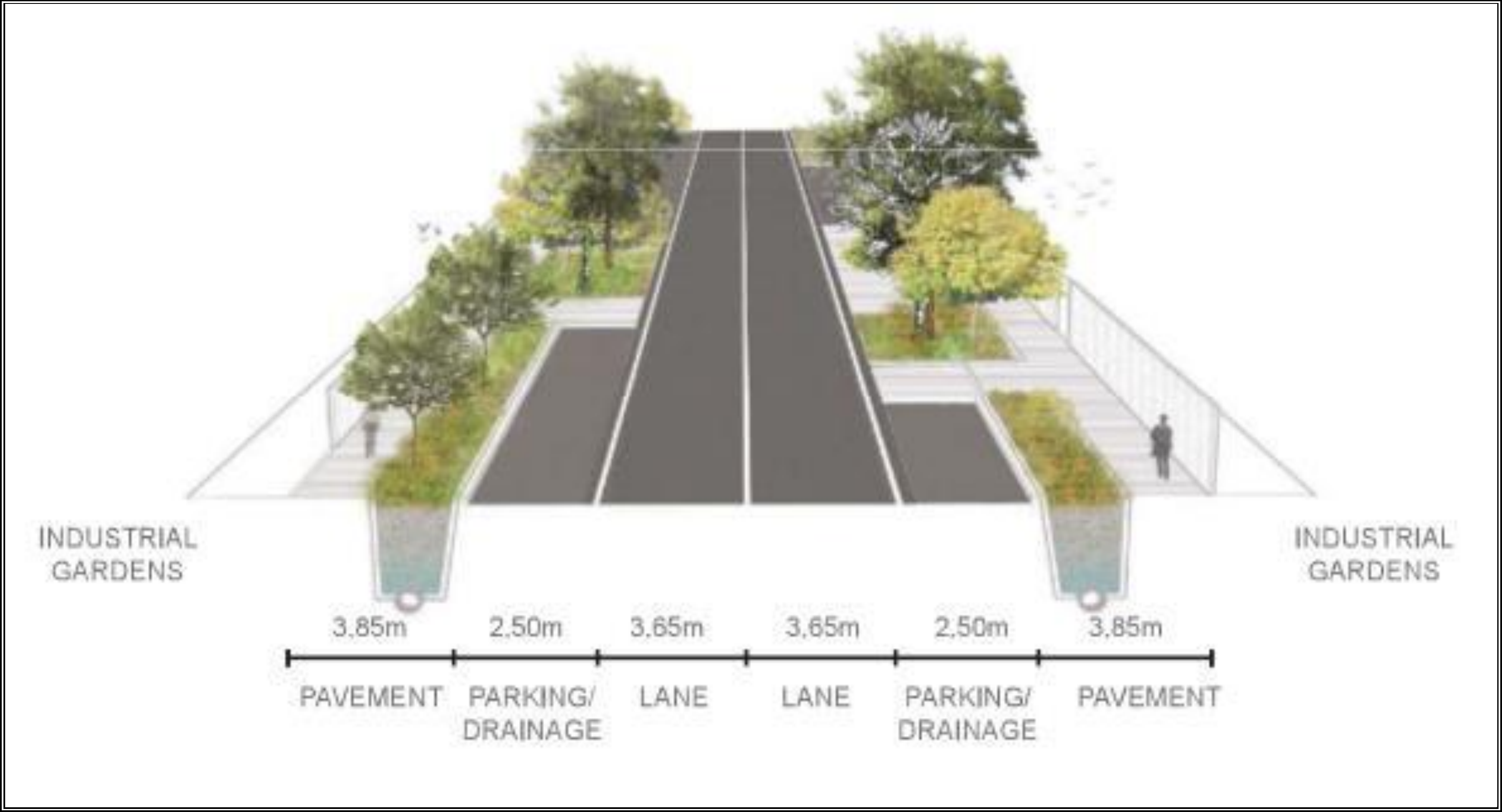


Figure 3.16: Local Road (ROW 20m)

3.7.1.5 Central Green Corridor

The Central Green Corridor (Figure 4.9) located at the core of the development includes pavement and parking areas on both sides of the road. It includes one lane per direction and a 20m wide central swale for pedestrian, cyclist and recreational use.

Figure 3.17: Central Green Corridor

3.7.1.6 Service Road
13m ROW Service Road allowing better access to the internal plots

3.7.2 Potable Water Supply
Construction of Water Treatment Plant (WTP) of capacity 200,000 m^3/d and related works (intake works, pumping station, storage reservoir, etc.) are proposed at Oshun River to serve for both the demand of Lekki Sub Region and Lekki FTZ; however, for the Lekki Industrial park only 32,000 m^3/d is required. From WTP the water shall be conveyed through Transmission Mains to Distribution Centre within Lekki Industrial Park. The WTP will

- treat the water at WHO standards
- supply the water to consumer 24 hours a day as per intermittent demand with minimum required pressure
- decentralized water supply system so that inconvenience to the consumer is minimal

Adequate pressure and quantity of water will be available at all junctions to draw sufficient quantity when fire accidents occur.
However, an alternative might be to install ground water wells (with a capacity to meet the demand for potable and process water and a water treatment works designed to achieve potable water standards with groundwater as feed.

Table 3.5: Water Treatment Plant Specification

Description	Length (km)/Number
Bulk supply metered connection	1
Balancing reservoir	1
Pump station	1
Water Tower	1
Distribution network	8.80

Source: DAR Feasibility Studies and Masterplan, 2019

3.7.3 Security Fence
The security fence round the industrial Park is 7.93km in length with 2No entrance. See table 3.6.

Table 3.6: Security Fence Specifications

Description	Length (km)/Number
Security Fence	7.93
Entrances to secure area	2

3.7.4 Storm Drainage

The table below shows the storm drainage specifications

Table 3.7 Storm Drainage Specifications

Description	Length (km)/Number
Gravity drains	0
Open channels	12.60
Green swale and associated SUDS	11.0

3.7.5 Process Water

It has been indicated that is not clear whether process water will be needed for Phase 1. The Real Estate Model should have the facility to allow the impact of provision of process water in Phase 1 to be assessed. It is assumed that process water will be partially supplied from Treated Sewage Effluent and from potable water supply

3.8 OUTSIDE FENCE INFRASTRUCTURE

3.8.1 Railway Station

A Freight and Passenger Railway Station is proposed on the East Border of the site. It will be directly connected to both the city centre and the industrial area with primary roads. A connection to a future airport will also be planned to the north-east of the Site.

3.8.2ICT Network

It is not clear what ICT connection will be needed for Phase 1. One solution might be the provision of 55 km of multiple ducts from EKO City. However (assumption of length and number of ducts required is to be confirmed by NEPZA/FMITI/LMIPC).

3.8.3 Gas Supply

A single station is required to receive and supply the city with gas through the medium pressure network. The estimated main pipe size is 315m. 8 pressure reducing stations are foreseen to reduce the pressure. Low pressure gas network laid under collector and local road, distributes the gas to different plots. Each plot is provided with a connection box, comprising an isolation valve and a gas meter. A gas pipeline right of way has been protected from KP 292 Mojoda that follows the Primary Road to the west of the North-West Quadrant and on to the Dangote Refinery. The pipeline might be installed by the gas powered IPP concessionaire.

It is not clear whether the gas connection will be needed for Phase 1. The Real Estate Model should have the facility to allow the impact of provision of gas in Phase 1 to be assessed. It is estimated that a 315 mm diameter medium pressure gas main, 17 km long will be required to connect to phase 1.

Table 3.8: Gas Supply Specifications

Description	Length (km)/Number
Bulk supply metered connection	1 Station
MP network	2km
Pressure reducing stations	8
LP network	2km
Metered connection to individual plots	33

Source: DAR Feasibility Studies and Masterplan, 2019

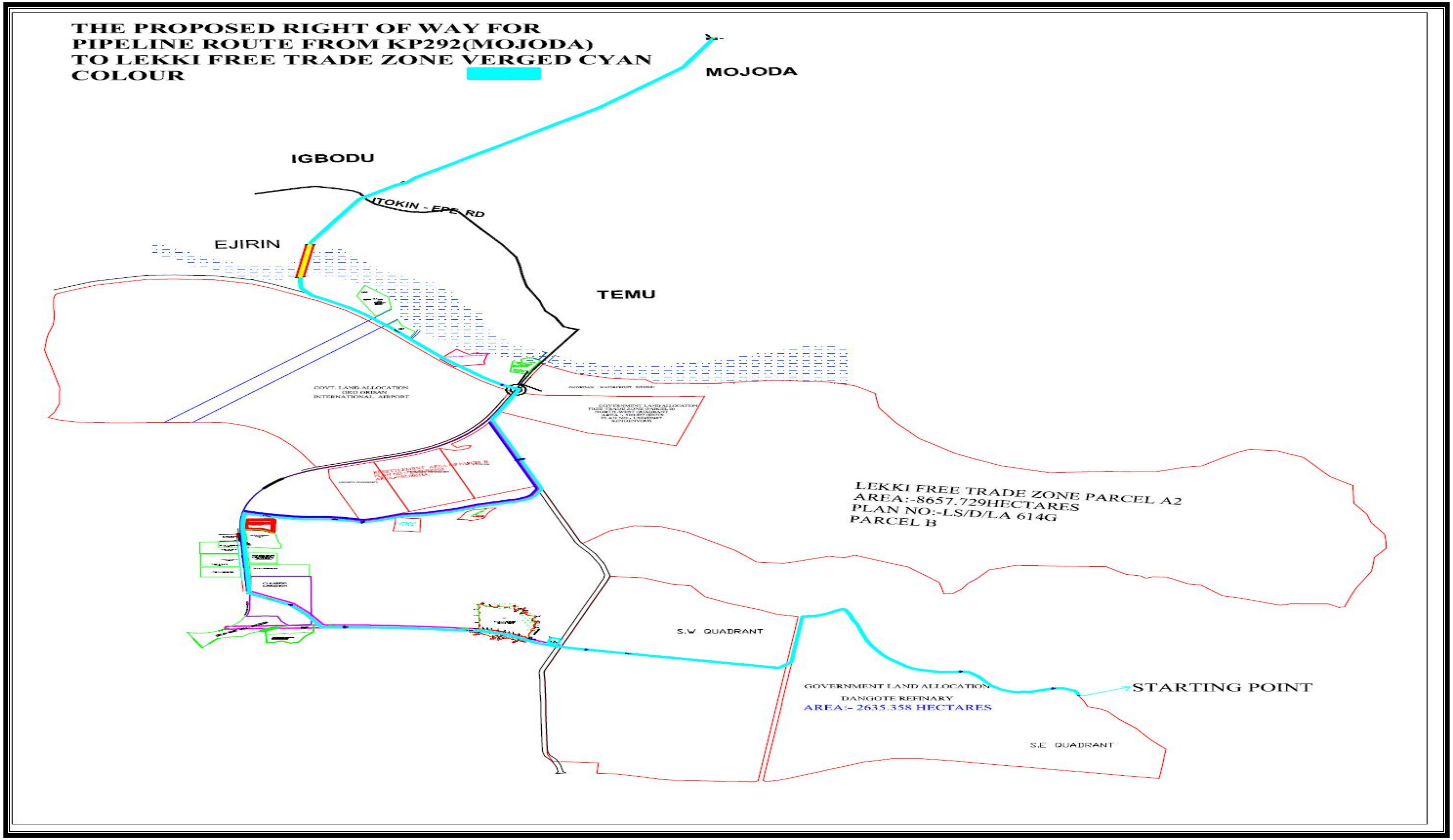


Figure 3.18: Protected right of way for gas Pipeline from Mojoda to SE Quadran

3.8.4 Electrical Power

It is not clear what power connection will be needed for Phase 1.Based on an estimated load of 7GVA for the Lekki peninsula, PHCN has to be approached to study the alternatives for supplying Lekki with power. To cater for the additional power demand of Lekki development, power local authority will have to build new generating plants or upgrade existing ones. It is essential that the construction or upgrade of these plants should be scheduled concurrently with the development plans inside Lekki peninsula. For internal distribution of each part of Lekki peninsula, several 132/11kV substations will be provided.

Table 3.9: Electrical Power Specifications

Description	Length (km)/Number
Main Sub-station	1
MV network	24.00
Step down Stations	20
LV	16.00
Metered connection to individual plots	73
Standby generation for critical LMIPC facilities	4.00

Source: DAR Feasibility Studies and Masterplan, 2019

3.8.5 Offsite Road

It is not clear what connecting road will be needed. In the long-term a dual carriageway may be needed. Given the size of ITGP Phase 1 it is assumed that a 2-way road will be adequate, but it is likely that the sub-grade and drainage would be in place for the 2nd carriageway.
The 2009 Implementation Plan and Project Profiles Special Report for Lekki Sub-Region and Lekki Free Trade Zone indicated a project to connect the Lekki-Epe Expressway to the North-East and North-West Quadrants. Allowance has been made for 9 km of access road.

3.9INDICATIVE UTILITY CONSUMPTIONS

The factories direct consumption of the Utilities,

Table 3.10: Utility Consumption for a 2,000m^2 factory

	GFA Area (m^2)	Working Days per Month	Unit	Consumption (Unit/m^2/working day)
Power	2000	22	kWh/m^2 GFA/working day	0.5621
Processed Water	2000	22	m^3/m^2 GFA/working day	0.0403
Potable Water	2000	22	m^3/m^2 GFA/working day	0.0077
Gas	2000	22	MBTU/m^2 GFA/working day	0.0133

3.10 PROVISION OF FACILITIES FOR COMMUNITY FACILITIES

It is not anticipated that any buildings will be provided on this plot, and it will be leased to a developer to provide community facilities such as Food and Beverage outlets, retail space and other leisure/recreation facilities.

Table 3.11: Undeveloped Plot for Community Facilities

Plots	Plot Area (m^2)	Building ref	Building footprint (m^2)	No. of Floors	GFA (m^2)
C	15,468.7	**74**	1,125	**2**	2,250

3.11 UTILITIES FOR COMMON AREA INFRASTRUCTURES

3.11.1 Power Consumption

Table 10.12: Estimated Power Consumption for Common Areas

Description	Power Consumed (MWH/year)
Street-lighting	1,750
Potable water pumping	250
Process water pumping	1,200
Sewage Pumping	650
Sewage Treatment	19,053
Security Fence Lighting	300
Total	**23,203**

3.11.2 Utilities for Factories and Warehouses

Indicative Utility Consumption

The factories direct consumption of the Utilities,

Table 3.13: Utility Consumption for a 2,000m^2 factory

	GFA Area (m^2)	Working Days per Month	Unit	Consumption (Unit/m^2/working day)
Power	2000	22	kWh/m^2 GFA/working day	0.5621
Processed Water	2000	22	m^3/m^2 GFA/working day	0.0403
Potable Water	2000	22	m^3/m^2 GFA/working day	0.0077
Gas	2000	22	MBTU/m^2 GFA/working day	0.0133

With regard to process water, it is assumed that 90% of potable and 50% of the process water is returned to the sewage system and converted to TSE. The estimated volume of water being returned to the sewers is therefore, circa 54.62 Mm^3/year (90% of 59.8 Mm^3 plus 50% of 1.60 Mm^3).
The balance of the process water will therefore need to be made up from the mains water supply, total demand for potable water will be 1.60 Mm^3/year.

3.12 PROJECT WASTES

A lot of wastes of different kinds are expected and generated during construction, decommissioning/dismantling, operation, and maintenance. Table 3.14 shows sources, disposal method, place of disposal and the responsible party.

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

- Leaves, branches, trunks, grasses from the clearing of the vegetation in the Project site.
- Kitchen wastes from human feeding and activities involving many workforces.
- Scrap metals – from cuttings, fittings, rods, nuts, bolts, and welding etc.
- Concrete waste – from foundations including building construction.
- Nylons/Plastics packaging materials – from textile and garment production, pieces of fabrics wrappings, water sachet, food etc.
- Oil spills from heavy duty machinery and equipment, vehicle engines during maintenance work.
- Human wastes – from activities of personnel involved in the work or secondary business group.

Table 3.15: Proposed Project Waste Estimates and Disposal Plan

PROJECT PHASE	TYPE OF WASTE	FORM OF WASTE	SOURCE OF WASTE	DISPOSAL COMPANY	DISPOSAL METHOD/USE	DISPOSAL LOCATION
Site preparation/ clearing	Degradable	Vegetation, kitchen waste	Camp Site, Project Site	Community members	Timber, fuel wood, compost	-
Construction	Degradable	Kitchen waste	Camp Site	LAWMA or LASMEnv. registered Waste Contractor	Compost	LASEPA approved site
	Mixed	metal piece, wood piece, unused concrete, broken bricks, ceramics, broken glass	Camp Site, Project Site	LAWMAor LASMEnv. registered Waste Contractor	Reuse, recycle	Scrap buyers/ reuse location
	Sewage	Camp sites	Personnel	LAWMA or	Vacuum-	Any

PROJECT PHASE	TYPE OF WASTE	FORM OF WASTE	SOURCE OF WASTE	DISPOSAL COMPANY	DISPOSAL METHOD/USE	DISPOSAL LOCATION
				LASMEnv. registered Waste Contractor	sucked into septic tanked trucks	approved sewage treatment facility close to the project Site
Operation	Effluent	Textile Wastewater	Various stages of processing Textile	-	Effluent Treatment Plant	Lekki Lagoon
	Mixed	Office wastes,	Offices and warehouses	LAWMA or LASMEnv. registered Waste Contractor		LASEPA approved site
	E- Waste	Cartridges,	O	LAWMA or LASMEnv. registered Waste Contractor		
Decommissioning	Mixed	Demolished concrete	Project Facility	LAWMA or LASMEnv. registered Waste Contractor	Backfill	LASEPA approved site
	Mixed	Pipes, Rods, machine parts	Project Facility	LAWMA or LASMEnv. registered Waste Contractor	Reuse, recycle	Scrap buyers/ reuse location

Source: EAECL Survey, 2019

Solid Waste Generation from Proposed Project

Waste to be generated during construction phase will be left out construction material like metal piece, wood piece, unused concrete, broken bricks, glass, ceramic, demolition waste etc. Quantity of the solid waste to be generated during construction phase may vary from 30-50 kg/day. This waste should be collected and segregated at the site itself. Recyclable and Re-usable waste should be separated and should be sent to recycler. Rejected waste should be disposed off at the designated sites by Lagos State Waste Management Authority (LAWMA).

Nature of solid waste generated during the operation phase will be highly variable due to presence of different kind of operations in the Park. Solid waste can be of variable nature and will include industrial nonhazardous waste, hazardous waste, bio-degradable, non-biodegradable, e-waste etc.

3.13 TENTATIVE PROJECT SCHEDULE

The actual activity from commencement of site preparation to decommissioning is expected to last approximately thirty-six (36 months) months

Procurement Period

The construction of the common infrastructure and buildings on serviced plots is to be procured on the basis of a detailed design. It is assumed that the procurement on this basis will take 6 months to complete.

Construction Period.

At the Workshop on 16 October 2018. FMITI identified the construction and commissioning period of the inside fence infrastructure and a similar period to build factories and hand them over to the future users for fitting out and commissioning. At the meeting with NEPZA on 1 July 2019, it was agreed that a construction period of 24 months expected to start on 1 January 2020 will be assumed.

NEPZA is strongly committed to the completion of the proposed Integrated Textile and Garment Industrial Park (Phase 1), and every effort is geared towards actualizing this goal. The proposed project execution schedule is presented in Table 3.16 and indicates construction period of 24 months expected to start on 1 January 2020.

The implementation schedule for the construction of the proposed Integrated Textile and Garment Industrial Park (Phase 1), would follow the under-listed duration.

Table 3:16: Implementation schedule for construction of the Textile and Garment Industrial Park (Phase 1)

Phase I	**Phase II**	**Phase III**	**Phase IV**
Feasibility Studies EIA Studies	Engineering Procurement and	Construction (EPC)	Commissioning Project closure
12 months	6 months	24 months	6 months

Invariably, some percentage variation is allowed in the duration for contingencies. In that case, the average total duration for the entire project execution is put at 36 months.

CHAPTER FOUR

4.0 DESCRIPTION OF EXISTING ENVIRONMENT

4.1. GENERAL.

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

The summary of baseline conditions is based on information sourced from literatures (see relevant sections) as well as findings from a two seasons (wet and dry) field sampling program. The data acquired will be used in further environmental management decisions and future monitoring of changes, if any, in the environmental components.

4.2. SCOPE OF STUDY

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

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

4.2.1. Area of Influence

Sample stations were distributed within and outside the project site. The zone of influence from project site covered 10km for surface water, sediment while soil, air and noise was within the project site in compliance with the FMEnv. sampling requirement letter **Appendix A** Statutorily, the Federal Ministry of Environment from prior engagements and recent technical review sessions has required a 10km radius zone of influence for Category 1 projects EIA field sampling design. However, based on the expert judgment and understanding of the dynamics of aquatic systems, the EIA consultant only extended to 10km for surface water.

Environmental factors considered when selecting sample points were sensitivity of physical and biological receptors (e.g. location of water body, flora and fauna, settlements) as well as geographical dynamics of the study area such as wind direction, upstream/ downstream system and topography of the area. Receptors within the study area include; settlements, seasonal streams, Epe lagoon, Lekki Lagoon, Flora, Fauna and Soil.

4.2.2. Baseline Data Acquisition Methods

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

- review of existing reports that contain environmental information on the study area;
- designing and development of field sampling strategies to meet work scope and regulatory requirements;
- pre-mobilization activities (assembling of field team, sampling equipment/materials calibrations/checks, review of work plan and schedule with team, and job hazard analysis);
- mobilization to field; fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; and
- demobilization from field; transfer of sample custody to the laboratory for analyses.

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

4.2.3. Desktop Studies

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

4.2.4. Field Sampling/Measurement

In order to effectively characterize the ecology and meteorology of study area and determine seasonal variations of specific environmentally related parameters, a two season field data gathering exercise was performed from 27th to 30th November 2019 and 25th to 29th February, 2020 for wet and dry seasons respectively. The specific objectives of the ecological field sampling were to determine:

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

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

a. Field Study and Sampling Design

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

- Sampling obtained from Forty One (40 + 1 control) soil stations;
- Surface water/sediment sampling in Nineteen (17 + 2 Controls) stations;
- Air quality measurement in Forty One (40 + 1 controls) stations;
- Noise level measurement in Forty One (40 + 1 controls) stations
- Ground water sampling in Three (3) stations
- Geology/Geophysics measurement in Six (5 + 1 control) Stations
- Vegetation and wildlife in (10) Plots

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

Table 4.1: Inventory of Biophysical and Socio Samples

S/N	Environmental Component	Parameter	No of samples requested by FMEnv	Actual No of samples collected		Remark
				WET Season	DRY Season	
1	Surface water and Sediments	Physico chemical microbial, Benthos and Plankton	4 sampling unit/water body and Control	17 +2 Controls	8+2 Control	The streams were dried in the dry season field work
2	Ground water	Physico chemical and microbial	-	3	3	-
3	Soil	Physico chemical and microbial	40 +Control	82	82	Top and Sub soil
4	Ambient air quality	Criteria pollutants	40	40 +1 Control	40 +1 Control	-
5	Noise	Sound level	40	40 +1 Control	40+ 1 Control	-
6	Geoogy/ Geophysics	Static water level, Stratigraphy, Flow direction	-	5 +1 Control	5 + 1 Control	-
7	Meteorology	Temperature, Relative Humidity,	-	40 +1 Control	40 +1 Control	-
8	Biodiversity	Taxa	-	10	10	-
9	Socio economics	Human and infrastructures	-	14	14	-

Source: EAECL Fieldwork, 2019/2020

Table 4.2: Sampling Stations and Sampling Requirements

S/N	dentification	Latitude	Longitude	Soil	Air/Noise	Meteorology	S. Water/Sediment Plankton/Benthos	Ground water	Biodiversity	Geology
1	SP1	6.527250	4.007050							
2	SP2	6.526790	4.005160							
3	SP3	6.527220	4.006120							
4	SP4	6.527170	4.006180							
5	SP5	6.527770	4.007170							
6	SP6	6.528000	4.007620							
7	SP7	6.526710	4.006520							
8	SP8	6.526560	4.006330							
9	SP9	6.526180	4.006400							
10	SP10	6.526360	4.006050							
11	SP11	6.526690	4.006080							
12	SP12	6.532680	4.004070							
13	SP13	6.531190	4.006300							
14	SP14	6.529990	4.009090							
15	SP15	6.527770	4.007900							
16	SP16	6.529850	4.007650							
17	SP17	6.532750	4.008080							
18	SP18	6.530020	4.005060							
19	SP19	6.523670	4.011070							
20	SP20	6.523240	4.001250							
21	SP21	6.526510	4.004200							
22	SP22	6.525780	4.003240							
23	SP23	6.521910	4.005890							
24	SP24	6.523520	4.003400							
25	SP25	6.528930	4.006300							
26	SP26	6.529190	4.008280							
27	SP27	6.526800	4.004530							
28	SP28	6.522760	4.010830							
29	P29	6.522710	4.008400							

S/N	dentification	Latitude	Longitude	Soil	Air/Noise	Meteorology	S. Water/Sediment Plankton/Benthos	Ground water	Biodiversity	Geology
30	P30	6.527020	4.008640							
31	P31	6.528360	4.011490							
32	SP32	6.531490	4.004510							
33	SP33	6.528870	4.006550							
34	SP34	6.526070	4.011510							
35	SP35	6.532260	4.006160							
36	SP36	6.527250	4.007050							
37	P37	6.526790	4.005160							
38	SP38	6.523870	4.009600							
39	SP39	6.522840	4.003540							
40	SP40	6.526160	4.012200							
41	SP41 (Contrl 1)	6.316010	3.995004							
42	SP43	6.543197	3.947269							
43	SP44	6.543223	3.947481							
44	SP45	6.543072	3.947384							
45	SP46	6.543432	3.947427							
46	SP47	6.543063	3.947188							
47	SP48	6.541963	3.982168							
48	SP49	6.543168	3.981112							
49	SP50	6.543657	3.980384							
50	SP51	6.542501	3.981393							
51	SP52	6.508420	4.000830							
52	SP53	6.508040	4.001480							
53	SP54	6.506580	4.003360							
54	SP55	6.504990	4.004220							
55	SP56	6.554700	4.013120							
56	SP57	6.553500	4.015750							
57	SP58	6.547420	4.019970							
58	SP59	6.546890	4.020820							

S/N	dentification	Latitude	Longitude	Soil	Air/Noise	Meteorology	S. Water/Sediment Plankton/Benthos	Ground water	Biodiversity	Geology
59	SP60 (Contrl 1)	6.560440	4.009140							
60	SP61 (Contrl 2)	6.509850	3.989760							
61	SP62	6.52115	4.007070							
62	SP63	6.53288	4.001190							
63	SP64	6.52492	4.011750							
64	SP65	4°0’23.6’’	6°31’36.6’’							
65	SP66	4°0’13.6	6°31’38.9’							
66	SP67	4°0’39.7	6°31’38.6’’							
67	SP68	4°0’17.0’’	6°31’24.0’’							
68	SP69	4°0’25.6’’	6°31’52.7’’							
69	SP70 (**Control**)	3°59’29.0’’	6°32’08.9’’							
70	SP71	6.152725	4.00705							
71	SP72	6.52639	4.00486							
72	SP73	6.523586	4.008101							
73	SP74	6.52035	4.00290							
74	SP75	6.53268	4.00487							
75	SP76	6.53189	4.00630							
76	SP77	6.52999	4.00909							
77	SP78	6.52977	4.00790							
78	SP79	6.63276	4.00808							
79	SP80	6.530652	4.011925							

Source: EAECL Field Work 2019/2020

b. ***Analytical Methods***

Samples collected from the field were analysed in Federal Ministry of Environment accredited laboratory, **LACH Consult and Scientific Support Limited**, Block D6 Small Scale Industrial Estate, Fatai Atere Way, Matori Ladipo Mushin Lagos State using various methods.

The methods of analysis used in this study were those approved by Federal Ministry of Environment. Other international analytical procedures were also adopted, for instance, the APHA, EPA and ASTM analytical procedures for water quality, soil and sediment. To ensure the reliability and integrity of some unstable physico-chemical parameters, in-situ measurement of pH, conductivity, TDS, and temperature were carried out in the field. All field instruments were regularly cleaned and recalibrated after each use. Table 4.3. gives the summary of all analytical methods and techniques for various parameters.

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

Table 4.3: Ecological Components, Analytical Methods and Test Equipment

Sample Matrix	Parameters	Test Method	Test Equipment
Water	pH	EPA 150.1	Apera Water Meter SX823-B
Water	Temperature (^{0}C)	EPA 150.1	Apera Water Meter SX823-B
Water	Conductivity	EPA 150.1	Apera Water Meter SX823-B
Water	TDS	EPA 150.1	Apera Water Meter SX823-B
Water	Turbidity	APHA 2130B	Dr / 890 colorimeter
Water	TSS	APHA 2540D	Gravimetry
Water	Dissolved Oxygen	APHA 4500-OG	multi 340i/set Meter
Water	BOD	APHA 5220D	WTW oxitop
Water	COD	APHA 5220D	Titration
Water	Chloride	APHA 4500 Cl-	Titration
Water	Nitrate	EPA 352.1	Uv/ Visible light
Water	Sulphate	APHA 4500-SO4	Uv/ Visible light
Water	Magnesium	APHA 3111B/ASTM D 3561	FAAS
Water	Potassium	APHA 3111B/ASTM D 3561	FAAS
Water	Sodium	APHA 3111B/ASTM D 3561	FAAS
Water	Calcium	APHA 3111D	FAAS
Water	Total Hardness	APHA 2340C	Titration
Water	Oil & Grease	ASTM D 3921	FTIR
Water	Cadmium	APHA 3111B	FAAS
Water	Total Chromium	APHA 3111C	FAAS
Water	Copper	APHA 3111B	FAAS
Water	Total Iron	APHA 3111B	FAAS
Water	Lead	APHA 3111B	FAAS
Water	Nickel	APHA 3111B	FAAS
Water	Zinc	APHA 3111B	FAAS
Water	Manganese	APHA 3111B	FAAS
Water	Mercury	APHA 3112B	AAS* / Hydrite unit
Water	Vanadium	APHA 3111D	FAAS
Water	Salinity	APHA 2520	multi 340i/set Meter
Water	Microbiology	ASTM D5465-93	Microscope
Water	Zooplankton	APHA 10200 G	Counting (microscope)
Water	Phytoplankton	APHA 10200 F	Counting (microscope)
Soil/Sediment	pH	ASTM D 4972	multi 340i/set Meter
Soil/Sediment	PSD	ASTM D 422	Hydrometer / water bath
Soil/Sediment	All heavy metals	USEPA 6200	XRF
Soil/Sediment	Extractable Sulphate	CAEM/APHA 4500 SO42-E	UV /visible spectrphoto
Soil/Sediment	Extractable Phosphate	CAEM/APHA 4500 PD	UV /visible spectrphoto
Soil/Sediment	Growth in MCB media	ASTM D5465-93	Incubators, Petri Dishes, etc.
Sediment	Macrobenthos	APHA 10500C	Microscope

Soil/Sediment	TOC	BS 1377	Titration
Soil/Sediment	THC	ASTM D 3921	FTIR

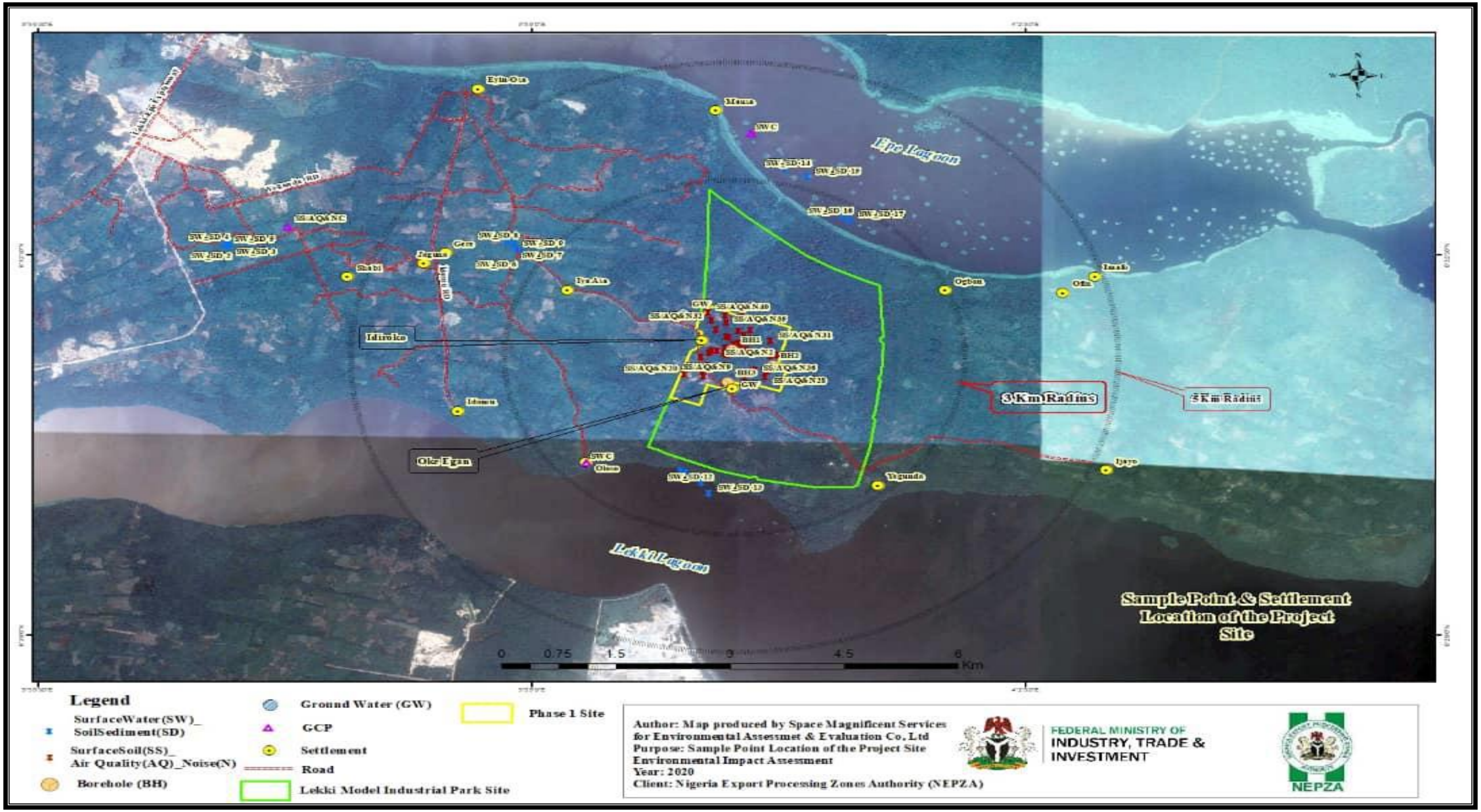


Figure 4.1a Generalised sampling map for all the environmental components

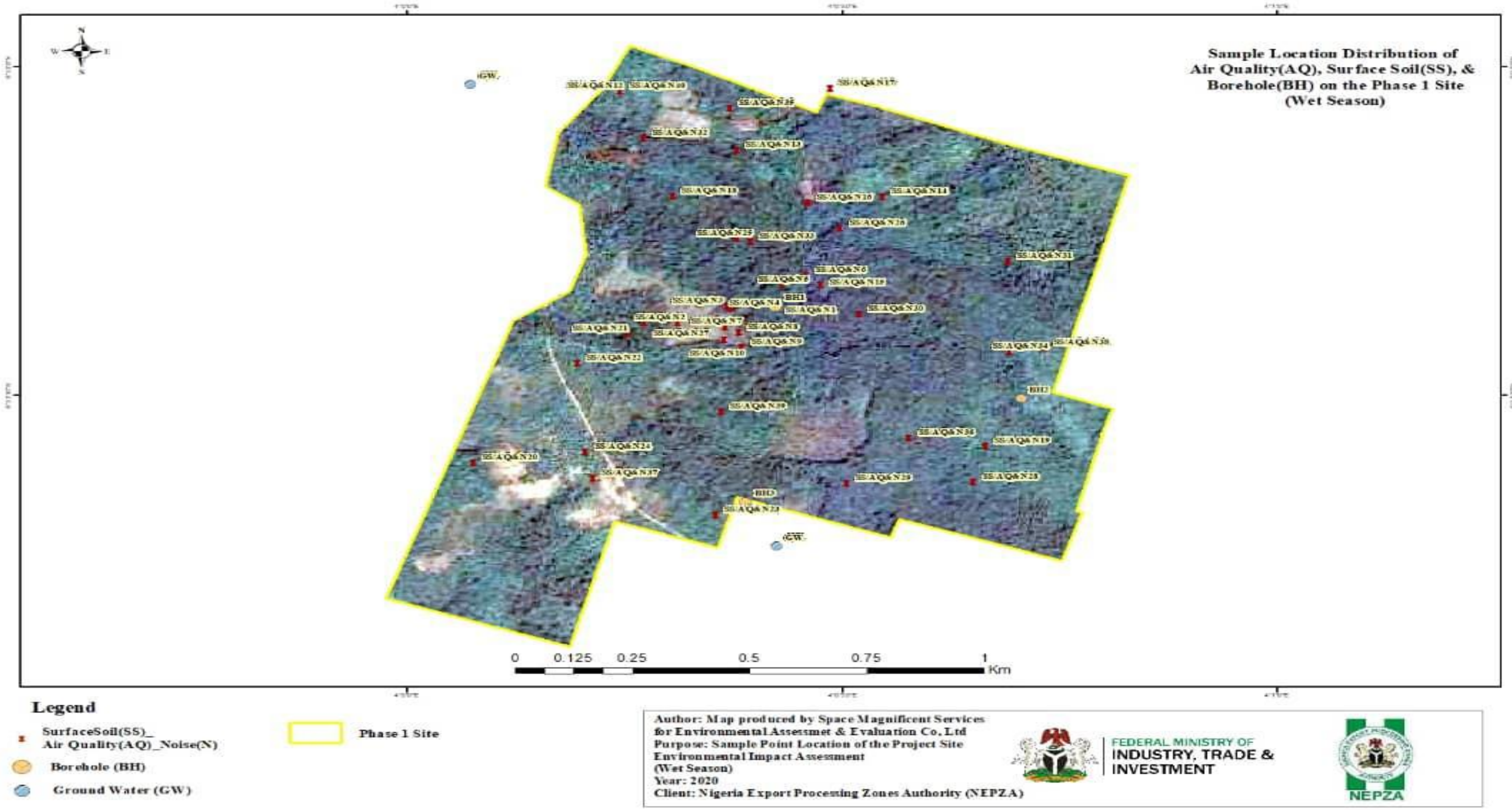


Figure 4.1b Sampling map for the environmental components within the 150ha proposed project site.

4.3. CLIMATE AND METEOROLOGY.

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

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

The data presented below spans a period of thirty (30) years; from 1987 to 2017.

4.3.1. Rainfall

The mean annual rainfall within Lagos State for the period 1987 to 2017 ranged from 13.8 mm in January to 282.6 mm in June. Rainfall distribution was observed to be highest in the months of June, followed by July, September and May. The lowest was in January and December (Figure 4.2).

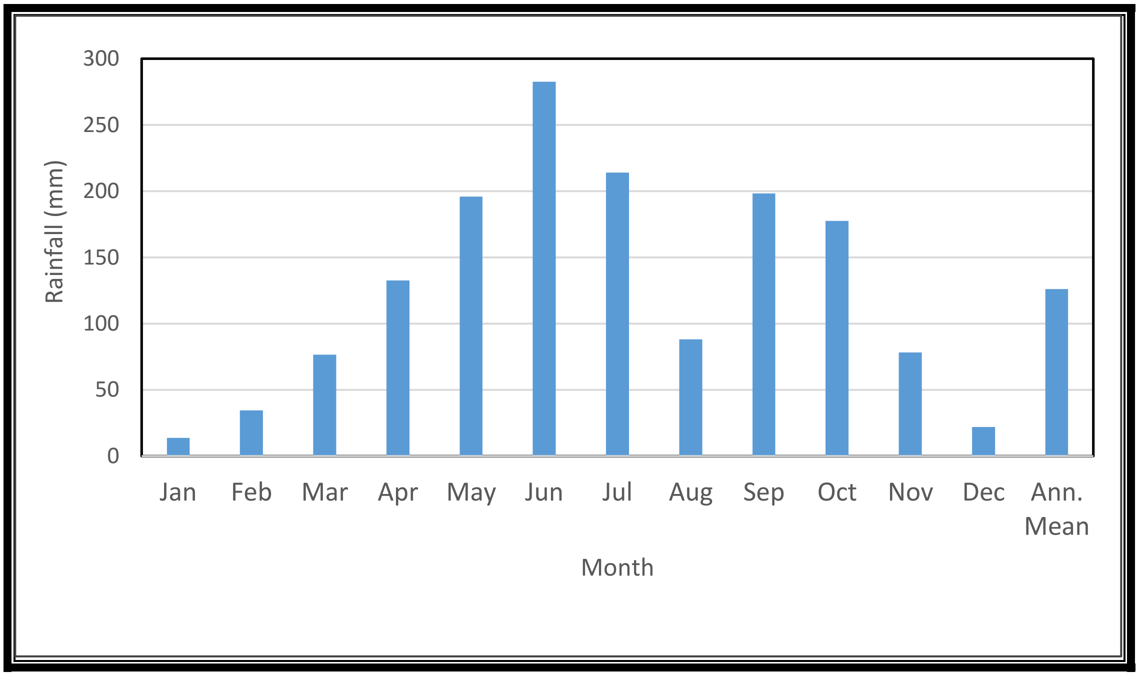


Figure 4.2: Mean Monthly Rainfall in Lagos State (1987 - 2017)
Source: Nigerian Meteorological Agency (NIMET), 2018

4.3.2. Temperature

The mean monthly maximum and minimum temperatures recorded for Lagos State by the Nigerian Meteorological Agency (NIMET) over same climatic period is shown in Figure 4.3. From the data obtained, the maximum temperature was highest in the month of February (33.9^{o}C) and lowest in July for Lagos State. The annual mean value was 31.5^{o}C. Minimum temperature was highest in March (25.3^{o}C), while the lowest temperature was recorded in the months of July and August (23.1^{o}C). The overall mean monthly minimum temperature was 23.9^{o}C.

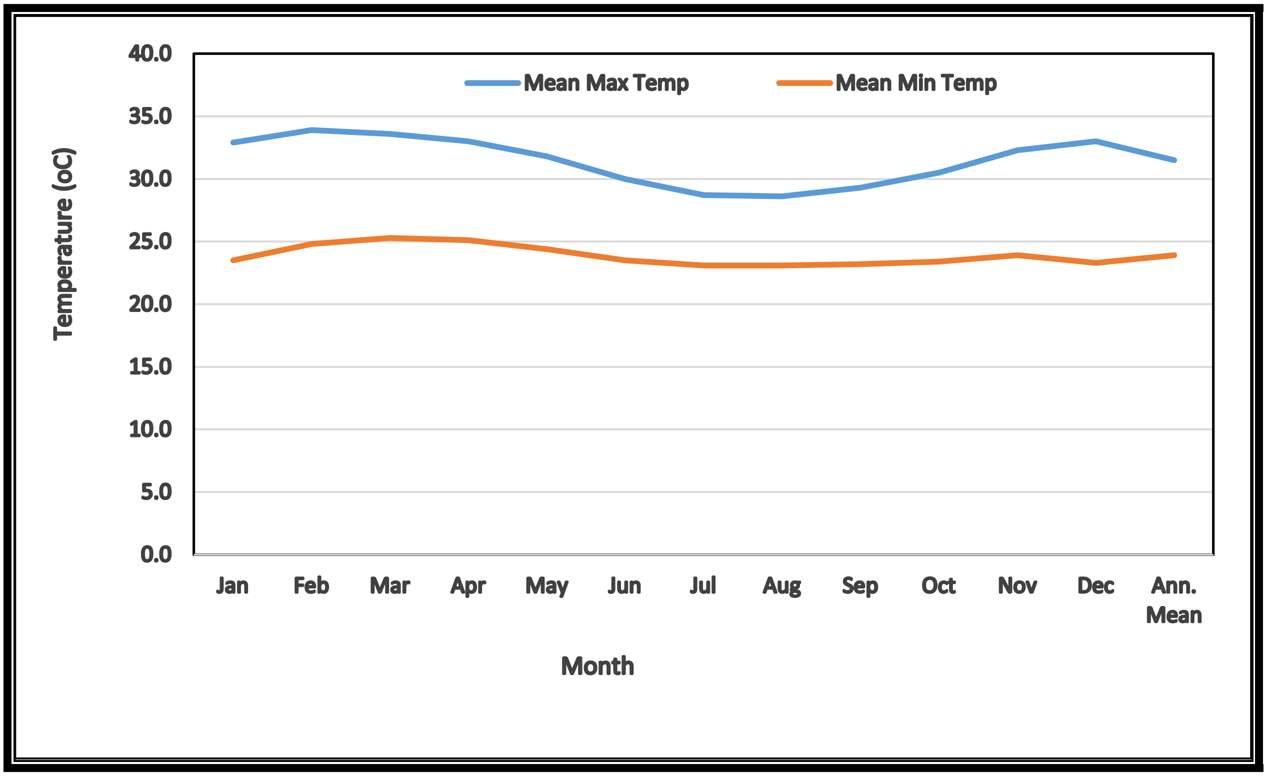


Figure 4.3: Mean Monthly Minimum and Maximum Temperatures for Lagos State (1987 - 2017)

Source: Nigerian Meteorological Agency (NIMET), 2018

4.3.3. Solar Radiation

Data obtained from NIMET indicate that sunlight in the proposed project area was most intense between the month of December and February for Lagos State. The lowest solar radiation was recorded between the month of June and August; month with the least being July. Average sunlight hours for both states, ranged between 3 and 7 hours with an annual average of 5 hours. The overall mean monthly sunshine was 16.8 MJ/m^2/day for entire 30 years (Figure 4.4).

The pattern of rainfall and intensity of solar radiation was inverse. Generally, periods of intense rains characterised by thick cloud cover usually witness low sunlight. While the dry season had relatively higher solar radiation, the wet season on the other hand showed low sun's radiation.

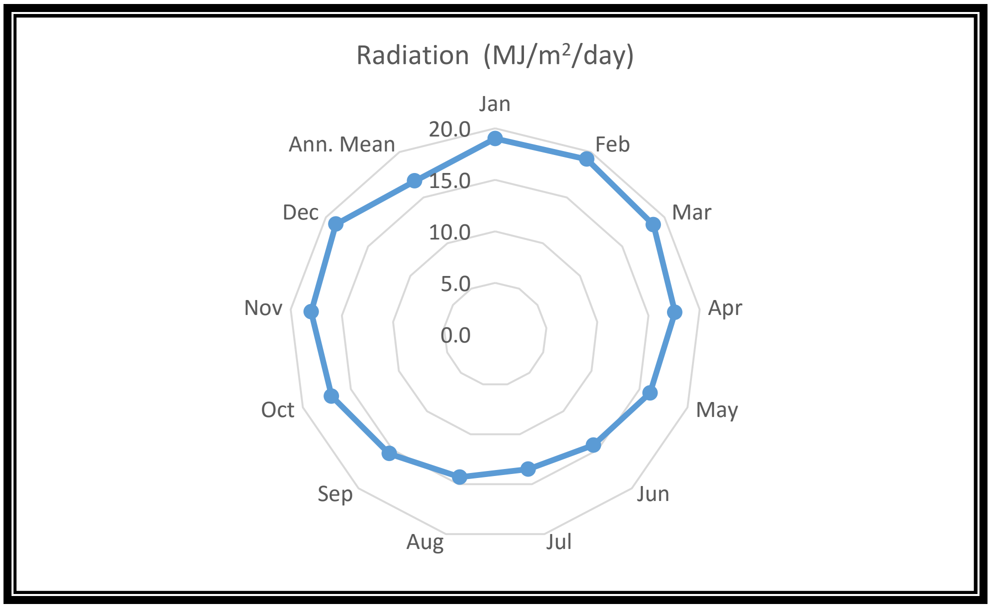


Figure 4.4 Mean Monthly Solar Radiation in Lagos State (1987 - 2017)

Source: Nigerian Meteorological Agency (NIMET), 2018

4.3.4. Wind speed

The mean monthly wind speed for the proposed study area ranged between 3.6 and 6.3 Knots. Wind speed was observed to be highest in August while November had the lowest for Lagos state. Months that recorded wind speed above 5.0 knot included February to April, and July to September (Figure 4.5).

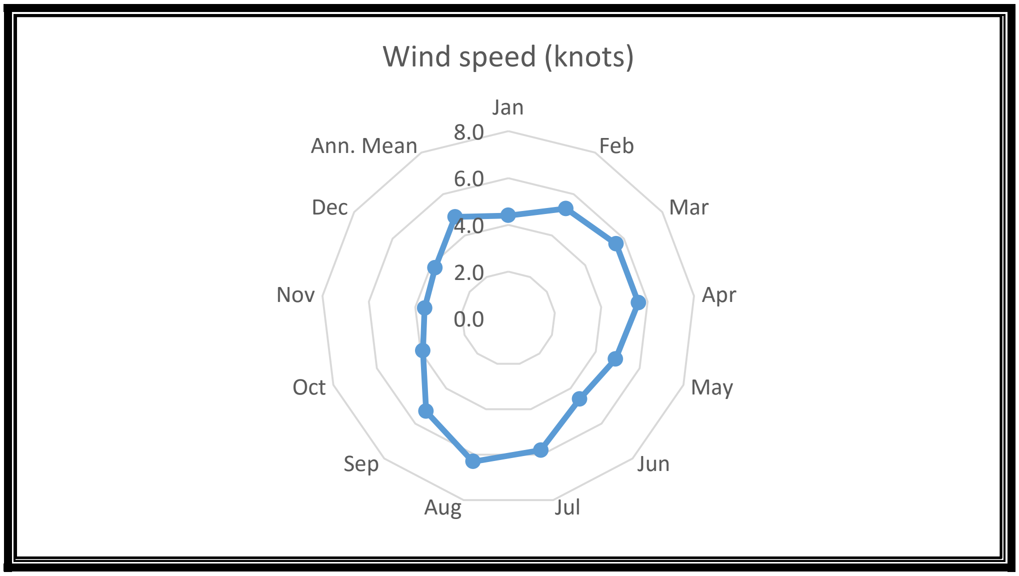


Figure 4.5: Mean Monthly Wind speed (Knots) for Lagos State (1987 - 2017)

Source: Nigerian Meteorological Agency (NIMET), 2018

From the in situ collection during the field data gathering, measurement of humidity and wind speed and direction were taken with the aid of Weather-hawk (Windmate[R]). The data generated from the exercise are presented as weather condition of the project area in Epe.

4.3.5. Wind Direction

Data obtained with the aid of Weather-hawk (Windmate[R]) revealed that south westerly wind direction is prevalent in the study area (2019). The wind direction varied from the northeast (100) to northwest direction. Moreover, the wind speed ranged from 0.0 and 1.2 m/s. Being a well forested environment, the wind speed is expected to be low due to the interception of wind by trees of different sizes.

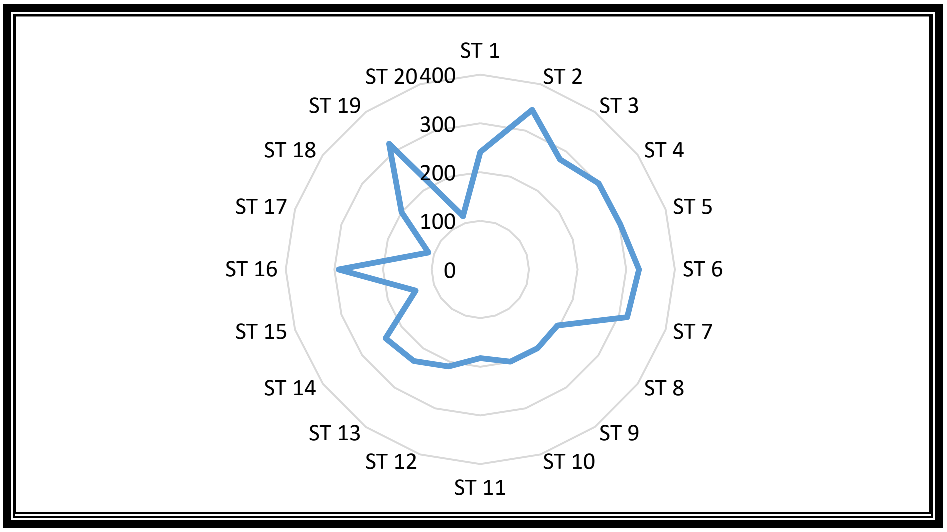


Figure 4.6a: Local wind direction of the Project site

Source: EAECL Fieldwork 2019/2020 (Wet season)

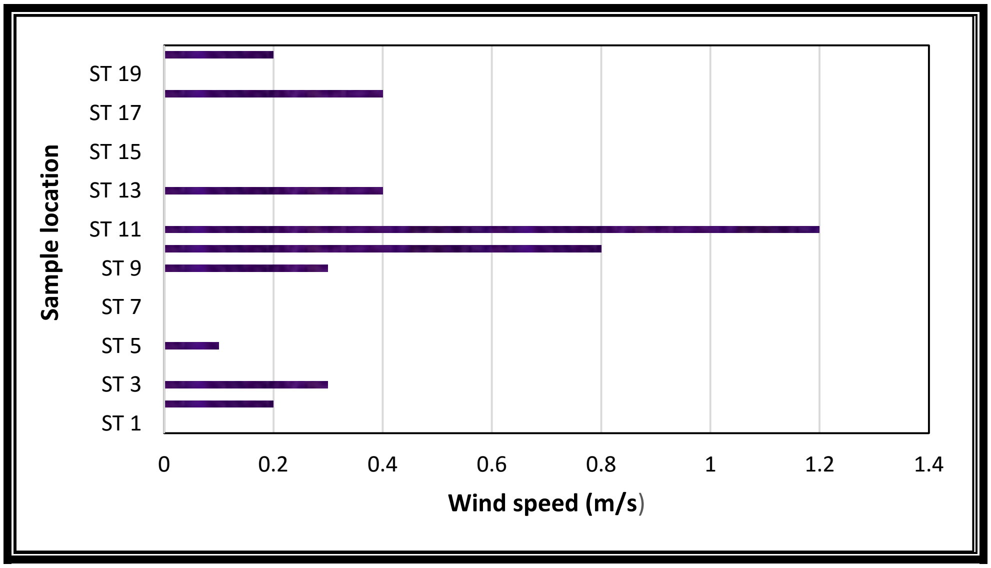


Figure 4.6b: Local wind speed of the Project site
Source: EAECL Fieldwork, 2019/2020 (Wet season)

4.3.6. Relative Humidity

Relative humidity is the ratio of the amount of water vapour in the air at a specific temperature to the maximum amount that the air could hold at that temperature, expressed as a percentage. For example, a reading of 100 percent relative humidity means that the air is totally saturated with water vapour and cannot hold any more, creating the possibility of rain. Relative humidity is usually higher in the wet season than the dry season because of rainfall caused by precipitation of vapour in the atmosphere.

Relative humidity in the study area was generally above 50% during the period. The value ranged from 53.4 to 73.3% in site ST12 and ST16 respectively (Figure 4.7).

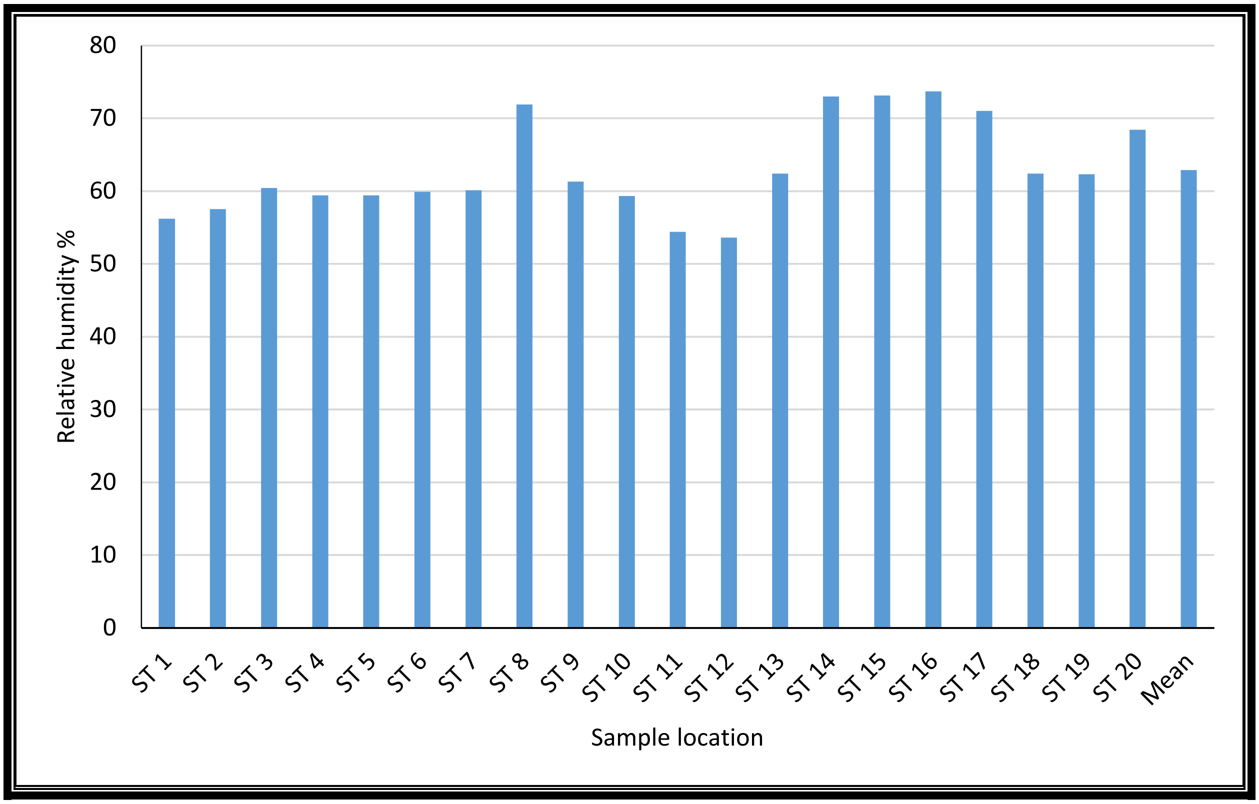


Figure 4.7: Relative humidity of the sampling locations in the project Area

Source: Fieldwork 2019 (wet season)

4.4. AMBIENT AIR QUALITY

4.4.1. Methodology

Ambient air quality measurements were carried out on site using Aeroqual gas monitor series 300 and Aerocet 531S, with up-to-date calibration. The Aeroqual handheld monitors are specifically designed to give accurate ambient gas measurement, with dedicated sensor per parameter. Concentrations of particulate matter ($PM_{2.5}$and PM_{10}) and gaseous parameters $SO_{2,}$ H_2S, CO, CO_2, $CH_{4,}$ and VOCs were determined by interchangeably inserting sensor heads on the base monitor, and allowing the required warming time before actual measurement. Total Suspended Particles (TSP) concentrations of the site were determined with Aerocet 531S.

Extech digital sound level meter was deployed for noise measurement of the project area alongside particulate matter measurement. Noise measurement was taken in dB (A) weighted band, to express the relative loudness in air as perceived by the human ear and also at a slow time weighting, which gave the average noise level per sampling location. Calibration of the sound level meter was up-to-date.

Conditions of meteorological parameters Temperature, Relative Humidity, Wind Speed and Wind Direction, of the project area were measured with WindMate® Weather Station. WindMate is a hand held weather station that is built to precision and gives wind direction in degrees and compass points; and it calculates crosswind, head/tail wind, with a wind speed accuracy of better than +/- 3%. It also measures a full range of other indicated meteorological. All these methods are in line with the recommendations of the Federal Ministry of Environment.

Table 4.4: List of Air and Noise Quality Equipment used in the study

Parameter	**Equipment**	**Detection Limit**
Particulate Matter: Total Suspended Particles	Aerocet 531SMass Particle Counter	0 - 1000µg/m^3
Particulate Matter: $PM_{2.5}$ and PM_{10}	Aeroqual Gas Monitor Series 500	0 - 1000µg/m^3
Carbon II oxide	Aeroqual Gas Monitor Series 500	0 – 200ppm
Sulphur IV oxide	Aeroqual Gas Monitor Series 500	0 – 100ppm
Hydrogen Sulphide	Aeroqual Gas Monitor Series 500	0 – 100ppm
Methane	Aeroqual Gas Monitor Series 500	0 – 10000ppm
Total Volatile Organic Compounds (TVOCs)	Aeroqual Gas Monitor Series 500	0 – 50ppm
Noise Level	Igital Sound Level Meter (HP-882A)	30 – 130 dB(A)
Meteorology	WindMate® Weather Station	+/-3%

Plate 4.1 is the sampling set-up at two out of the forty sampling locations where measurements were taken during the field survey.

Plate 4.1: Air Quality Sampling during the field survey

Sampling took place from November 28 through 30, 2019 and February 26 through 28, 2020 for wet and dry seasons respectively, at forty sampling points and one control point (Table 4.2).

4.4.2. Air Quality

Suspended Particulates

Particulates are a mixture of solid, liquid or solid and liquid particles suspended in the air. These particles are seen as smoke or haze. They are hazardous to human health – they cause acute and chronic effects to the respiratory and cardiovascular systems. Particles may carry any or all of the other pollutants dissolved in or adhering to their surfaces. Particles raging from aggregate of a few molecules to pieces of dust, readily visible to the naked eye are commonly found in the atmosphere. Aligning with the assertion of San and El (2012) that particulates cause acute and chronic effects to the respiratory and cardiovascular systems, CCDI (2001) revealed that high concentrations of suspended particulate matter (SPM) are known to irritate the mucous membranes and may initiate a variety of respiratory diseases. Fine particulates may cause cancer and aggravate morbidity and mortality from respiratory dysfunctions.

Particulates were detected in all the locations sampled. Table 4.5 summarizes the obtained 1 – hour measured particulate concentration levels in the ambient environment of the Proposed site. The measured concentrations were in the range of 3.00 – 29.00μg/m^{3}with an average and SD of 16.85±5.56μg/m^3; 7.0– 48.0 μg/m^{3}with an average and SD of 28.80±9.31μg/m^3 respectively for $PM_{2.5}$and $PM_{10}$for the wet season, while the measured concentrations for the dry season were in the range of 50.3–163.6μg/m^3, with an average and SD of 68.57±22.97μg/m^3; 54.4–237.5μg/m^3 with an average and SD of 79.55±32.28μg/m^{3}and 114.3–1478.9μg/m^{3}with an average and SD of 355.93±536.15μg/m^3 for $PM_{2.5}$,PM_{10} and TSP respectively. Measured concentrations of TSP were within withing the FMEnV limit of 250 μg/m^3 at 28 points out of the 40 sampled points. The one hourly average concentration level of TSP, 355.93 μg/m^3, exceeded the FMEnV limit of 250 μg/m^3.This may be attributed to the dispersal and subsequent suspension ash remains from combustions.

Table 4.5: 1-Hourly Measured Particulate Concentrations in the Study Locations

Sampling Location	Concentrations ($\mu g/m^3$)					
	Wet Season			Dry Season		
	$PM_{2.5}$	PM_{10}	TSP	$PM_{2.5}$	PM_{10}	TSP
PT1	16.0	20.0	57	53.6	62.6	290.6
PT2	18.0	45.0	100	50.3	54.4	120.9
PT3	17.0	27.0	70	53.2	59.9	194.7
PT4	17.0	37.0	86	53.3	58.6	186.2
PT5	15.0	29.0	70	70.4	92.2	716.8
PT6	18.0	36.0	86	54.6	60.2	174.5
PT7	11.0	23.0	54	62.2	68.9	197.6
PT8	21.0	36.0	91	53.7	58.5	164.5
PT9	29.0	41.0	112	56.5	66.5	292.3
PT10	19.0	37.0	89	55.5	60.6	170.4
PT11	14.0	41.0	88	51.9	57.7	163.7
PT12	27.0	31.0	92	53.5	63.5	240.9
PT13	11.0	22.0	52	52.8	58.5	185.9
PT14	17.0	32.0	78	95.3	99.1	162.3
PT15	18.0	24.0	67	54.6	58.9	141
PT16	14.0	19.0	52	56.4	62.9	185.7
PT17	13.0	23.0	57	52.6	59.4	153.7
PT18	16.0	28.0	70	53.7	60.3	154.8
PT19	15.0	32.0	75	52.5	59.8	183.4
PT20	17.0	35.0	83	55.1	66.5	405.4
PT21	19.0	31.0	80	163.6	237.5	3317.8
PT22	5.0	9.0	22	83.7	125.9	1478.9
PT23	3.0	7.0	16	66.5	86.8	587.7
PT24	5.0	9.0	22	53.4	80.9	182.4
PT25	17.0	21.0	60	56.6	63.8	186.9
PT26	21.0	34.0	88	97.5	108.4	452.8
PT27	20.0	31.0	81	54.2	60.3	220.6
PT28	19.0	34.0	84	93.4	107.2	298.9
PT29	26.0	48.0	118	93.8	108.7	530.5
PT30	19.0	31.0	80	53.7	57.7	114.3
PT31	17.0	23.0	64	92.6	104.5	427.9
PT32	11.0	31.0	67	55.7	63.8	229.1
PT33	28.0	41.0	110	68.8	83.4	474.5
PT34	17.0	21.0	60	95.1	99.4	145.4

PT35	16.0	23.0	62	56.8	64.3	218.9
PT36	20.0	28.0	76	92.4	96.5	149.2
PT37	23.0	31.0	86	52.7	59.5	172.6
PT38	17.0	37.0	86	92.4	96.1	151.1
PT39	13.0	23.0	57	95.3	100.4	189.7
PT40	15.0	21.0	57	82.7	87.8	222.6
Control	17.0	30.0	62	80.5	84.3	205.5
Mean values	**16.8**	**28.8**	**72.6**	**68.5**	**79.5**	**355.9**

Source: EAECL Fieldwork, 2019/2020

Sulphur IV Oxide

Sulphur iv oxide in the air results primarily from activities associated with the burning of fossil fuels (coal, oil) such as at power plants or from copper smelting. Exposure occurs from breathing and it affects the lungs and at high levels may result in burning of the nose and throat, breathing difficulties, and severe airway obstructions (ATSDR, 1999). Sulphur iv oxide is known to be a harsh irritant, and is capable of aggravating asthma, bronchitis and emphysema and promoting impaired functions in the human system (CCDI, 2001).

SO_2 was detected at all the sampling points, with concentration level ranging from 0.10 to 0.50mg/m^3 and 0.00 to 0.52mg/m^3 respectively for wet and dry seasons, during the 1-hour measurement time.The average of measured concentrations, 0.28mg/m^{3}and 0.26 mg/m^3,respectively for wet and dry seasons, were less than the limit, 0.35 mg/m^3, recommended of the National Environmental Air Quality Control Regulation (NEAQCR) 2014.

Carbon II oxide

Carbon ii oxide (CO) is a poisonous, colorless, odorless and tasteless gas resulting from the incomplete burning of material containing carbon such as natural gas, gasoline, kerosene, oil, propane, coal, or wood (OSHA, 2012). Adverse health effect has been observed with carbon ii oxide concentrations of 12 - 17ppm for 8 hours (Canter and Hill, 1977) while prolonged (45 minutes to 3 hours) exposure to concentrations of CO between 200ppm and 800ppm often results in severe headache, dizziness, nausea and convulsions (CCDI, 2001). CO was obtained in all the sampling points with concentration level ranging from 2.96 to 8.33mg/m^{3}and 2.31 to 6.10mg/m^3 respectively for wet and dry seasons, during the 1-hour measurement time.The average of measured concentrations, 5.18 mg/m^3 and 3.92 mg/m^3, respectively for wet and dry seasons, were less than the limit, 10.00 mg/m^3, recommended by the National Environmental Air Quality Control Regulation (NEAQCR) 2014.

Methane

Methane, CH4, is a colorless, odorless gas with a wide distribution in nature. It is the principal component of natural gas. Anaerobic bacterial decomposition of plant and animal matter, such as occurs under water, produces marsh gas, which is another name for methane. It is nontoxic when inhaled, but it can produce suffocation by reducing the concentration of oxygen inhaled (SCIFUN, 2017). CH_4 was obtained in all sampling points with concentration level ranging from 5.00 to 45.00 mg/m^3 and 10.50 to 18.37 mg/m^3 respectively for wet and dry seasons. Neither Nigeria nor the World Bank has 1-hour recommended limit for Methane (CH_4) and Hydrogen sulphde (H_2S) pollutants.

Hydrogen Sulphide

Hydrogen sulphide is a colourless, flammable gas with a characteristic odour of rotten eggs. It is produced naturally, a few of which are anaerobic bacterial reduction of sulphates and sulphur-containing organic compounds, and also as a result of human activity. Nasal olfactory lesions were reported in Sprague-Dawley CD rats exposed to hydrogen sulphide at 42 or 110 mg/m^3; the no-observed adverse- effect level (NOAEL) was 14 mg/m^3 (WHO, 2003). Hydrogen sulphide was detected at almost all the points sampled, with concentration level ranging from 0.0 – 0.5 mg/m^3 and 0.0 – 0.42mg/m^{3}respectively for wet and dry seasons.

Carbon iv Oxide

The concentration of CO_2 in the atmosphere has risen from close to 280 parts per million (ppm) in 1800, at first slowly and then progressively faster to a value of 367 ppm in 1999, echoing the increasing pace of global agricultural and industrial development. Current anthropogenic emissions of CO_2 are primarily the result of the consumption of energy from fossil fuels (IPCC, 2018). Carbon dioxide is a naturally occurring gas, a by-product of burning fossil fuels and biomass and a result of land-use changes and other industrial processes. It is the principal anthropogenic gas that is thought to affect the Earth's radiative balance (Florides and Christodoulides, 2008 citing IPCC, 2007). Carbon iv oxide was detected at all the points sampled, with concentration level ranging from 361.00–1425.00 mg/m^3 and 855.00–1089.01 mg/m^3 respectively for wet and dry seasons.

The average of measured concentrations, 1042.55 mg/m^3 and 998.78 mg/m^3,respectively for wet and dry seasons, were less than the limit, 9000.00 mg/m^3, recommendation of the American Conference of Governmental Industrial Hygienists (ACGIH).

Volatile Organic Compound

Volatile organic compounds (VOCs) are a large group of organic chemicals that include any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate). VOCs are of interest in part because they participate in atmospheric photochemical reactions that contribute to ozone formation, they play a role in formation of secondary organic aerosols, which are found in airborne particulate matter, and because many individual VOCs are known to be harmful to human health. VOCs are emitted from a variety of sources, including motor vehicles, chemical manufacturing facilities, refineries, factories, consumer and commercial products, and natural (biogenic) sources (mainly trees), and health effects vary by pollutant (EPA, 2018).Volatile Organic Compounds (VOCs) was detected in all the points sampled, with concentration levels ranging from 0.02–0.20 mg/m^{3}and 0.03–0.23 mg/m^3 respectively for wet and dry seasons. The average of measured concentrations, 0.07 mg/m^3 and 0.10 mg/m^3, respectively for wet and dry seasons, were less than the limit, 0.60 mg/m^3, recommended of the National Environmental Air Quality Control Regulation (NEAQCR) 2014.

The values of temperature, relative humidity, wind speed and direction of the project site were measured during field survey.

Table 4.6: 1-Hour Measured Gaseous Concentrations in the Study Area (Wet Season)

Sampling Location	Mean Concentration (ppm)						Temperature (°C)	Relative Humidity (%)	Wind Direction	Wind Speed (MPH)
	SO_2	VOC	CH_4	CO	CO_2	H_2S				
PT1	0.4	0.14	21.18	8.33	1212.22	0.2	37.39	56.2	WSW	0.0
PT2	0.3	0.18	16.11	5.74	1212.22	0	36.33	57.5	NNW	0.2
PT3	0.4	0.16	23.33	5.42	1212.22	0.1	32.94	60.4	WEW	0.3
PT4	0.3	0.08	19.44	5.56	1212.22	0.4	36.16	59.4	WNW	0.0
PT5	0.3	0.06	18.89	6.57	1161.39	0.4	35.77	59.4	WNW	0.1
PT6	0.32	0.12	21.11	5.00	858.06	0.1	36.05	59.9	NW	0.0
PT7	0.3	0.10	23.89	6.57	837.78	0.2	36.05	60.1	NW	0.0
PT8	0.4	0.06	29.44	4.54	841.39	0.3	35.16	71.9	SSW	0.0
PT9	0.1	0.10	26.94	4.72	782.50	0.4	37.50	61.3	SSW	0.3
PT10	0.23	0.12	20.00	6.48	1212.22	0.3	36.89	59.3	SSW	0.8
PT11	0.34	0.10	34.72	7.22	1142.50	0.2	35.05	54.4	S	1.2
PT12	0.2	0.13	22.50	5.97	1212.22	0.3	37.44	63.6	SW	0.0
PT13	0.3	0.08	17.50	5.42	1060.00	0.4	34.61	62.4	SW	0.4
PT14	0.2	0.20	24.07	5.28	1364.00	0.3	32.72	73.0	WSW	0.0
PT15	0.3	0.15	14.17	4.63	1424.00	0.4	32.77	73.1	SE	0.0
PT16	0.3	0.11	25.00	5.69	1055.00	0.4	32.66	73.7	WNW	0.0
PT17	0.35	0.05	21.00	5.97	969.44	0.3	32.94	71.0	EWE	0.0
PT18	0.29	0.05	5.00	4.63	862.78	0	35.72	62.4	SSW	0.4
PT19	0.23	0.07	7.00	4.63	911.11	0.2	35.50	62.3	NW	0.0
PT20	0.3	0.06	11.00	4.17	818.33	0.1	37.44	68.4	SW	1.2
PT21	0.3	0.02	9.00	5.00	818.33	0.2	31.44	69.3	ESE	0.7
PT22	0.3	0.02	7.00	4.63	1370.00	0.2	34.11	67.1	E	0.7
PT23	0.1	0.03	13.00	4.07	1045.00	0.2	33.94	67.1	EN	0.6
PT24	0.1	0.03	6.00	4.26	1056.00	0.2	33.66	55.4	WS	0.6
PT25	0.5	0.04	5.00	5.00	1143.00	0.1	36.33	52.9	EN	0.3
PT26	0.1	0.02	45.00	5.97	1272.00	0.1	33.22	57.3	SW	0.1
PT27	0.3	0.07	31.00	6.53	1261.00	0.3	33.55	62.3	SW	0.0
PT28	0.2	0.08	24.00	6.67	997.00	0.3	32.94	61.4	SW	0.1
PT29	0.4	0.08	19.00	4.07	1380.00	0.3	36.39	61.5	SES	0.2
PT30	0.1	0.05	16.00	5.09	1370.00	0.3	35.72	55.6	ESE	0.0
PT31	0.3	0.04	11.00	4.54	841.00	0.3	33.00	61.3	SWE	0.0
PT32	0.3	0.04	14.00	4.72	890.00	0.3	33.05	52.9	WE	0.0
PT33	0.3	0.04	13.00	6.11	361.00	0.3	32.83	54.3	SWE	0.4

PT34	0.21	0.04	30.00	4.63	1142.50	0.3	37.27	51.0	EW	0.0
PT35	0.24	0.05	32.00	4.07	838.89	0.3	32.27	66.0	NE	0.4
PT36	0.5	0.05	19.00	3.70	862.78	0.5	33.00	66.5	EN	0.4
PT37	0.3	0.04	15.00	3.33	755.00	0.3	30.77	69.5	WS	0.3
PT38	0.3	0.05	19.00	6.11	688.89	0.1	33.11	64.3	ESE	0.1
PT39	0.28	0.05	17.00	3.15	1160.00	0.1	36.33	65.9	WE	0.0
PT40	0.4	0.05	13.00	2.96	1088.00	0.2	36.27	54.8	WN	0.0
Control 1	0.3	0.04	29.0	5.10	696.89	0.2	34.22	54.2	WE	0.0
Mean	**0.28**	**0.07**	**19.01**	**5.18**	**1042.55**	**0.25**	-	-	-	-
S. D	**0.10**	**0.05**	**8.71**	**1.15**	**229.97**	**0.12**	-	-	-	-
FMEnv	**0.01**	**NS**	**NS**	**10.0**	**NS**	**NS**				
NEAQCR	**0.35**	**0.60**	NS	**10.0**	NS	NS	-	-	-	-
ACGIH	**NS**	NS	NS	NS	**9000.00**	NS	-	-	-	-

Source: EAECL Fieldwork, 2019 NS- No Specification

Table 4.7: 1-Hour Measured Gaseous Concentrations in the Study Area (Dry Season)

Sampling Location	Mean Concentration (ppm)						Temperature (°C)	Relative Humidity (%)	Wind Direction	Wind Speed (MPH)
	SO_2	VOC	CH_4	CO	CO_2	H_2S				
PT1	0.34	0.06	11.81	3.42	1011.61	0.42	39.61	47.7	0.0	NW
PT2	0.26	0.10	14.43	5.74	878.40	0.14	34.61	59.4	0.0	E
PT3	0.41	0.06	11.81	4.21	990.00	0.28	38.95	50.2	0.0	S
PT4	0.31	0.10	16.40	3.24	991.80	0.14	39.00	51.6	0.0	ESE
PT5	0.32	0.06	12.46	2.54	999.00	0.28	39.45	48.7	0.0	NW
PT6	0.51	0.10	11.15	3.71	1033.21	0.14	38.67	58.7	0.0	ENE
PT7	0.43	0.52	18.37	4.21	954.00	0.28	34.06	55.1	0.0	ESE
PT8	0.51	0.10	13.12	2.34	999.00	0.14	37.34	49.9	0.0	E
PT9	0.41	0.10	15.09	4.21	946.80	0.14	36.89	54.1	0.0	E
PT10	0.29	0.06	12.46	4.23	1026.01	0.14	37.28	53.3	0.0	E
PT11	0.25	0.10	15.09	3.51	1081.81	0.14	37.00	52.7	0.0	NW
PT12	0.26	0.10	13.12	4.21	1053.01	0.00	39.73	47.3	0.0	NW
PT13	0.00	0.10	13.78	2.31	1035.01	0.14	39.17	508	0.0	SSE
PT14	0.52	0.13	10.50	3.41	907.20	0.14	33.06	59.3	0.0	ESE
PT15	0.49	0.10	13.12	5.21	1031.41	0.14	36.67	560	0.0	E
PT16	0.00	0.10	13.78	4.32	1065.61	0.14	39.23	47.4	0.0	E
PT17	0.00	0.06	12.46	4.25	1042.21	0.28	39.89	42.6	1.0	NNW
PT18	0.00	0.06	12.46	6.10	1049.41	0.00	39.61	42.9	0.0	NW

PT19	0.26	0.13	12.46	5.24	1089.01	0.00	39.89	41.5	0.0	NW
PT20	0.00	0.10	13.12	4.23	948.60	0.14	39.61	43.4	0.1	S
PT21	0.26	0.03	12.46	2.56	1152.01	0.28	37.45	53.6	0.0	ESE
PT22	0.26	0.13	14.43	4.23	982.80	0.14	39.84	42.8	0.0	WSW
PT23	1.05	0.23	13.78	5.21	1157.41	0.28	35.06	56.4	0.0	SSE
PT24	0.36	0.19	11.15	4.23	937.80	0.14	39.11	47.6	0.2	NW
PT25	0.26	0.10	13.12	2.34	1029.61	0.00	39.67	43.1	0.0	E
PT26	0.00	0.10	12.46	5.30	876.60	0.00	33.00	57.8	0.0	E
PT27	0.41	0.06	15.74	4.23	934.20	0.28	36.56	55.5	0.0	E
PT28	0.26	0.06	11.81	2.54	864.00	0.00	32.89	57.9	0.0	ENE
PT29	0.00	0.10	13.78	3.52	873.00	0.00	32.61	60.7	0.0	ENE
PT30	0.29	0.06	13.12	2.32	945.00	0.14	35.61	60.9	0.0	ENE
PT31	0.00	0.10	13.78	4.12	1065.61	0.00	32.84	59.8	0.0	SSE
PT32	0.00	0.13	13.12	2.35	941.40	0.00	39.17	45.1	0.0	W
PT33	0.26	0.10	12.46	5.21	1018.81	0.00	39.50	43.7	0.0	SSE
PT34	0.26	0.06	11.81	2.31	1337.41	0.28	33.17	59.2	0.0	ENE
PT35	0.00	0.06	11.81	2.54	855.00	0.14	39.06	45.4	0.0	W
PT36	0.26	0.06	11.15	3.21	914.40	0.00	33.67	58.7	0.0	E
PT37	0.31	0.13	13.78	4.36	1049.41	0.00	37.34	51.0	0.0	E
PT38	0.26	0.10	13.12	5.21	972.00	0.14	32.34	61.5	0.0	E
PT39	0.32	0.10	13.78	4.96	1029.61	0.28	34.50	58.4	0.0	ESE
PT40	0.00	0.06	13.78	5.31	882.00	0.14	32.28	61.6	0.0	ENE
Control 1	0.22	0.12	13.12	4.98	996.00	0.11	33.56	60.0	0.0	ENE
Mean	**0.26**	**0.10**	**13.19**	**3.92**	**998.78**	**0.14**	-	-	-	-
S. D	**0.21**	**0.08**	**1.52**	**1.10**	**93.32**	**0.11**	-	-	-	-
FMEnv	**0.01**	**NS**	**NS**	**10.0**	**NS**	**NS**	-	-	-	-
NEAQCR	**0.35**	**0.60**	NS	**10.0**	NS	NS	-	-	-	-
ACGIH	NS	NS	NS	NS	**9000.00**	NS	-	-	-	-

Source: EAECL Fieldwork, 2020   NS- No Specification

4.5. NOISE QUALITY

Ambient noise quality measurements were carried out in situ using digital sound level meter at the sampling points.

Plate 4.2: Noise measurement during the field survey

4.5.1. Noise Quality Measurement

Noise is a pressure variation (wave) that travels through air, producing excessive or unwanted sound which potentially results in annoyance and/or hearing loss. Physical manifestation of noise is a pressure wave which is caused by vibrating surfaces Patrick and Peter (2006). Apart from causing disturbance to the affairs of man, long term exposure to excessive noise can damage health and have psychological effects (SIEP, 1995; Oguntoke *et al.*, 2015; Oguntoke *et al.*,2019). The effects of noise on residents generally relate to the annoyance/nuisance caused by the short and long term high noise levels. Also, disturbance to wildlife is significant especially during breeding seasons and/or when rare species are present. The following are listed in WHO, 1999 as the adverse health effect of exposure to noise: noise-induced hearing impairment; interference with speech communication; disturbance of rest and sleep; psychophysiological, mental-health and performance effects; effects on residential behaviour and annoyance; and interference with intended activities. The rate at which these fluctuations of air pressure occur is the frequency, expressed in hertz (cycles per second). The range of sound pressures encountered is very large and to keep numbers in manageable proportions, noise levels are measured in decibels (dB), which have a logarithmic scale. Most legislations and measurements refer to the ‘A' frequency weighting, dB(A) which covers the range audible to the human ear (20 – 20000Hz). Sound pressure or acoustic pressure is the local pressure deviation from the ambient (average, or equilibrium) atmospheric pressure caused by a sound wave. Sound pressure in air can be measured using a microphone, and in water using a hydrophone. The SI unit for sound pressure p is the Pascal (symbol: Pa). Sound pressure level (SPL) or sound level is a logarithmic measure of the effective sound pressure of a sound relative to a reference value. It is measured in decibels (dB) above a standard reference level. The regulatory limit for noise provided by the FMEnv [90dB (A)] is specific to the workplace. However, noise due to construction and installation activities are expected to rise.

The IFC, WHO and FMEnv limits shall be used to benchmark the ambient noise levels measured in the project area. Table 4.8 presents the WHO guidelines for community noise.

Table 4.8: WHO Guidelines for Community Noise

Specific Environment	Critical Health Effect(s)	LAeq(dB)	Time base (hours)	Lamax, fast (dB)
Outdoor living area	Serious annoyance, daytime and evening. Moderate annoyance, daytime and evening.	55 50	16 16	- -
Dwelling, indoors Inside bedrooms	Speech intelligibility and moderate annoyance at daytime and evening. Sleep disturbance at night.	35 30	16 8	 45
Outside bedrooms	Sleep disturbance, window open (outdoor values).	45	8	60
School classrooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication.	35	During class	-
Pre-schools bedrooms, indoors	Sleep disturbance	30	Sleeping time	45
School, playground outdoors	Annoyance (external source)	55	During play	-
Hospitals, wardrooms, indoors	Sleep disturbance at night time Sleep disturbance at daytime and evenings.	30 30	8 16	40
Hospitals, treatment rooms, indoors.	Interference with rest and recovery.	#1	-	-
Industrial, commercial shopping and traffic areas, indoors and outdoors.	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events.	Hearing impairment (patrons:<5 times/year)	100	4	110
Public address, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/earphone	Hearing impairment (free-field value)	85#4	1	110
Impulse sounds from toys, fireworks and firearms.	Hearing impairment (adults) Hearing impairment (children)	-	-	140#2 120#2
Outdoors in parkland and conservation areas	Disruption of tranquillity	#3		

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

The summary results of the 10-minute measurements are shown in Figure 4.8.The rectangular boxes indicate the interquartile range (first and third quartiles); median values are indicated by the centerline within each box; outliers are indicated by asterisks.

At locations PT1 – PT40 are as shown in Figure 4.8 with the minimum and the maximum noise levels range 33.3 – 53.3 dB(A). These minimum measured noise levels during the study were below both the sleep disturbance limit (Berglund et al, 1999) of 45 dB(A)and the WHO's limit of 55 dB(A) for ambient environment. The measured noise level in the location are attributable to the sound of sawing machine used for felling trees and turning logs to planks before transportation the nearby towns.

The sleep disturbance limit was breached by the maximum levels in 12 of the sampling locations while the WHO's limit was not exceeded at any location. However, both the measured minimum and maximum noise levels in the forty sampling locations were within the 8-hour shop floor limit (Table 4.9) of the Federal Ministry of Environment. In general, the measured noise levels are representative of typical rural areas. The major observed primary sources of noise during the study include lumbering activities, moving motor cycles, distant voices, river, birds and crickets.

Table 4.9: Noise (dBA) measurement in the Project Area

Sampling Point	Area	Reading dB(A)	
		Wet	Dry
PT 1	Area 1	39.9	49.2
PT 2		35.9	44.4
PT 3		38.1	48.3
PT 4		38.6	43.3
PT 5		33.3	47.1
PT 6	Area 2	39.7	50.4
PT 7		41.5	48
PT 8		49.2	46.1
PT 9		43.7	46.7
PT 10		40.2	44.4
PT 11	Area 3	36.3	47.9
PT 12		35.7	48.3
PT 13		39.5	47.2
PT 14		40.1	46.5
PT 15		40.9	45.9
PT 16	Area 4	43.3	46.3
PT 17		41.3	46.1
PT 18		41.1	48
PT 19		45.1	45.8
PT 20		51.3	45.6
PT 21	Area 5	48.7	48.8
PT 22		53.3	47.5
PT 23		45.2	44.3
PT 24		41.7	48
PT 25		40.5	47.2
PT 26	Area 6	39.6	46.5
PT 27		37.5	46.1
PT 28		41.3	47.2

PT 29		45.2	45.5
PT 30		46.3	48.5
PT 31	Area 7	52.3	48.5
PT 32		51.4	48.2
PT 33		51.4	47.5
PT 34		51.4	46.3
PT 35		53.3	45.7
PT 36	Area 8	52.4	45.6
PT 37		39.6	47
PT 38		35.7	47.3
PT 39		37.4	43
PT 40		51.3	45.2
Control		46.5	42.8

Source: EAECL Fieldwork, 2019/2020

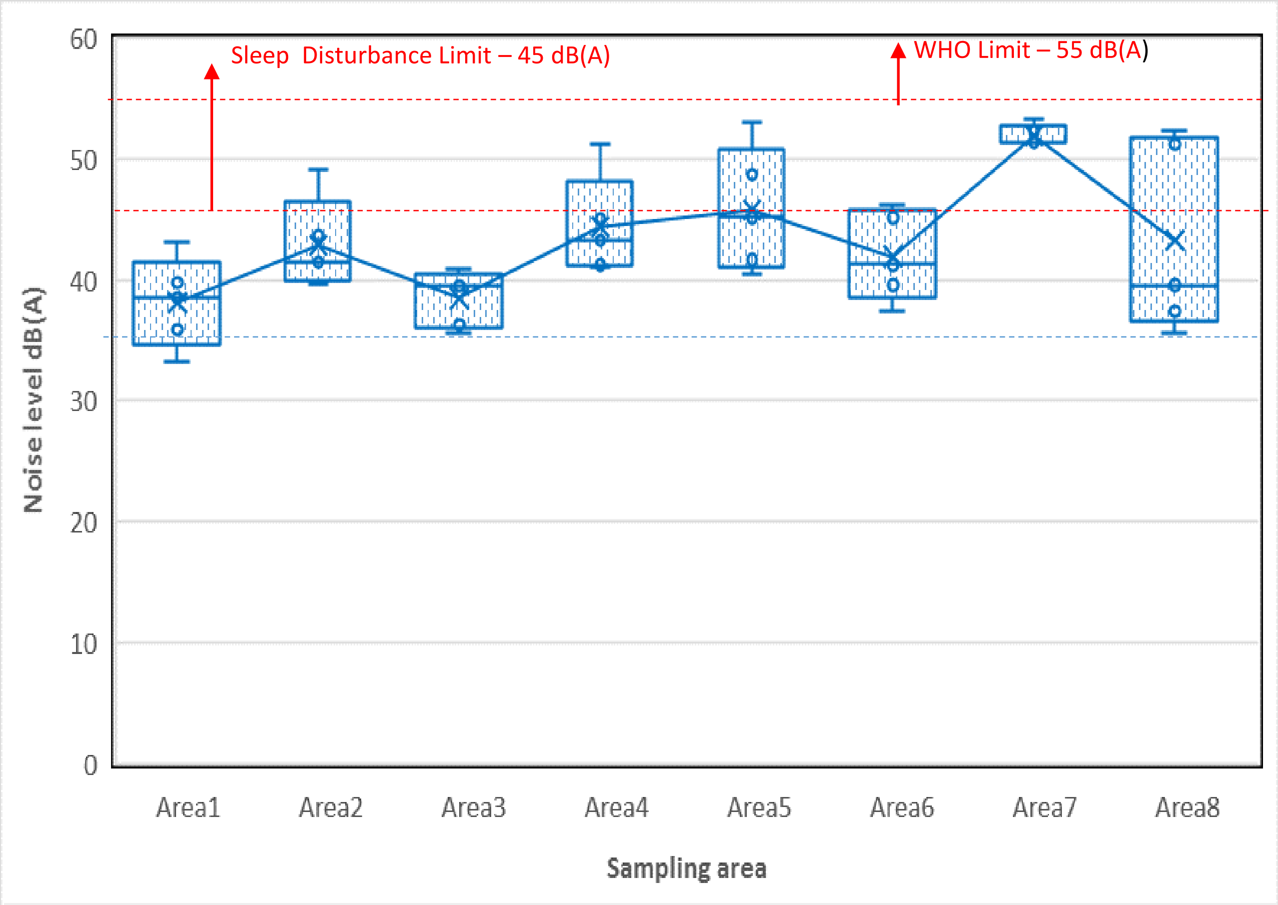


Figure 4.8: Summary results of the 10-minute Noise measurements

Area1 (Station 1 – 5); **Area 2** (Station 6 –10); **Area 3** (Station 11 – 15); **Area 4** (Station 16 -20); **Area 5** (Station 20–25); **Area 6** (Station 26-30); **Area 7** (Station 31-35); **Area 8** (Station 36-40)

4.5.2 Climate Change

Climate change impact/estimate of greenhouse gas emission from the proposed project were assessed in this section in order to provide an indication of what amounts will be contributed through the project phases and to find ways to mitigate the impact. GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide N_2O. As a support for the Environmental Impact Assessment (EIA), this climate change impact/greenhouse gas (GHG) emission assessment was carried out on the proposed Lekki Textile and Garment Industrial Park located in Lagos State in Southwestern area of Nigeria.

Site Description

The Land Cover for the proposed Textile and Garment processing industry at the Lekki Modern Industrial Park (LMIP) falls under the Urban/Built-up land category due to the awaited intensive human anthropogenic in-print, with almost all the land set to be covered with structures intended for the economic purposes.

Information on the spatial distribution of the site development opportunities is contained in the Lekki Model Industrial Park (LMIP) feasibility study and master plan (Figure 3.2). Thirty-eight Garment buildings are to be located to the south side of the east-west road. They will benefit from the nearby railway on the western side of the plots. Seventeen out of these buildings will be allocated for Ruyi Garment industrial buildings which will be accessed from the east-west road and from the Collector Road (30 m) surrounding the plot on the southern side. The Ruyi plot will also include an expansion area bounded by the Primary Road (60 m) and the Collector Road (30 m) heading to the south of the site. The remaining twenty-one Garments buildings will be distributed across the area covering the southern and eastern part of the site.

4.5.3 GHG Emission Estimates

This section summarizes the necessary activity data highlighted for the establishment of the industry on the proposed project site and emission factors sourced from IPCC Emission Factor Database (EFDB), needed to compile the inventory. A Tier 1 approach is adopted for the analyses. The estimated Land Allocation for the project is presented in Table 4.10. The total land allocated to the project is expected to be fully utilized by the year 2025.

Table 4.10: Estimated Land Allocation

Land Clearing Emissions (based on projections)						
Particulars	**Cumulative Land Area Required (Acres)**					
	2020	2021	2022	2023	2024	2025
Textile industry (acres)	32	65	105	145	194	242
Wearing Apparels Industry (acres)	0	0	0	1	2	3
Leather industry (acres)	2	4	6	7	9	11
Total (acres)	34	69	111	153	205	256
Land off-take other amenity @2% of total industrial land off-take (acres)	0.68	0.68	0.84	0.87	1.03	1.03
Commercial Space (acres)	0.94	0.94	1.15	1.28	1.49	2.02
Total Industrial Land Off-take inclusive of all components (acres)	35.62	70.62	112.99	155.15	207.52	259.05
Remaining forest land (acres)	293.03	258.03	215.66	173.5	121.13	69.6
% allocation of textile industry	89.80					
% allocation of Wearing Apparels Industry	1.20					
% allocation of Leather industry	4.30					
% allocation of Land off-take other amenity @2% of total industrial land off-take	1.90					
% allocation of Commercial Space	2.70					
% allocation of Total Industrial Land Off-take	100					

4.6 CONSTRUCTION PHASE

Emission embodied in the construction phase of the project include those associated with land clearing, bush burning, and construction of access roads within the project site. Greenhouse gas emission association with the construction of factory buildings were not included due to lack of adequate information to quantify this. In addition, greenhouse gas emission associated with production of cement and other building are part of indirect sources. Calculated emissions associated with the assumption that 35% of the forest land might be burnt during land clearing ranged between 43.43 in the year 2020 and 315.83 tCO_2e in 2025 (Table 4.11) while those associated with fuel consumption during clearing are in the range of 0.26 and 0.69 tCO_2e (Table 4.12). Total greenhouse gas emission associated with road construction is estimated to be 0.68 tCO_2e (Table 4.13).

4.6.1 Portion of forest land set for bush burning

Table 4.11: Emission from forest land clearing (bush burning)

	2020	2021	2022	2023	2024	2025
Activity (kg)	78183.76	155006.6 6	248006.27	340544.94	455493.9 5	568599.21
tCO_2e (kg)	123530.3 5	244910.5 3	391849.91	538061.01	719680.4 4	898386.75
tCH_4 (kg)	531.65	1054.05	1686.44	2315.71	3097.36	3866.47
tN_2O (kg)	15.64	31.00	49.60	68.11	91.10	113.72
Assuming 35% of the total land off-take is burned						
CO_2 (kg)	43235.62	85718.68	137147.47	188321.35	251888.1 5	314435.36
CH_4 (kg)	186.08	368.92	590.25	810.50	1084.08	1353.27
N_2O (kg)	5.47	10.85	17.36	23.84	31.88	39.80
tCO_2e	43.42717	86.09845	137.7551	189.1557	253.0041	315.82843

4.6.2 Forest Clearing by Bulldozer

Table 4.12: Emission estimates from fuel consumed (in litres) for the clearing of total industrial land off-take

	2020	2021	2022	2023	2024	2025
fuel (litre)	909.6	1803.3	2885.3	3961.9	5299.2	6615.0
Unburned forest land (acre)	23.15	45.90	73.44	100.85	134.89	168.38
fuel/km	2970.37156	4182.420332	5290.34293	6199.25799	7169.5814	8010.426112
fuel (mg/km)	2970371560	4182420332	5290342931	6199257991	7169581400	8010426112
N_2O	89.11	125.47	158.71	185.98	215.09	240.31
CH_4	68.32	96.20	121.68	142.58	164.90	184.24
CO_2e	97.99	138.07	174.49	204.54	236.59	264.36

tCO_2e	0.25542	0.35974	0.45488	0.5331	0.61658	0.68891

4.6.3 Road paving

The road is expected to be paved with asphalt concrete based on the pre-defined road layout

Table 4.13: Emission estimates from road paving

	100 m primary road	**60 m primary road**	**43 m Green Corridor**	**30 m Collector Road**	**20 m Local road**	**13 m Service road**
CO_2e (kg) per m of asphalt	230.11	138.10	99.00	69.01	46.00	29.90
tCO_2e	0.237014	0.142245	0.056429	0.202189	0.026223	0.017045

4.7 OPERATION PHASE

The carbon footprint of the NEPZA textile wearing and Apparel industry is calculated in accordance to the GHG protocol guidelines, in view of all the comprising storage and sink within the spatial and temporal edge of the area under study. The methodology adopted to calculate the total carbon foot print in the operational phase (start-up) of the industry commences from the gathering of data from three major sources including activities involving combustion of fossil fuels, non-combustion activities and purchased electricity and natural gas. Data regarding fossil fuel combustion are obtained from the NEPZA Feasibility Study Report, and this estimated value is then multiplied with a fuel specific emission factor in order to convert the data into carbon-dioxide release. Non combustion activities are basically those activities that would be carried out on the proposed site but are other than combustion of fossil fuels or purchase of electricity.

Data from electricity purchase are calculated in kilowatt hours then applying carbon-dioxide emission factor to it (in kg/kWh). The estimated data are then combined to provide the desired result. The US EPA 2008 Guideline suggests that only an assumption is to be made that all the emissions from fossil fuel consumption and electricity purchase comprise of carbon-dioxide only and no other GHG.

4.7.1 Scope of analysis:

The scope of analysis was defined by adopting a tactful approach that brought into account all the areas of the industry that were made part of the study and led to the setting up of system boundaries. The boundaries were aligned according to the three scopes that were considered, on behalf of which the sources of emissions were identified. Those scopes and sources are:

4.7.2 Scope 1: Direct GHG emissions:

In light of the GHG protocol, all those activities which were controlled by industry or organization itself and were resulting in direct release of emissions into the atmosphere were regarded as part of scope 1. Broadly the sources of direct emissions were classified as stationary combustion sources and mobile combustion sources.

- Stationary combustion sources majorly included the boilers and generators present in the industry which required the combustion of fuel for the production of steam and energy respectively to trigger mid-stream activities like singeing process which is part of grey go down stage, batching, curing, calendaring, etc.

- Mobile combustion sources include the industry owned vehicles which run by burning either petrol or diesel and ends in releasing a major proportion of GHG emissions.

4.7.3 Scope 2: Indirect GHG emissions:

As per the GHG protocol within Scope 2, indirect emissions, the focus was on the emissions that fallouts from the purchase and use of electricity as well as from the purchase of natural gas for various purposes such as heating, cooling etc. These are activities which are not owned by the TWA industry itself. Electricity is one such factor which is required for the functioning of entire machinery, in order to determine the industry's production capacity. Therefore, it was recognized that widely all processes fall under scope 2.

However, the prominent sources of indirect emissions within the industry were identified as those resulting from processes like dyeing, printing, cutting, wadding plant, tanning, sewing and quality control processes.

4.7.4 Scope 3: Miscellaneous GHG emissions:

All other indirect emissions which did not fall in the category of scope 1 and scope 2 were considered as scope 3 emissions. More specifically these are emissions which are neither owned by the industry nor come under scope 2. Infact these are the emissions which result from all the upstream and downstream activities such as emissions from transportation within the industrial units and waste disposal. These activities are neither fully owed by the organization nor controlled. It is optional to include scope 3 emissions in calculating and estimating the carbon footprint of the industry. Hence, the focus was retained over scope 1 and scope 2 emissions in the current study.

Prevalent sources of scope 3 emissions in textile industry were mainly the emissions from transport which include transport of grey (raw material) to the industry, movement of products out of the site premises, and systems for inventory control. Estimated greenhouse gas emission associated with the operation phase of the project are presented in Tables 4.14, 4.15 and 4.16.

Table 4.14: Scope-wise categorization of emissions

Textile and Wearing Apparels		
Scope 1	**Scope 2**	**Scope 3**
Singeing	Dyeing	Transportation of grey materials into the site premises
Curing	Printing	Transportation of products out of the site premises
Batching	Cutting	Stack emissions
Calendaring	Sewing & Stitching Quality control	Inventory control emissions Miscellaneous emissions
Leather		
Tanning	Cutting	Transportation of grey materials into the site premises
Dyeing	Sewing	Transportation of products out of the site premises
Plucking	Footwear Design	Stack emissions

Curing	Inventory control emissions
Bleaching	Miscellaneous emissions

Table 4.15: Scope-specific emissions

Scope 1 emissions					
A. Stationary sources					
	Activity data (per year) **Ruyi**	Activity data (per year) **Others**	kg CO_2	CO_2 tonnes	tCO_2e
i. Factory Generator (8 working hours)	282172.32 litres	Same	753400.09	753.40	754.68
			51.64	0.052	
			1227.45	1.227	
B. Mobile sources					
	Activity data (per year) Ruyi	Activity data (per year) Others	kg CO_2	CO_2 tonnes	tCO_2e
i. 360° wheeled excavator (10 hrs of daily performance)	23150.7 litres	Same	61812.37	61.81	61.91
			4.24	0.0042	
			100.71	0.10071	
ii. tractor loader backhoe (10 hrs of daily performance)	78336.5 litre	Same	209158.46	209.158	212.77
			285.93	0.286	
			3321.47	3.321	
iii. truck with loading grab (2 hrs of daily performance before exit)	19491.5 litres	Same	52042.31	52.042	52.94
			71.14	0.071	
			826.44	0.826	
iv. truck with crane (10 hrs of daily performance)	97457.4 litres	Same	260211.26	260.211	264.70
			355.72	0.356	
			4132.19	4.132	
v. truck with road sweeping attachment (2 hrs of daily performance)	9745.7 litres	Same	26021.02	26.021	26.47
			35.57	0.036	
			413.22	0.413	
vi. ride-on mower (2 hrs of daily performance)	3492.2 litres	Same	8136.83	8.137	8.25
			57.62	0.058	
			52.03	0.052	

Table 4.16: Indirect emissions from energy consumption

Scope 2 emissions		
	Ruyi	**Others**
Plot size requirement- GFA (m^2)	316225.00	159405.00
Electricity consumed (kWh) (7 operational hours of constant supply)	1217466	613709.3
Electricity consumed per year (kWh)	444375181.3	224003876.3
Gas (kWh)	18.21	9.18
Gas (kWh/yr)	4751.90	2395.37
Gas (MMBTU)	62138.21	31323.08

Table 4.17: Indirect emissions from energy consumption

	Activity data (per year) Ruyi	**Activity data (per year) Others**	**kg CO_2**	**CO_2 tonnes**	**tCO_2e**
Indirect emissions i. Electricity	211078211.1 (kWh)	106401841 (kWh)	CO_2: 317480052.4	CO_2: 317480.05	317486.2
			CH_4: 3479.58	CH_4: 3.479	
			N_2O: 2631.92	N_2O: 2.631	
ii. Natural gas	16218073.46 (kWh)	8175324.53 (kWh)	CO_2: 1293337961.69	CO_2: 1293337.96	1320170.7
			CH_4: 24393397.99	CH_4: 24393.40	
			N_2O: 2439339.80	N_2O: 2439.34	

Table 4.18: Miscellaneous emissions

Scope 3 emissions					
Industrial Waste water treatment					
	Activity data (per year) Ruyi	Activity data (per year) Others	kg CO_2	CO_2 tonnes	tCO_2e
i. Waste water treatment sludge	10711356.611 tons	5399458.615 tons	CO_2: 64910475	CO_2: 64910.48	72079.8
			4059925.44	4059.93	

			3109387	3109.387	
ii. Landfilled waste[i]	37500 tons	same		112500	112.5

4.8 DECOMMISSIONING PHASE

4.8.1 Forest Expansion during Decommissioning

It is expected that during the decommissioning stage, the `buildings would be retained and possibly converted for other functionary activities. The reclamation of the forest would ultimately serve as carbon sink for the project site. Estimated CO_2 emission capture from the decommissioning phase of the project are presented in Table 4.19.

Table 4.19: Emission capture from biomass expansion

		2020	2021	2022	2023	2024	2025
Mass of dry matters on unburned forest land to be cleared by excavation		643,183.27	566,360.37	473,360.76	380,822.09	265,873.08	152,767.82
Remaining forest land unused (acre)		23.15	45.90	73.44	100.85	134.89	168.38
tCO2e (tons)							
Gallery forest(living trees)	[ii]1.75	3747.89	7430.55	11888.67	16324.69	21835.00	27256.92
Gallery forest(dead trees)	1.22	2612.82	5180.15	8288.10	11380.64	15222.11	19001.97
Closed semi-deciduous forest (living tree)	1.48	3169.65	6284.12	10054.42	13806.02	18466.17	23051.56
Closed semi-deciduous forest(dead trees)	1.07	2291.57	4543.25	7269.07	9981.38	13350.54	16665.66
Open forest and savannah woodland(dead trees)	1.07	2291.57	4543.25	7269.07	9981.38	13350.54	16665.66
Shrub savannah (living tree)	1.79	3833.56	7600.39	12160.41	16697.82	22334.08	27879.93
Shrub savannah(dead trees)	1.05	2248.74	4458.33	7133.20	9794.81	13101.00	16354.15

By choosing a closed semi-deciduous forest (living tree), which is most peculiar forest to the belt region, the tCO_2e is thus given as 3169.65 tons.

4.8.2 Comparison of the Project Greenhouse gas Emission Levels

The estimated Project Greenhouse Gas Emission Levels were compared with the international and provincial GHG emission totals as a proxy for assessing the effect of the project GHG emissions on the atmosphere (Table 20). This is done in agreement with the recommendation of the The Canadian Environmental Assessment Agency's recommendation (Agrawala *et al.*, 2010). The project GHG emissions are considered negligible due to dilution factor in the atmosphere as a whole.

Table 4.20: Comparison of the proposed line Route project to Provincial and International GHG emission

Comparison Source	GHG Emission (tCO_2e)	This Project (TWA) (tCO_2e)	This Project Emission Comparison (%)
International Total (2009)	30086265000	1708068.39	0.0057
Canadian Total (2010)	677740000	1708068.39	0.2520
British Columbia (2010)	56185000	1708068.39	3.0401
Nigeria (1994)	192000000	1708068.39	0.8896

4.9 CLOSURE PLAN

To ensure that project components not pose a future threat to human health or to the environment and to allow the natural environment to recover and flourish again, all elements of closure for each of the pre-construction and construction project activities have already been identified. The closure details are summarized below, and can serve as a checklist for completion of all pre-construction and construction activities.

4.9.1 Temporary land use for storage of materials and machines

A Compensatory Afforestation Program (CAP) should be looked into that will ensure all areas that have been used will be identified and processes by which such lands would be gradually restored as they are concurrently used for storage purposes. The following recommendations are thereby made;
For the labour Camps

(2) All buildings and service infrastructure will be de-constructed and recycled, or disposed as solid waste;

(ii) All equipment, debris, residual waste, etc. will be cleared from the site and disposed according to the project solid waste management plan;

(iii) Septic tanks will be cleaned, filled and covered;

(iv) The remaining area, once cleared as described above, will be graded and prepared for re-vegetation (a target for compensatory afforestation);

(v) All camp sites will then be inspected, documented, and photographed as evidence of full camp closure;

4.9.2 Mitigation Strategies

No heavy vehicles shall be deployed regularly for the project construction. Transportation shall be done as and when required, the impact on the society is not foreseen.

4.10 CONCLUSION

Total GHG Emission anticipated from activities related to the proposed project is summarized in Table 4.21 11 and the contribution of project phases to atmospheric GHG levels to the atmosphere are presented in Figure 2. The results indicated that the project GHG assessment estimated amount of 1711.23 $ktCO_2e$ is being anticipated. About 98.03% of the total figure are from the operation phase.

Table 4.21: Summary of GHGs emissions for operation phase

Carbon Footprint	
GHG inventory	CO_2e
Construction Phase	
Land clearing (bush burning)	43.43
Land clearing (fuel)	2.91
Asphalt paving	0.681
tCO_2e	**47.021**
Operation Phase	
Scope 1	1381.72
Scope 2	1637657.0
Scope 3	72192.3
tCO_2e	1711231.02
Decommissioning phase	
tCO_2e	3169.65

Therefore, the overall tCO_2e for all the activities selected across the three phases can be obtained by the differential in the carbon source and the sink i.e. Carbon footprint = $E_{so} - E_{si}$;

Where, E_{so} is the Emission from sources and $E_{si}4$ is the emission to sink.

Therefore, the overall tCO_2e for all the activities is thus calculated to be (7.021 + 1711231.02) – 3169.65 = **1708.07 $ktCO_2e$.**

4.10.1 Topography

Terrain or relief (also topographical relief) involves the vertical and horizontal dimensions of land surface. In physical geography, terrain is the lay of the land. This is usually expressed in terms of the elevation, slope, and orientation of terrain features. Terrain affects surface water flow and distribution. Over a large area, it can affect weather and climate patterns. The proposed Project's License area is located within the North-East quadrants of the Lekki Free Trade Zone (LFTZ) in Epe LGA.

Worker safety during construction is widely accepted, but the selection of safe sites for a building is generally not considered. Safe site selection (SSS) largely depends upon compiling, analyzing, and refining the information of an area where a building/construction is likely to be located. Construction professionals consider safety-related issues of proposed sites, such as the geologic/seismic, hydrological, and meteorological characteristics, to protect the public from the potential hazards of serious accidents. Environmental factors (physical and cultural factors) are critical issues to be addressed when making site selection decisions. The topography focuses only on the spatial safety aspects of SSS of the project site, aspects that is discussed is the elevation, slope and contour.

The topography of the Phase 1 site is to integrate the area with the natural environment with least damage to nature as well as to harness all-natural resources. The two-dimensional 2D) map Fig 4.13 and solid three-dimensional (3D) model (Fig 4.9) were used to evaluate the elevation and visualization of the site. The Topography of the Lekki Phase 1 site is shaped like wave or moving up and down like a wave undulating terrain and the land is gently undulating to relatively flat terrain (Fig 4.9).

The elevation of the study area is its height above a fixed reference point, most commonly the Earth's mean sea level. It is one of the important factors associated with site safety. The elevation varies from -3.6m to 22.6m amsl (Fig 4.10). However, the elevation within the phase 1 site vary from 6.5m – 16m amsl Fig 4.12. A location at a high-elevation of the Phase 1 site should be considered suitable for overhead tanks, whereas a location at a low elevation is suitable for rain-harvesting, water tanks.

Architect and Engineer professionals should consider the topography when integrating the smart blue and green network that will comprise a series of productive landscapes such as Water Sustainable Urban Drainage Systems (WSUDS), Flood mitigation and protection, Rainwater harvesting, Wastewater remediation, Storage and reuse of rainwater that will create a series of economic, ecological and social benefits for the state, the industrial developers and workers, in the Model Industrial Park (Lekki Phase 1 site).

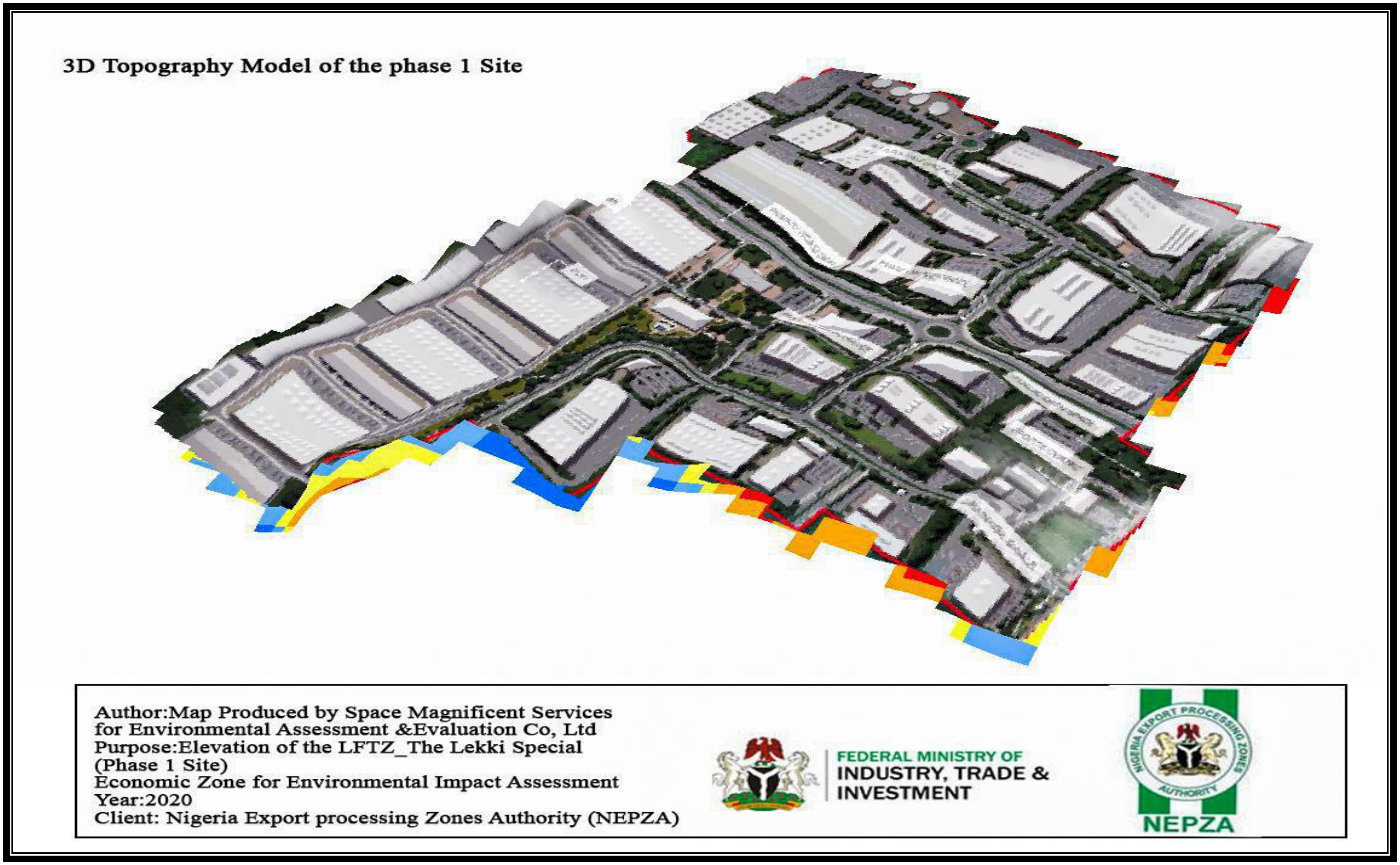


Fig 4.9: 3D Topography Model of Phase 1 Site with Super Imposed Master Plan

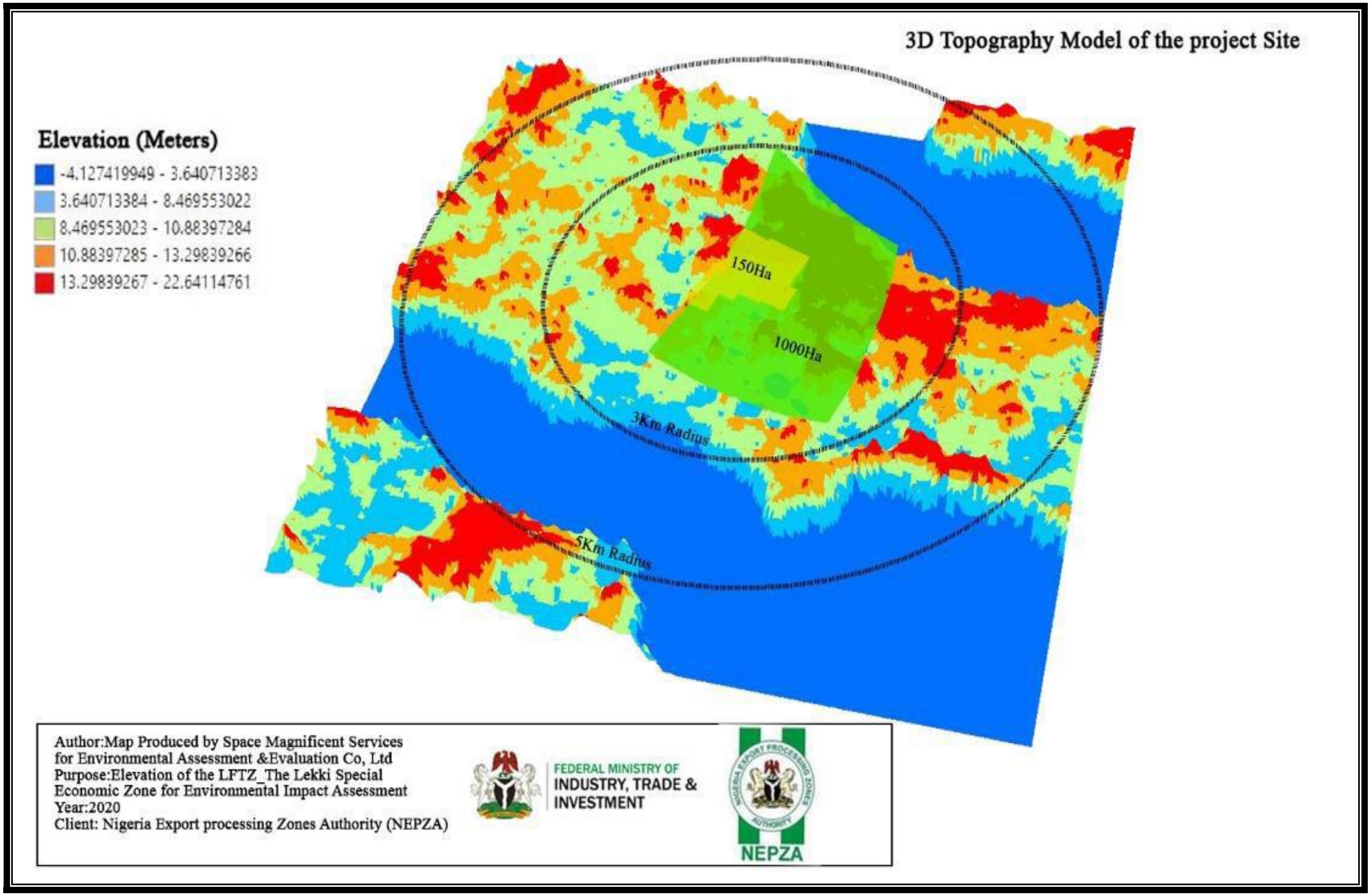


Fig 4.10: 3D Topography of Lekki Model Industrial Park Site.

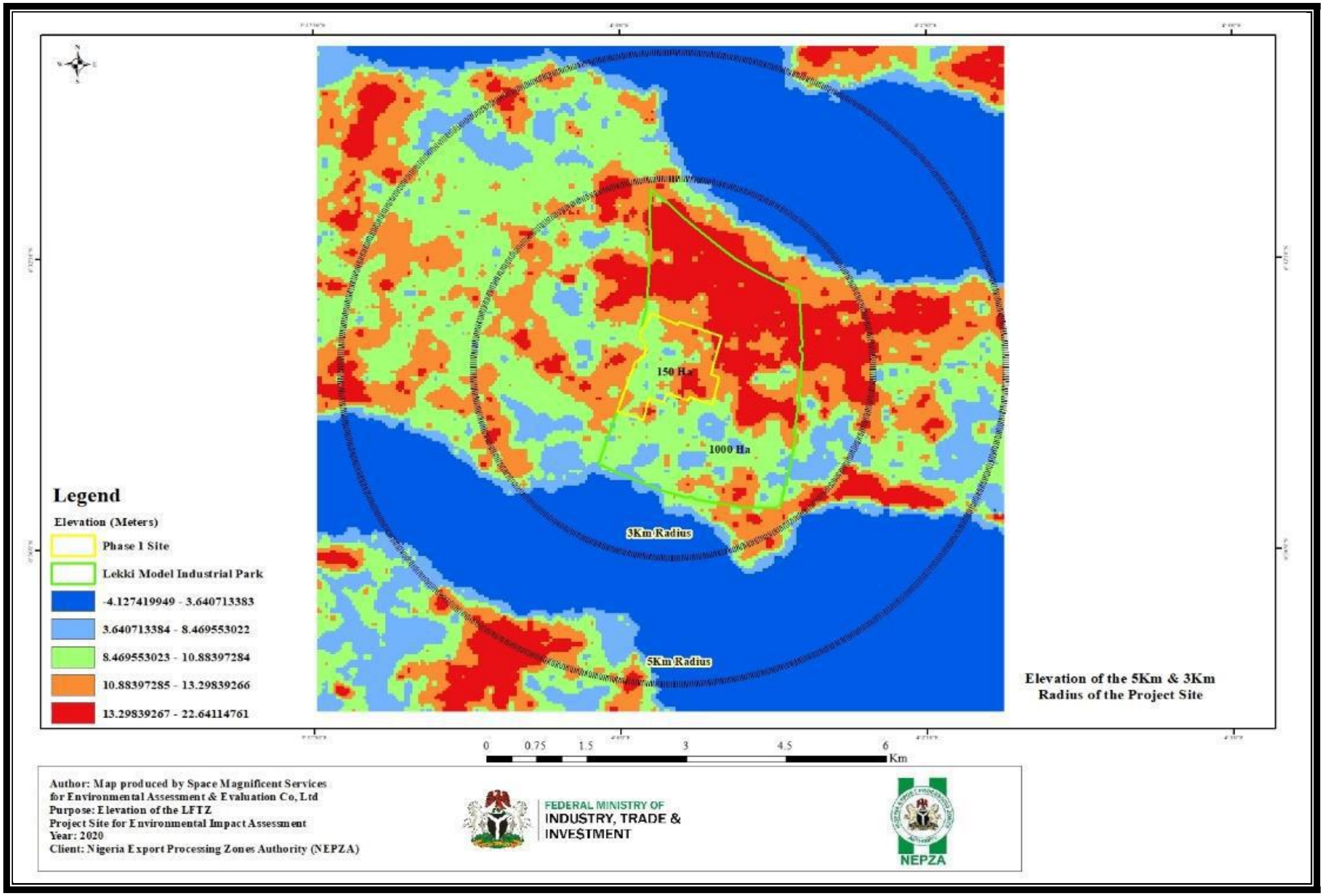


Fig 4.11: 2D Topography of Lekki Model Industrial Park Site.

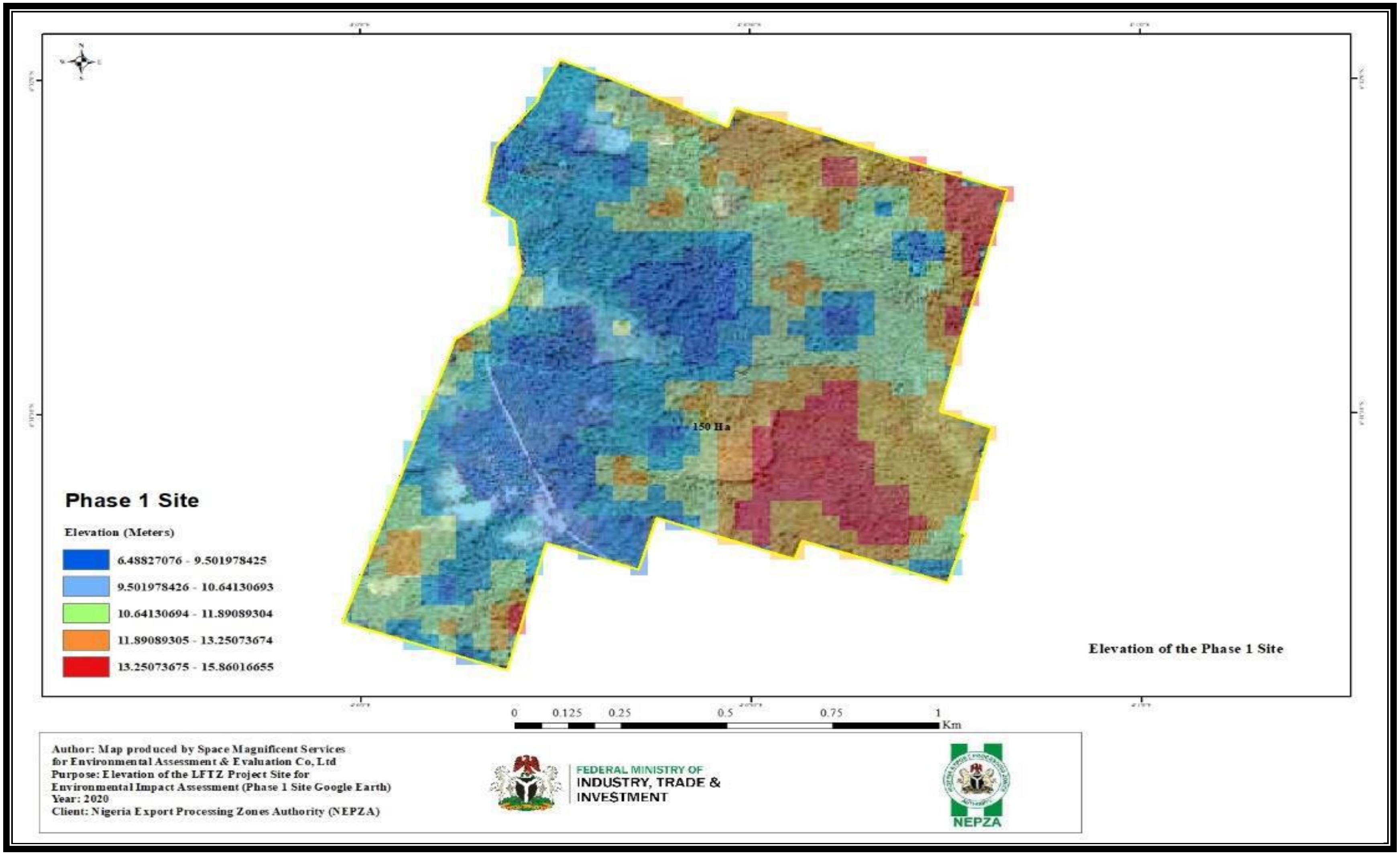


Fig 4.12: Elevation of the Phase 1 Site

Given the land use distribution of Lekki Phase 1 site Fig 3.12, according to the feasibility study and master plan of the project site, the South West and North West portion of the project (Garment and Agro-processing) will be sited have the lowest elevation that vary from 6m to 11m and a less proportion of the project site at the South East and North East portion have the highest elevation that vary from 11m to 15m Fig 4.12.

Slope is the measure of steepness or the degree of inclination of a feature relative to the horizontal plane. The natural course of topography of the Lekki Phase 1 site indicates that it is efficient to direct all surface run-off and industrial generated liquid waste to the Lekki Lagoon rather than Epe Lagoon because of its gentle slope towards the Lekki lagoon Fig 4.14. The Lekki Phase 1 site have a relatively gentle slope and steep slope towards the Lekki and Epe lagoon and slope rise between 0-8-degree Fig 4.15 and 4.16s

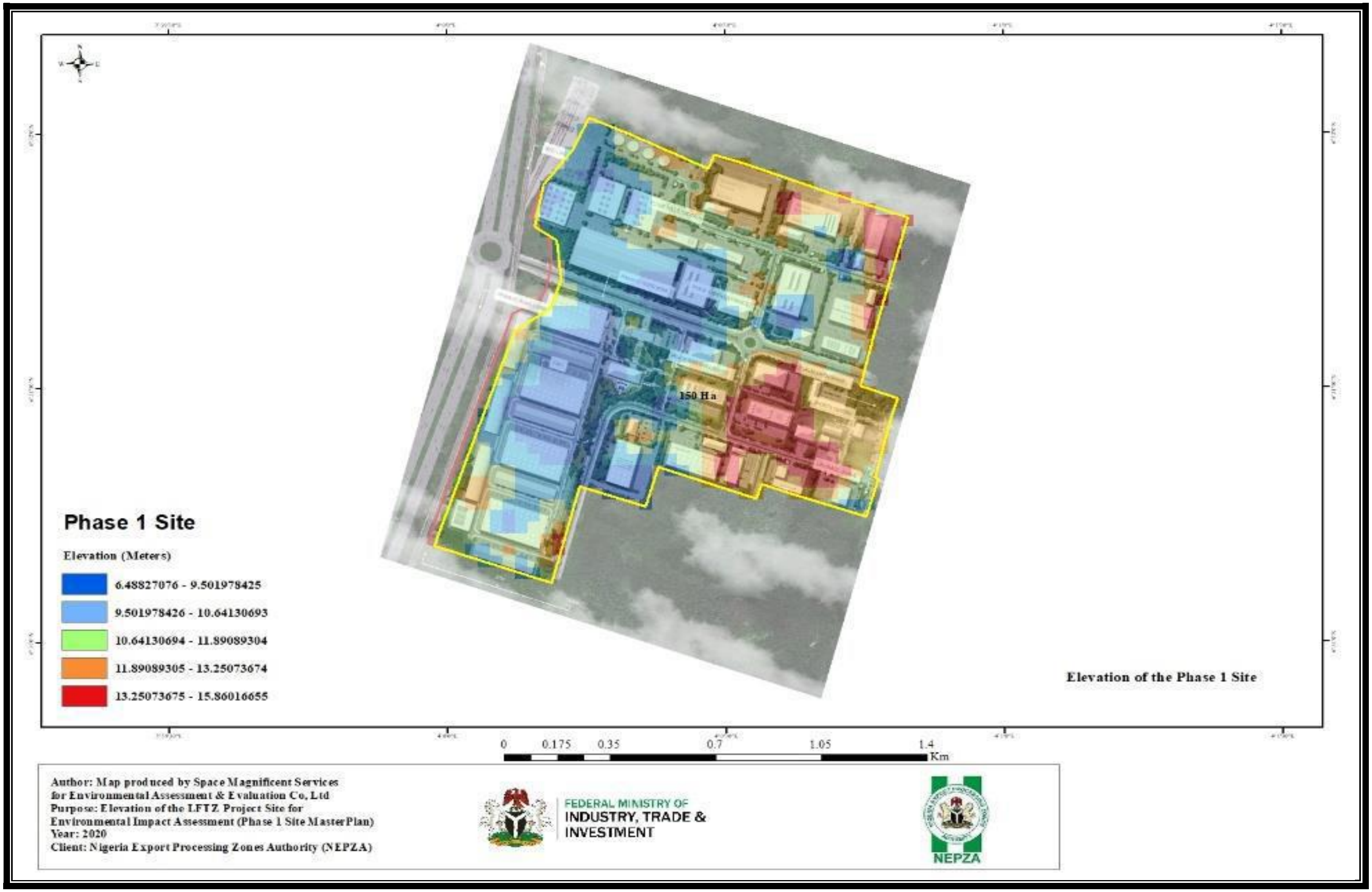


Fig 4.13: Superimposed elevation map on the Phase 1 site Land use distribution

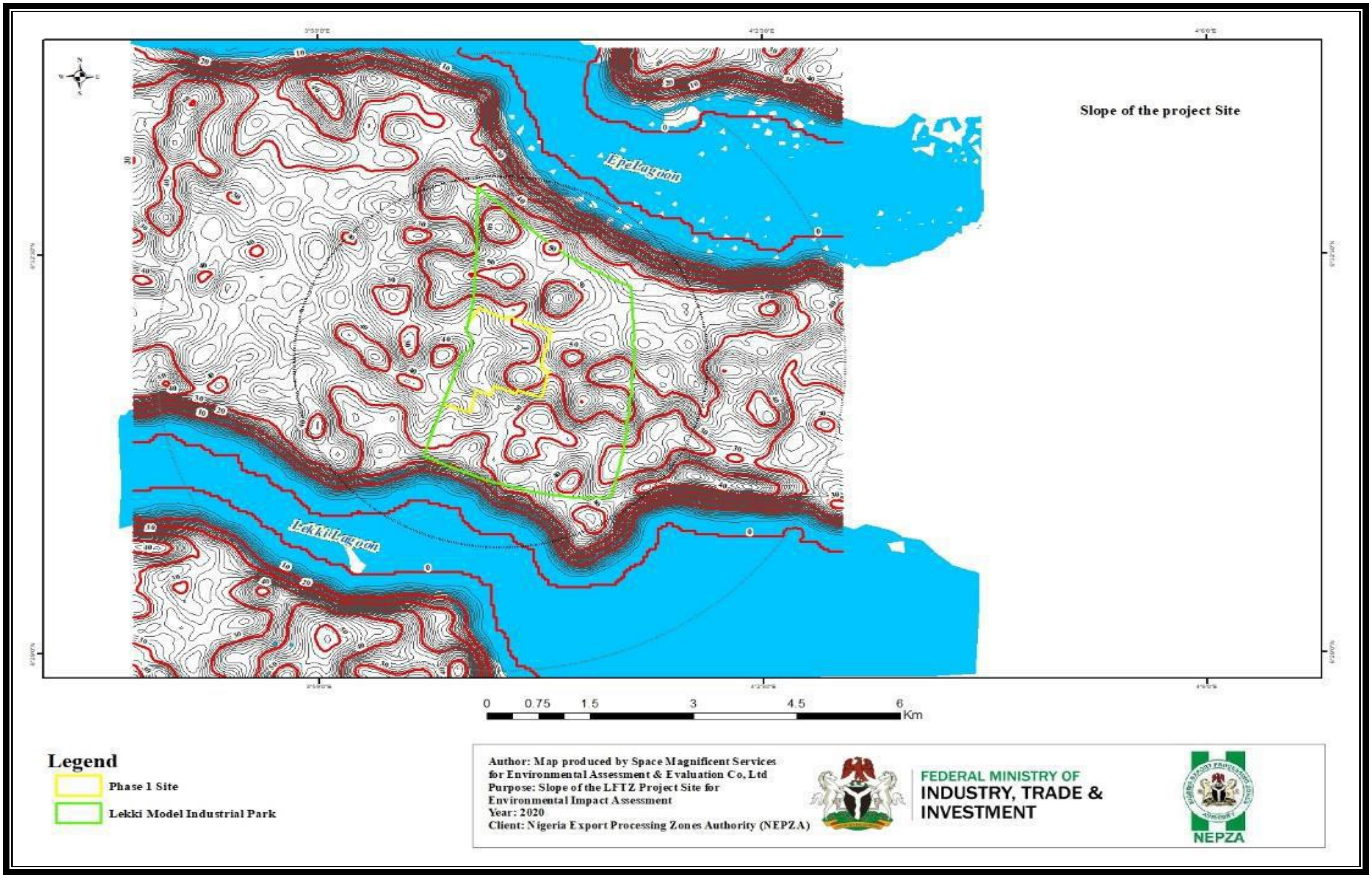


Fig 4.14: Contour Map of the Lekki Model Industrial Park Site

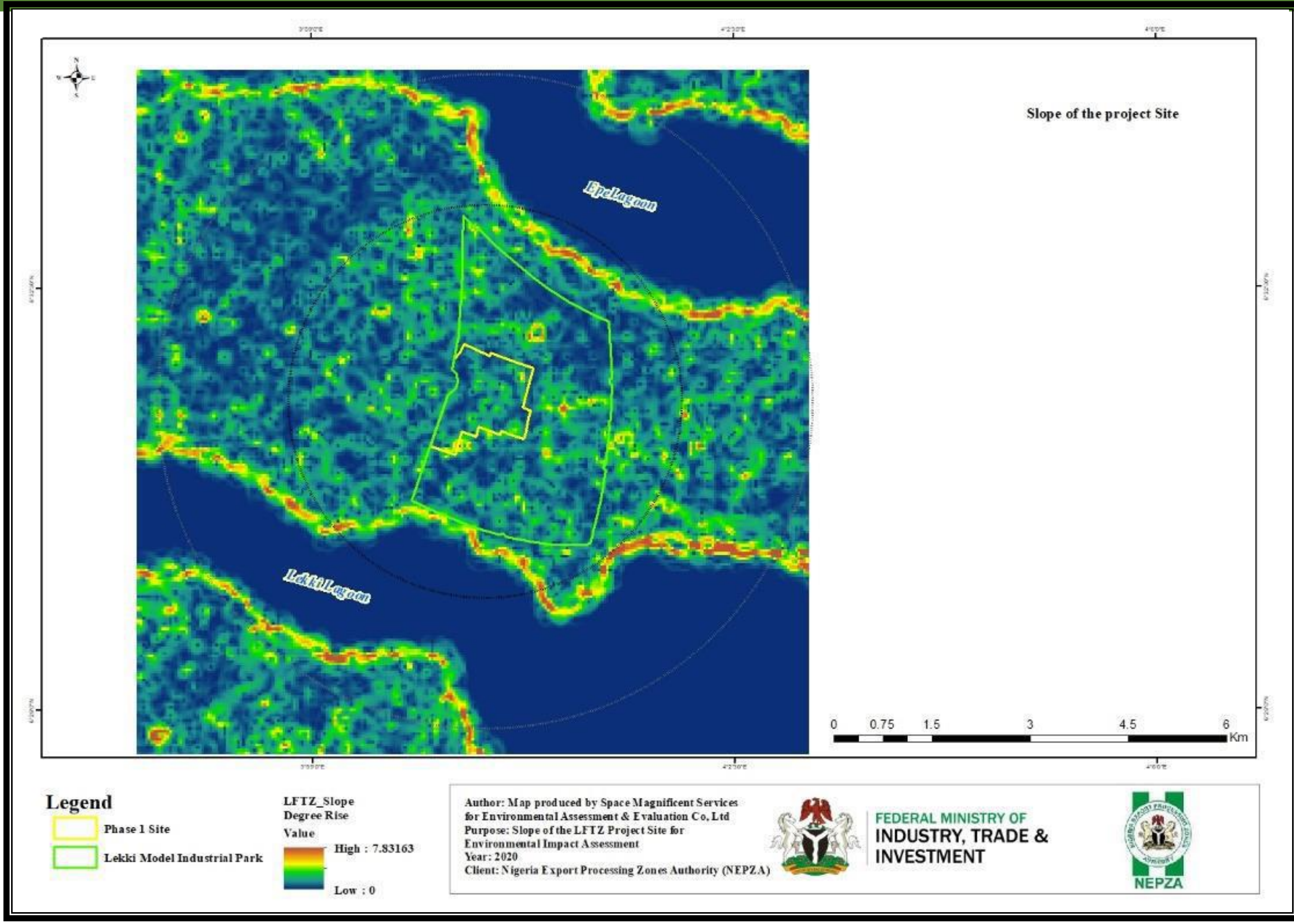


Fig 4.15: Slope of the Lekki Model Industrial Park Site

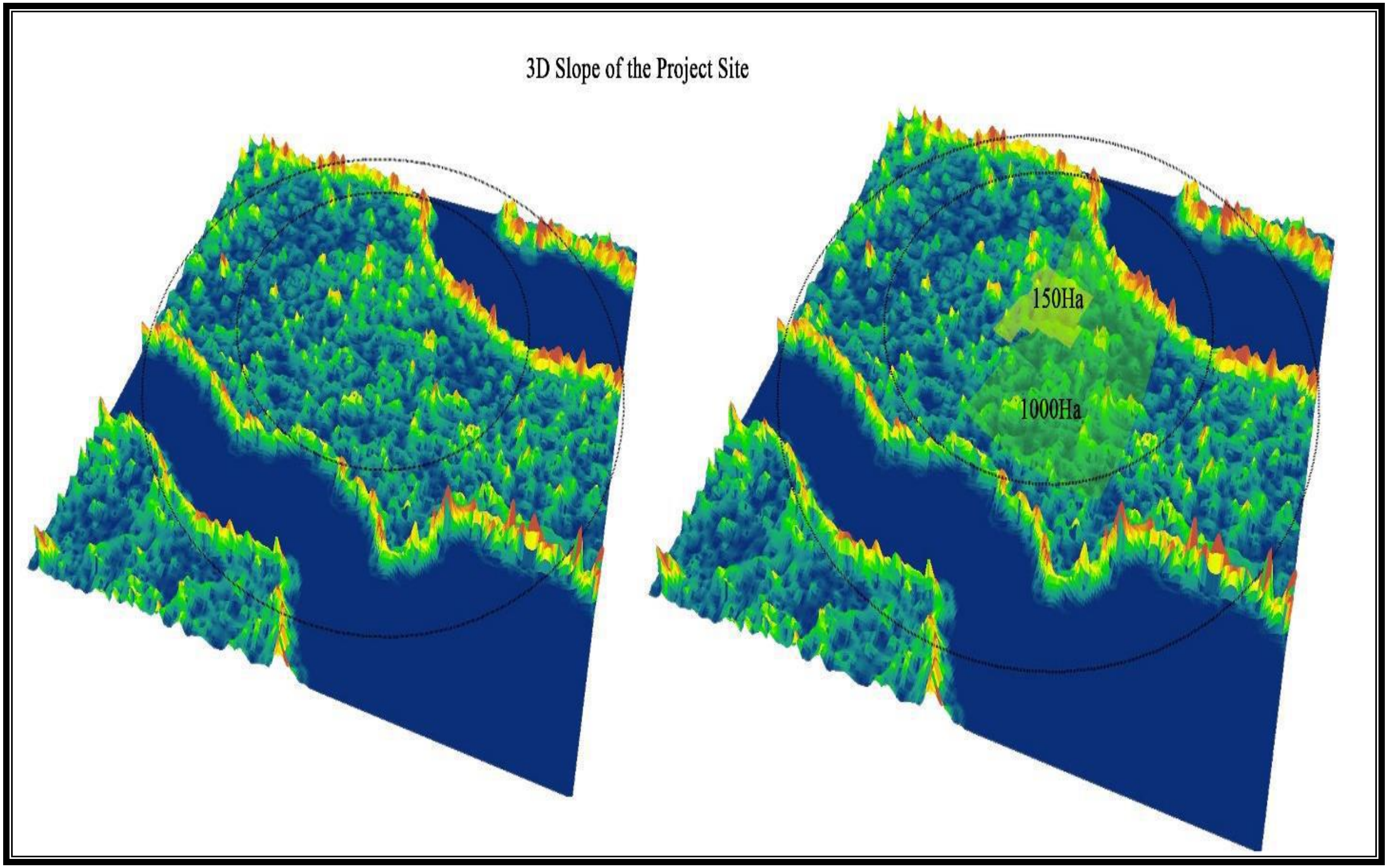


Fig 4.16: 3D Slope of the Lekki Model Industrial Park Site.

4.11 REGIONAL GEOLOGY AND HYDROGEOLOGY

4.11.1 Regional Geology

The study area lies within Lagos State. Lagos State lies in Southwestern Nigeria and the formations found here occur within the sedimentary series. According to Jones and Hockey, (1964) the geology of Southwestern Nigeria reveals a sedimentary basin which is classified under five major formations. The state overlies the Dahomey basin which extends almost from Accra in Ghana, through the Republic of Togo and Benin to Nigeria where it is separated from the Niger Delta basin by the Okitipupa ridge at the Benin hinge flank. According to their geological formation age the five formations include: the Littoral and the Lagoon deposits, Coastal Plain sands, the Ilaro formation, the Ewekoro formation and the Abeokuta formation overlying the crystalline basement complex with their ages ranging from Recent to Cretaceous.

Four of these formations, excluding Ilaro, constitute aquifers in the Dahomey Basin, from which the geological section of Lagos was drawn. The Ilaro formation is composed predominantly of shaley clay (argillaceous sediments). Limestone forms the aquifer material in the Ewekoro formation while sands and gravels constitute the materials in aquifers of the recent sediments, Coastal plain sands and Abeokuta formations contain brackish water.

4.11.2 Regional Geology

Lagos state comprises sedimentary series and basement formations as well as transitional zones.

The basement complex according to Jones and Hockey (1964) is made up of magmatite – gneiss complex, the schist belt and the older granites which are 800 to 500 million years in age (Hurley et aI., 1967) as shown in Fig. 4.18. These rocks are well displayed in Odeda, Abeokuta, Igbo – Ora, and Ijebu Igbo, etc

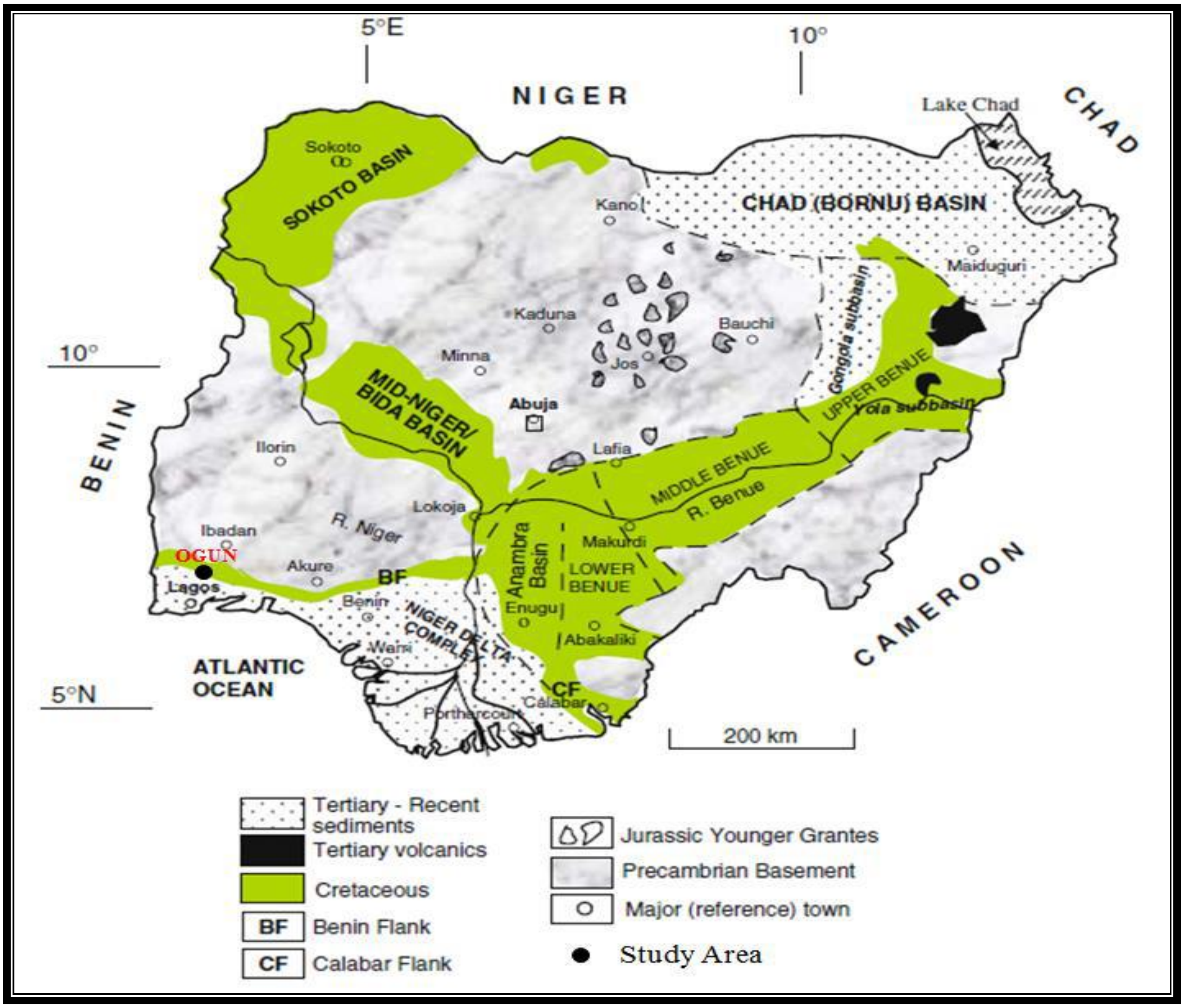


Figure 4.17: Geological Map of Nigeria identifying Lagos as the Study Area (Obaje 2009)

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

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

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

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

The basement complex outcrops are distributed in three areas.

- A triangular area in southwestern Nigeria, where the rocks continue westwards into the neighboring Benin Republic.

- A roughly circular area in North-central Nigeria.

- A rectangular area broken up into three zones by sedimentary rocks on the eastern border of Nigeria with Cameroon Republic.

The Basement Complex was differentiated into four (4) different groups of by Oyawoye (1964). These are the: the ancient meta-sediments, the gneisses-migmatite and older granites, the newer meta-sediments, and the pegmatite as awell as dolerite dikes which are considered as a special minor group.

Isotopic age distribution has demonstrated the polycyclic nature of the migmatite-gneiss complex. The age of the schist belt and their possible role in the evolution of the Nigeria Basement Complex during the Pan African event has become controversial. McCurry (1971), Ogezi (1977) and Ajibade (1980) noted that apart from the Older Granite, no other rock group can confidently be assigned to the Pan African. They were of the opinion that the nature of the Pan African events in Nigeria has therefore become obscured. They also suggested that to understand the evolution of the Nigeria basement, it must be considered in the context of Pan African belt as a whole.

The Dahomey basin extends from southeastern Ghana through Togo and the Republic of Benin to southwestern Nigeria. It is separated from the Niger Delta by a subsurface basement high referred to as the Okitipupa Ridge. According to Jones and Hockey (1964), the geology of southwestern Nigeria reveals a sedimentary basin, which is classified under five major formations. According to their geological formation age, the five formations include the Littoral and the Lagoon deposits, Coastal Plain sands, the Ilaro formation, the Ewekoro formation and the Abeokuta formation overlying the crystalline basement complex with their ages ranging from Recent to Cretaceous. Four of these formations, excluding Ilaro, constitute aquifers in the Dahomey Basin, from which the geological section of Lagos was drawn. The most recent detailed stratigraphy is that of Omatsola and Adegoke (1981) that proposed three new easily recognized lithostatigraphic unit of formation ranks which are the Ise formation, Afowo formation and the Araromi formation, all made up of the Abeokuta group; others are Ewekoro Formation, Oshosun formation and Ilaro formation (Fig 4.18).

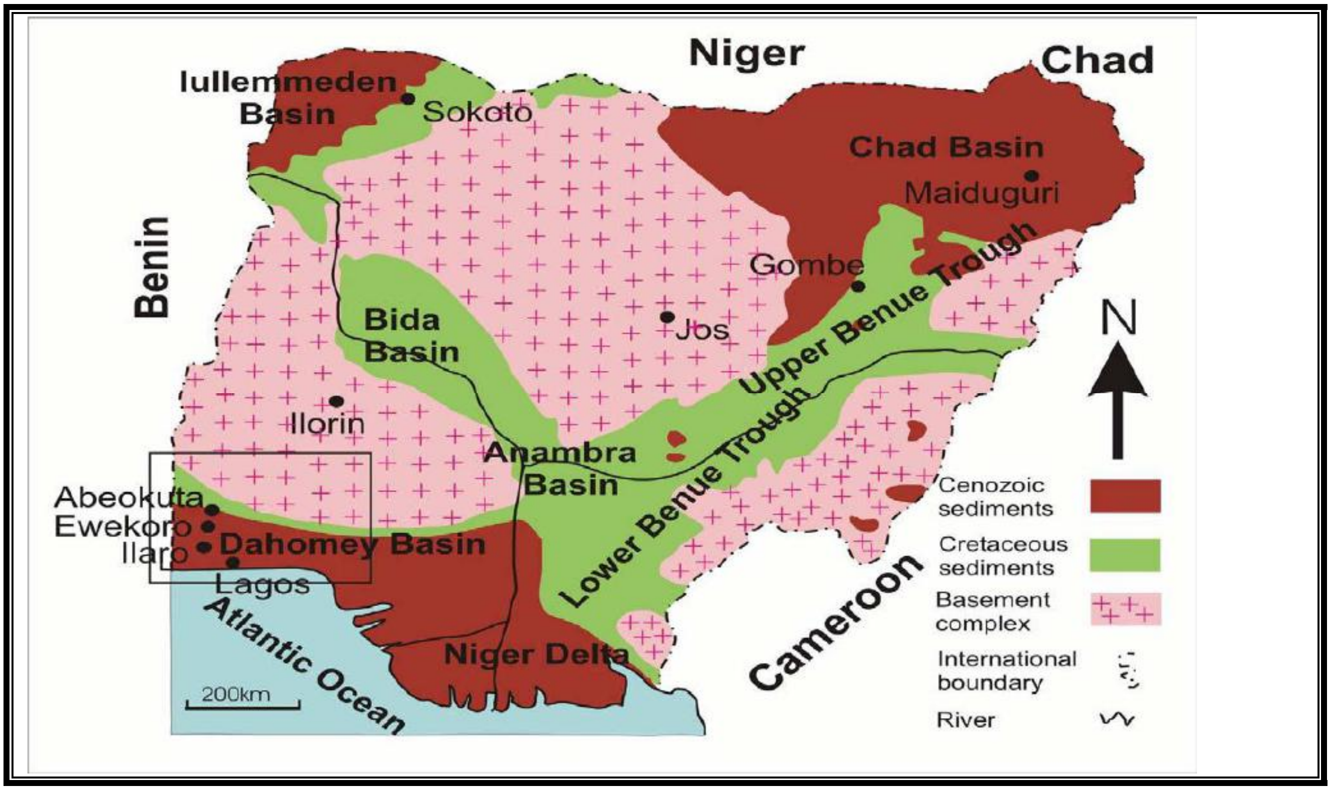


Figure 4.18: Location of Dahomey Basin in Nigeria (modified from Bankole et al., 2007)

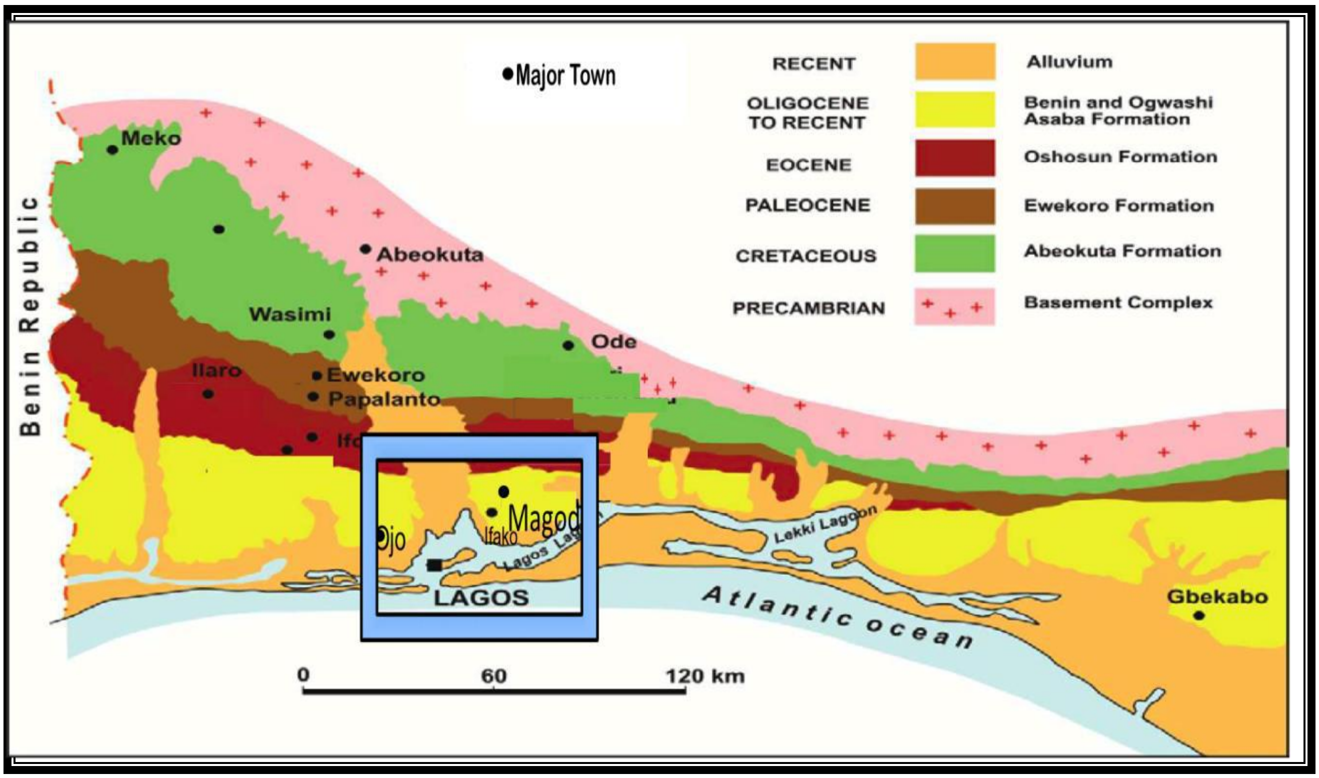


Figure 4.19: Geological Map of Dahomey Basin (Billman, 1992).

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

The stratigraphy of the eastern Dahomey basin has been discussed by various workers and several classification schemes have been proposed. These notably include those of Jones and Hockey (1964); Ogbe (1972); Omatsola and Adegoke (1981); Coker et al (1983); Billman (1992) Fig 4.20, Nton (2001); Elueze and Nton (2004); Nton et al., (2006) among others. Inspite of all these classification schemes, there are still controversies on age assignments and nomenclatures of the different lithological units within the basin.

Table 4.22: Different Classification Schemes of the Dahomey Basin

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

4.11.3 Local Geology and Hydrology of the Area

In the study area, the surface geology is made up of recent alluvial sediments as well as lagoonal and coastal plain deposits Fig 4.20. The lithological material overlying the site is clearly distinguished as loose very fine to medium fine sand (Plate 4.3). This stratum is consistent up to a depth of about 0.5m.

Topography of the study area is gently undulating to relatively flat with an inte-rnetwork of seasonal streams coursing through the land area forming ponds, puddles **(**Plate 4.4) and seasonal streams around the area of interest. These streams drain into the Lagoon during the wet season but are non-existent in the dry season. Although, they serve as source of drinking water to farmers in the communities when available, they are not used for household consumption or major activities such as washing of clothes.

Furthermore, depth to groundwater around the study area is observed to be shallow as observed in the borehole on site (BH2) which has a static water level of 5.82m. Dug wells within around the vicinity of the project site reveal that water level as low as 2.5m eg Idiroko and Oke-Egan well.

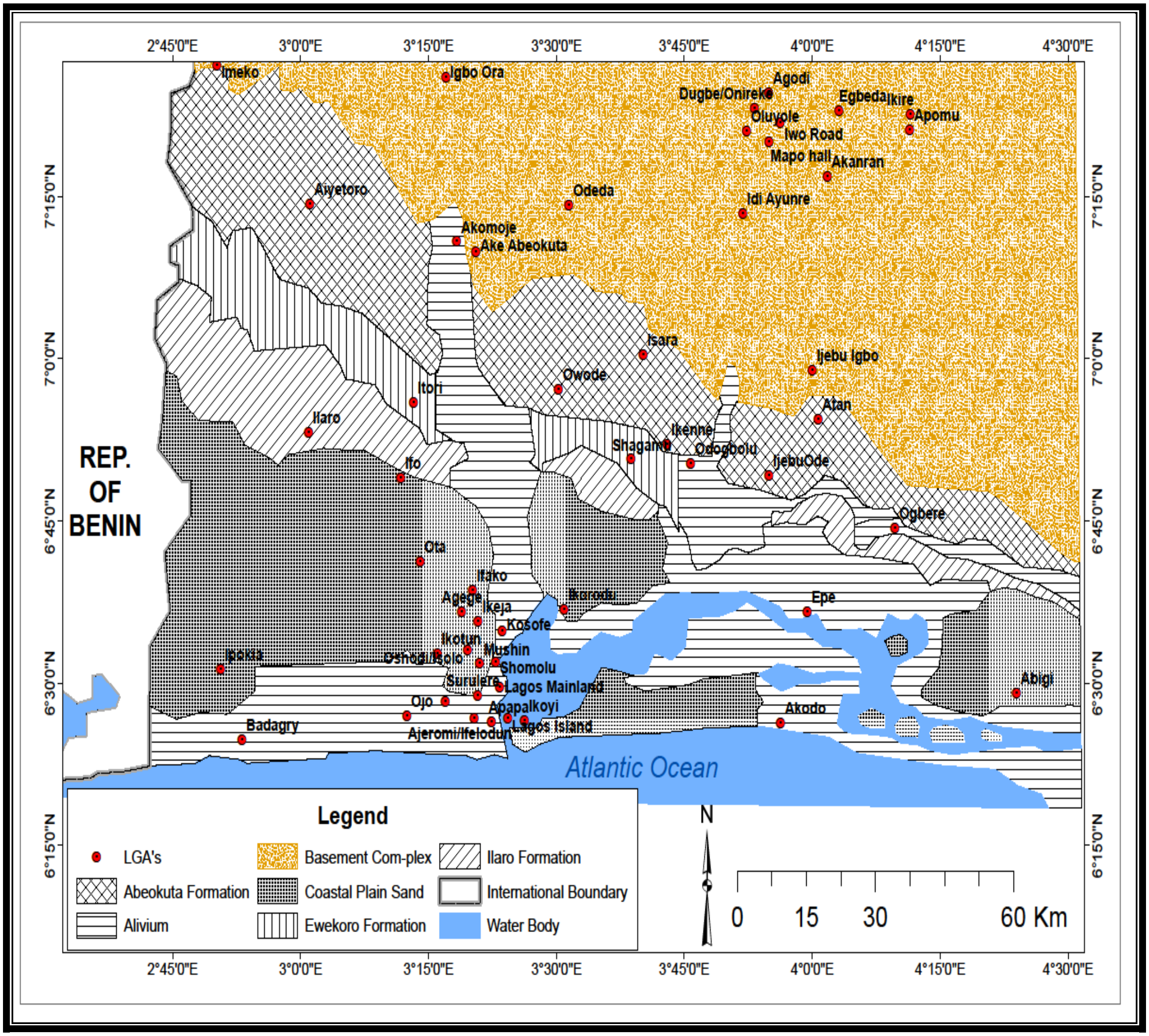


Fig. 4.20: Geological map of south west Nigeria (adopted from Jones and Hockey, 1964)

Plate 4.3: Very fine to fine sand within Study Area

Plate 4.4: Puddle located around the study area

4.12 GEOPHYSICAL SURVEY

Data was acquired during a field experience/ survey carried out over 27th – 30th November, 2019. A team of three (3) experts were involved in the data acquisition of the Vertical Electrical Sounding Studies while a team of two (2) experts were assigned for the hydrogeological and geotechnical data gathering exercise.

The data collection methodologies used were in line with well-established field sampling guidelines and standards. Sounding locations were distributed to establish the geological characteristics of the study area as much as possible.

4.12.1 Methodology

4.12.2 Sampling Design

The locations of the sampling points, including the control point, were predetermined and marked out prior to field exercise and were properly geo-referenced with Differential Geographical Positioning System (DGPS). However, minor adjustments in positioning were made in cases where water levels were too high to make data acquisition impossible. **Figure 4.21** Shows the distribution of the sampling points across the study area as well as the provided locations of existing geotechnical or monitoring boreholes drilled during feasibility studies on the site while table 4.23 shows the coordinates and elevations of the sampling points.

Table 4.23: Shows the coordinates and elevations of the sampling points.

Sampling Point	Easting	Northing	Elevation
VES 1	Long:4°0’23.6’’	Lat:6°31’36.6’’	2.7m
VES 2	Long:4°0’13.6	Lat:6°31’38.9’	2.1m
VES 3	Long:4°0’39.7	Lat:6°31’38.6’’	2.1m
VES 4	Long:4°0’17.0’’	Lat:6°31’24.0’’	2.6m
VES 5	Long:4°0’25.6’’	Lat:6°31’52.7’’	7m
Control	Long:3°59’29.0’’	Lat:6°32’08.9’’	7m

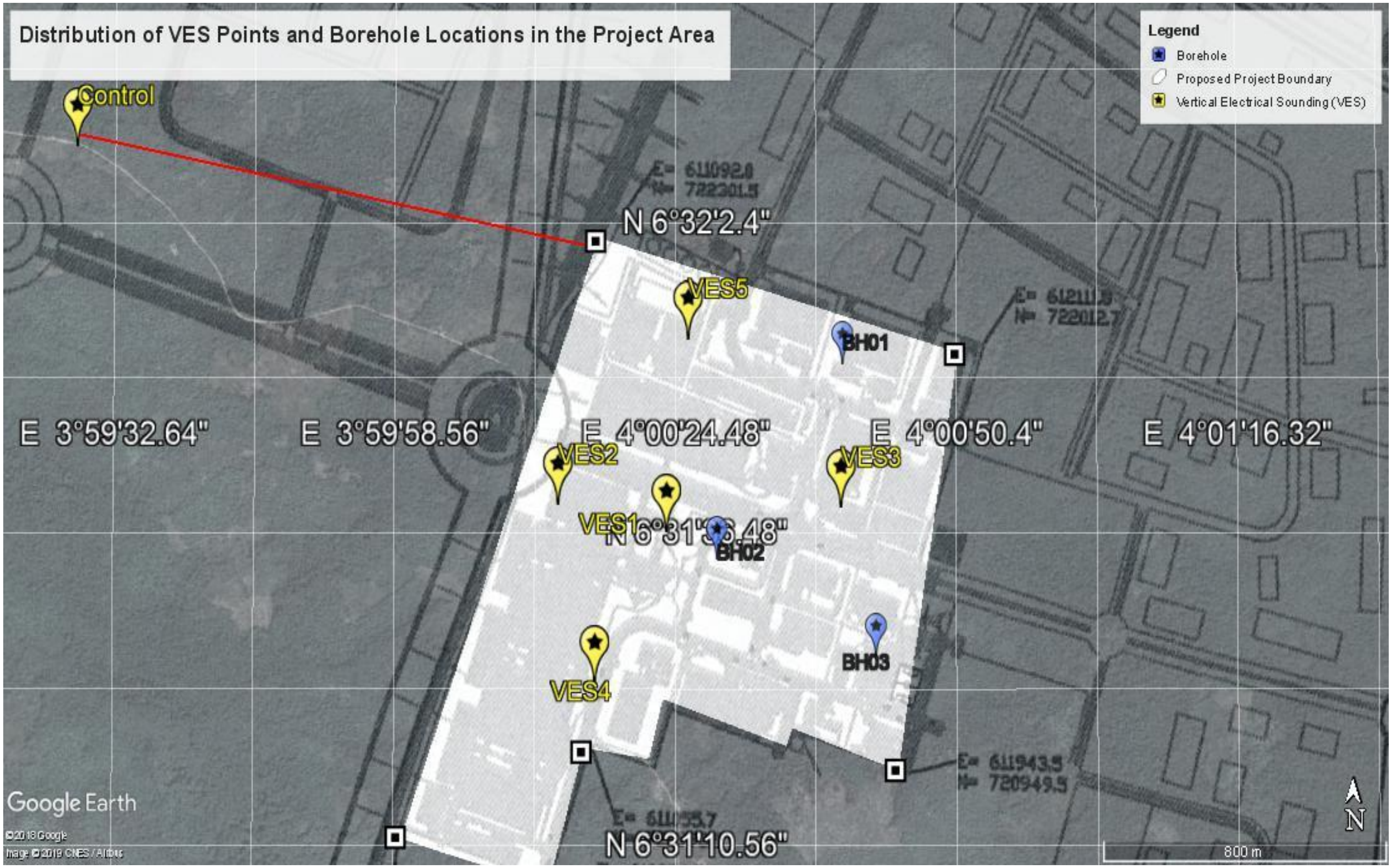

Distribution of VES Points and Borehole Locations in the Project Area
Legend
Borehole
Proposed Project Boundary
Vertical Electrical Sounding (VES)
Control
E= 611092.8
N= 722301.5
N 6°32'2.4"
VES5
BH01
E= 612111.9
N= 722012.7
E 3°59'32.64"
E 3°59'58.56"
E 4°00'24.48"
E 4°00'50.4"
E 4°01'16.32"
VES2
VES3
VES1
BH02
BH03
VES4
E= 611943.5
N= 720949.5
E= 611155.7
N 6°31'10.56"
Google Earth
800 m
N

Figure 4.21: Distribution of VES and Existing Boreholes Sampling Points across the Project Site

Table 4.24: Resistivity Values of VES Data

AB/2	K-factor	VES1	VES2	VES3	VES4	VES5	Control
1	6.28	1000	1400	73.3	2100	1900	2000
2	25.12	512.2	501.7	17.4	689.2	595.5	581.2
3	50.54	286.1	243.5	6.3	288.5	243.1	242.6
4	100.54	182.7	138.5	2.6	151.3	132.8	123
6	226.2	82.1	53.7	1.3	68.5	66.7	34.6
6	113.1	170.5	111.4	2.8	126.3	123.8	66.1
9	254.47	78.5	30.6	1.9	34.4	79.9	13.5
12	452.4	18.7	9.5	1.8	11.5	30	3.9
15	706.86	6.8	2	1.5	7.9	12.3	1.7
15	353.45	13.4	3.8	3.3	13.4	19.8	3.9
20	628.32	3.1	2.1	3.3	3.7	5.3	1.6
25	981.75	0.87	1	3.4	0.58	2	0.962
32	1608.5	0.414	0.515	2.2	0.232	0.584	0.494
40	2513.28	0.251	0.138	1.2	0.102	0.203	0.344
40	1005.31	0.651	0.272	2.4	0.174	0.426	0.628
50	1570.8	0.149	0.144	1.1	0.146	0.166	1.1
65	2656.65	0.111	0.098	0.555	0.122	0.111	0.569
80	4021.24	0.014	0.072	0.111	0.098	0.086	0.232

Source EAECL Field Survey, 2020

Table 4.25: Static Water Levels at Existing Boreholes

No.	Sample Code	Elevation (m)	Longitude	Latitude	SWL (m)	Remark
1	BH1	N/A	4° 0'39.91"E	6°31'50.62"N	N/A	Not Available
2	BH2	2.1	4° 0'28.32"E	6°31'34.36"N	5.82	Found
3	BH3	N/A	4° 0'42.95"E	6°31'26.29"N	N/A	Not Available

i) Vertical Electrical Sounding (VES) Acquisition

Five (5nos.) Vertical Electrical Sounding (VES) of schlumberger electrode array were occupied within the study area (Figure 4.21). The total electrode spread (AB) varied from 2.0 m to a maximum of 160 m. PASI Earth Resistivity Meter was used for the data acquisition. Other equipment employed include: metal electrodes, hammers, meter rule and four reels of wire. The VES positions were geo referenced using Garmin Etrex model Global Positioning System (GPS) handset with a view to determining the longitude, latitude and elevation of the VES locations (**Table 4.25)** within the study area. Additionally, one (1nos.) Control Point (Control) Vertical Electrical Sounding (VES) of Schlumberger electrode array was occupied at a distance of 6 km away North West from the project site boundaary (**Figure 4.21**). General note on Resistivity method are contained in Appendix B of this report.

Plate 4.5: Geophysical Acquisition Team Collecting Data at VES Sampling Point using PASI Terrameter and its Accessories

ii) Water Level Sampling of Boreholes

The locations of the three (3nos.) existing geotechnical/monitoring boreholes named:- BH1, BH02 and BH03 were plotted to be ascertained and assessed in the study area. However, only BH2 was located close to the provided location. Therefore, the Static Water Level (SWL) of Borehole 2 (BH2) was obtained using steel meter graduated tape as provided in Table 4.25. General note on determination of SWL using graduated steel meter tape method are contained in **Appendix B** of this report.

Plate 4.6: Picture of the Field Staff taking Static Water Level Measurement with Graduated Steel Meter Tape at Borehole 2 (BH2)

iii) Lithographic and Hydrogeologic Mapping

The study area was traversed with to assess changes in topography, soil structure and general terrain. In cases where water bodies were encountered, knowledge of the locals were sourced to determine if the feature of interest is seasonal or perennial - existing through the year with minor changes. Stream profiles were determined as far as the eye can see with measurements of depth and width taken for the perennial water bodies. The influence of the lagoon in creating pockets of water bodies towards the vicinity of the study area was also assessed.

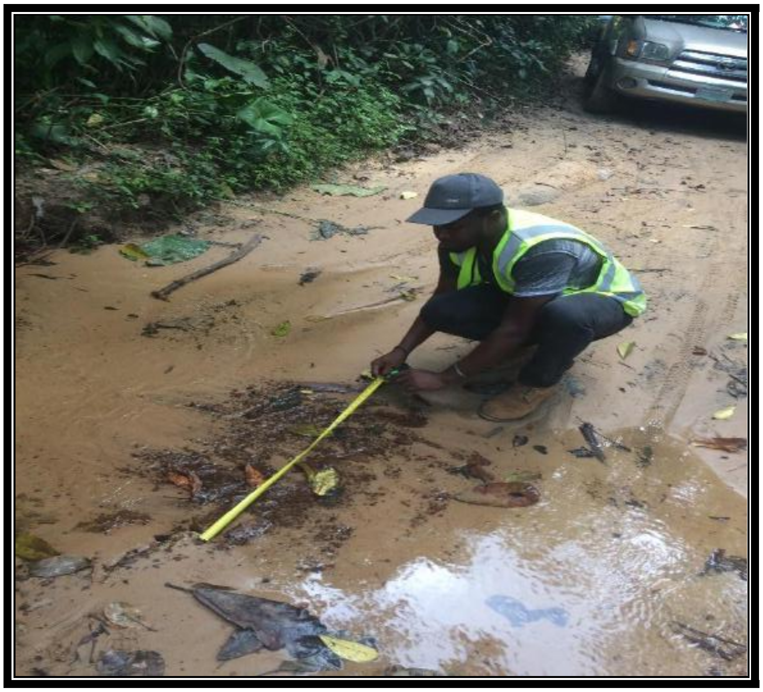


Plate 4.7: Field personnel taking measurements at a Seasonal Stream within Zone of Influence of Proposed Project

4.12.3 Geophysical Results

The samples of resistivity curves are shown in **Figures 4.22(a-f)**. The curves were interpreted qualitatively and quantitatively. Quantitative interpretation of the curves involves partial curve matching using two layer Schlumberger master curves and the auxiliary K, Q, A and H curves. The qualitative interpretation reveals two KQQ curves (VES1 & VES5), two KQQH curves (VES2 & VES4), one HKQ curve (VES4) and one KQH curve (CONTROL). Outputs were modeled using computer iterations. WinResist software was utilized for the iterations. The interpretation results are presented in Table 4.26. The geoelectric sections beneath the VES stations are shown in Figures 4.23, 4.24 and 4.25.

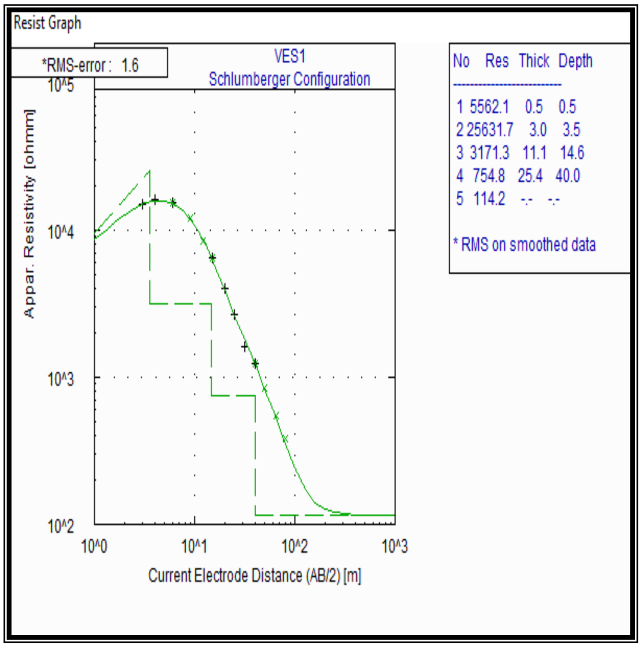


Figure 4.22(a): Resistivity Curve for VES 1

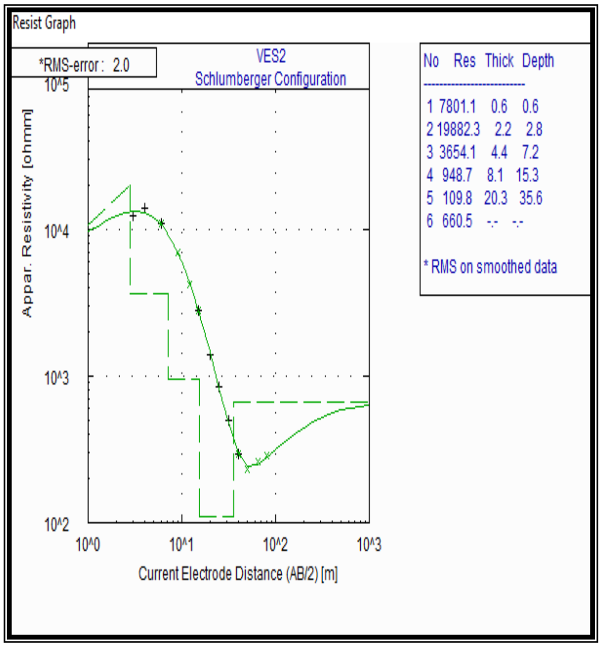


Figure 4.22(b): Resistivity Curve for VES 2

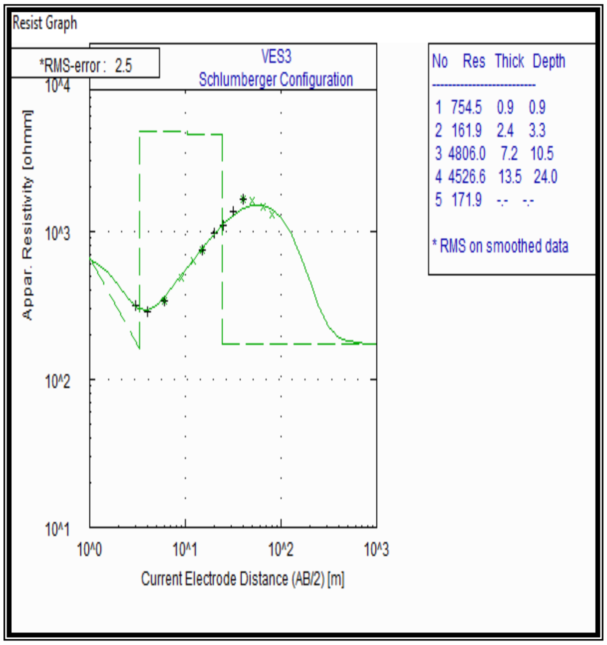


Figure 4.22(c): Resistivity Curve for VES 3

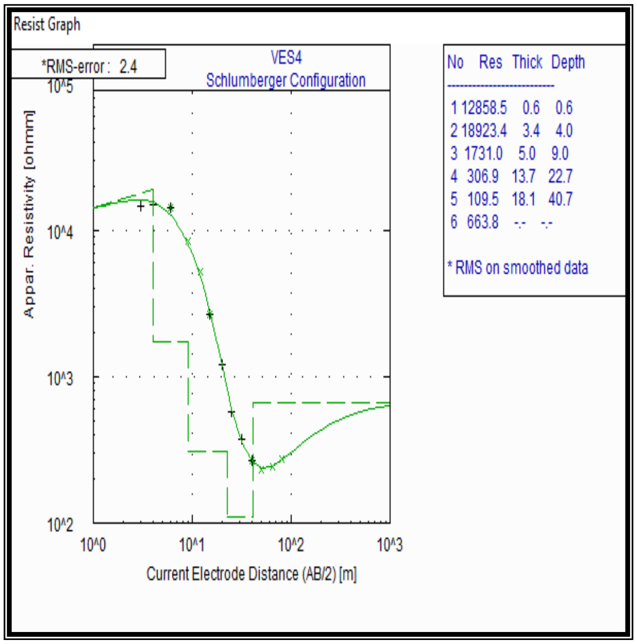
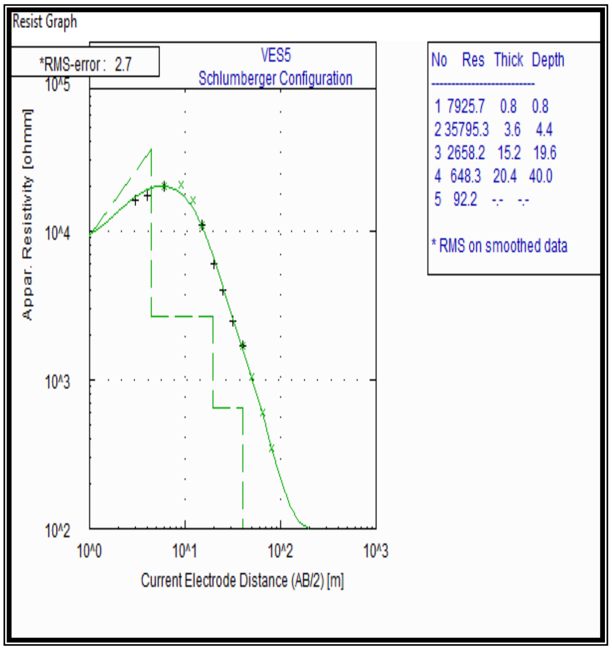


Figure 4.22(d): Resistivity Curve for VES 4



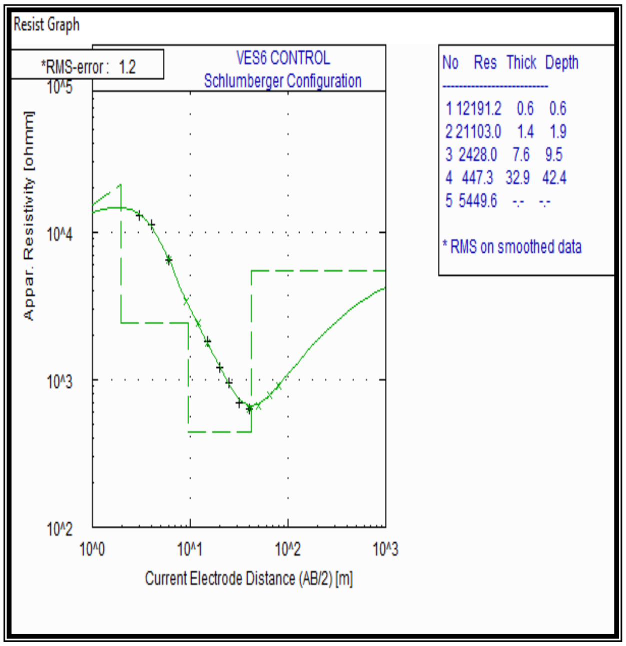


Figure 4.22(e): Resistivity Curve for VES 5 **Figure 4.22(f): Resistivity Curve for Control**

Table 4.26: Interpreted VES Results

VES Station	Layer	Resistivity (Ωm)	Thickness (m)	Depth (m)	Lithology
1	1	5562.1	0.5	0.5	Topsoil
	2	25631.7	3.0	3.5	Sand(Dry)
	3	3171.3	11.1	14.5	Sand(Wet)
	4	754.8	25.4	40.0	Sandy Clay
	5	114.2	--	--	Clay
2	1	7801.1	0.6	0.6	Topsoil
	2	19882.3	2.2	2.8	Sand(Dry)
	3	3654.1	4.4	7.2	Sand(Wet)
	4	948.7	8.1	15.3	Sandy Clay
	5	109.8	20.3	35.6	Clay
	6	660.5	--	--	Sandy Clay
3	1	754.5	0.9	0.9	Topsoil
	2	161.9	2.4	3.3	Clay
	3	4805.0	7.2	10.5	Sand(Wet)

	4	4526.6	13.5	24.0	Clayey Sand
	5	171.9	--	--	Clay
4	1	12858.5	0.6	0.6	Topsoil
	2	18923.4	3.4	4.0	Sand(Dry)
	3	1731.0	5.0	9.0	Sand(Wet)
	4	306.9	13.7	22.7	Sandy Clay
	5	109.5	18.1	40.7	Clay
	6	663.8	--	--	Sandy Clay
5	1	7952.7	0.8	0.8	Topsoil
	2	35795.3	3.6	4.4	Sand(Dry)
	3	2658.2	15.2	19.6	Sand(Wet)
	4	648.3	20.4	40.0	Sandy Clay
	5	92.2	--	--	Clay
Control	1	12191.2	0.6	0.6	Topsoil
	2	21103.0	1.4	1.9	Sand(Dry)
	3	2428.0	7.6	9.5	Sand(Wet)
	4	447.3	32.9	42.4	Sandy Clay
	5	5449.6	--	--	Sand

Source: EAECL Field Survey 2020

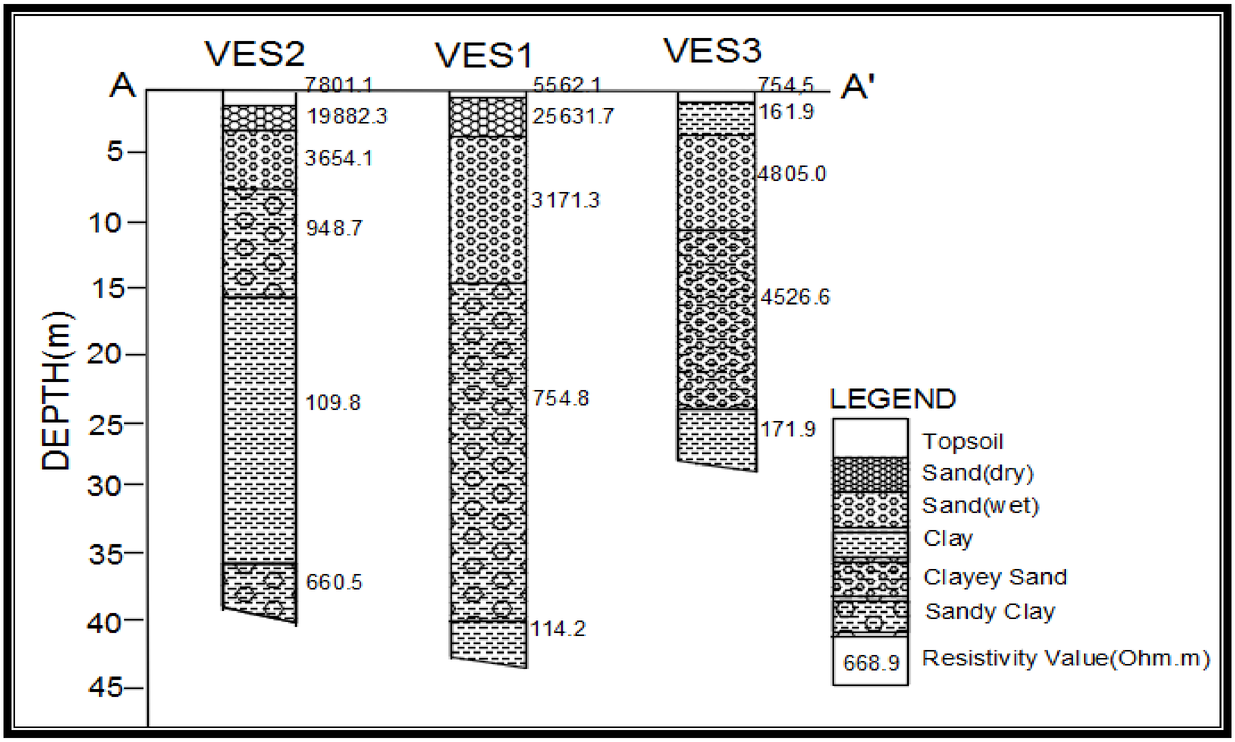


Figure 4.23: Geoelectric Section along AA'

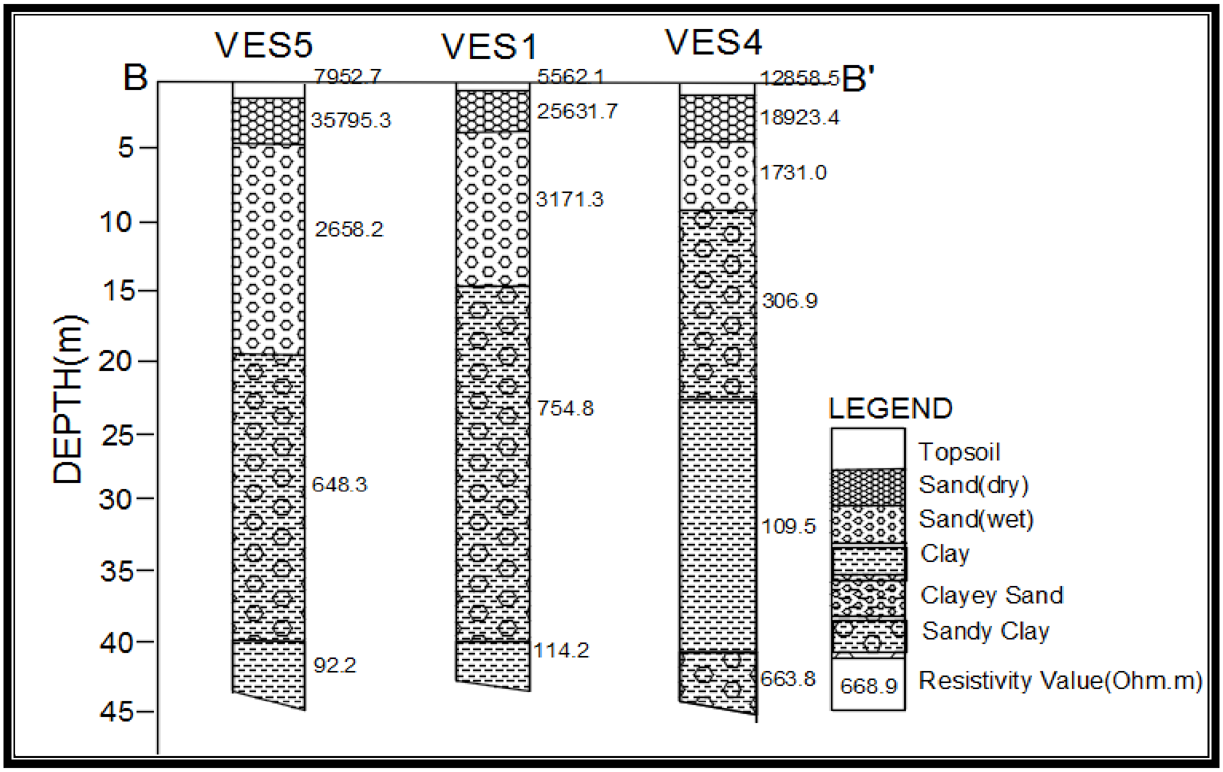


Figure 4.24: Geoelectric Section along BB'

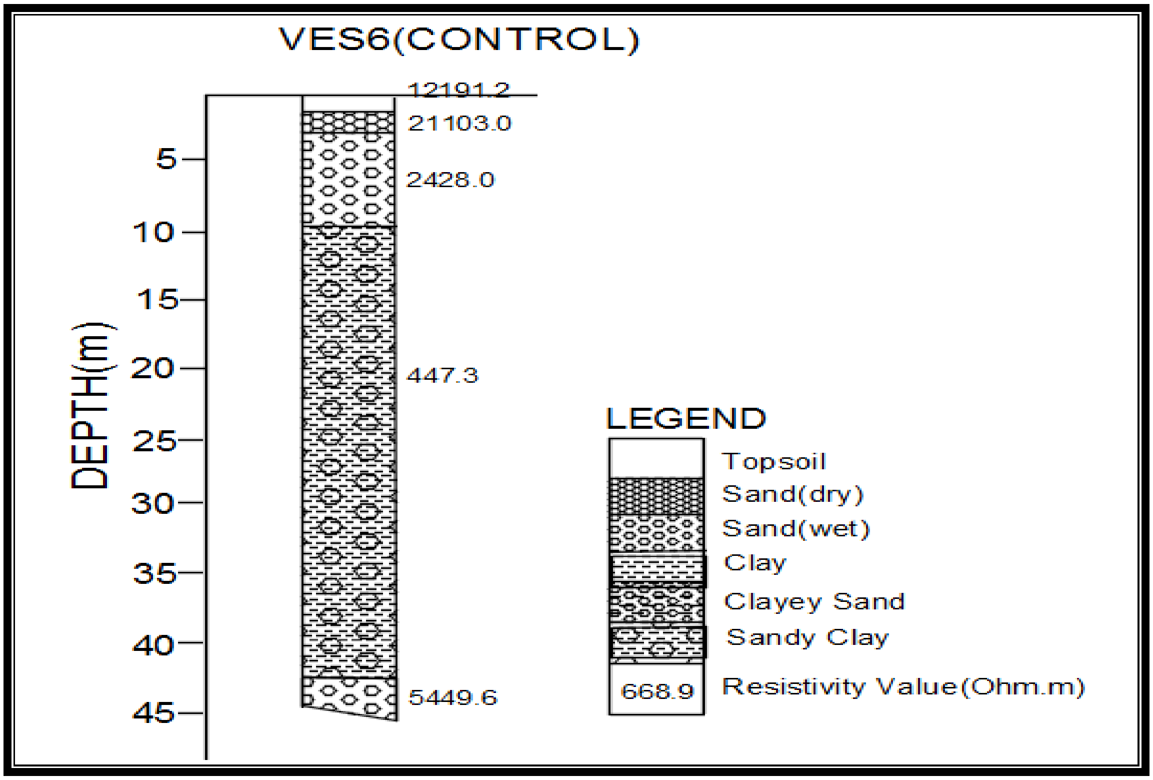


Figure 4.25: Geoelectric Section on Control Point

4.13 DISCUSSION OF RESULTS

4.13.1 Geolectric Sections along AA'

This is comprised of three VES Stations (VES1, VES2&VES3) with a maximum of six geoelectric layers beneath the profile. The layers identified correspond to topsoil, dry sand, wet sand, clayey sand, sandy clay and clay.

The first horizon corresponds to topsoil with a maximum thickness of 0.9m and resistivity values ranging from 754.5 to 7801.1Ωm. The second geoelectric layer depicts dry sand (resistivity values of 19882.3 to 25361.7Ωm. A sharp contrast of this layer is observed in VES3 which has a low resistivity of 161.9Ωm signifying clay material. The average thickness of this horizon is 2.5m.

The third geoelectric section depicts the top of the water table and section of the sand saturated with groundwater in the study area. The top of this horizon ranges from 2.8 to 3.5m. Resistivity values for this layer ranges from 3171.3Ωm to 4805Ωm while the average thickness for this zone is 7.6m.

The fourth geoelectric layer denotes sandy clay evident from the sharp drop in resistivity values for VES1 and VES2. However, the drop in resistivity in VES3 is small compared to the former revealing the lithology to be clayey sand. Resistivity Values in this zone range from 754.8 to 948.7Ωm in VES1&2 and 4526.6Ωm in VES3. The average thickness across the profile for this horizon is 15.7m.

The fifth geoelectric zone depicts clay across all sections evident form a further sharp drop in resistance from the previous layer. Resistivity values range from 109.8 to 171.9Ωm. The thickness of this layer is revealed to be 20.3m in VES2 but could not be ascertained in VES1&3 as current terminated within this zone at the stations.

The sixth geoelectric layer shown under VES2 depicts sandy clay. It has a resistivity value of 660.5Ωm, however the thickness of this zone could not be ascertained due to current termination within this layer.

4.13.2 Geolectric Sections along BB'

This is comprised of three VES Stations (VES5, VES1&VES4) with a maximum of six geoelectric layers beneath the profile. The layers identified correspond to topsoil, dry sand, wet sand, sandy clay and clay.

The first horizon corresponds to topsoil with a maximum thickness of 0.8m and resistivity values ranging from 5562.1 to 12858.5Ωm. The second geoelectric layer depicts dry sand with high resistivity values ranging from 18923.4 to 35795.3Ωm. The thickness of this stratum ranges from 3.0 to 3.6m

The third geoelectric section depicts the top of the water table and section of the sand saturated with groundwater in the study area. The top of this horizon ranges from 3.5 to 4.4m. Resistivity values for this layer ranges from 1731.0Ωm to 3171.3Ωm while the average thickness for this zone is 10.6m.

The fourth geoelectric layer denotes sandy clay evident from the sharp drop in resistivity values across the profile. Resistivity Values in this zone range from 306.9 to 754.8Ωm. The average thickness across the profile for this horizon is 19.8m.

The fifth geoelectric zone depicts clay across all sections evident form a further significant drop in resistance from the previous layer. Resistivity values range from 92.2 to 114.2Ωm. The thickness of this layer is revealed to be 18.1m in VES4 but could not be ascertained in VES1&5 as current terminated within this zone at the stations.

The sixth geoelectric layer shown under VES4 depicts sandy clay. It has a resistivity value of 663.8Ωm; however the thickness of this zone could not be ascertained due to current termination within this layer.

Recommendations

Hydrological studies identified seasonal streams around the area. These streams are formed during the wet season and are highly internetworked around the area of interest forming ponds, puddles and channels within the area. Although they eventually serve as tributaries to the lagoon, they are observed to be potable and serve as occasional source of drinking water to the travelling members of surrounding communities.

Geophysical and Lithological studies revealed that the area is overlain by coastal plain sands which constitute the aquifer in the subsurface. The soil layers revealed beneath the study area correspond to topsoil, clay, clayey sand, sandy clay and sand. The analysis shows that the depth to the groundwater table is shallow with the aquifer sand layer being very close to the surface. The depth to groundwater in the area is between 2.8 and 4.4m. This is supported by the reading taken at borehole 2(BH2) which revealed static water level to be 5.82m. This shows that groundwater in the area will be easily exposed to contamination from external influences. Interview and observation revealed that community members extract water used for consumption from this shallow aquifer.

Effluent discharge, domestic sewage from construction camps and incidental discharges comprising petrol, diesel, lubricants, paints and other chemicals may degrade ground water. Surface runoff that mobilizes any of; chemicals, fuel, accidental spills may easily find their way into groundwater from the aforementioned reasons. Any of the circumstances here that breach local ground water will result in contamination that is localized and short term.

Waste water generated in any of the future development or construction camps/facilities should be minimal. Changing oil or other fluids or solids while repairing machinery and equipment would affect ground water if discharged on the ground. During this stage, ground water (borehole) will be needed to meet the needs of the camp and of the construction.

Water demand by highly water dependent construction activities or industries will be supplied via borehole. The volume of ground water to be used at the different phases will not drastically affect the level of ground water and any impact will be temporary and short term since the aquifer will regularly be recharged by rain fall.

It is recommended that groundwater development via borehole drilling to depth not less than 200m in the area should be drilled to ensure high groundwater yield protected from contamination by thick clay layers identified in the study as well as devoid of saline water intrusion due to the proximity of the study area to saline water bodies.

Plate 4.8 Seasonal Stream and Lagoon in the Study Area

Plate 4.9: Borehole within the Project Site

4.14 SURFACE WATER QUALITY

In the course of this study, a total of nineteen (19 No) surface water samples, inclusive of two (2 No) Control,were collected from nine (9No) streams and ten (10) lagoon (Epe Lagoon and Lekki lagoon) within the proposed project area in the wet seasonwhile in the Dry Season, a total of ten (10 No) surface water samples, inclusive of two (2 No) control were collected from Epe lagoon (North of the proposed project site) and Lekki lagoon (South of the proposed project site). There was no water sample taken from the streams during the dry seasonas they were all dried up.

Plates 4.10 - 4.12 shows pictures of some of the surface water sampled within the proposed project area used to determine the physicochemical factors, trace metal contents, microbiological status and productivity of the streams and lagoon.

The people depend on them for various activities ranging from drinking, cooking, washing and bathing. In view of the pivotal role the lagoon plays in the day to day lives of the people coupled with the expected roles they will assume on the commencement of the project life cycle, the baseline physical, chemical and biological characteristics was conducted. Some of the parameters analysed *in situ* were pH, temperature, conductivity and total dissolved solids. Others analysed in the laboratory were turbidity, nitrate, sulphate, chloride, BOD_5, COD, Oil and Grease and various heavy metals etc.

The surface water bodies ranges in depth from few meters to tens of meters (observation and personal communication).The rationale for surface water studies is to acquire baseline concentrations for the physico-chemical and microbial contents for which future evaluation and monitoring could be based. Several activities of the project may impact negatively on the surface water within the proposed project area. Such activities include: waste water disposal from maintenance and servicing of the base stations, sewage disposal on surface water by camp workers and migrant food seller thus polluting the water bodies in the proposed project area. Pollution of these water bodies, shall impact negatively on the health and socioeconomic status of the residents. However, the mitigation measures of these impacts are presented in chapter six of this report.

The surface water sampling location is shown in table 4.27.

Table 4.27: Surface Water Sampling Location

S/N	Water Sample Points	Name of River/stream	Longitude	Latitude	Sampling Requirements
1	SW1	Stream1	3.947269	6.543197	Surface water
2	SW2	Stream1	3.947481	6.543223	Surface water
3	SW3	Stream1	3.947384	6.543072	Surface water
4	SW4	Stream1	3.947427	6.543432	Surface water
5	SW5	Stream1	3.947188	6.543063	Surface water
6	SW6	Stream2	3.982168	6.541963	Surface water
7	SW7	Stream2	3.981112	6.543168	Surface water
8	SW8	Stream2	3.980384	6.543657	Surface water
9	SW9	Stream2	3.981393	6.542501	Surface water
10	SW10	Epe Lagoon, North of the project area	4.000830	6.508420	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
11	SW11	Epe Lagoon, North of the project area	4.001480	6.508040	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
12	SW12	Epe Lagoon, North of the project area	4.003360	6.506580	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
13	SW13	Epe Lagoon, North of the project area	4.004220	6.504990	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
14	SW14	Lekki Lagoon, South of the project area near dangote refinery, Oloso village	4.013120	6.554700	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
15	SW15	Lekki Lagoon, South of the project area near dangote refinery, Oloso village	4.015750	6.553500	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
16	SW16	Lekki Lagoon, South of the project area near dangote refinery, Oloso village	4.019970	6.547420	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
17	SW17	Lekki Lagoon, South of the project area near dangote refinery, Oloso	4.020820	6.546890	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton

		village			
18	SWC1	Epe Lagoon, North of the project area	4.009140	6.560440	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
19	SWC2	Lekki Lagoon, South of the project area near dangote refinery, Oloso village	3.989760	6.509850	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton

4.14.1 Sampling Methodology

Water samples from the lagoons and streams were collected at different points in the lagoons and streams. At each sampling point, samples were collected by lowering the sample bottles into the stream since each points are easily accessible and water samples were collected directly from the lagoon with the aid of a boat. See plate 4.10.

Plate 4.10: Sampling at the lagoon by direct water sample collection

Samples for physico chemical analysis were stored in an ice-packed Dometic cooler and transported to laboratory were they are transferred into the fridge and preserved at 4^0C before the analysis.
Samples for Heavy metal analysis were preserved using 1:1 nitric acid while those for oil and grease were preserved by acidifying to pH 2 using 1:1 sulphuric acid.

Plate 4.11: Preservation of Surface Water Sample with high grade analytical Preservatives

In situ measurement of Temperature, pH, Conductivity, and Total dissolved solid were carried out at all sample locations. Plate 4.12; shows surface water *in situ* measurement.
Samples for microbiology were collected and preserved in a sterilized McCartney bottles and stored in an ice packed Dometic cooler and transported to the laboratory for identification and counting.
Samples for BOD were collected using the BOD bottles. The bottles were filled to brim and cover with the stopper to ensure that no air bubble was trapped in the bottles. The samples were then kept away from sunlight.

Plate 4.12: In situ measurement of unstable parameter using Apera water meter SX823-B Model

4.14.2 Surface water Physico-Chemical Result

The physico-chemical characteristics of the surface water bodies within the proposed project areas in first and dry season are summarized in Table 4.28 (see Appendix C for detailed result)

Table 4.28: Results of physical and chemical surface water quality parameters in the study area for Wet and Dry Seasons

PARAMETER	Wet Season				Dry Season				FMEnv. Limit
	Mean	Range	SWC (N)	SWC (S)	Mean	Range	SWC (N)	SWC (S)	
Temperature (^oC)	25.74	23.02-27.80	25.10	26.20	27.70	26.90-28.40	27.5	27.00	<40
Conductivity (µS/cm)	65.19	16.3-117.91	112.70	117.20	156.95	133.40-182.00	175.0	130.50	NS
pH	5.94	5.27-6.64	6.63	6.99	7.24	6.99--7.55	7.43	6.93	6-9
Colour (Pt-Co)	56.68	26- 192.3	29.00	29.00	94.78	32.91-199.30	15.83	16.04	
Total Dissolved Solids (mg/L)	46.80	13.00-83.12	80.50	83.34	91.42	82.00-97.2	90.00	90.00	2000
Turbidity(FNU)	10.44	1-33	2.40	2.10	20.09	10.22-31.00	9.00	12.11	NS
Dissolved Oxygen (mg/L)	5.70	4.10-6.50	6.00	6.10	6.36	5.92-6.90	6.03	5.92	<2
Biological Oxygen Demand (mg/L)	54.89	38.00-80.00	36.00	39.00	30.37	23.00-37.00	36.00	32.00	30
Chemical Oxygen Demand (mg/L)	136.34	95.00-200.00	90.00	97.50	89.57	83.00-95.00	92.50	90.20	40
Total Suspended Solids (mg/L)	117.08	5.90-251.00	140.20	23.65	2.16	1.08-2.92	1.04	1.90	30
Total Solids (mg/L)	163.88	18.90-69.30	220.70	106.99	93.57	83.78-99.70	91.04	91.90	NS
Total Hardness (mg/L)	70.07	16-289.4	16.70	18.40	34.88	28.52-42.73	52.30	41.99	NS

Oil and Grease (mg/L)	0.50	0.01-2.41	0.07	0.08	0.43	0.02-0.90	0.07	0.03	10
Phosphate (mg/L)	0.55	0.10-0.95	0.13	0.11	0.34	0.07-0.76	0.42	0.62	5
Nitrate (mg/L)	6.46	1.25-18.2	1.28	1.33	3.87	2.56-5.84	2.93	2.71	20
Nitrite (mg/L)	0.93	0.01-6.92	0.01	0.02	0.30	0.02-0.83	0.05	0.03	
Ammonia (mg/L)	0.72	0.01-4.23	0.01	0.02	0.28	0.05-0.72	0.75	0.71	
Sulphate (mg/L)	89.12	5.02-672.1	12.35	14.57	6.86	5.00-10.00	10.00	5.00	500
Chloride (mg/L)	208.62	32-1029.78	77.72	81.61	51.49	37.92-64.99	67.93	69.22	600
Salinity (ppt)	0.091	0.01-0.55	0.01	0.01	0.02	0.01-0.03	0.02	0.02	
Calcium Hardness (mg/L)	42.28	0.08-184	12.20	13.60	23.99	18.90-32.11	37.01	31.06	NS
Magnesium Hardness (mg/L)	31.48	4.5-111.3	4.50	4.80	11.20	9.62-12.94	15.29	10.93	NS
Potassium (mg/L)	1.70	0.32-2.9	2.00	2.17	1.71	1.10-2.04	2.01	1.96	NS
Sodium (mg/L)	1.85	0.36-3.4	0.38	0.40	2.91	2.03-4.03	3.05	4.01	NS
Calcium (mg/L)	15.50	0.03-73.6	4.88	5.44	9.60	7.56-12.84	14.80	12.42	200
Magnesium (mg/L)	7.56	1.08-26.712	1.08	1.15	2.69	2.31-3.11	3.67	2.62	200
Chromium (mg/L)	0.16	0.020.71	0.04	0.03	0.06	BDL-0.11	0.09	0.13	<1
Copper (mg/L)	0.10	0.21	0.10	0.12	0.02	0.00-0.02	ND	ND	<1
Iron (mg/L)	1.76	0.2-3.7	1.25	1.56	0.61	0.17-1.25	1.11	1.04	20

Zinc (mg/L)	1.20	0.1-2.94	1.02	1.87	0.47	0.08-1.08	1.16	0.93	<1
Lead (mg/L)	0.10	0.0-0.42	ND	0.01		ND	ND	ND	<1
Nickel (mg/L)	0.24	0.0-1.65	0.11	0.02	0.04	0.01-0.10	0.06	0.17	<1
Cadmium (mg/L)	0.03	0.0-0.11	0.01	0.01	0.02	0.00-0.02	0.02	0.03	<1
Mercury (mg/L)	ND	ND	ND	ND		ND	ND	ND	0.05
Vanadium (mg/L)	ND	ND	ND	ND		ND	ND	ND	<1
Manganese (mg/L)	0.042	0.0-0.09	ND	ND	0.06	0.01-0.12	0.21	0.16	5

EAECL Field Work, 2019/2020, BDL: Below Detection Limit, ND: Not Detected

4.14.3 Physico-chemical Characteristics of Surface Water

a. *pH*

The acidic or basic nature of a solution is expressed as pH, which is determined by the hydrogen ion (H^+) concentration in a solution. In natural waters, this is usually dependent on the carbonic acid equilibrium. A pH range of 6.0 to 9.0 is normal for aquatic life (KWW, 2001).

The pH of an aquatic ecosystem is important because it is closely related to biological productivity (UNEP/GEMS, 2008). The recorded pH values in surface water samples from the study area in first and dry season ranged from 5.27 – 6.64 with a mean value of 5.94 and 6.99-7.55 with mean value of 7.24 respectively indicating slight acidic status in the wet season and slight basic status in the dry season. The mean pH value in wet season is below established pH range for surface waters by FMEnv. This water quality parameter is likely to be affected especially during site construction in the rainy season as the run-off will be discharged into the surface waters.

b. *Temperature*

The temperature of the water bodies within the proposed project area for wet and dry seasons ranged from 23.02 – 27.80^{0}C with mean value of 25.74^{o}C and 26.90 – 28.40^{0}C with mean value of 27.50^{0}C respectively. These fell within FMEnv limit of <40^{0}C. The mean temperature of the water samples collected in the dry season was higher than the mean temperature of water samples collected in the Wet Season. However, the variation of the temperature of the water bodies was within the range of 15 - 32^{o}C and 21 - 32^{o}C recommended by WHO (2011) for drinking water and ICAR (2006) for aquatic life in the tropical environment respectively. Water temperature is one of the major factors that the presence, survival and abundance of biotic organisms in aquatic ecological systems and fluctuates both daily and seasonally (Odulate *et al*., 2016). The proposed project is not expected to impact negatively on the temperature of the water bodies except thermal waste water is discharged into them. Temperature affects the speed of chemical reactions, the rate at which algae and aquatic plants photosynthesize, the metabolic rate of other organisms. Besides, it influence how pollutants, parasites and other pathogens interact with aquatic residents (UNEP/GEMS, 2008). Water temperature affects the behaviour, reproduction, growth, migration, feeding, mortality and distribution of fishes in the aquatic environment. The time of sampling might be responsible for the higher temperature recorded at some points.

c. *Electrical Conductivity (EC)*

Electrical conductivity (E.C) also referred to as the specific conductance, is a measure of the ability of a water sample to convey an electric current. This is related to the concentration of ionized substances in the water samples.

The Electrical conductivity in the wet seasonranged from 16.30 -117.91 µscm^{-1}, while in the Dry Season, it ranged from 133.40 -182.00 µscm^{-1}. This water parameter is not likely to be impaired except there is a discharge of ionisable and corrosive elements into the water bodies during site construction.

d. *Color*

The color of the surface water samples from the stream and lagoon in the wet season ranged from 26.00 -192.30pt-Co and water samples from the lagoon ranged from 32.91- 199.30pt-Co in the Dry Season. Colour in drinking water can be caused by the presence of dissolved and suspended organic materials and compounds of calcium and iron. WHO therefore recommends that any water suitable for drinking must be colourless.

e. *Total dissolved solids (TDS)*

The concentrations of total dissolved solids ranged from 13.00 – 83.12 mg/L in the wet season and 82.00 – 199.30 mg/L in the dry season within the safe limit (<500 mg/L) recommended by WHO for drinking.

f. *Nitrate*

Natural waters in their unpolluted state contain minute concentration of nitrate. Increased nitrate level is an indication of anthropogenic influence and may also be due to fresh water inflow, litter fall decomposition and terrestrial run-off during rainy months (Odulate *et al.*, 2011). Nitrate concentrations in the water bodies ranged from 1.25 – 18.20mg/L with mean value 6.46mg/L in the wet season and 2.56 – 5.84mg/L with mean value 3.87mg/L in the dry season and are below 50mg/L recommended by WHO (2011) in drinking water and FMEnv Limit of 20mg/L.

g. *Phosphate*

Phosphate is essential for the growth of organisms and a nutrient that limits the primary productivity of the water body. Phosphate and nitrate were reported to be limiting nutrients in aquatic ecosystems and are primary drivers of eutrophication of aquatic systems (Soulsby *et al.*, 2001; UNEPGEMS/Water Programme, 2006). Phytoplankton production in aquatic systems, which serves as link in the food chain, is dependent on the amount and bioavailability of phosphate and nitrate. Intrusion of phosphorus into aquatic ecosystems, among other sources includes detergents, soil run-off, septic effluents, industrial discharges and fertilizers from agricultural lands (Odulate *et al.,* 2016). The concentrations of phosphate ranged between 0.10mg/L and 0.95mg/L with mean value of 0.55mg/L in the wet season and between 0.07 and 0.76mg/L with mean value of 0.34mg/L in the dry Season. The mean values for both season are below FMEnv limit of 5mg/L.

h. *Dissolved oxygen*

Dissolved oxygen is a very important water quality parameter as it serves as an indicator of the physical, chemical and biological activities of the water body. The amount of dissolved oxygen in water is greatly influenced by water temperature with inverse relationship. The primary source of dissolved oxygen in aquatic ecosystem is through photosynthesis of green aquatic flora especially phytoplankton and it is a key factor for aquatic life. Concentrations of dissolved oxygen obtained during the study were within the range recommended by WHO for aquatic lives. However, this healthy situation may be hampered if dumping of waste into the water bodies during execution of the project is encouraged. Dissolved oxygen averaged between 4.10 mg/L and 6.50 mg/L in the wet season and 5.92 – 6.90 mg/L in the dry Season. These values compared well with natural limits expected for fresh water bodies and are within FMEnv limit of <2mg/L.

i. *Turbidity*

The Turbidity is an indication of the extent to which light passing through the water is reduced by floating suspended solids and colloidal materials. High turbidity lowers the light penetration through the water, which results to lower primary productivity in the water. It also reduces the aesthetic values.

The turbidity of the surface water samples from the streams and lagoon ranged from 1.00 - 33.00FNU in the wet season and water samples from the lagoon ranged from 10.22- 31.00FNU in the dry Season.

j. *Total Suspended Solids*

The total suspended solid (TSS) comprises colloidal suspension components such as clay, silt, sand, finely divided organic and inorganic matter, plankton and other microorganisms in water.

High concentration of suspended solid affects water clarity and light penetration, which will affect photosynthetic processes and consequently primary production. A positive effect of the presence of suspended solids in water is that toxic chemicals (pesticides and metals) tend to adsorb to them or from complexes with them, thus making the toxics less available to be absorbed by living organisms (Kentucky water watch, 2001). The concentrations of TSS in water bodies from the study area recorded values ranging from 5.90 – 251.00 mg/L, with mean value of 117.08mg/L in the wet season and 1.08 – 2.92 mg/L, with mean value of 2.16mg/L in the dry Season. There was a significant seasonal variation in the mean concentration of TSS in the surface water. The TSS mean value of the water samples in the wet season was above FMEnv limit of 30mg/L. This could be attributed to runoff of debris and other materials into the water bodies.

k. *Total Hardness*

Total concentration of Calcium and Magnesium expressed as their $CaCO_3$ equivalent denotes the Total Hardness of water. Carbonate hardness can be regarded as temporary hardness since they can be easily removed from water by boiling. The metal carbonate reacts with soap or detergents leading to formation of scum. The Total Hardness concentrations ranged between 16.00mg/L and 289.40mg/L with mean concentration of 70.70mg/L in the wet season and between 28.52mg/L and 42.73mg/L with mean concentration of 34.88mg/L in the dry Season. The mean concentration of Total Hardness of the surface water in the rainy season was higher than the mean concentration of Total Hradness in the dry season. This variation could be attributed to rain and runoff of debris and other materials into the surface water.

l. *Biochemical Oxygen Demand (BOD)*

BOD is an indirect measure of the amount of biologically degradable organic materials in water and is an indicator of the amount of dissolved oxygen that will be depleted from water during natural biological assimilation of organic pollutants. Excess BOD in water therefore could adversely affect aquatic organisms and by extension humans. BOD concentration in surface water samples from the study area ranged from 38.00 -80.00mg/L with mean concentration of 54.89mg/L in the wet season and ranged from 23.00mg/L – 37.00mg/L with mean concentration of 30.37mg/L in the dry Season. The mean concentration of BOD in the wet season is above FMEnv. limit of 30.00mg/L and slightly above FMEnv. limit of 30.00mg/L in the dry season. The high mean concentration of BOD recorded in the wet season could be attributed to anthtropogenic activities around the surface water and runoff of organic substances into the surface water due to rain.

m. *Chemical Oxygen Demand (COD)*

Chemical oxygen demand is a rapid test which measure the oxygen required for the oxidation of all the substance present in water, included those are not biologically decomposable. COD is a reliable parameter for judging the extent of pollution in water. The COD of water increases with increasing concentration of organic matter. Chemical Oxygen Demand values ranged from 95.00 – 200.00mg/L with mean concentration of 136.34mg/L in the wet season and ranged from 83.00mg/L – 95.00mg/L with mean concentration of 89.57mg/L in the dry Season, above FMEnv limit of 40mg/L.

n. *Sulphate*

Sulphate is naturally present in surface waters as SO_4^{2-}. It rises from atmospheric deposition of oceanic aerosols and the leaching of sulphur compounds, either sulphate minerals such as gypsum or sulphide mineral such as pyrite, from sedimentary rocks. It is the stable, oxidized form of sulphur and is readily soluble in water (with the exception of lead, barium and strontium sulphates which precipitate). Industrial discharges and atmospheric precipitation can also add significant amounts of sulphate to surface waters. Sulphate can be used as an oxygen source by bacteria which convert it to hydrogen sulphide (H_2S, HS^-) under anaerobic conditions.

Sulphate concentration in surface water samples ranged from 5.02 -672.10mg/L with mean concentration of 89.12mg/L in the wet season and 5.00 – 10.00mg/L with mean concentration of 6.86mg/L in the dry Season. Two water samples (SW1 and SW2) from the stream had sulphate concentration of 672.10mg/l and 521.20mg/l above FMEnv. limit of 500.00mg/l in the Wet Season, see detailed result in appendix. All other values are below FMEnv limit.

o. *Alkali and alkaline earth metals*

Sodium (Na), Calcium (Ca) and Magnesium (Mg) are the alkali and alkaline earth metal analysed. These alkali and alkaline earth metals in solution make up the exchangeable cations. Their mean values ranged from 0.36 – 3.40mg/L (Na) and 2.03 – 4.03mg/L (Na) in first and Dry Seasons respectively, 0.03 – 73.60mg/L (Ca) and 7.56 – 12.84mg/L (Ca) in first and Dry Seasons respectively and 1.08 – 26.71mg/L (Mg) and 2.31 – 3.11mg/L (Mg) in first and Dry Seasons respectively. The mean concentrations of Na, Ca and Mg were 1.85(Na), 15.50mg/L(Ca) and 7.56mg/L(Mg) in wet season and 2.91mg/L(Na), 9.60mg/L(Ca) and 2.69mg/L(Mg) in the dry season. The order of dominance is thus Ca>Mg>Na and Ca>Na>Mg in wet and dry season respectively. Also these concentrations are within FMEnv regulatory limits.

p. *Heavy Metals*

Natural water also contain very small quantities of many essential metals viz, Zinc (Zn), cadmium (Cd) Copper (Cu), Lead (Pb), Iron (Fe), Manganese (Mn) called trace or heavy metals. They are required by plants and animals in minute quantities. They are toxic if present in relatively high concentrations and are non-biodegradable as well easily assimilated and bio-accumulated in the protoplasm of aquatic organisms.

q. *Zinc*

Zinc is found in some natural water, most frequently in areas where it is mined. It is not considered health risk unless it occurs in very high concentrations. It imparts an undesirable taste to drinking water. For the Wet Season, Zinc concentrations of the water samples ranged from 0.10 – 2.94mg/L, with mean 1.20mg/L above FMEnv limit. For the Dry Season, Zinc concentrations of the water samples ranged from 0.08 – 1.08mg/L with mean 0.47mg/L below FMEnv limit.

r. *Chromium*

The concentration of chromium in the lake water was quite low and fluctuated vary widely. Chromium is a specific pollutant providing evidence of industrial pollution like dye or paint operations. In the Wet Season, the concentrations of Cr ranged from 0.02-0.71 mg/L with mean value of 0.16mg/L below FMEnv limit of <1 mg/L. For the Dry Season, the concentrations of Cr ranged from Below Detection Limit (BDL) to 0.13mg/L with mean value of 0.06mg/L. The mean value is below FMEnv. limit of <1 mg/L.

Mercury and Vanadium were not detected in all the sampled points. The mean concentrations of Lead Cadmium, Nickel, Iron and Manganese heavy metals in the surface water samples from all the streams and lagoons were generally low with concentrations within their respective FMEnv. limits.

s. *Oil and Grease*

The oil and grease concentrations of the surface water ranged from 0.01 – 2.41 mg/L, with mean value of 0.50mg/L in the wet season and 0.02 – 0.90mg/L, with mean value of 0.43mg/L in the Dry Season. The mean values are below FMEnv. limit of 10.00mg/L.

Surface Water Microbiology

The microbiological characteristics of the surface water in the study area are presented in table 4.29

t. ***Total Heterotrophic Bacteria (THB)***

The most predominant bacterial genera found in the water samples is Bacillus which was present in all the sample water bodies. Pseudomonas was also predominant. Other bacteria genera found are Proteus, Enterobacter, *Actinomyces*, *Proteus* and *Klebsiella*. THB ranged between 1.0×10^1cfu/ml and 5.0×10^1cfu/ml in the wet seasonand 19.00 – 41.00cfu/ml in the Dry Season.

u. ***Total Heterotrophic Fungi (THF)***

Total Heterotrophic Fungi (THF) ranged between 1.00cfu/ml to 27.00cfu/ml and 2.00cfu/ml to 5.00cfu/ml in the first and Dry Seasons respectively. The predominant fungus found in the water bodies is *Aspergillus sp.*

v. ***Hydrocarbon Utilising Bacteria (HUB)***

The Hydrocarbon Utilizing Bacteria (HUB) ranged between 0.00cfu/ml and 6.00cfu/ml both in the first and Dry Season. The predominant HUB found in the water bodies is *Bacillus sp and Pseudomonas sp. Micrococcus sp* was also found. Their counts were low indicating no hydrocarbon contamination.

w. ***Hydrocarbon utilizing Bacteria (HUF)***

The various Hydrocarbon utilizing Fungi found in the surface water of the study area include *Mucor sp* and *Rhizopus sp*, HUF count ranged between 1.00cfu/ml and 8.00cfu/ml in the wet seasonand 0.00cfu/ml and 6.00cfu/ml in the Dry Season. The predominant fungus found in the water bodies is *Aspergillus sp.* Their counts were low which indicates that the water bodies are not polluted with hydrocarbons.

x. ***Total Coliform***

The Total Coliform count ranged from 1.00MPN/100mL and 8.00MPN/100mL in the wet season and between 2.00MPN/100mL and 5.00MPN/100mL in the dry seasonwhich are below FMEnv. limit of 400.00MPN/100ml.

Table 4.29: Microbiological Characteristics of Surface Water in the Study Area

Parameter / Sample Stations	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Ultilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)	Hydrocarbon Ultilising Fungi	Count (cfu/ml)	Total Coliform	Count (MPN/ 100ml)
Wet Season										
SW1	*Pseudomonas sp Proteus sp Bacillus sp*	2.00 x10^1		ND	*Aspergillus Cladosprium sp*	10	*Aspergillus*	6	*Pseudomonas sp*	4
SW2	*Proteus sp Pseudomonas sp*	3.00 x10^1		ND	*Candida sp Aspergillus sp*	20	*Aspergillus sp Candida sp*	3	*Pseudomonas sp*	3
SW3	*Pseudomonas sp Proteus sp Bacillus sp*	6.00 x10^1		ND	*Penicillium sp Aspergillus sp Rhizopus sp*	27	*Rhizopus sp*	7	*Pseudomonas sp*	5
SW4	*Proteus sp Pseudomonas sp*	4.00 x10^1		ND	*Aspergillus Cladosprium sp*	3	*Aspergillus*	5	*Pseudomonas sp*	7
SW5	*Pseudomonas sp*	1.00 x10^1		ND	*Candida sp Aspergillus sp*	4	*Aspergillus sp Candida sp*	3	*Pseudomonas sp*	5
SW6	*Proteus sp Pseudomonas sp, Bacillus sp*	5.00 x10^1		ND	*Penicillium sp Aspergillus sp Rhizopus sp*	5	*Rhizopus sp*	6	*Pseudomonas sp*	4
SW7	*Pseudomonas sp, Bacillus sp*	3.00 x10^1		ND	*Aspergillus Cladosprium sp*	15	*Aspergillus*	8	*Pseudomonas sp,*	6
SW8	*Proteus sp Pseudomonas sp*	2.00 x 10^1		ND	*Candida sp Aspergillus sp*	3	*Aspergillus sp Candida sp*	6	*Pseudomonas sp*	8
SW9	*Pseudomonas sp*	1.00 x 10^1		ND	*Penicillium sp Aspergillus sp Rhizopus sp*	1	*Rhizopus sp*	2	*Pseudomonas sp*	4

SW10	*Bacillus sp*	1.00 x 10^1		ND	*Aspergillus Cladosprium sp*	1	*Aspergillus*	2	*Bacillus sp*	6
SW11	*Proteus sp Pseudomonas sp*	21	*Pseudomonas sp*	6	*Candida sp Aspergillus sp*	3	*Aspergillus sp Candida sp*	3	*Pseudomonas sp*	1
SW12	*Pseudomonas sp Proteus sp Bacillus sp*	24	*Pseudomonas sp*	2	*Penicillium sp Aspergillus sp Rhizopus sp*	2	*Rhizopus sp*	4	*Pseudomonas sp*	6
SW13	*Proteus sp Pseudomonas sp*	30	*Pseudomonas sp Bacillus sp*	2	*Aspergillus Cladosprium sp*	2	*Aspergillus*	6	*Pseudomonas sp*	3
SW14	*Pseudomonas sp Proteus sp Bacillus sp*	30	*Pseudomonas sp*	2	*Candida sp Aspergillus sp*	4	*Aspergillus sp Candida sp*	2	*Pseudomonas sp Bacillus sp*	3
SW15	*Proteus sp Pseudomonas sp*	22	*Pseudomonas sp*	3	*Penicillium sp Aspergillus sp Rhizopus sp*	3	*Rhizopus sp*	5	*Pseudomonas sp*	2
SW16	*Pseudomonas sp Proteus sp Bacillus sp*	34	*Pseudomonas sp Bacillus sp*	1	*Aspergillus Cladosprium sp*	4	*Aspergillus*	2	*Pseudomonas sp Bacillus sp*	2
SW17	*Proteus sp Pseudomonas sp*	28	*Pseudomonas sp*	2	*Candida sp Aspergillus sp*	3	*Aspergillus sp Candida sp*	1	*Pseudomonas sp*	3
SWC	*Pseudomonas sp Proteus sp Bacillus sp*	1.00 x 10^1		ND	*Penicillium sp Aspergilus sp Rhizopus sp*	1	*Rhizopus sp*	2	*Pseudomonas sp Bacillus sp*	3
SWC	*Proteus sp Pseudomonas sp*	1.00 x 10^1		ND	*Aspergillus Cladosprium sp*	1	*Aspergillus*	2	*Pseudomonas sp*	2
Dry Season										
SW10	*Proteus sp Bacillus sp*	28	*Pseudomonas sp Bacillus sp*	1	*Aspergillus Cladosprium sp*	5	*Aspergillus*	2	*Bacillus sp*	2

SW11	*Pseudomonas sp Proteus sp*	19	*Pseudomonas sp*	6	*Candida sp Aspergillus sp*	3	*Aspergillus sp Candida sp*	3	*Pseudomonas sp*	5
SW12	*Pseudomonas sp Proteus sp Bacillus sp*	26	*Pseudomonas sp*	2	*Penicillium sp Aspergilus sp Rhizopus sp*	2	*Rhizopus sp*	4	*Pseudomonas sp*	3
SW13	*Proteus sp Pseudomonas sp*	30		Nil	*Aspergillus Cladosprium sp*	2	*Aspergillus*	6	*Pseudomonas sp*	4
SW14	*Pseudomonas sp Proteus sp Bacillus sp*	30	*Pseudomonas sp*	2	*Candida sp Aspergillus sp*	4	*Aspergillus sp*	2	*Pseudomonas sp*	5
SW15	*Proteus sp Pseudomonas sp*	19	*Pseudomonas sp*	4	*Penicillium sp Aspergilus sp Rhizopus sp*	3	*Rhizopus sp*	5	*Pseudomonas sp*	2
SW16	*Pseudomonas sp Proteus sp Bacillus sp*	41	*Bacillus sp*	1	*Aspergillus Cladosprium sp*	4		Nil	*Pseudomonas*	5
SW17	*Proteus sp Pseudomonas sp*	28	*Pseudomonas sp*	2	*Candida sp Aspergillus sp*	3	*Candida sp*	1	*Pseudomonas sp*	3
SWC	*Pseudomonas sp Proteus sp Bacillus sp*	20	*Pseudomonas sp*	4	*Penicillium sp Aspergilus sp Rhizopus sp*	2	*Rhizopus sp*	2	*Pseudomonas sp Bacillus sp*	4
SWC	*Proteus sp Pseudomonas sp*	29	*Pseudomonas sp Bacillus sp*	2	*Aspergillus Cladosprium sp*	2	*Aspergillus*	1	*Pseudomonas sp*	4
FMEnv. limit		ND		ND		ND		ND		400

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4.15 GROUND WATER QUALITY

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

4.15.1 Groundwater Vulnerability

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

4.15.2 Sampling Methodology

Ground water sample were typically collected from the discharge line of the borehole while for the shallow hand dug wells, samples were collected by directly dipping the sample bottles into the groundwater. In wet season only one borehole, named borehole 2, was located at 4° 0' 25.38" E, 6° 31' 38.1" N at the proposed project site and water sample was taken from it. In the dry season, borehole 1 and borehole 3 were located at 4° 0'39.91"E , 6°31'50.62"N and 4° 0'42.95"E, 6°31'26.29"N respectively but water sample could not be taken as the boreholes were closed and groundwater could not be accessed.

Groundwater is never chemically pure; it is a solution of substances taking place during the course of percolation through the rocks. Ground water were collected from one (1No) existing borehole and two (2No) hand dug wells located within the communities at the proposed project area. The water observed in the boreholes and hand dug wells in the area of investigation were found to be colourless. Groundwater sampling location is provided in table 4.29.

Plate 4.13: Ground water sample collection and *in situ* measurement.

Table 4.30: Groundwater sampling locations

S/N	Water Sample Points	Name of Location	Latitude	Longitude	Sampling Requirements
1	GW1	Oke Egan Groundwater	6° 31' 16.14" N	4° 0' 25.452" E	Ground Water
2	GW2	Idi Iroko Groundwater	6° 31' 58.37"N	4° 0' 4.284" E	Ground Water
3	GW3	Borehole2	6° 31' 38.1" N	4° 0' 25.38" E	Ground Water

Table 4.31: Phisiochemical Characteristics of Groundwater

PARAMETER	UNIT OF MEASUREMENT	Wet Season			Dry Season			NSDW Limit, 2007	FMEnv Limit	WHO Limit
		GW1 Oke Egan	GW2 Idi Iroko	GW3 BH2	GW1 Oke Egan	GW2 Idi Iroko	GW3 BH2			
Temperature	°C	23.50	22.30	23.20	25.70	30.20	27.60	**NS**	**NS**	**40^0C**
Conductivity	µS/cm	120.00	85.50	45.30	112.10	31.10	60.30	**1000**	**NS**	**250**
pH		7.02	7.05	6.99	7.21	6.95	7.03	**6.5 – 8.5**	**6.5 – 8.5**	**6.5 – 9.2**
Colour	Pt-Co	6.00	6.21	4.69	5.00	6.92	5.55	**Clear**	**Clear**	**Clear**
Total Dissolved Solids	mg/L	66.00	34.00	23.20	60.20	22.20	41.80	**500**	**500**	**NS**
Turbidity	FNU	4.00	4.30	4.92	2.04	4.10	4.11	**5**	**1.0**	**5**
Dissolved Oxygen	mg/L	6.67	6.90	6.84	6.04	6.51	6.20	**NS**	**7.5**	**<5**
Total Suspended Solids	mg/L	1.83	1.60	1.01	0.93	1.00	0.82	**NS**	**10**	**50**
Total Solids	mg/L	67.83	35.60	33.21	61.13	23.20	42.62			
Total Hardness	mg/L	39.47	38.05	27.24	41.94	35.94	31.55	**150**	**200**	**-**
Oil and Grease	mg/L	0.03	0.02	0.02	ND	0.01	0.04	**NS**	**NS**	**-**
Phosphate	mg/L	0.23	0.21	0.05	0.19	0.09	0.08	**NS**	**>5**	**5**
Nitrate	mg/L	2.00	1.91	1.34	1.04	1.91	1.82	**50**	**10**	**10**
Nitrite	mg/L	0.02	0.02	0.01	0.02	0.02	0.02			
Ammonia	mg/L	0.07	0.08	0.03	0.06	0.10	0.08			
Sulphate	mg/L	4.00	6.00	6.00	5.00	ND	5.00	**100**	**500**	**500**
Chloride	mg/L	39.30	41.20	23.45	46.99	42.01	32.96	**250**	**NS**	**250**
Salinity	ppt	0.03	0.02	0.01	0.02	0.02	0.02			
Calcium	mg/L	24.75	25.00	21.12	29.01	25.11	22.92			

Hardness										
Magnesium Hardness	mg/L	14.72	13.05	6.11	12.93	10.83	8.63			
Potassium	mg/L	3.40	3.53	3.23	4.11	3.21	1.93	**NS**	**NS**	**10**
Sodium	mg/L	5.93	6.21	4.03	7.84	6.32	3.77	**200**	**NS**	**-**
Calcium	mg/L	9.90	10.00	8.45	11.60	10.04	9.17	**NS**	**NS**	**-**
Magnesium	mg/L	0.53	0.47	0.22	0.46	0.39	0.31	**0.20**	**NS**	**-**
Chromium	mg/L	0.12	0.15	0.01	0.09	0.18	0.05	**0.05**	**0.05**	**-**
Copper	mg/L	0.02	0.02	0.01	0.02	0.03	0.02	**1.0**	**0.1**	**2.0**
Iron	mg/L	1.22	1.34	1.00	1.32	1.83	1.03	**0.3**	**1.0**	**0.3**
Zinc	mg/L	0.29	0.31	0.13	0.39	0.23	0.29	**3.0**	**5.0**	**-**
Lead	mg/L	ND	ND	ND	ND	ND	ND	**0.01**	**0.05**	**0.02**
Nickel	mg/L	0.05	0.03	ND	0.09	0.06	0.05	**0.02**	**0.05**	**-**
Cadmium	mg/L	ND	ND	ND	0.03	ND	ND	**0.003**	**0.01**	**-**
Mercury	mg/L	ND	ND	ND	ND	ND	ND	**0.001**	**0.1S**	**-**
Vanadium	mg/L	ND	ND	ND	ND	ND	ND			
Manganese	mg/L	0.10	0.09	ND	0.19	0.11	0.15			

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4.15.3 Physico-chemical Characteristics of Ground water

a. Colour

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

The color concentration of the groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet seasonwere 6.00pt-Co, 6.21pt-Co and 4.69pt-Co and the color concentration of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) were 5.00Pt-Co, 6.92Pt-Co and 5.55Pt-Co in the Dry Season.

b. DO

Dissolved Oxygen (DO) is a measure of the amount of gaseous oxygen dissolved in the water sample. It is an indicator of biological activity in a water body and is essentially for aerobic respiration. The DO concentration of the groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet seasonwere 6.67mg/L, 6.90mg/L and 6.84mg/L and the DO concentration of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) in dry seasonwere 6.04mg/L, 6.51mg/L and 6.20mg/L.

c. Total Hardness

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

According to WHO, groundwater with concentration ranging from 0 to 60 mg/L is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and >180 mg/L as very hard. The Total Hardness of the groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet seasonwere 39.47mg/L, 38.05mg/L and 27.24mg/L and the Total Hardness of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) in dry seasonwere 41.94mg/L, 35.94mg/L and 31.55mg/L.

The concentrations are below NSDW limit of 50mg/L. With reference to WHO classification of hardness of ground water the ground water in the study area is soft.

d. Total suspended Solids (TSS)

These are minerals and organic materials present in water. It enters groundwater through runoff from industrial, urban or agricultural areas. Elevated TSS causes rise in groundwater temperature which in turn supports growth of some microbial organisms. The TSS of the groundwater sample from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet seasonwere 1.83mg/L, 1.60mg/L and 1.01mg/L and the TSS of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) in dry seasonwere 0.93mg/L, 1.00mg/L and 0.82mg/L. The concentrations range is below the WHO limit.

e. pH

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

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

The pH of the groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet seasonwere 7.02, 7.05 and 6.99 and the pH of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) in dry seasonwere 7.21, 6.95 and 7.03.These values are within NSDW limit and WHO limit.

f. Temperature

The rate of chemical reactions generally increases as temperature increases. Groundwater with higher temperatures tend to dissolves more minerals from the rocks in the aquifer and therefore have a higher electrical conductivity (EC). **High temperature** negatively impact water quality by enhancing the growth of micro-organisms which may increase taste, odour, colour and corrosion problems. Temperature above ambient level is therefore an index of groundwater pollution. The Temperature of the groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet seasonwere 23.50^oC, 22.30^oC and 23.20^oC and the Temperature of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) in dry seasonwere 25.70^oC, 30.20^oC and 27.60^oC.

Result of the study is within WHO permissible limits for drinking and for other domestic uses.

g. Electrical Conductivity (EC)

Electrical conductivity gives an indication of the amount of total dissolved substitution in water. Pure water containing less or no organic salt is an excellent insulator which cannot conduct electricity, hence any water with EC concentration above WHO/FMEnv limits is said to be polluted (IFC EHS 2007). The Electrical Conductivity of the groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet seasonwere 120.00µScm^{-1}, 85.50µScm^{-1} and 45.30µScm^{-1} and the Electrical Conductivity of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) in dry season were 112.10µScm^{-1}, 31.10µScm^{-1} and 60.30µScm^{-1}.

Results of this study are within WHO limits.

h. Total Dissolved Solids (TDS)

TDS values depend on climate, the host rock, and the residence time of the groundwater in the geological matrix. The TDS of the groundwater sample from Oke Egan, Idi Iroko and borehole (BH2) located within the proposed project area in the wet seasonwere 66.00mg/L, 34.00mg/L and 23.20mg/L and the TDS of groundwater samples from the groundwater at Oke Egan, Idi Iroko and borehole (BH2) in dry seasonwere 60.20mg/L, 22.20mg/L and 41.80mg/L. The TDS was found to be in an acceptable range.

i. Turbidity

Turbidity or cloudiness is caused by the presence of clay, silt, suspended matter, colloidal particles and other microorganisms. These particles of turbidity provide "shelter" for microbes by reducing their exposure to attack by disinfectants. High turbidity promotes re-growth of pathogens in the distribution system, leading to waterborne disease outbreaks, which have caused significant cases of gastroenteritis throughout the world.

Turbidity also affects other water quality parameters such as colour, when it is imparted by colloidal particles as well as rise in temperature. The Turbidity concentration of the groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) located within the proposed project area in the wet season were 4.00FNU, 4.30FNU and 4.92FNU and the Turbidity concentration of groundwater samples from the groundwater at Oke Egan, Idi Iroko and Borehole (BH2) in dry seasonwere 2.04FNU, 4.10FNU and 4.11FNU. The Turbidity values were found to be in acceptable limit of NSDW and WHO limit of 5mg/L. There is currently little information regarding turbidity in groundwater and the cause is not fully understood. The common assumption is that turbidity in groundwater indicates a fast transport pathway connecting potentially contaminated surface water with the aquifer.

j. Nutrients (Nitrate, Sulphate and Phosphate)

Nutrients are essential for the growth of micro-organisms in groundwater. Excessive concentrations of nutrients in drinking water, however, promote bacterial growth, as well as imparting bitter taste (WHO 2011). High level of nutrients in groundwater is attributed to failing septic systems, excessive use of agriculture fertilizers, leachable from refuse dumps and industrial discharges. Nutrients level above the maximum permissible limits in drinking water, indicates pollution, and thus poses some health challenges (WHO 2011). Nitrate, Sulphate and Phosphate recorded concentrations of 2.00mg/L, 4.00mg/L and 0.23mg/L respectively in groundwater samples from Oke Egan, 1.91mg/L, 6.00mg/L and 0.21mg/L respectively in groundwater samples from Idi Iroko and 1.34mg/L, 6.00mg/L and 0.05mg/L respectively in groundwater samples from Borehole (BH2) in Wet Season. Nitrate, Sulphate and Phosphate recorded concentrations of 1.04mg/L, 5.00mg/L and 0.19mg/L respectively in groundwater samples from Oke Egan, 1.91mg/L, 0.00mg/L and 0.09mg/L in groundwater samples from Idi Iroko and 1.82mg/L, 5.00mg/L and 0.08 in groundwater samples from Borehole (BH2) in Dry Season.
The results of all samples revealed concentration within WHO limits.

k. Potassium (K)

Potassium is an essential element in humans and it is hardly found in groundwater at levels that could be a concern for healthy humans. It occurs widely in the environment, including all natural waters. It can also occur in drinking water as a consequence of the use of potassium permanganate as an oxidant in water treatment.

Although concentrations of potassium normally found in drinking water are generally low and do not pose health concerns, high solubility of potassium chloride and its use in treatment devices such as water softeners can lead to significantly increased exposure. Potassium concentration of groundwater samples from Oke Egan, Idi Iroko and Borehole (BH2) were 3.40mg/L, 3.53mg/L and 3.23mg/L in Wet Season. In the Dry Season, potassium concentration of groundwater samples was 4.11mg/L at Oke Egan, 3.21mg/L at Idi Iroko and 1.93mg/L at Borehole (BH).
Result of this study therefore indicates that K level in all the samples are within WHO permissible limits.

l. Lead (Pb)

Lead is a cumulative poison; toxic in small concentrations. Pb level in groundwater above WHO/FMEnv limits can cause lethargy, loss of appetite, constipation, anaemia, abdominal pain, gradual paralysis in the muscles, and death. Lead was not detected in any of the groundwater samples collected in both seasons.

m. Copper (Cu)

Copper is both an essential nutrient and a drinking-water contaminant. Cu concentrations in groundwater vary widely as a result of variations in water characteristics, such as pH, hardness and copper availability in the distribution system. Copper is an essential nutrient, but at high doses it has been shown to cause stomach and intestinal distress, liver, kidney damage and anemia (WHO, 2006). Copper concentration of Oke-Egan, Idi Iroko and Borehole (BH2) groundwater samples were 0.02mg/L, 0.02mg/L and 0.01mg/L in the Wet Season. In the Dry Season, copper concentration of the groundwater samples were 0.02mg/L, 0.03mg/L and 0.02mg/L at Oke-Egan, Idi Iroko and Borehole (BH2) respectively. Result of all samples showed concentration within WHO/NSDW permissible limits.

n. Iron

Iron is the second most abundant metal in earth's crust. It is an essential element in human nutrition. The minimum daily requirement of iron ranged from about 10 to 50 mg/day (FAO/WHO 1988). Iron can be a troublesome chemical in water supplies. Making up at least 5 percent of the earth’s crust, iron is one of the earth’s most plentiful resources. Rainwater as it infiltrates the soil and underlying geologic formations dissolves iron, causing it to seep into aquifers that serve as sources of groundwater for wells. Although present in drinking water, iron is seldom found at concentrations greater than 10 milligrams per liter (mg/L) or 10 parts per million. However, as little as 0.3 mg/l can cause water to turn a reddish brown color. High concentration can also promote growth of certain kinds of bacteria that clog pipes and well openings of boreholes. Iron concentration of the groundwater samples collected at Oke Egan, Idi Iroko and Borehole (BH2) in the wet seasonwere 1.22mg/L, 1.34mg/L and 1.00mg/L respectively. In the Dry Season, 1.32mg/L, 1.83mg/L and 1.03mg/L were recorded at Oke Egba, Idi Iroko and Borehole (BH2) groundwater samples. The concentrations of iron in all the samples were higher than WHO and NSDW limits.

o. Zinc

Zinc levels in groundwater normally do not exceed 0.05 mg/l. Zinc is found naturally at low concentrations in my rocks and soils principally as sulphide ores and to a lesser degree as carbonates. Most zinc is introduced into water by artificial pathways such as byproducts of steel production or coal –fired power station or from burning of waste materials, from fertilizer that may leach into groundwater. Zinc is considered an essential trace metal which functions as a catalyst for enzymatic activity in human bodies. Drinking water contains this trace metal in very small quantities which may reduce the possibility of its deficiency in the diet. However, its accumulation in the human body causes harmful effects such as stomach cramps, nausea, vomiting, decrease good cholesterol and acceleration of anemic conditions (Reda, 2016). Zinc concentration of groundwater samples at Oke Egan, Idi Iroko and Borehole (BH2) were 0.29mg/L, 0.31mg/L and 0.13mg/L in the Wet Season. In the Dry Season, concentration of groundwater samples were 0.39mg/L, 0.23mg/L and 0.29mg/L at Oke Egba, Idi Iroko and Borehole (BH2) respectively. The maximum permissible limit for Zn in drinking water is 3.0 mg/L as recommended by NSDW, 2007.

p. Cadmium

The Cadmium was only detected at groundwater sample collected from Oke Egan in the dry seasonwith a concentration of 0.03mg/L which is above FMEnv. limit of 0.01mg/L. Cadmium was not detected at Idi Iroko and Borehole (BH2) groundwater samples in both seasons.

q. Oil and Grease

The oil and grease content of groundwater samples collected at Oke Egan, Idi Iroko and borehole (BH2) were 0.03mg/L, 0.02mg/L and 0.02mg/L in Wet Season. In the Dry Season, the concentration of the groundwater samples were 0.00mg/L, 0.01mg/L and 0.04mg/L at Oke Egan, Idi Iroko and Borehole (BH2) respectively. Thus, the observed values of Oil and Grease in the ground water reflect an unpolluted environment.

4.15.4 Ground Water Microbiology

More than 95 percent of the world's available fresh water (excluding ice caps and glaciers) is groundwater. This ground water is valuable as a source of drinking water for most communities in the world, especially small ones. The groundwater in a drinking-water well may contain a wide variety of microbes without presenting a public health risk. However, groundwater in some areas becomes contaminated by the faecal material of humans and other animals.

This is a cause for concern because faecal material may contain pathogenic (disease-causing) microbes that can infect the intestinal tract of humans. Faecal pathogens may be bacterial, viral, or protozoan. Water containing faecal material may seep into the groundwater from the land surface or from underground sources of contamination. Major surface sources include, wastewater and bio solids from sewage treatment facilities that have been applied to land as a soil conditioner; seepage from shallow artificial ponds (lagoons) used for processing sewage; seepage from contaminated lakes and other surface-water bodies; urban runoff; faeces from cattle and other livestock operations; and improperly constructed sanitary landfills where trash and garbage are disposed. Faecal contamination also can reach the groundwater from underground sources, such as improperly functioning septic tank systems, underground reservoirs for liquid household sewage (cesspools), or leaking underground sewer lines.

y. *Total Heterotrophic Bacteria (THB)*

The most predominant bacterial genera found in the ground water samples is *Pseudomonas* which was present in 75% of the sampled ground water. Other bacteria genera found are *Proteus sp and Bacillus sp.* In the Wet Season, THB count at Oke Egan and Idi Iroko groundwater samples were 6.00cfu/ml and 5.00cfu/ml respectively. In the Dry Season, THB counts of groundwater samples at Oke Egan and Idi Iroko were 10.00cfu/ml and 10.00cfu/ml respectively. THB was not detected in the groundwater samples from Borehole (BH2) in first and Dry Season..

r. Hydrocarbon Utilizing Bacteria (HUB)

The hydrocarbon utilizing bacteria (HUB) was not detected in any of the ground water samples indicating no hydrocarbon contamination.

s. Total Heterotrophic Fungi (THF)

The total heterotrophic fungi (THF) was not detected in any of the ground water samples.

t. Hydrocarbon utilizing Fungi (HUF)

HUF was not detected in any of the ground water samples indicating that the ground water is not polluted with hydrocarbons.

Table 4.32: Microbiological Characteristics of Ground Water in the Study Area

Parameter **Sample Stations**	**Total Heterotrophic Bacteria**	**Count (cfu/ml)**	**Hydrocarbon Ultilising Bacteria**	**Count (cfu/ml)**	**Total Heterotrophic Fungi**	**Count (cfu/ml)**	**Hydrocarbon Ultilising Fungi**	**Count (cfu/ml)**
Wet Season								
GW1(@Oke Egan)	*Pseudomonas sp* *Proteus sp* *Bacillus sp*	6.00		Nil		Nil		Nil
GW2 (@Idi Iroko)	*Proteus sp* *Pseudomonas sp*	5.00		Nil		Nil		Nil
GW3 (@Borehole)		Nil		Nil		Nil		Nil
Dry Season								
GW1(@Oke Egan)	*Proteus sp Bacillus sp*	10.00		Nil		Nil		Nil
GW2 (@Idi Iroko)	*Pseudomonas sp* *Proteus sp*	10.00		Nil		Nil		Nil
GW3 (@Borehole)		Nil		Nil		Nil		Nil

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Plate 4.14 Sediment sample collection and Bentos studies

4.16 SEDIMENT CHARACTERISTICS

Sediment quality is an important aspect of aquatic ecosystems. It can influence the quality of overlying waters and also supports benthic communities. Monitoring the chemical content and physical composition of sediments provides information on how the environment is changing and the natural or human factors that may be linked to such changes.

Physico-chemical results of sediment samples obtained from ten (10) points within the study area (Epe and Lekki Lagoon) inclusive of two (2) control points are summarised in Table 4.33 below, details are presented in Appendix C.

Table 4.33: Physiochemical Characteristics of Sediments in the Study Area

PARAMETER		Wet Season				Dry Season				FMEnv. Limit
		Mean	Range	SDC (N)	SDC (S)	Mean	Range	SWC (N)	SWC (S)	
pH		6.38	6.00-6.80	30.10	33.20	6.475	6.00-6.90	7.00	7.01	6.0-9.0
PSD	Sand (%)	64.44	12.45-91.28	19.61	4.19	73.03	12.45-93.66	4.19	25.00	
	Silt (%)	12.12	0.44-45.78	57.76	65.87	11.32	1.00-45.78	65.87	63.10	
	Clay (%)	24.06	7.36-41.77	22.63	29.94	15.65	5.34-41.77	29.94	11.90	
Permeability (%)		2.65	2.1-3.2	2.30	2.50	2.39	2.30-2.50	2.40	2.60	
Oil & grease (mg/kg)		0.01	0.00-0.01	ND	0.01	0.02	0.00-0.02	ND	ND	
Acidity (mg/kg)		30.75	22.00-36.00	20.00	28.00	27.00	20.00-32.00	24.00	24.00	
Alkalinity (mg/kg)		26.25	18.00-32.00	32.00	36.00	22.50	16.00-28.00	28.00	32.00	
Sulphate (mg/kg)		99.10	75.90-117.28	56.98	55.27	92.35	69.25-110.29	50.26	53.06	
Nitrate (mg/kg)		32.63	20.25-58.69	12.74	18.36	30.53	18.36-51.70	11.89	15.73	
Chromium (mg/kg)		21.38	12.24-31.14	5.14	9.36	20.32	11.03-29.65	6.05	8.66	**0.006**
Cadmium (mg/kg)		5.95	2.58-8.21	4.25	4.89	5.50	2.33-7.59	4.60	7.49	**0.025**
Zinc (mg/kg)		20.30	12.58-26.35	10.11	12.39	19.91	12.74-25.63	9.52	11.09	**123-540**
Lead (mg/kg)		1.45	0.78-3.60	0.55	0.67	1.07	0.62-2.30	0.60	0.60	**35-170**
Iron (mg/kg)		199.74	25.14-298.36	114.45	112.37	199.97	26.30-300.30	125.00	119.30	
Mercury (mg/kg)				ND	ND			ND	ND	
Calcium (mg/kg)		23.20	12.45-29.71	12.12	14.55	21.43	11.70-28.90	11.85	13.69	
Sodium (mg/kg)		20.77	14.88-31.24	9.65	10.24	20.48	14.60-30.50	8.66	10.71	
Potassium (mg/kg)		22.14	6.99-107	10.90	10.45	10.20	7.11-12.80	11.29	10.76	
Magnesium (mg/kg)		54.62	36.99-96.25	24.25	29.63	51.84	34.80-89.46	23.90	30.28	
TOC (%)		1.83	1.03-2.35	1.17	1.16	1.86	1.12-2.47	1.26	1.32	

Bulk Density (g/cm3)	1.59	1.25-1.90	1.60	1.37	1.62	1.50-1.80	1.70	1.50	
Moisture Content (%)	32.27	27.85-43.21	28.29	27.45	32.00	26.80-42.80	28.77	26.19	
Total hydrocarbon content (mg/kg)	0.03	0.00-0.05	ND	ND	0.015	0.00-0.02	ND	ND	
CEC (meg/100g)	4.0175	3.26-5.49	2.01	2.31	3.85	3.14-5.19	1.96	2.35	

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a. pH

The pH of the sediment samples obtained from the study area range between 6.00 and 6.80, in the wet season and from 6.00 to 6.90 in the dry season. The pH values show that the sediment samples are acidic in nature. Values obtained compared well with control points.

b. Total Organic Carbon

Total Organic Carbon (TOC) measured in the sediment samples range between 1.03 and 2.35% in the wet season and between 1.12 and 2.47% in the dry season. TOC values recorded compared well with control point values.

c. Total Hydrocarbon Content

Total hydrocarbon content (THC) concentration recorded range from 0.00mg/kg to 0.05mg/kg (wet season). Dry season was from 0.00mg/kg to 0.02mg/kg. Low levels of THC suggest little or no hydrocarbon in the sediment.

d. Particle Size Distribution

Sediment particle size distribution (PSD) investigations carried out on samples obtained shows that sand was the most dominant particle, followed by clay and lastly by silt in both wet and dry seasons.

e. Nutrients ***and Heavy Metals***

Sediment nutrient (Sulphate and Nitrate) and heavy metal (Zinc, Lead, Chromium and Iron) concentrations did not vary much over the two seasons. Respective parameter concentrations were also similar to control point concentrations.

Sediment Microbial Characteristics

Bacteria and fungi load analysed in sediment samples from the study area are presented below in Table 4.34

Table 4.34: Microbiological Characteristics of Sediments in the Study Area

Parameter / Sample Stations	Total Heterotrophic Bacteria	Count (cfu/g)	Hydrocarbon Ultilising Bacteria	Count (cfu/g)	Total Heterotrophic Fungi	Count (cfu/g)	Hydrocarbon Ultilising Fungi	Count (cfu/g)	Total Coliform	Count (cfu/g)
Wet Season										
SD10	*Pseudomonas sp Proteus sp Bacillus sp*	1.1×10^1	*Pseudomonas sp Bacillus sp*	31	*Aspergillus Cladosprium sp*	2.1×10^2	*Aspergillus*	2	*Pseudomonas Bacillus sp*	2.0
SD11	*Proteus sp Pseudomonas sp*	1.1×10^1	*Pseudomonas sp*	18	*Candida sp Aspergillus sp*	2.6×10^2	*Aspergillus sp Candida sp*	4	*Pseudomonas sp*	1.9
SD12	*Pseudomonas sp Proteus sp Bacillus sp*	2.0×10^2	*Pseudomonas sp*	15	*Penicillium sp Aspergilus sp Rhizopus sp*	2.6×10^2	*Rhizopus sp*	3	*Pseudomonas sp Bacillus sp*	2.1
SD13	*Proteus sp Pseudomonas sp*	1.1×10^1	*Pseudomonas sp Bacillus sp*	19	*Aspergillus Cladosprium sp*	4.0×10^2	*Aspergillus sp Candida sp*	6	*Pseudomonas sp*	4.0
SD14	*Pseudomonas sp Proteus sp Bacillus sp*	2.1×10^1	*Pseudomonas sp*	20	*Candida sp Aspergillus sp*	1.6×10^2	*Aspergillus sp Candida sp*	8	*Pseudomonas sp Bacillus sp*	6.0
SD15	*Proteus sp Pseudomonas sp*	2.6×10^1	*Pseudomonas sp*	14	*Penicillium sp Aspergilus sp Rhizopus sp*	1.4×10^2	*Rhizopus sp Candida sp*	7	*Pseudomonas sp*	4.0
SD16	*Pseudomonas sp Proteus sp Bacillus sp*	1.3×10^2	*Pseudomonas sp Bacillus sp*	16	*Aspergillus Cladosprium sp*	2.2×10^2	*Aspergillus Candida sp*	8	*Pseudomonas sp Bacillus*	8.0

									sp	
SD17	*Proteus sp Pseudomonas sp*	1.5×10^1	*Pseudomonas sp*	12	*Candida sp Aspergillus sp*	2.8×10^2	*Aspergillus sp Candida sp*	6	*Pseudomonas sp*	5.2
SDC (South)	*Pseudomonas sp Proteus sp Bacillus sp*	1.4×10^1	*Pseudomonas sp*	10	*Penicillium sp Aspergilus sp Rhizopus sp*	1.1×10^2	*Rhizopus sp*	10	*Pseudomonas sp Bacillus sp*	6.0
SDC (North)	*Proteus sp Pseudomonas sp*	1.2×10^1	*Pseudomonas sp Bacillus sp*	11	*Aspergillus Cladosprium sp*	2.2×10^2	*Aspergillus*	11	*Pseudomonas sp*	6.0
Dry Season										
SD10	*Proteus sp Bacillus sp*	10	*Pseudomonas sp Bacillus sp*	29	*Aspergillus Cladosprium sp*	180	*Aspergillus*	1	*Bacillus sp*	3.0
SD11	*Pseudomonas sp Proteus sp*	10	*Pseudomonas sp*	16	*Candida sp Aspergillus sp*	230	*Aspergillus sp Candida sp*	3	*Pseudomonas sp*	2.0
SD12	*Pseudomonas sp Proteus sp Bacillus sp*	120	*Pseudomonas sp*	14	*Penicillium sp Aspergilus sp Rhizopus sp*	210	*Rhizopus sp*	4	*Pseudomonas sp Bacillus sp*	1.0
SD13	*Proteus sp Pseudomonas sp*	13	*Pseudomonas sp Bacillus sp*	16	*Aspergillus Cladosprium sp Rhizopus sp*	360	*Aspergillus*	5	*Pseudomonas sp*	3.0
SD14	*Pseudomonas sp Proteus sp Bacillus sp*	19	*Pseudomonas sp*	18	*Candida sp Aspergillus sp*	150	*Aspergillus sp Candida sp*	7	*Pseudomonas sp Bacillus sp*	5.0

SD15	*Proteus sp Pseudomonas sp*	24	*Pseudomonas sp*	15	*Penicillium sp Aspergilus sp*	120	*Rhizopus sp*	8	*Pseudomonas sp*	5.0
SD16	*Pseudomonas sp Proteus sp Bacillus sp*	110	*Pseudomonas sp Bacillus sp*	13	*Aspergillus Cladospriu m sp*	200	*Aspergillus*	7	*Pseudomonas sp Bacillus sp*	7.0
SD17	*Proteus sp Pseudomonas sp*	14	*Pseudomonas sp*	14	*Candida sp Aspergillus sp*	240	*Aspergillus sp Candida sp*	6	*Pseudomonas sp*	5.0
SDC (South)	*Pseudomonas sp Proteus sp Bacillus sp*	12	*Pseudomonas sp*	9	*Penicillium sp*	90	*Rhizopus sp*	9	*Pseudomonas sp Bacillus sp*	7.0
SDC (North)	*Proteus sp Pseudomonas sp*	9	*Pseudomonas sp Bacillus sp*	12	*Aspergillus Cladospriu m sp*	200	*Aspergillus*	12	*Pseudomonas sp*	5.0

a. Total Heterotrophic Bacteria

Total Heterotrophic bacterial populations in the sediment sample obtained from the study area ranged from 110.00cfu/g and 260.00cfu/g in the wet season, and from 9.00cfu/g and 2.00cfu/g in the dry season. Values recorded correspond to those from control point. Hydrocarbon utilising bacteria range from 10 to 3,900cfu/g (dry season), wet season range from 10 to 900cfu/g. The predominant bacteria species encountered in the sediment samples were *Pseudomonas, Bacillus and Proteus* species. Values recorded were similar to control point.

b. Hydrocarbon Ultilizing Bacteria

Hydrocarbon Utilizing Bacteria ranged between 10.00cfu/g and 31.00cfu/g in wet season and between 9.00 and 29.00cfu/g in the Dry Season. The predominant bacteria species encountered in the sediment samples were *Pseudomonas and Bacillus* species. Values recorded were similar to control point.

c. Total Heterotrophic Fungi

Heterotrophic fungi count in the area range between 110 and 400cfu/g for wet season and from 120 to 360cfu/g for dry season. Similar counts were recorded in control point. Predominant fungal species include *Candida, Rhizopus and Aspergillus species.*

d. Hydrocarbon Ultilizing Fungi

Hydrocarbon utilising fungi (HUF) count range between 2 and 11cfu/g in the wet season and from 1 to 8cfu/g in the dry season. Results were similar to control point. Predominant fungal species include *Candida, Rhizopus and Aspergillus species.*

e. Total Coliform

The Coliform of the surface water sediments in the area ranged between 1.9cfu/g and 8cfu/g in the wet season and fbetween 1.0 and 7.0cfu/g in the dry season. Similar counts were recorded in control point.

4.17 SOIL QUALITY

Soil provides water, nutrients and anchorage for plants and trees in natural forests and grasslands, annual and perennial crops and planted grassland. It also provides the habitat for decomposer organisms which have an essential role in the cycling of carbon and mineral nutrients. Soil degradation occurs as a result of human activities such as dumping of solid waste, construction (road and building), and industrial activities. The activities that are likely to affect the soil quality includes construction of access road, transportation of equipment and other materials needed for construction and indiscriminate dumping of waste by the construction worker. Mitigation measures will be provided for these impacts in chapter six.

4.17.1 Soil Sampling

A total of forty (40Nos) soil samples were collected within the proposed project site and one (1No) control soil sample. At each sampled point, soil samples were collected at two depths (0-15cm for top soil and 15-30cm for sub soil). This operation was carried out with the aid of stainless steel Dutch auger (Plate 4.15).

Plate 4.15: Soil sample collection using soil auger

Each sample was collected in polyethylene bags, McCartney bottles and foil, labelled appropriately, and stored in a cooler ready for transportation to an FMEnv. accredited laboratory LACH Consult and Scientific Support Limited, Block D6 Small Scale Industrial Estate, Fatai Atere Way, Matori Ladipo Mushin Lagos.

The physico-chemical characteristics of soil samples obtained from forty (40) points and one (1) control point within the study area after insitu/ laboratory measurement and analyses is summarised in Table 4.35 below. Details of the results are presented in Appendix C.

Table 4.35: Soil Physico-chemical Characteristics

PARAMETER		Depth	Wet Season Mean	Wet Season Range	Wet Season C1	Dry Season Mean	Dry Season Range	Dry Season C1	FMEnv. Limit
pH		0-15cm	5.63	4.93-6.01	5.08	5.83	5.40-6.10	5.47	5.0-8.0
		15-30cm	5.48	4.80-6.01	5.00	5.71	5.00-6.60	5.60	
PSD	Sand (%)	0-15cm	60.86	28.28-81.82	31.46	62.50	8.22-85.15	24.32	
		15-30cm	60.27	27.04-80.12	30.98	60.39	8.00-85.00	24	
	Silt (%)	0-15cm	21.50	7.69-53.56	66.29	17.87	2.27-70.27	49.64	
		15-30cm	21.69	7.00-55.33	65.83	16.84	2.21-70.00	48.89	
	Clay (%)	0-15cm	17.61	6.53-47.73	2.25	19.63	2.38-45.74	26.04	
		15-30cm	17.37	8.88-46.90	2.02	18.66	2.25-45.56	25.54	
Permeability		0-15cm	2.64	2-4	2.50	3.75	2.10-26.00	2.40	
		15-30cm	2.49	1.9-3.5	2.10	3.91	2.00-24.23	2.20	
Oil & grease		0-15cm	0.50	0.03-1.93	0.94	0.55	0.08-1.40	1.00	
		15-30cm	0.43	0.01-1.8	0.45	0.50	0.08-1.25	1.00	
Acidity		0-15cm	61.37	32.8-550.6	48.20	48.28	28.00-68.00	44.00	
		15-30cm	58.76	23.9-520.3	45.10	47.43	30.00-58.00	45.00	
Alkalinity		0-15cm	28.45	8.9-120.3	22.80	24.38	18.00-36.00	22.00	
		15-30cm	27.61	8-120	21.40	25.62	15.00-36.00	24.00	
Sulphate		0-15cm	164.09	83.9-250	182.00	157.87	86.35-197.25	187.00	
		15-30cm	163.35	80.3-220	162.00	157.92	77.00-192.30	192.00	
Nitrate		0-15cm	31.59	19.8-52.9	19.70	31.27	20.10-49.87	21.00	

	15-30cm	30.75	19.9-50	19.20	30.27	22.40-46.50	22.00	500
Chromium	0-15cm	33.33	21.7-56.1	21.10	30.90	21.00-54.28	23.00	
	15-30cm	33.22	20-56	23.00	31.12	20.65-54.00	20.00	
Cadmium	0-15cm	17.41	5.02-112.81	12.07	18.14	7.14-100.25	13.69	
	15-30cm	17.17	5-111.98	11.50	18.13	6.20-104.00	10.30	
Zinc	0-15cm	85.59	26.98-212.9	68.91	92.06	46.90-163.25	64.28	140
	15-30cm	84.21	26-197.6	66.90	93.20	51.00-171	72.30	
Lead	0-15cm	10.08	2.95-14.11	8.92	10.05	3.98-12.87	9.08	85
	15-30cm	9.93	3.05-15.02	10.10	9.67	3.21-13.20	9.00	
Iron	0-15cm	422.15	100.7-752.9	422.70	411.23	99.45-645.00	432.00	30,000
	15-30cm	410.72	110.1 -755.5	420.30	402.06	56.90-632.00	420.00	
Mercury	0-15cm			ND			ND	
	15-30cm			ND			ND	
Calcium	0-15cm	33.16	18.34-56.2	23.95	34.07	25.80-46.20	25.46	
	15-30cm	32.17	20-56	23.00	34.41	23.30-46.00	25.00	
Sodium	0-15cm	26.77	17.3-54.12	25.50	29.19	19.80-52.10	26.78	
	15-30cm	25.57	15.2-52.2	23.50	31.21	20.00-50.78	29.20	
Potassium	0-15cm	16.63	9.78-26.9	11.42	16.87	10.28-26.30	11.59	
	15-30cm	16.38	9.4-28	10.40	16.68	10.00-30.30	10.00	
Magnesium	0-15cm	97.55	67.9-124.6	99.03	97.29	69.10-124.00	100.00	
	15-30cm	96.09	71.1-124.1	100.02	95.28	46.50-131	100.00	
TOC	0-15cm	0.98	0.02-2.93	1.76	1.42	0.31-3.00	1.80	
	15-30cm	0.98	0.01-2.43	1.34	1.48	0.52-3.00	1.69	
Bulk Density	0-15cm	1.50	0.94-1.98	1.36	1.62	1.35-1.81	1.60	
	15-30cm	1.43	0.55-1.92	1.46	1.54	0.90-2.00	1.00	
Moisture	0-15cm	39.22	27.4-55.99	28.36	38.23	31.5-52.55	29.50	

Content	15-30cm	38.73	26.9-55.33	28.00	36.97	30.00-49.30	23.00	
Total hydrocarbon content	0-15cm	1.33	0.96-2.94	1.11	1.27	1.00-1.57	1.28	
	15-30cm	1.28	1.00-3.02	1.04	1.33	1.00-2.00	1.20	
CEC	0-15cm	1.37	0.96-2.11	1.96	1.47	1.18-1.86	1.39	
	15-30cm	1.34	0.92-2.05	1.30	1.46	0.50-2.00	1.30	

Physico-chemical Characteristics of Soil

a. Colour

Soil colour is influence by moisture. The colour of the soil samples collected were mostly gray, brown and black.

b. Moisture content

Percentage moisture content ranged from 27.40 – 55.99% with mean value of 39.22% (topsoil) and 26.90 – 55.33% with mean value of 38.73% (subsoil) in the wet season and 31.50 – 52.55% with mean value of 38.23% (topsoil) and 30.00 – 49.30% with mean value of 36.97% (subsoil) in the Dry Season. The soil moisture varied across the soil depths and the values were similar when compared to control point values.

c. pH

The mean values of the pH were 5.63 (Top soil) and 5.48 (Sub soil) in the wet season and 5.83 (Top soil) and 5.71 (Sub soil) in the dry season respectively. The soil pH of the proposed project area were slightly acidic. The soil pH reduced across the soil depths and within the limits set by WHO/FMEnv. There is no significant variation in the pH of the soil samples in both seasons.

d. Soil texture

Soil texture is based upon the arbitrary division of the soil into three size fractions: sand, silt and clay. If one of these fractions dominates the grain size composition of a soil, the name of that fraction is included in the name of the soil texture. The textural analysis results of the soil of the project area revealed the soil to vary between Silty Loam, Sandy Clay Loam and Sandy Loam for both season.

e. Bulk density

Bulk density is defined as mass of oven-dry soil per unit volume, and depends on the densities of the constituent soil particles (clay, organic matter etc.), and their packing and arrangement into peds. Values of bulk density range from < 1 Mg/m^3 for soils rich in organic matter, to 1.0-1.4 for well aggregated loamy soils, to 1.2 – 1.8 for sands and compacted horizons in clay soils (White, 2006). The Bulk density of the soil collected ranged from 0.94 – 1.98g/cm^3 with mean value of 1.50g/cm^3 (topsoil) and 0.55 – 1.92 g/cm^3 with mean value of 38.73g/cm^3(subsoil) in the wet season and 1.35 – 1.81 g/cm^3 with mean value of 1.62g/cm^3(topsoil) and 0.90 – 2.00 g/cm^3 with mean value of 1.54g/cm^3 (subsoil) in the Dry Season.

f. Cation Exchange Capacity

The mineral and organic colloid of soils exhibits a negative charge which attracts and holds cations in such a way as to be exchangeable with other cations. The extent of this negative charge present in a soil is called the Cation Exchange Capacity of the soil and is usually expressed in milliequivalents per 100 g of oven-dry soil. The Cation Exchange Capacity of a soil, however, is not a unique value, for it is dependent, to some extent, on the cation species and on the pH of the saturating solution used in its determination. The CEC of tropical soils is due primarily to the organic matter, since tropical soils contain negligible amounts of vermiculite (125 – 175 meq/100g) and montmorillonite (75 – 125 meq/100 g). For humus and kaolinite, the CEC ranged between 150 – 400 meq/100 g and 2 – 5 meq/100 g respectively. The CEC of the soil collected ranged from 0.96– 2.11 meq/100 g with mean value of 1.37meq/100g (topsoil) and 0.92 – 2.05 meq/100 g with mean value of 1.34meq/100g (subsoil) in the wet season and 1.18 – 1.86 meq/100 g with mean value of 1.47meq/100g (topsoil) and 0.50 – 2.00 meq/100g with mean value of 1.46meq/100g (subsoil) in the Dry Season.

g. Nitrate

All sampled points recorded Nitrate concentration below the WHO/FMEnv. limit (USDA 2007). The influencing factors for the occurrence of Nitrate in the soil may be attributed to the intensification of agricultural activities such as use of fertilizers and land- use practices. Nitrate in the soil samples ranged from 19.80 – 52.90mg/kg (topsoil) and 19.90 – 50.00mg/kg (subsoil) in the wet season and 20.10 – 49.87mg/kg (topsoil) and 22.40 – 46.50mg/kg (subsoil) in the Dry Season

h. Total Organic Carbon (TOC)

The Total Organic Carbon of the soil samples ranged from 0.02 – 2.93% with mean value of 0.98%(topsoil) and 0.01 – 2.43% with mean value of 0.98%(subsoil) in the wet season and 0.31–3.00% with mean value of 1.42% (topsoil) and 0.52 – 3.00% with mean value of 1.48% (subsoil) in the Dry Season.

i. Sodium (Na) and Potassium (K)

The sodium and potassium content of the soil samples ranged from 17.30 – 54.12 mg/kg (Top soil), 15.20 – 52.20 mg/kg (Sub soil) and 9.78– 26.90 mg/kg (Top soil), 9.40 – 28.00mg/kg (Sub soil) in the wet season while in the Dry Season, sodium and potassium of the soil samples ranged from 19.80– 52.10 mg/kg (Top soil), 20.00 – 50.78mg/kg (Sub soil) and 10.28 – 26.30mg/kg (Top soil), 10.00 – 30.30mg/kg (Sub soil) respectively.

j. Hydrocarbons

The oil and grease content of the soil ranged from 0.03 mg/kg to 1.93mg/kg for top soil and ranged from 0.01-1.80mg/kg in the wet season and 0.08 mg/kg to 1.40mg/kg for top soil and ranged from 0.08-1.25mg/kg for sub soil in the Dry Season, while total hydrocarbon content ranged from 0.96 mg/kg to 2.94 mg/kg for top soil and ranged from 1.00-3.02mg/kg for sub soil in the wet seasonand 1.00 mg/kg to 3.10 mg/kg for both soil depth in the Dry Season.

Total petroleum hydrocarbon values obtained in this study were lower than 50 mg/kg DPR Target value and more so, it has been widely reported that soils with a hydrocarbon level below 100 mg/kg are considered unpolluted (Concawe, 1975).

k. Heavy metals

The concentration of Zinc in the soil samples ranged from 26.98 – 212.90mg/kg for top soil and ranged from 26.00-197.60mg/kg for sub soil in the wet season. In the dry season, Zinc concentration ranged from 46.90 – 163.25mg/kg for top soil and ranged from 51.00-171.00mg/kg for sub soil. The concentration of Lead in the soil samples ranged from 0.00 – 14.11mg/kg for top soil and 0.00-15.02mg/kg for sub soil in the wet season while in the dry season it ranged from 3.98 – 12.87mg/kg for top soil and 3.21-13.20mg/kg for sub soil. The concentration of Iron in the soil samples ranged from 100.70 – 752.90mg/kg for top soil and 110.10-755.50mg/kg for sub soil in the wet season while in the dry season it ranged from 99.45 – 645.00mg/kg for top soil and 56.90-632.00mg/kg for sub soil. Mercury was not detected in any of the soil samples collected. The concentrations of the heavy metals such as Zn, Pb and Fe analysed were low when compared to WHO/FMEnv. Limit (USDA 2007**)** thus there is no evidence of heavy metal accumulation in the soil as at the time of the field investigation.

4.17.2 Soil Microbiology

Soil microorganisms are very important as almost every chemical transformation taking place in soil involves active contributions from soil micro-organisms. In particular, they play an active role in soil fertility as a result of their involvement in the cycle of nutrients like carbon and nitrogen, which are required for plant growth. For example, soil micro-organisms are responsible for the decomposition of the organic matter entering the soil (e.g. plant litter) and therefore in the recycling of nutrients in soil.

Soil is generally made up of five major components such as mineral matter, water, air, organic matter and living organisms and the quantity of each of these constituents vary from one locality to another. “The five major groups of micro-organisms present in soil include: Bacteria, *Actinomycetes*, Fungi, Algae and Protozoa and the soil ecosystem include these microbial groups as well as the organic and the inorganic constituents of a given site. For the purpose of the present study, we are interested only in those microbial groups that have the potential to degrade and detoxify complex organic compounds that may be present in the soil and these microbial groups are basically “Bacteria and Fungi”.

Naturally, “the bacterial populations in soil are usually higher than those of fungi”, however because of their small size in relation to large size and extensive filament of Fungi and other groups. In a well aerated soil, both bacteria and fungi are present, however, if limited oxygen conditions prevail, bacteria accounts for most of the microbial community biomass. Numerically, Fungi are much less than bacteria in soil, but are the major contributor to soil biomass because of their large size.

Table 4.35 shows the microbial counts species diversity of the soil of the study area. The total heterotrophic bacterial count (THB) of these soils ranged from $0.1x10^2$cfu/g to $3.0\ x10^2$cfu/g in the wet seasonand 40.00cfu/g to 330.00cfu/g in the Dry Season. Lower counts were recorded at sub soil while the higher counts were recorded at top soil as a result of the presence of more organic content, air and moisture at the surface soil require for growth. The Hydrocarbon Utilizing Bacteria (HUB) counts ranged from 13.00cfu/100g to 39.00cfu/g in the wet seasonand 10.00cfu/g to 33.00cfu/g in the Dry Season.

The Total Heterotrophic Fungi (THF) ranged from $3.1x10^2$cfu/g to $9.0x10^2$cfu/g in the wet seasonand 30.00cfu/g to 800.00cfu/g in the dry seasonfor both top soil and sub soil. The Total Hydrocarbon Utilizing Fungi (HUF) ranged from 6.00cfu/g to 18.00cfu/g in in the wet seasonfor both the top soil and sub soil and 3.00cfu/g to 15.00cfu/g in the dry seasonfor both top soil and sub soil. Total Coliform ranged from <2cfu/g to 28.00cfu/g in the wet seasonfor both top soil and sub soil, and 1.00cfu/g to 20.00cfu/g in the dry seasonfor both top soil and sub soil.

The most predominant Heterotrophic bacteria species isolated in the area are the *Pseudomonas sp* and *Bacillus species*. However a wide range of other genera of bacteria were found and these include: *Enterobacter*, *Serratia*, *Alcaligene*, *Micrococcus*, *Arthrobacter*, *Citrobacter*, *Proteus*, *Enterobacter*, *Klebsiella*, *Streptococcus fecalis* and *Escherichia coli*. The presence of *Escherichia coli* indicates the presence of fecal contamination in some of the soil sampled. *Streptococcus fecalis* was also found in some of the soil samples. The most predominant Heterotrophic Fungi genera encountered in the area is *Rhizopus* and *Aspergillus.* Other genera present include *Geotrichum, Candida, Penicillium, Cladosporium, Rhodotorula, Cuvularia, Mucor* and *Trichoderma.*

Majority of the soil samples analyzed especially the surface soil recorded relatively high concentrations of total heterotrophic Bacteria (THB). The corresponding hydrocarbon utilizing bacterial counts (HUB) were however low, same is applicable to hydrocarbon utilizing fungal counts (HUF). A lower concentration of hydrocarbon utilising bacterial (HUB) species is a clear evidence of insignificant concentrations of hydrocarbons in majority of the soil samples. Also, the load of the hydrocarbon utilizing fungi (HUF) was however low suggesting no hydrocarbon contamination of the study area. The heterotrophic microbial load is suggestive of relatively high amount of biodegradable organic matter in the soil of the study area. The hydrocarbon utilizing bacteria genera isolated in the area *include Bacillus, Pseudomonas, Micrococcus* and *Alcaligene* while the hydrocarbon utilizing fungi genera include *Rhizopus, Mucor* and *Candida*.

Table 4.36: Microbiological Characteristics of Soil in the Study Area

Sample	Depth	Total Heterotrophic Bacteria (THB)	Counts (cfu/g)	Hydrocarbon utilizing Bacteria (HUB)	Counts (cfu/g)	Total Heterotrophic Fungi (THF)	Counts (cfu/g)	Hydrocarbon Utilizing Fungi (HUF)	Counts (cfu/g)	Coliform	Counts (cfu/g)
SS1	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	2.1×10^2	*Bacillus Pseudomonas*	25	*Aspergillus Penicillium*	6.6×10^2	*Mucor*	10	*Enterobacter*	2.5
	15 – 30cm	*Pseudomonas Serratia Enterobacter*	2.0×10^2	*Pseudomonas*	23	*Geotricum Penicillium Mucor Rhizopus*	6.2×10^2	*Mucor Rhizopus*	10	*Enterobacter*	2.2
SS2	0 – 15cm	*Alcaligene Pseudomonas Enterobacter*	1.1×10^2	*Pseudomonas Alcaligene*	28	*Trichoderma Rhizopus*	7.0×10^2	*Rhizopus*	12	*Enterobacter*	12.0
	15 – 30cm	*Pseudomonas Proteus*	1.0×10^2	*Pseudomonas*	22	*Trichoderma Rhizopus*	6.8×10^2	*Rhizopus*	11	*Enterobacter*	12.0
SS3	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	2.2×10^2	*Pseudomonas Bacillus*	34	*Aspergillus Cladosporium Rhizopus*	5.9×10^2	*Rhizopus*	7	*Klebsiella Enterobacter*	15.0
	15 – 30cm	*Proteus Pseudomonas Klebsiella Bacillus*	2.2×10^2	*Bacillus Pseudomonas*	33	*Aspergillus Cladosprium Rhizopus*	5.5×10^2	*Rhizopus*	5	*Klebsiella*	14.0
SS4	0 – 15cm	*Proteus Alcaligene Bacillus Enterobacter*	2.4×10^2	*Bacillus Acaligene*	28	*Aspergillus Penicillium Candida*	5.2×10^2	*Candida*	11	*Enterobacter*	9.0
	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	2.2×10^2	*Bacillus Alcaligene*	22	*Aspergillus Penicillium Candida*	5.3×10^2	*Candida*	9	*E.coli, Enterobacter*	8.5
SS5	0 – 15cm	*Pseudomonas Micrococus Enterobacter*	1.8×10^2	*Pseudomonas Micrococcus*	20	*Cuvularia Aspergillus Mucor*	6.1×10^2	*Mucor*	12	*Enterobacter*	13.0

		Serratia									
	15 – 30cm	*Pseudomonas Proteus Enterobacter*	1.5 x 10^2	*Pseudomonas Micrococcus*	20	*Aspergillus Cuvularia Rhizopus*	6.0 x 10^2	*Rhizopus*	13	*Enterobacter*	13.0
SS6	0 – 15cm	*Pseudomonas Arthrobacter E.coli, Proteus Bacillus*	2.1 x 10^2	*Pseudomonas Bacillus*	19	*Aspergillus Geotrichum Rhizopus*	5.1 x 10^2	*Rhizopus*	12	*E.coli, Enterobacter*	19.0
	15 – 30cm	*Pseudomonas Proteus Arthrobacter Bacillus*	2.2 x 10^2	*Pseudomonas Bacillus*	18	*Aspergillus Cuvularia Rhizopus*	5.0 x 10^2	*Rhizopus*	11		18.0
SS7	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	0.8 x 10^2	*Bacillus Pseudomonas*	39	*Cuvularia Aspergillus Penicillium Rhizopus*	6.0 x 10^2	*Rhizopus*	9	*Enterobacter*	10.0
	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	0.5 x 10^2	*Pseudomonas*	35	*Rhodotorula Rhizopus*	6.0 x 10^2	*Rhodotorula Rhizopus*	6	*Enterobacter*	10.0
SS8	0 – 15cm	*Bacillus Erwinia Pseudomonas*	3.0 x 10^2	*Bacillus Pseudomonas*	35	*Cuvularia Mucor Geotrichum Pencillium*	4.9 x 10^2	*Mucor*	10		11.0
	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	2.9 x 10^2	*Pseudomonas Micrococcus*	33	*Aspergillus Cuvularia Mucor Rhizopus*	4.5 x 10^2	*Mucor Rhizopus*	10		10.0
SS9	0 – 15cm	*Alcaligene Pseudomonas Ecoli Streptococcus fecalis Micrococcus*	2.3 x 10^2	*Alcaligene Pseudomonas Bacillus Micrococcus*	34	*Penicillium Mucor Aspergillus*	7.0 x 10^2	*Mucor*	10	*Ecoli Streptococcus fecalis*	10.0

	15 – 30cm	*Ecoli Pseudomonas Proteus*	2.2 x 10^2	*Pseudomonas*	32	*Penicillium Mucor Aspergillus*	7.0 x 10^2	*Mucor*	10	*Ecoli*	10.0
SS10	0 – 15cm	*Pseudomonas proteus Serratia Enterobacter Bacillus*	0.9 x 10^2	*Pseudomonas Bacillus*	27	*Penicillium Cuvularia Rhizopus Mucor*	6.2 x 10^2	*Rhizopus Mucor*	12	*Enterobact er*	4.0
	15 – 30cm	*Pseudomonas Bacillus Enterobacter Proteus*	1.2 x 10^2	*Pseudomonas Bacillus*	25	*Penicillium Cuvularia Rhizopus*	6.0 x 10^2	*Rhizopus*	11	*Enterobact er*	3.0
SS11	0 – 15cm	*Bacillius Proteus citrobacter Klebsiella*	3.1 x 10^2	*Bacillus*	23	*Aspergillus Geotrichum Rhizopus*	5.8 x 10^2	*Rhizopus*	13	*citrobacter Klebsiella*	24.0
	15 – 30cm	*Proteus Citrobacter Bacillus Klebsiella*	2.8 x 10^2	*Bacillus*	22	*Aspergillus Rhizopus*	5.4 x 10^2	*Rhizopus*	12	*Citrobacter Klebsiella*	22.0
SS12	0 – 15cm	*Bacillus Proteus Pseudomonas E. coli*	2.0 x 10^2	*Bacillus Pseudomonas*	20	*Rhizopus*	9.0 x 10^2	*Rhizopus*	18	*E. coli*	26.0
	15 – 30cm	*E. coli Bacillus Proteuss*	2.2 x 10^2	*Bacillus*	20	*Geotrichum Rhizopus*	8.2 x 10^2	*Rhizopus*	15	*E. coli*	25.0
SS13	0 – 15cm	*Alcaligene Pseudomonas Arthrobacter*	2.5 x 10^2	*Alcaligene Pseudomonas*	19	*Trichodenma Rhizopus Mucor*	8.1 x 10^2	*Mucor Rhizopus*	12	*Arthrobact er*	28.0
	15 – 30cm	*Pseudomonas Proteus Artrobacter*	2.2 x 10^2	*Pseudomonas*	18	*Trichoderma Rhizopus*	7.3 x 10^2	*Rhizopus*	12	*Arthrobact er*	28.0
SS14	0 – 15cm	*Bacillus Erwinia Pseudomonas*	2.0 x 10^2	*Bacillus Pseudomonas*	28	*Aspergillus Penicillium*	7.2 x 10^2	*Mucor*	10	*Pseudomon as*	3.0

	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	2.1 x 10^2	*Pseudomonas*	25	*Geotricum Penicillium Mucor Rhizopus*	7.6 x 10^2	*Mucor Rhizopus*	10	*Pseudomonas*	3.0
SS15	0 – 15cm	*Bacillus Erwinia Pseudomonas*	2.6 x 10^2	*Pseudomonas Alcaligene*	30	*Trichoderma Rhizopus*	4.9 x 10^2	*Rhizopus*	9	*Pseudomonas*	4.0
	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	2.3 x 10^2	*Pseudomonas*	30	*Trichoderma Rhizopus*	4.4 x 10^2	*Rhizopus*	8	*Pseudomonas*	3.0
SS16	0 – 15cm	*Alcaligene Pseudomonas Ecoli Streptococcus fecalis Micrococcus*	0.1 x 10^2	*Pseudomonas Bacillus*	32	*Aspergillus Cladosporium Rhizopus*	6.1 x 10^2	*Rhizopus*	6	*Ecoli Streptococcus fecalis*	7.0
	15 – 30cm	*Ecoli Pseudomonas Proteus*	0.1 x 10^2	*Bacillus Pseudomonas*	30	*Aspergillus Cladosprium Rhizopus*	5.8 x 10^2	*Rhizopus*	7	*Ecoli*	7.0
SS17	0 – 15cm	*Pseudomonas proteus Serratia Enterobacter Bacillus*	2.2 x 10^2	*Bacillus Acaligene*	31	*Aspergillus Penicillium Candida*	6.5 x 10^2	*Candida*	12	*Enterobacter*	11.0
	15 – 30cm	*Pseudomonas Bacillus Enterobacter Proteus*	2.1 x 10^2	*Bacillus Alcaligene*	29	*Aspergillus Penicillium Candida*	5.5 x 10^2	*Candida*	10	*Enterobacter*	10.0
SS18	0 – 15cm	*Bacillius Proteus citrobacter Klebsiella*	2.5 x 10^2	*Pseudomonas Micrococcus*	28	*Cuvularia Aspergillus Mucor*	5.9 x 10^2	*Mucor*	11	*citrobacter Klebsiella*	<2
	15 – 30cm	*Proteus Citrobacter Bacillus Klebsiella*	2.5 x 10^2	*Pseudomonas Micrococcus*	28	*Aspergillus Cuvularia Rhizopus*	5.3 x 10^2	*Rhizopus*	10	*citrobacter Klebsiella*	<2
SS19	0 – 15cm	*Bacillus*	2.7 x 10^2	*Pseudomonas*	24	*Aspergillus*	4.8 x 10^2	*Rhizopus*	14	*E. coli*	6.0

		Proteus Pseudomonas E. coli		*Bacillus*		*Geotrichum Rhizopus*					
	15 – 30cm	*Bacillus Ecoli Proteuss*	2.8 x 10^2	*Pseudomonas Bacillus*	22	*Aspergillus Cuvularia Rhizopus*	4.9 x 10^2	*Rhizopus*	12	*Ecoli*	7.0
SS20	0 – 15cm	*Alcaligene Pseudomonas*	2.2 x 10^2	*Bacillus Pseudomonas*	27	*Cuvularia Aspergillus*	3.1 x 102	*Rhizopus*	14	*Pseudomon as*	8.0
	15 – 30cm	*Pseudomonas Proteus Artrobacter*	2.3 x 10^2	*Pseudomonas*	25	*Rhodotorula Rhizopus*	3.2 x 102	*Rhodotorula Rhizopus*	14	*Pseudomon as*	6.0
SS21	0 – 15cm	*Bacillus Erwinia Pseudomonas*	0.9 x 10^2	*Bacillus Pseudomonas*	23	*Aspergillus Penicillium*	5.6 x 10^2	*Mucor*	10	*Pseudomon as*	14.0
	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	0.8 x 10^2	*Pseudomonas*	23	*Geotricum Mucor Rhizopus*	5.5 x 10^2	*Mucor Rhizopus*	8	*Pseudomon as*	11.0
SS22	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	0.6 x 10^2	*Pseudomonas Alcaligene*	26	*Trichoderma Rhizopus*	6.4 x 10^2	*Rhizopus*	11	*Enterobact er*	10.0
	15 – 30cm	*Pseudomonas Serratia Enterobacter*	0.5 x 10^2	*Pseudomonas*	20	*Trichoderma Rhizopus*	6.6 x 10^2	*Rhizopus*	11	*Enterobact er*	10.0
SS23	0 – 15cm	*Alcaligene Enterobacter Proteus*	1.3 x 10^2	*Pseudomonas Bacillus*	27	*Aspergillus Cladosporium Rhizopus*	6.3 x 10^2	*Rhizopus*	9	*Enterobact er*	11.0
	15 – 30cm	*Pseudomonas Proteus*	1.1 x 10^2	*Bacillus Pseudomonas*	22	*Aspergillus Cladosprium Rhizopus*	6.0 x 10^2	*Rhizopus*	8	*Pseudomon as*	10.0
SS24	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter, E.coli*	2.1 x 10^2	*Bacillus Acaligene*	26	*Aspergillus Penicillium Candida*	5.7 x 10^2	*Candida*	12	*E.coli*	17.0
	15 – 30cm	*Proteus Pseudomonas*	1.9 x 10^2	*Bacillus Alcaligene*	27	*Aspergillus Penicillium*	5.3 x 10^2	*Candida*	10	*Klebsiella*	13.0

		Klebsiella Bacillus				*Candida*					
SS25	0 – 15cm	*Proteus Alcaligene Bacillus*	1.1 x 10^2	*Pseudomonas Micrococcus*	30	*Cuvularia Aspergillus Mucor*	5.6 x 10^2	*Mucor*	12	*Klebsiella*	15.0
	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	1.2 x 10^2	*Pseudomonas Micrococcus*	30	*Aspergillus Cuvularia*	5.2 x 10^2	*Rhizopus*	11	*E.coli,*	10.0
SS26	0 – 15cm	*Pseudomonas Micrococus Enterobacter Serratia Proteus*	3.1 x 10^2	*Pseudomonas Bacillus*	25	*Aspergillus Geotrichum Rhizopus*	6.0 x 10^2	*Rhizopus*	10	*Enterobact er*	14.0
	15 – 30cm	*Pseudomonas Proteus Enterobacter*	3.0 x 10^2	*Pseudomonas Bacillus*	22	*Aspergillus Rhizopus*	6.0 x 10^2	*Rhizopus*	10	*Enterobact er*	11.0
SS27	0 – 15cm	*Pseudomonas Arthrobacter E.coli Proteus Bacillus*	2.3 x 10^2	*Bacillus Pseudomonas*	28	*Cuvularia Aspergillus Penicillium Rhizopus*	5.9 x 10^2	*Rhizopus*	11	*E.coli*	14.0
	15 – 30cm	*Pseudomonas Proteus Arthrobacter Bacillus*	2.3 x 10^2	*Pseudomonas*	24	*Rhodotorula Rhizopus*	5.5 x 10^2	*Rhodotorula Rhizopus*	10	*Arthrobact er*	13.0
SS28	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	3.2 x 10^2	*Bacillus Pseudomonas*	24	*Aspergillus Penicillium*	7.2 x 10^2	*Mucor*	14	*Enterobact er*	13.0
	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	3.0 x 10^2	*Pseudomonas*	23	*Geotricum Penicillium Mucor Rhizopus*	7.0 x 10^2	*Mucor Rhizopus*	10	*Enterobact er*	10.0
SS29	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	2.8 x 10^2	*Pseudomonas Alcaligene*	24	*Trichoderma Rhizopus*	6.8 x 10^2	*Rhizopus*	9	*Enterobact er*	10.0
	15 – 30cm	*Pseudomonas*	2.2 x 10^2	*Pseudomonas*	22	*Trichoderma*	6.6 x 10^2		9	*Enterobact*	10.0

		Serratia Enterobacter				*Rhizopus*		*Rhizopus*		*er*	
SS30	0 – 15cm	*Alcaligene Pseudomonas Enterobacter Proteus*	2.5 x 10^2	*Pseudomonas Bacillus*	28	*Aspergillus Cladosporium Rhizopus*	6.1 x 10^2	*Rhizopus*	13	*Enterobact er*	10,0
	15 – 30cm	*Pseudomonas Proteus*	2.3 x 10^2	*Bacillus Pseudomonas*	25	*Aspergillus Rhizopus*	6.0 x 10^2	*Rhizopus*	11	*Pseudomon as*	10.0
SS31	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	2.6 x 10^2	*Bacillus Acaligene*	29	*Aspergillus Penicillium Candida*	5.7 x 10^2	*Candida*	15	*Klebsiella Enterobact er*	19.0
	15 – 30cm	*Proteus Pseudomonas Klebsiella Bacillus*	2.5 x 10^2	*Bacillus Alcaligene*	28	*Aspergillus Penicillium Candida*	5.1 x 10^2	*Candida*	12	*Klebsiella*	20.0
SS32	0 – 15cm	*Proteus Alcaligene Bacillus Pseudomonas*	2.2 x 10^2	*Pseudomonas Micrococcus*	25	*Cuvularia Aspergillus Mucor*	6.0 x 10^2	*Mucor*	12	*Pseudomon as*	13.0
	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	2.0 x 10^2	*Pseudomonas Micrococcus*	25	*Aspergillus Cuvularia Rhizopus*	6.0 x 10^2	*Rhizopus*	12	*E.coli*	10.0
SS33	0 – 15cm	*Pseudomonas Micrococus Enterobacter Serratia Proteus*	2.3 x 10^2	*Pseudomonas Bacillus*	28	*Aspergillus Geotrichum Rhizopus*	4.0 x 10^2	*Rhizopus*	12	*Enterobact er*	10.0
	15 – 30cm	*Pseudomonas Proteus Enterobacter Micrococcus*	2.2 x 10^2	*Pseudomonas Bacillus*	23	*Aspergillus Cuvularia Rhizopus*	3.3 x 10^2	*Rhizopus*	11	*Enterobact er*	10.0
SS34	0 – 15cm	*Pseudomonas E.coli Proteus Bacillus*	1.7 x 10^2	*Bacillus Pseudomonas*	30	*Cuvularia Aspergillus Rhizopus*	4.9 x 10^2	*Rhizopus*	15	*E.coli*	9.0

	15 – 30cm	*Pseudomonas Proteus Arthrobacter Bacillus*	1.6 x 10^2	*Pseudomonas*	30	*Rhodotorula Rhizopus*	4.4x 10^2	*Rhodotorula Rhizopus*	12	*Arthrobacter*	8.0
SS35	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	1.9 x 10^2	*Bacillus Pseudomonas*	31	*Aspergillus Penicillium*	6.1 x 10^2	*Mucor*	12	*Enterobacter*	8.0
	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	1.4 x 10^2	*Pseudomonas*	28	*Geotricum Penicillium Mucor Rhizopus*	5.9 x 10^2	*Mucor Rhizopus*	12	*Enterobacter*	8.0
SS36	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	1.2 x 10^2	*Pseudomonas Alcaligene*	31	*Trichoderma Rhizopus*	5.1 x 10^2	*Rhizopus*	9	*Enterobacter*	4.0
	15 – 30cm	*Pseudomonas Serratia Enterobacter*	1.0 x 10^2	*Pseudomonas*	33	*Trichoderma Rhizopus*	5.1 x 10^2	*Rhizopus*	9	*Enterobacter*	3.0
SS37	0 – 15cm	*Alcaligene Pseudomonas Enterobacter Proteus*	1.8 x 10^2	*Pseudomonas Bacillus*	26	*Aspergillus Cladosporium Rhizopus*	5.5 x 10^2	*Rhizopus*	12	*Enterobacter*	6.0
	15 – 30cm	*Pseudomonas Proteus*	1.9 x 10^2	*Bacillus Pseudomonas*	29	*Aspergillus Cladosprium Rhizopus*	5.1 x 10^2	*Rhizopus*	10	*Pseudomonas*	4.0
SS38	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	2.1 x 10^2	*Bacillus Acaligene*	24	*Aspergillus Penicillium Candida*	4.8 x 10^2	*Candida*	14	*Klebsiella Enterobacter*	7.0
	15 – 30cm	*Proteus Pseudomonas Klebsiella*	2.0 x 10^2	*Bacillus Alcaligene*	21	*Aspergillus Penicillium Candida*	4.4 x 10^2	*Candida*	11	*Klebsiella*	8.0
SS39	0 – 15cm	*Proteus Pseudomonas Alcaligene Bacillus*	1.1 x 10^2	*Pseudomonas Micrococcus*	29	*Cuvularia Aspergillus Mucor*	6.0 x 10^2	*Mucor*	14	*Pseudomonas*	5.0

	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	1.0 x 10^2	*Pseudomonas Micrococcus*	25	*Aspergillus Cuvularia Rhizopus*	5.3 x 10^2	*Rhizopus*	14	*E.coli*	6.0
SS40	0 – 15cm	*Pseudomonas Micrococus Enterobacter Serratia Proteus*	2.7 x 10^2	*Pseudomonas Bacillus*	23	*Aspergillus Geotrichum Rhizopus*	4.9 x 10^2	*Rhizopus*	13	*Enterobact er*	8.0
	15 – 30cm	*Pseudomonas Proteus Enterobacter Micrococcus*	2.3 x 10^2	*Pseudomonas Bacillus*	23	*Aspergillus Cuvularia Rhizopus*	4.5 x 10^2	*Rhizopus*	10	*Enterobact er*	5.0
C1	0 – 15cm	*Pseudomonas Arthrobacter E.coli Proteus Bacillus*	2.4 x 10^2	*Bacillus Pseudomonas*	25	*Cuvularia Aspergillus Penicillium Rhizopus*	5.4 x 10^2	*Rhizopus*	14	*E.coli*	5.0
	15 – 30cm	*Pseudomonas Proteus Bacillus*	2.4 x 10^2	*Pseudomonas*	20	*Rhodotorula Rhizopus*	5.6 x 10^2	*Rhodotorula Rhizopus*	11		5.0
C2	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	2.3 x 10^2	*Bacillus Pseudomonas*	18	*Aspergillus Penicillium*	6.2 x 10^2	*Mucor*	10	*Enterobact er*	9.0
	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	2.0 x 10^2	*Pseudomonas*	13	*Geotricum Penicillium Mucor Rhizopus*	6.3 x 10^2	*Mucor Rhizopus*	10	*Enterobact er*	7.0

DRY SEASON											
Sample	**Depth**	**Total Heterotrophic Bacteria (THB)**	**Counts (cfu/g)**	**Hydrocarbon utilizing Bacteria (HUB)**	**Counts (cfu/g)**	**Total Heterotrophic Fungi (THF)**	**Counts (cfu/g)**	**Hydrocarbon Utilizing Fungi (HUF)**	**Counts (cfu/g)**	**Coliform**	**Counts**
SS1	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	200	*Bacillus Pseudomonas*	25	*Aspergillus Penicillium*	520	*Mucor*	11	*Enterobacter*	3.0
	15 – 30cm	*Pseudomonas Serratia Enterobacter*	200	*Pseudomonas*	23	*Geotricum Penicillium Mucor Rhizopus*	510	*Mucor Rhizopus*	10	*Enterobacter*	2.0
SS2	0 – 15cm	*Alcaligene Pseudomonas Enterobacter*	150	*Pseudomonas Alcaligene*	28	*Trichoderma Rhizopus*	500	*Rhizopus*	13	*Enterobacter*	13.0
	15 – 30cm	*Pseudomonas Proteus*	156	*Pseudomonas*	22	*Trichoderma Rhizopus*	520	*Rhizopus*	11	*Pseudomonas*	10.0
SS3	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	200	*Pseudomonas Bacillus*	34	*Aspergillus Cladosporium Rhizopus*	600	*Rhizopus*	8	*Enterobacter, Klebsiella*	14.0
	15 – 30cm	*Proteus Pseudomonas Klebsiella Bacillus*	210	*Bacillus Pseudomonas*	33	*Aspergillus Cladosprium Rhizopus*	632	*Rhizopus*	9	*Klebsiella*	15.0
SS4	0 – 15cm	*Proteus Alcaligene Pseudomonas Bacillus*	270	*Bacillus Acaligene*	28	*Aspergillus Penicillium Candida*	460	*Candida*	10	*Pseudomonas*	10.0
	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	220	*Bacillus Alcaligene*	22	*Aspergillus Penicillium Candida*	440	*Candida*	11	*E.coli,*	11.0
SS5	0 – 15cm	*Pseudomonas Micrococcus Enterobacter Serratia*	200	*Pseudomonas Micrococcus*	20	*Cuvularia Aspergillus Mucor*	650	*Mucor*	13	*Enterobacte*	12.0
	15 – 30cm	*Pseudomonas Proteus Enterobacter*	200	*Pseudomonas Micrococcus*	20	*Aspergillus Cuvularia Rhizopus*	600	*Rhizopus*	11	*Enterobacte*	10.0

		Micrococcus									
SS6	0 – 15cm	*Pseudomonas Arthrobacter E.coli Bacillus*	250	*Pseudomonas Bacillus*	19	*Aspergillus Geotrichum Rhizopus*	500	*Rhizopus*	12	*E.coli*	20.0
	15 – 30cm	*Pseudomonas Proteus Arthrobacter Bacillus*	230	*Pseudomonas Bacillus*	18	*Aspergillus Cuvularia Rhizopus*	500	*Rhizopus*	13	*Arthrobacter*	20.0
SS7	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	100	*Bacillus Pseudomonas*	39	*Cuvularia Aspergillus Penicillium Rhizopus*	700	*Rhizopus*	11	*Enterobacter*	11.0
	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	110	*Pseudomonas*	35	*Rhodotorula Rhizopus*	270	*Rhodotorula Rhizopus*	8	*Enterobacter*	9.0
SS8	0 – 15cm	*Bacillus Erwinia Pseudomonas*	200	*Bacillus Pseudomonas*	32	*Cuvularia Mucor Geotrichum Pencillium*	220	*Mucor*	8	*Pseudomonas*	9.2
	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	200	*Pseudomonas Micrococcus*	33	*Aspergillus Cuvularia Mucor Rhizopus*	800	*Mucor Rhizopus*	7	*Pseudomonas*	12.0
SS9	0 – 15cm	*Alcaligene Pseudomonas Ecoli Streptococcus fecalis Micrococcus*	330	*Alcaligene Pseudomonas Bacillus Micrococcus*	28	*Penicillium Aspergillus*	810	*Mucor*	6	*Ecoli Streptococcus fecalis*	12.0
	15 – 30cm	*Ecoli Pseudomonas Proteus*	300	*Pseudomonas*	25	*Penicillium Mucor Aspergillus*	450	*Mucor*	11	*Pseudomonas*	6.0
SS10	0 – 15cm	*Pseudomonas proteus Serratia Enterobacter Bacillus*	120	*Pseudomonas Bacillus*	24	*Penicillium Cuvularia Rhizopus Mucor*	430	*Rhizopus Mucor*	12	*Enterobacter*	6.3

	15 – 30cm	*Pseudomonas Bacillus Enterobacter Proteus*	100	*Pseudomonas Bacillus*	21	*Penicillium Rhizopus*	320	*Rhizopus*	14	*Pseudomonas*	4.0
SS11	0 – 15cm	*Bacillius Proteus citrobacter Klebsiella*	280	*Bacillus*	25	*Aspergillus Geotrichum Rhizopus*	300	*Rhizopus*	16	*citrobacter Klebsiella*	4.1
	15 – 30cm	*Proteus Citrobacter Bacillus Klebsiella*	290	*Bacillus*	22	*Aspergillus Rhizopus*	700	*Rhizopus*	15	*citrobacter Klebsiella*	3.0
SS12	0 – 15cm	*Bacillus Proteus Pseudomonas E. coli*	100	*Bacillus Pseudomonas*	18	*Rhizopus*	600	*Rhizopus*	11	*E. coli*	3.3
	15 – 30cm	*Bacillus Ecoli Proteuss*	120	*Bacillus*	13	*Geotrichum Rhizopus*	410	*Rhizopus*	9	*E. coli*	2.0
SS13	0 – 15cm	*Alcaligene Pseudomonas Arthrobacter*	280	*Alcaligene Pseudomonas*	16	*Trichodenma Rhizopus Mucor*	400	*Mucor Rhizopus*	12	*Pseudomonas Arthrobacter*	2.2
	15 – 30cm	*Pseudomonas Proteus Artrobacter*	220	*Pseudomonas*	10	*Trichoderma Rhizopus*	660	*Rhizopus*	8	*Pseudomonas Arthrobacter*	6.0
SS14	0 – 15cm	*Bacillus Erwinia Pseudomonas*	150	*Bacillus Pseudomonas*	24	*Aspergillus Penicillium*	610	*Mucor*	8	*Pseudomonas*	6.1
	15 – 30cm	*Pseudomonas Micrococcus*	110	*Pseudomonas*	23	*Geotricum Penicillium Rhizopus*	270	*Mucor Rhizopus*	8	*Pseudomonas*	9.0
SS15	0 – 15cm	*Bacillus Erwinia Pseudomonas*	240	*Pseudomonas Alcaligene*	26	*Trichoderma Rhizopus*	320	*Rhizopus*	7	*Pseudomonas*	3.0
	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	250	*Pseudomonas*	23	*Trichoderma Rhizopus*	300	*Rhizopus*	6	*Pseudomonas*	3.3
SS16	0 – 15cm	*Alcaligene Pseudomonas Ecoli*	60	*Pseudomonas Bacillus*	27	*Aspergillus Cladosporium Rhizopus*	520	*Rhizopus*	5	*Ecoli Streptococcus*	7.0

		Streptococcus fecalis Micrococcus								*fecalis*	
	15 – 30cm	*Ecoli Pseudomonas Proteus*	100	*Bacillus Pseudomonas*	30	*Aspergillus Cladosprium Rhizopus*	500	*Rhizopus*	3	*Pseudomonas Ecoli*	7.6
SS17	0 – 15cm	*Pseudomonas proteus Serratia Enterobacter Bacillus*	200	*Bacillus Acaligene*	29	*Aspergillus Penicillium Candida*	500	*Candida*	13	*Pseudomonas Enterobacter*	12.0
	15 – 30cm	*Pseudomonas Bacillus Enterobacter Proteus*	230	*Bacillus Alcaligene*	32	*Aspergillus Penicillium Candida*	550	*Candida*	10	*Pseudomonas Enterobacter*	11.0
SS18	0 – 15cm	*Bacillius Proteus citrobacter Klebsiella*	220	*Pseudomonas Micrococcus*	26	*Cuvularia Aspergillus Mucor*	470	*Mucor*	9	*Klebsiella*	1.0
	15 – 30cm	*Proteus Citrobacter Bacillus Klebsiella*	200	*Pseudomonas Micrococcus*	23	*Aspergillus Cuvularia Rhizopus*	450	*Rhizopus*	10	*Klebsiella*	1.5
SS19	0 – 15cm	*Bacillus Proteus Pseudomonas E. coli*	230	*Pseudomonas Bacillus*	27	*Aspergillus Geotrichum Rhizopus*	41	*Rhizopus*	15	*E coli*	4.0
	15 – 30cm	*Bacillus Ecoli Proteuss*	200	*Pseudomonas Bacillus*	25	*Aspergillus Cuvularia Rhizopus*	30	*Rhizopus*	11	*E coli*	4.3
SS20	0 – 15cm	*Alcaligene Pseudomonas Arthrobacter*	200	*Bacillus Pseudomonas*	23	*Cuvularia Aspergillus Penicillium Rhizopus*	280	*Rhizopus*	13	*Pseudomonas Arthrobacter*	5.0
	15 – 30cm	*Pseudomonas Proteus Artrobacter*	220	*Pseudomonas*	22	*Rhodotorula Rhizopus*	200	*Rhodotorula Rhizopus*	10	*Pseudomonas*	4.0
SS21	0 – 15cm	*Bacillus Erwinia Pseudomonas*	70	*Bacillus Pseudomonas*	25	*Aspergillus Penicillium*	46	*Mucor*	11	*Pseudomonas*	13.0

	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	80	*Pseudomona s*	22	*Geotricum Penicillium Mucor Rhizopus*	40	*Mucor Rhizopus*	10	*Pseudomonas*	11.0
SS22	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	40	*Pseudomona s Alcaligene*	24	*Trichoderma Rhizopus*	520	*Rhizopus*	7	*Pseudomonas Enterobacter*	8.0
	15 – 30cm	*Pseudomonas Serratia Enterobacter*	50	*Pseudomona s*	20	*Trichoderma Rhizopus*	500	*Rhizopus*	5	*Pseudomonas Enterobacter*	8.0
SS23	0 – 15cm	*Alcaligene Pseudomonas Enterobacter*	110	*Pseudomona s Bacillus*	26	*Aspergillus Cladosporium Rhizopus*	490	*Rhizopus*	5	*Pseudomonas Enterobacte*	9.0
	15 – 30cm	*Pseudomonas Proteus*	100	*Bacillus Pseudomona s*	22	*Aspergillus Cladosprium Rhizopus*	420	*Rhizopus*	3	*Pseudomonas*	9.3
SS24	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	260	*Bacillus Acaligene*	23	*Aspergillus Penicillium Candida*	430	*Candida*	9	*Pseudomonas Klebsiella Enterobacter*	14.0
	15 – 30cm	*Proteus Pseudomonas Klebsiella Bacillus*	210	*Bacillus Alcaligene*	20	*Aspergillus Penicillium Candida*	400	*Candida*	6	*Pseudomonas Klebsiella*	14.0
SS25	0 – 15cm	*Proteus Pseudomonas Alcaligene Bacillus*	130	*Pseudomona s Micrococcus*	27	*Cuvularia Aspergillus Mucor*	410	*Mucor*	10	*Pseudomonas*	12.0
	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	110	*Pseudomona s Micrococcus*	22	*Aspergillus Cuvularia Rhizopus*	430	*Rhizopus*	9	*E coli*	12.3
SS26	0 – 15cm	*Pseudomonas Micrococus Enterobacter Serratia Proteus*	220	*Pseudomona s Bacillus*	21	*Aspergillus Geotrichum Rhizopus*	400	*Rhizopus*	8	*Pseudomonas Enterobacter*	13.0
	15 – 30cm	*Pseudomonas Proteus Enterobacter Micrococcus*	200	*Pseudomona s Bacillus*	20	*Aspergillus Cuvularia Rhizopus*	440	*Rhizopus*	6	*Pseudomonas Enterobacter*	12.0

SS27	0 – 15cm	*Pseudomonas Arthrobacter E.coli Proteus Bacillus*	250	*Bacillus Pseudomonas*	25	*Cuvularia Aspergillus Penicillium Rhizopus*	470	*Rhizopus*	9	*Pseudomonas Arthrobacter*	12.0
	15 – 30cm	*Pseudomonas Proteus Arthrobacter Bacillus*	210	*Pseudomonas*	23	*Rhodotorula Rhizopus*	450	*Rhodotorula Rhizopus*	9	*Pseudomonas Arthrobacter Bacillus*	11.0
SS28	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	270	*Bacillus Pseudomonas*	20	*Aspergillus Penicillium*	630	*Mucor*	13	*Pseudomonas Enterobacter Bacillus*	11.0
	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	220	*Pseudomonas*	20	*Geotricum Penicillium Mucor Rhizopus*	600	*Mucor Rhizopus*	10	*Pseudomonas Enterobacter Bacillus*	9.0
SS29	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	260	*Pseudomonas Alcaligene*	23	*Trichoderma Rhizopus*	460	*Rhizopus*	7	*Pseudomonas Bacillus Enterobacter*	11.0
	15 – 30cm	*Pseudomonas Serratia Enterobacter*	240	*Pseudomonas*	20	*Trichoderma Rhizopus*	500	*Rhizopus*	7.2	*Pseudomonas Enterobacter*	10.0
SS30	0 – 15cm	*Alcaligene Pseudomonas Enterobacter Proteus*	220	*Pseudomonas Bacillus*	27	*Aspergillus Cladosporium Rhizopus*	570	*Rhizopus*	12	*Pseudomonas Enterobacter*	7.0
	15 – 30cm	*Pseudomonas Proteus*	210	*Bacillus Pseudomonas*	22	*Aspergillus Cladosprium Rhizopus*	400	*Rhizopus*	11	*Pseudomonas*	10.0
SS31	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	220	*Bacillus Acaligene*	26	*Aspergillus Penicillium Candida*	460	*Candida*	16	*Pseudomonas Klebsiella Enterobacter*	15.0
	15 – 30cm	*Proteus Pseudomonas Klebsiella Bacillus*	250	*Bacillus Alcaligene*	28	*Aspergillus Penicillium Candida*	400	*Candida*	12	*Pseudomonas Klebsiella*	11.0
SS32	0 – 15cm	*Proteus Alcaligene Pseudomonas*	200	*Pseudomonas Micrococcus*	27	*Cuvularia Aspergillus Mucor*	400	*Mucor*	13	*Pseudomonas*	12.0

		Bacillus									
	15 – 30cm	*E.coli, Proteus* *Bacillus* *Acaligene*	230	*Pseudomona* *s* *Micrococcus*	29	*Aspergillus* *Cuvularia* *Rhizopus*	420	*Rhizopus*	10	*E.coli*	10.0
SS33	0 – 15cm	*Pseudomonas* *Micrococus* *Enterobacter* *Serratia Proteus*	150	*Pseudomona* *s* *Bacillus*	25	*Aspergillus* *Geotrichum* *Rhizopus*	300	*Rhizopus*	14	*Pseudomonas* *Enterobacter*	12.0
	15 – 30cm	*Pseudomonas* *Proteus* *Enterobacter* *Micrococcus*	120	*Pseudomona* *s* *Bacillus*	22	*Aspergillus* *Cuvularia* *Rhizopus*	400	*Rhizopus*	12	*Pseudomonas* *Enterobacter*	10.0
SS34	0 – 15cm	*Pseudomonas* *Arthrobacter* *E.coli Proteus* *Bacillus*	140	*Bacillus* *Pseudomona* *s*	28	*Cuvularia* *Aspergillus* *Penicillium* *Rhizopus*	440	*Rhizopus*	14	*Pseudomonas* *Arthrobacter*	8.0
	15 – 30cm	*Pseudomonas* *Proteus* *Arthrobacter* *Bacillus*	150	*Pseudomona* *s*	30	*Rhodotorula* *Rhizopus*	460	*Rhodotorula* *Rhizopus*	10	*Arthrobacter*	10.0
SS35	0 – 15cm	*Proteus* *Pseudomonas* *Enterobacter*	150	*Pseudomona* *s*	32	*Aspergillus* *Penicillium*	530	*Mucor*	10	*Pseudomonas* *Enterobacter*	9.0
	15 – 30cm	*Pseudomonas* *Erwinia* *Proteus* *Enterobacter*	170	*Pseudomona* *s*	30	*Geotricum* *Penicillium* *Mucor* *Rhizopus*	600	*Mucor* *Rhizopus*	10	*Pseudomonas* *Enterobacter*	10.0
SS36	0 – 15cm	*Pseudomonas* *Bacillus* *Enterobacter*	160	*Pseudomona* *s Alcaligene*	28	*Trichoderma* *Rhizopus*	450	*Rhizopus*	6	*Pseudomonas*	2.0
	15 – 30cm	*Pseudomonas* *Serratia* *Enterobacter*	100	*Pseudomona* *s*	26	*Trichoderma* *Rhizopus*	420	*Rhizopus*	6	*Pseudomonas*	2.0

SS37	0 – 15cm	*Alcaligene Pseudomonas Enterobacter Proteus*	150	*Pseudomonas Bacillus*	24	*Aspergillus Cladosporium Rhizopus*	460	*Rhizopus*	9	*Pseudomonas Enterobacter*	3.0
	15 – 30cm	*Pseudomonas Proteus*	120	*Bacillus Pseudomonas*	22	*Aspergillus Cladosprium Rhizopus*	400	*Rhizopus*	7	*Pseudomonas*	2.0
SS38	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	260	*Bacillus Acaligene*	26	*Aspergillus Penicillium Candida*	500	*Candida*	15	*Pseudomonas Enterobacter*	5.0
	15 – 30cm	*Proteus Pseudomonas Klebsiella Bacillus*	220	*Bacillus Alcaligene*	27	*Aspergillus Penicillium Candida*	530	*Candida*	13	*Pseudomonas Klebsiella*	4.0
SS39	0 – 15cm	*Proteus Bacillus Pseudomonas*	140	*Pseudomonas Micrococcus*	27	*Cuvularia Aspergillus Mucor*	500	*Mucor*	16	*Pseudomonas*	6.0
	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	140	*Pseudomonas Micrococcus*	22	*Aspergillus Cuvularia Rhizopus*	570	*Rhizopus*	14	*E.coli,*	2.0
SS40	0 – 15cm	*Pseudomonas Micrococus Enterobacter Serratia Proteus*	240	*Pseudomonas Bacillus*	21	*Aspergillus Geotrichum Rhizopus*	380	*Rhizopus*	16	*Pseudomonas*	7.0
	15 – 30cm	*Pseudomonas Proteus Enterobacter Micrococcus*	200	*Pseudomonas Bacillus*	20	*Aspergillus Cuvularia Rhizopus*	330	*Rhizopus*	14	*Pseudomonas*	3.0
C1	0 – 15cm	*Pseudomonas Arthrobacter E.coli Proteus Bacillus*	220	*Bacillus Pseudomonas*	24	*Cuvularia Aspergillus Penicillium Rhizopus*	510	*Rhizopus*	15	*Arthrobacter E.coli*	4.0
	15 – 30cm	*Pseudomonas Proteus Arthrobacter Bacillus*	200	*Pseudomonas*	23	*Rhodotorula Rhizopus*	500	*Rhodotorula Rhizopus*	16	*Arthrobacter*	2.0

C2	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	260	*Bacillus Pseudomonas*	16	*Aspergillus Penicillium*	530	*Mucor*	9	*Pseudomonas Enterobacter*	7.0
	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	210	*Pseudomonas*	10	*Geotricum Penicillium Mucor Rhizopus*	500	*Mucor Rhizopus*	9	*Enterobacter*	1.0

4. 18: PROTECTED/RESERVED AREAS

The International Union for Conservation of Nature (IUCN defines a protected area as ''An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources and managed through legal or other effective means''. Protected areas are special places which are established and designated for the protection of important cultural or natural values, Kuiper, 1997.

There is no protected area including natural reserve, national park, wildlife sanctuary and bird sanctuary in close proximity to the study area or any that will be directly affected by the project development. On the other hand, there are two reserved forests about 53.08 km and 39.57 km from the centre of project site**,** these are Lekki Conservation Forest Reserve and Lagos Urban Forest and Animal Sanctuary Initiative (LUFASI) respectively located south-west of the project site. Located close to the project site, 3.38 km west of project site is the Murtala Mohammed Memorial Botanical Garden shown in Figure 4.26 The Garden is a 60 ha natural sanctuary that preserves indigenous tree and palm species. Twenty three species of birds have been identified in the garden. The garden is in danger of the encroaching and out-of-control Lagos urban sprawl and greedy developers.
The Lekki Conservation Forest reserve, a 78 ha protected area in Lagos State preserves a large part of the region's biodiverse coastal ecosystem and educates visitors on the importance of coexisting with nature. The reserve is home to a plethora of wildlife, including monkeys, tortoises, and rare birds.

LUFASI a 90 ha green space in the Lekki Peninsula of Lagos, Nigeria, became an urban forest to connect people to interact with nature, while being a refuge for many fauna species like the African Civet (*Civettictis civetta)*, Blue Duiker (*Philantoba monticola)*, Nile Monitor (*Varanus niloticus)*, over 60 avian species including the Critically Endangered Hooded Vulture (*Necrosyrtes monachus)*, insect species, amphibian and reptilian species like the Western Green Mamba (*Dendroaspis viridis)*.

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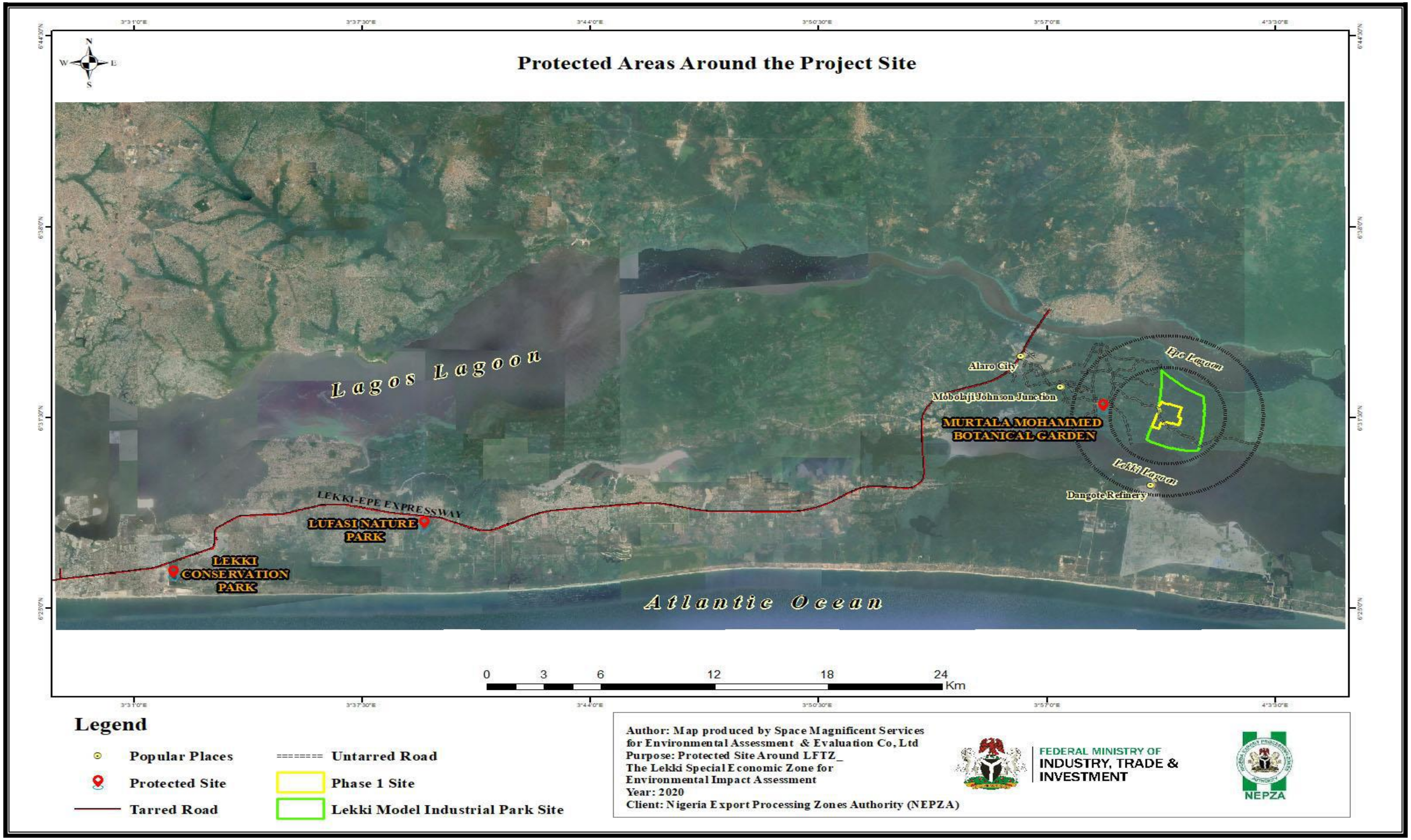


Figure 4.26: Location of Protected areas around the Project Site.

4.19 BIODIVERSITY STUDIES

Biological diversity or biodiversity simply means the resources upon which individuals, families, communities, nations and future generations depend. It is the link between all organisms on earth, binding each into an interdependent ecosystem in which all species have their role. It is the web of life.

4.19.1 Terrestrial Biodiversity

Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity, which defines biodiversity as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.” Biodiversity provides ecosystem services, thus ecosystem services are the benefits that people and the environment, derive from ecosystems. The services are organized into four types: (i) provisioning services, which are the products people obtain from ecosystems (ii) regulating services, which are the benefits people obtain from the regulation of ecosystem processes (iii) cultural services, which are the nonmaterial benefits people obtain from ecosystems; and (iv) support services, which are the natural processes that maintain the other services. Ecosystem services valued by humans are often underpinned by biodiversity. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services. This Performance Standard addresses how cliepnts can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project’s lifecycle.

The objectives of this biodiversity study are to:

- identify biodiversity resources in the study area,
- identify the benefits from biodiversity,
- Determine the ecosystem services of the biodiversity and ensure sustainable management of the resources through appropriate conservation measures.

Most of the detailed biodiversity inventories in Nigeria are held as propriety rights of multinational oil companies who often conduct such exercises as a pre requisite for their operations. However, private recording is a new and a fascinating trend. This is owed largely to greater awareness, economy liberalization, threat of changing climatic regimes and enforcement of the ESIA act and its various instruments. The availability of biodiversity data in most regions is poor. The few that exist are mainly ESIA reports of telecommunication firms and quarrying operation. And these include *Bridelia ferruginea, Cadaba grandulosa, Cola cordyla, Cordia stuhlmannii, Detarium microcarpum, Diospyros mespilliformis* and *Erythrophleum africanum* plant species, and *Osteolaemus tetraspis, Agama agama, Alligator sinensis, Civettictis civetta, Rattu rattus, Helioscius rufobrachium* and *Potamochoerus porcus* fauna species were constantly mentioned in the reports of the reviewed ESIAs.

Sampling site: Ten (10nos) sampling points were delineated using plant species physiognomic conditions and habitat types. Table 4.37 presents the sampling sites and their coordinates.
Sampling Size: An average of 625m^2 was adopted as sampling size per sampling point. This resulted in a total sampled area of 6250m^2.
Sampling Team: The team comprises a plant taxonomist/ecologist and an assistant and an animal ecologist.

4.19.2 Flora Studies

Sampling Parameters and Methods

Floristic data were collected from randomly selected (10) – 25m x 25m sample plots. However, these plots were further investigated with 1m by 1m plot at specified points under Tropical Biome in Transition (TROBIT) protocol as transects within the plots for a thorough investigation of understorey species.

Data collected comprise all trees and shrubs greater than 5cm diameter at breast height (dbh) and ground flora data. The dbh of the trees were measured and regeneration of the species determined through understorey species composition. Most of the species for this report were identified in the field. Unknown species were collected, pressed and preserved for identification at Forestry Research Institute of Nigeria (FRIN), Ibadan. Furthermore, botanical exploration was carried out for collection and listing of plant species not encountered within the sampled plots. Literature and herbaria were consulted for species already listed for the area.

Table 4.37: Sampling Sites, Locations and their coordinates

Sampling plot ID	Latitude (N)	Longitude (E)	Habitat feature
Plot 1	6.152725	4..00705	Secondary forest
Plot 2	6.52639	4.00486	
Plot3	6.523586	4.008101	
Plot4	6.52035	4.00290	Cleared land for farming
Plot 5	6.53268	4.00487	Open forest
Plot 6	6.53189	4.00630	Open forest
Plot 7	6.52999	4.00909	
Plot 8	6.52977	4.00790	Cassava Farmland
Plot 9	6.63276	4.00808	Open forest
Plot 10	6.530652	4.011925	*Raphia sudanica* dominated site

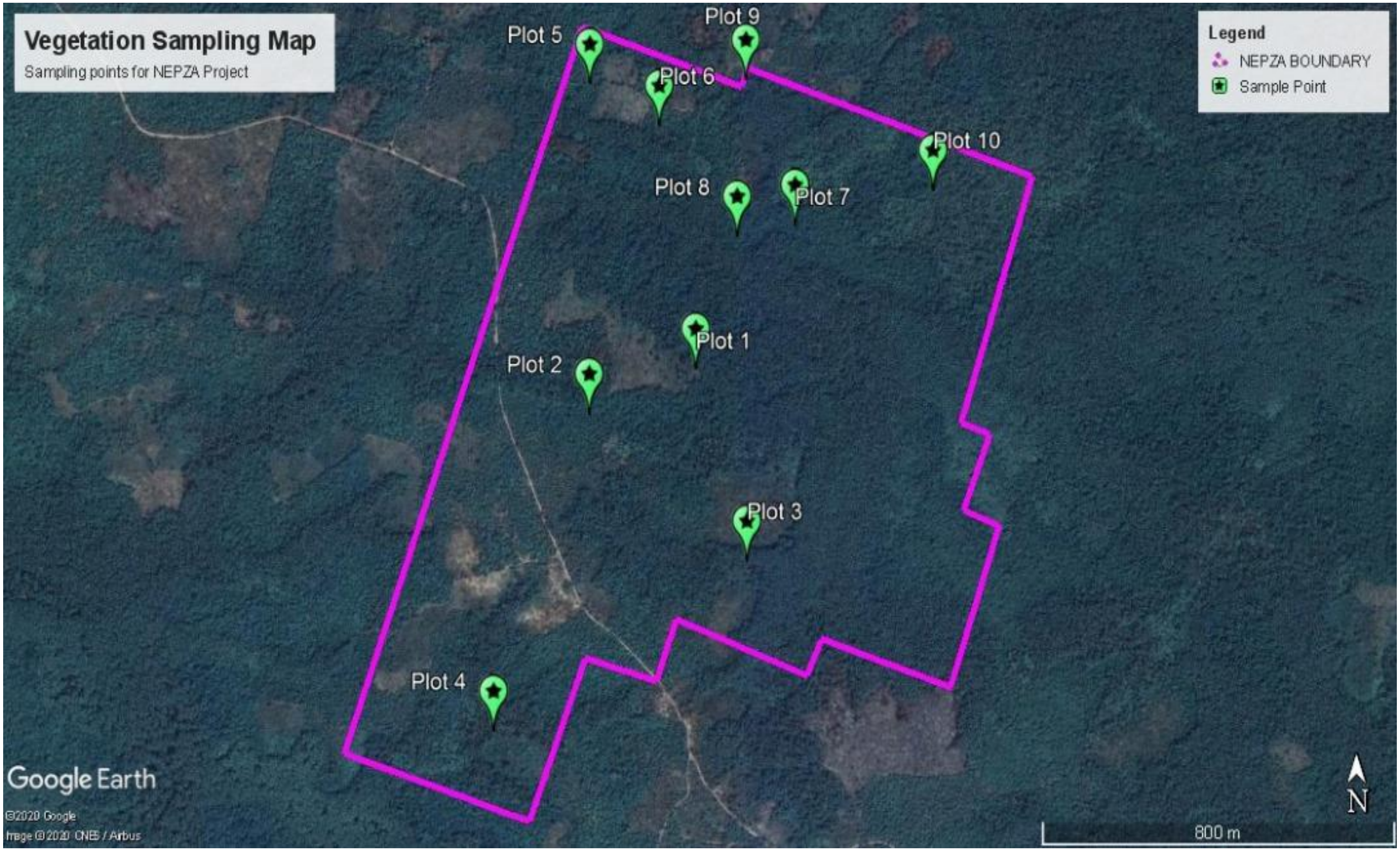


Figure 4.27: Vegetation Sampling Map

4.19.3 Habitat Description

The survey of the site revealed that the area shows partial degradation resulting from human activities. These activities range from firewood collection and farming. Each of these activities conferred different outlook on the ranges where they were carried out. Therefore, closer look of the profiles of the vegetation of the area showed that the site can be stratified into the following:

1. Degraded forestland
2. Riparian forest
3. Secondary forest regrowth
4. Farmland

4.19.3.1 Degraded Forestland

These are areas where housing and other human activities have pierced forest vegetation. It was noticed that those areas were either covered by patches of shrubs, grasses and creepers that were suspected to have evolved through succession with the intention of returning the vegetation to its climax form. The profile in this area appears with mostly understorey shrubs and herbs. They include*; Aspilia africana, Rauvolfia vomitoria, Chromolaena odorata, Crotallaria refusa, Alchornea cordifolia, Newbouldia laevis, Albizia zygia, Albizia ferruginea, Walteria indica Manihot esculentus.* High population of these plants is a reflection of dispersal agents and ability to out-compete and suppress weeds (Rodder et al., 1995, Ikuenobe and Anoliefo, 2003).

There also exist some forest fringes, though degraded but are either under succession on is left to fallow before it is cultivated again. These areas were suspected to have served as hamlet or enclave to migrant farmers or the former landowners. This suspicion was informed by the species of trees which are mostly fruit trees and those that can be linked closely with human habitation, some of which are; *Jatropha* curcass, *Newbauldia laevis, Vernonia species, Spondias mombim, Gliricidia sepium, Calotropis procera, Bridelia spp etc.* The fringe does not display a clear structure in most cases but with climbers of Dioscoreaceae, etc as undergrowth thus the claim that the area may be under succession. These types of vegetation are in patches and do not cover large expanse wherever they are present, but are usually adjoined with farmland.

Plate 4.16 Degraded forest in the Project site

4.19.3.2 Riparian forest

The forest exists on river bank and wetland with partial degradation through human activities for example felling for fuelwood, logging and farming but presently a larger percentage of the forest approaches climax vegetation under succession. There were palm species (*Elaeis guineensis*) in the location linking suspicion with human activities. The riparian forest does not display a clear vegetation structure but with dominant woody species such as *Elaeis guineensis*, *Musanga cecropioide, Alstonia boonei, Lepanodiscus cupanoides, Ceiba pentandra* and *Anthocleista vogelii*, *Uapaca togoensis* The presence of these tree species in nearly all the locations may indicate their wider range of ecological adaptation (Senbeta, 2005, Oladoye *et. al.*, 2014), with herbs of *Asteraceae, Euphorbiaceae, Malvaceae, Fabaceae* as undergrowth thus the claim that the area may be under succession. This area had undulating land terrain with valley more conspicuous in the area. Furthermore, there were water troughs with aquatic plants such as *Nymphaea lotus*, *abyssinica* and *Pteridium aquilinum, Sphenocentrum jollyanum*

Plate 4.17 Riparian Vegetation in the Project site

4.19.3.3 Farmland

Nearly all the locations visited recorded farmland. Almost 65% of the area around location was farmed with crops such as cassava and plantain, nearly, all the plots had been cultivated before and were still under cultivation with visible farms. Such areas harbour economic fruit trees determined by farmers choice or abandoned farmland under succession recovering from slash and burn agriculture. Thus, well noticed agricultural crops on the land were cassava, plantain, with few economic trees – Oil palm trees and Guava

Plate 4.18: Farmland with cassava only

Plate 4.19: showing Cassava farm replacing the wetland

Plate 4.20: showing a Degraded Mangrove

Plate 4.21: Vegetation Expert at Work using Haga Hypsometer, Tape and Digital Camera

4.19.4 Land Cover Classification of the Study Area and Project Site

The land cover of the project zone was classified for two different years (1987 and 2020). The classified land use or cover classes for 1987 shows the historical features of the zone while the year 2020 show the present land use or cover classes.

According to Figure 4.28, the land use or cover (LU/C) within the study zone in 1987 indicated that, there were eight distinct land use or cover including water body. A 150ha area size was extracted and delineated and named as phase 1 site (figure 4.30). The LU/C within this site was found to be palms (8.21ha), mangrove (41.12ha) and Savanna wood land (101.82ha).

According to Figure 4.29, the present LU/C classes within the zone for the year 2020 shown that, there were five major LU/C classes. Phase 1 site LU/C classes was found to be 3 distinct classes including Agricultural land, Forest and wet land (41.4ha, 46.62ha and 62.12ha) Figure 4.31. These LU/C classes may be resulting from the land cover conversion through anthropogenic activities as observed in the thematic image of 1987 and 2020. However, some part of mangrove swamp might had been converted to Agricultural land, wetland and forest. More so, half % of savanna-wood land area in 1987 might had been converted to wetland and forest while palm land might had been converted to forest and Agricultural land.

A summary of land use in the locations as presented in the figures below and the results of field data collected. Primary forest was not in any of the section as the forest in the project area are all degraded or secondary forest.

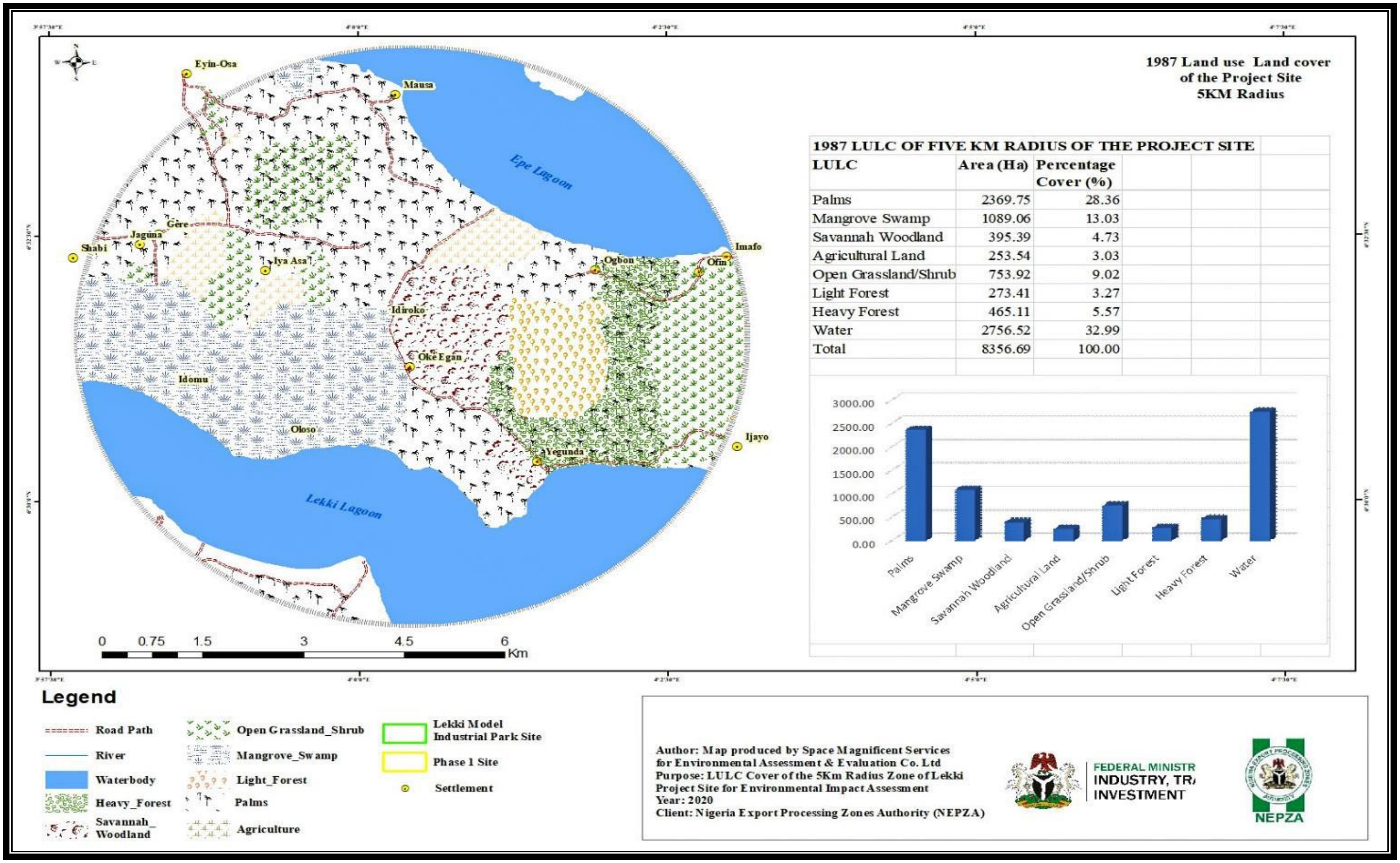
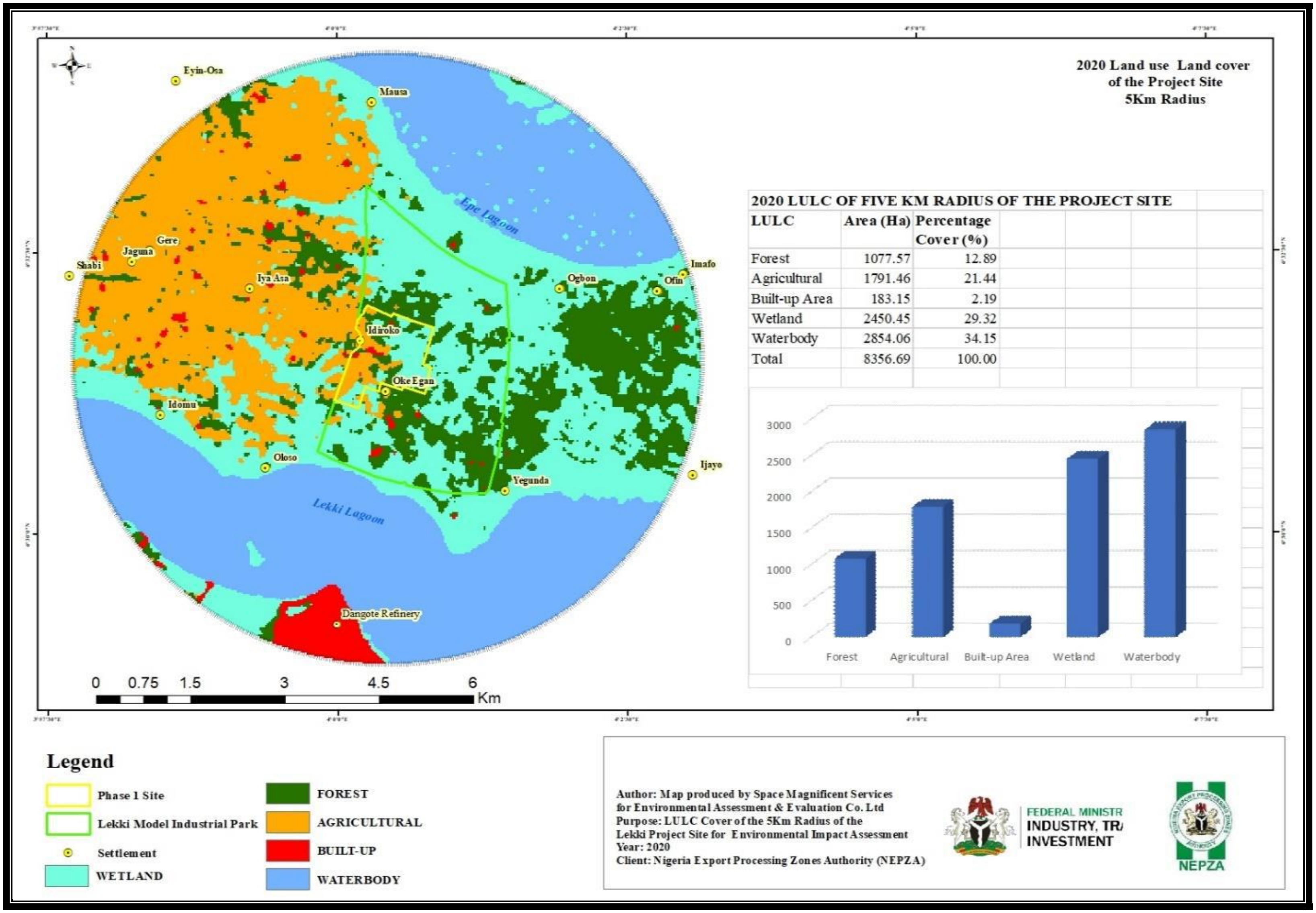


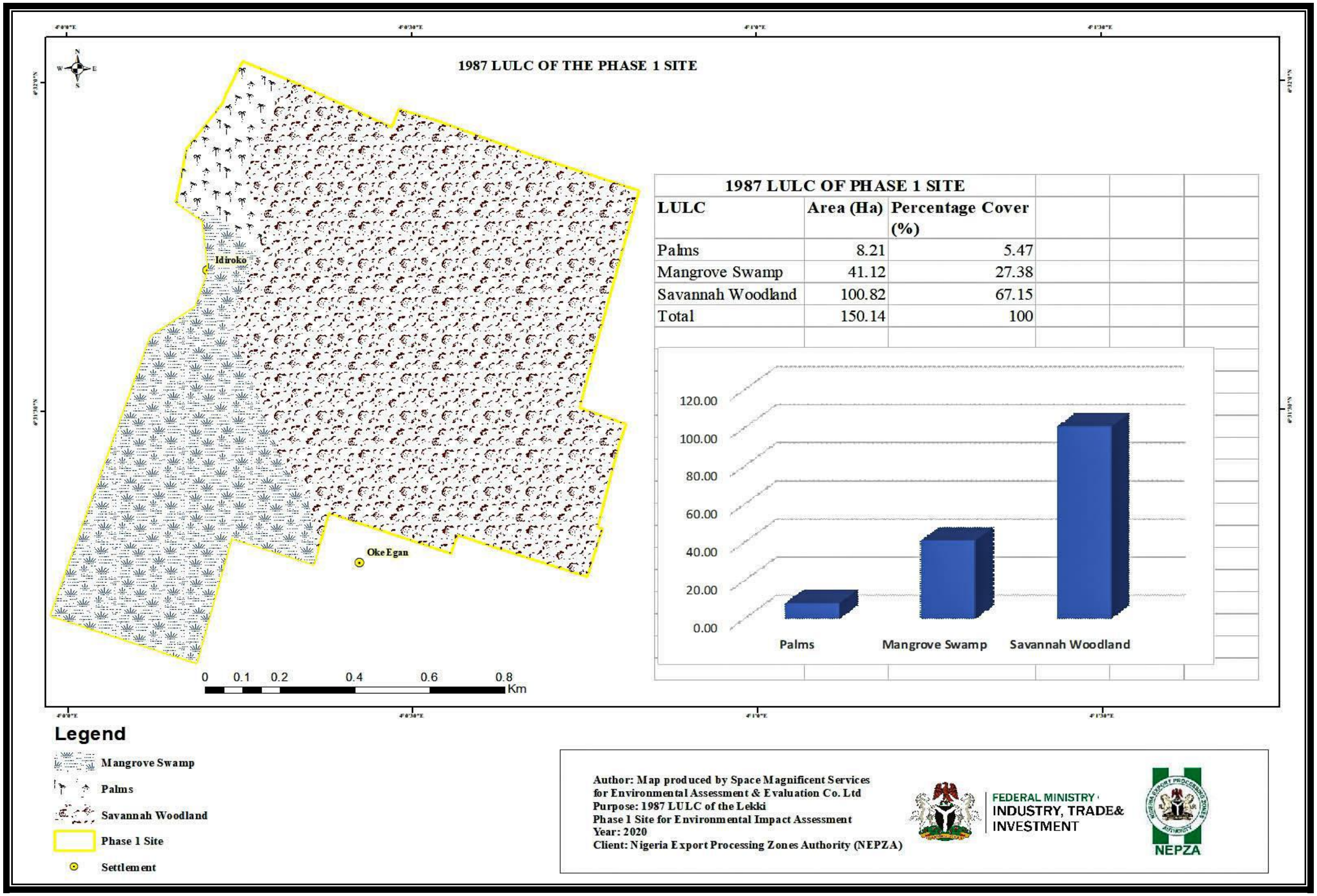
Figure 4.28: Land Use or Cover (LU/C) within the Study Zone in 1987



2020 LULC OF FIVE KM RADIUS OF THE PROJECT SITE

LULC	Area (Ha)	Percentage Cover (%)
Forest	1077.57	12.89
Agricultural	1791.46	21.44
Built-up Area	183.15	2.19
Wetland	2450.45	29.32
Waterbody	2854.06	34.15
Total	8356.69	100.00

Figure 4.29: Land Use or Cover (LULC) within the Study Zone in 2020



1987 LULC OF PHASE 1 SITE

LULC	Area (Ha)	Percentage Cover (%)
Palms	8.21	5.47
Mangrove Swamp	41.12	27.38
Savannah Woodland	100.82	67.15
Total	150.14	100

Figure 4.30: Land Use or Cover (LULC) within the Project Site in 1987

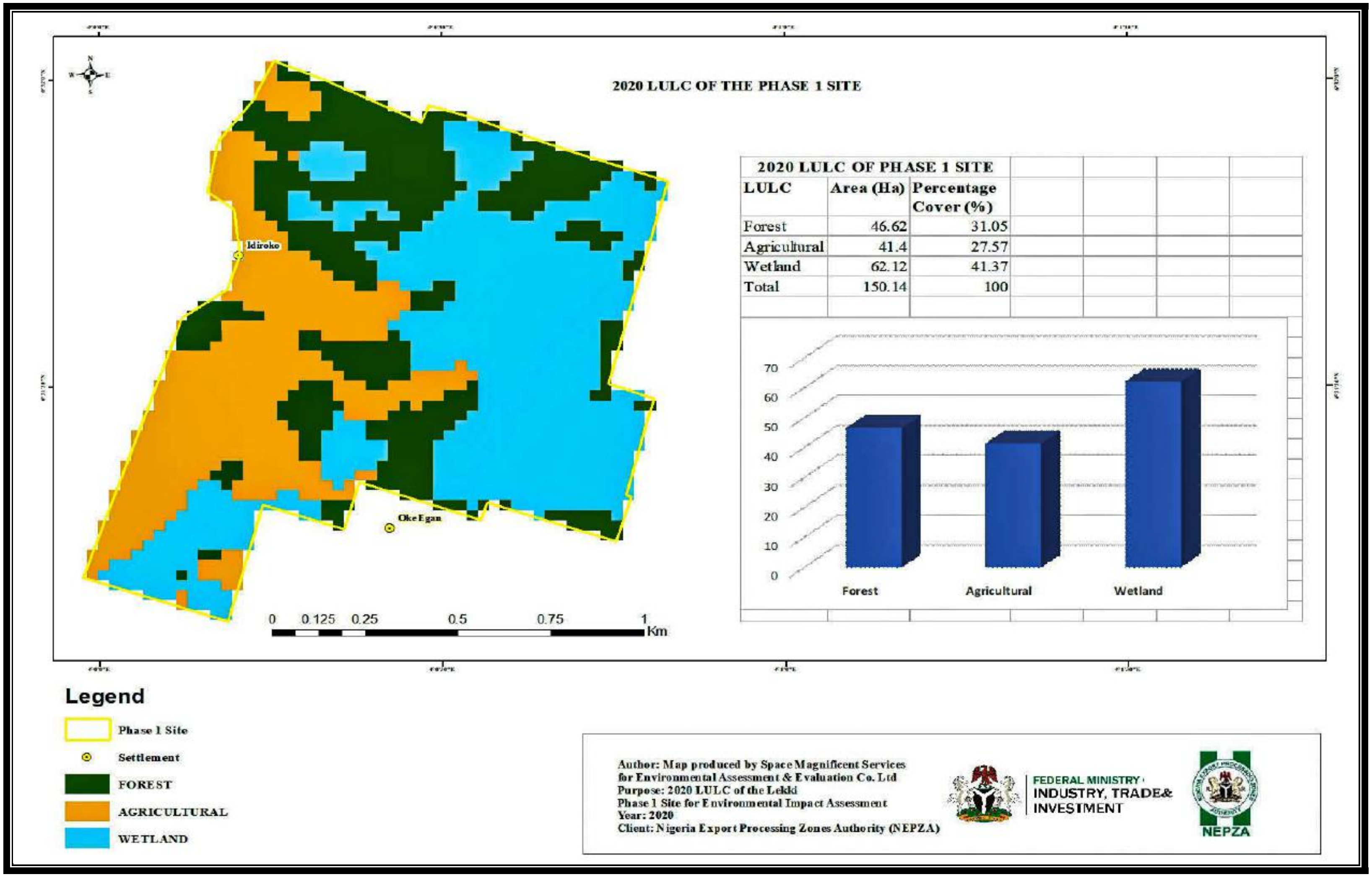


Figure 4.31: Land Use or Cover (LULC) within the Project Site in 2020.

4.19.5 Species Density

Density is the number of species per given area. Densities of plants per unit area are useful for taking decision in forest management. The result showed that density/ha ranged from 1.6/ha to 118.4/ha and 0.067/ha to 42.66/ha for trees and understory respectively. Trees with the highest density is *Raphia sudanica* (118.4/ha) and understorey with the highest density *Chromolaena odorata* (42.66/ha) followed by *Manihot esculentus* (37.50/ha) (table 4.38 and 4.39). A total of 422 and 2, 292 trees and understorey species respectively were encountered during the study. The result showed that species density/ha was lower this is a reflection of anthropogenic activities such farming, logging and collection of sand filling in those area which has adversely degraded the land and explained the shortage of economic timber species that are typical of the ecosystem.

Table 4.38 Checklist of Tree Species in the study locations

Species	Family	Total	DENSITY	IVI
Albizia ferruginea	Mimosaceae	14	22.4	10.91
Albizia zygia	Mimosaceae	15	24	11.15
Alchornia cordifolia	Euphorbiaceae	6	9.6	3.95
Alstonia boonei	Apocynaceae	1	1.6	2.77
Alafia baterii	Apocynaceae	38	60.8	16.60
Anthocleista vogelli	Loganiaceae	11	17.6	6.40
Celtis zenkeri	Ulmaseae	24	38.4	10.75
Chrysophyllum albidum	Sapotaceae	2	3.2	3.01
Diospyros	Loganiaceae	5	8	4.98
Elaeis guineensis	Palmae	18	28.8	10.59
Ficus sur	Moraceae	1	1.6	2.77
Cola gigantean	Sterculiaceae	4	6.4	2.21
Musanga Cecropioides	Cecropiaceae	11	17.6	7.67
Nauclea latifolia	Rubiaceae	14	22.4	7.12
Raphia sudanica	Palmae	74	118.4	20.07
Senna fistula		3	4.8	3.24
Spondias mombin	Anacardiaceae	3	4.8	3.24

Sterculia oblongata	Sterculiaceae	5	8	3.72
Sterculia tragacantha	Sterculiaceae	3	4.8	3.24
Terminalia ivorensis	Combretaceae	11	17.6	3.87
Uapaca togoensis	Euphorbiaceae	14	22.4	7.12
Ceiba petandra	Malvaceae	3	4.8	3.24
Cleistopholis patens	Annonaceae	2	3.2	1.74
Anthonotha marcophylla	Fabaceae	34	54.4	9.32
Baphia nitida	Fabaceae	25	40	10.99
Rauvolvia vomitoria	Apocynaceae	20	32	9.80
Tabeneamontana pachysiphion	Apocynaceae	50	80	14.38
Bridelia micrantha	Euphorbiaceae	4	6.4	2.21
Icus polita	Moraceae	7	11.2	2.92
		422	**675.2**	**200**

Source: EAECL Field Work, 2019/2020

Table 4.39: **Checklists of understory Species in the study locations**

SPECIES	**Form**	**Family**	**TOTAL**	**DENSITY**	**IVI**
Agelaea oblique	*Herb*	Connaraceae	7	0.48	0.74
Albizia ferruginea	Tree	Mimosaceae	23	1.58	2.78
Albizia lebbeck	Tree	Mimosaceae	5	0.34	0.67
Albizia zygia	Tree	Mimosaceae	27	1.86	3.41
Alchornia cordifolia	Shrub	Euphorbiaceae	113	7.77	6.29
Amanranthus hybridus	Herb	Amaranthaceae	12	0.83	0.90
Anchomanes difformis	Herb	Araceae	3	0.21	0.60
Anthocleista vogelii	Tree	Loganiaceae	31	2.13	4.05
Anthonothata macrophylla	Shrub	Fabaceae	25	1.72	1.84

Argylocalyx oligophyllus			8	0.55	0.77
Aspilia Africana	Herb	Asteraceae	36	2.48	2.71
Asystasia gigentica	Herb	Acanthaceae	6	0.41	0.70
Baphia nitida	Tree	Fabaceae	34	2.34	4.15
Blighia unijugata	Tree	Sapindaceae	9	0.62	1.31
Bridelia micrantha	Tree	Euphorbiaceae	6	0.41	1.71
Brysocaprus coccinea	Shrub	Connaraceae	62	4.27	4.58
Cajanus cajan	Shrub	Fabaceae	2	0.14	0.57
carica papaya	Herb	Caricaceae	7	0.48	1.74
Carpolobia lutea	Shrub	Polygalaceae	32	2.20	2.58
Ceiba pentandra	Tree	Malvaceae	2	0.14	0.57
Celosia argentea	Herb	Amaranthaceae	16	1.10	1.04
Celtis zenkeri	Tree	Ulmaceae	21	1.44	2.71
Chrisopyhlum albidum	Tree	Sapotaceae	7	0.48	1.74
Chromolaena odorata	Shrub	Asteraceae	620	42.66	24.24
Cnestis ferruginea	Shrub	Connaraceae	52	3.58	4.25
Cnestis ferruginea	Shrub	Connaraceae	19	1.31	2.65
Corchorus olitotius	Herb	Malvaceae	15	1.03	1.51
Curviera truncate	Shrub	Zerenidae	15	1.03	1.00
Cyrtosperma senegalense	Herb	Araceae	28	1.93	1.44
Dalbergiella welwitschii	Shrub	Leguminosae	13	0.89	0.94
Dissotis rotundifolia	Shrub	Melastomataceae	10	0.69	0.84
Eugenia trifoliolata	Herb	Myrtaceae	9	0.62	0.80
Elaeis guineensis	Tree	Palmae	123	8.46	6.62
Ficus exaperata	Tree	Moraceae	34	2.34	3.15
Harungana madagascariensis	Tree	Hypericaceae	4	0.28	0.64
Holarrhena floribunda	Tree	Apocynaceae	4	0.28	0.64
Icacina trichantha	Shrub	Icacinaceae	13	0.89	2.44
Imperata cylindrical	Grass	Poaceae	159	10.94	8.33
Ipomea invoculata	Shrub	Convolvulaceae	49	3.37	3.15
Landolphia oweriensis	climber	Apocynaceae	19	1.31	1.64

Malacanta alnifolia	*Tree*	Sterculiaceae	11	0.76	1.37
Manihot esculentum	Shrub	Euphorbiaceae	545	37.50	21.23
Mariscus alternifolia	Herb	Cyperaceae	2	0.14	0.57
Microdesmis puberula	Shrub	Pandaceae	5	0.34	1.17
Mimosa pudica	Herb	Mimosaceae	10	0.69	0.84
Mitragyna ciliate	Tree	Rubiaceae	15	1.03	1.00
Mucuna prureriens	Herb	*Fabaceae*	1	0.07	0.54
Musa paradisiaca	Herb	Musaceae	5	0.34	0.67
Musanga cecropioides	Tree	Cecropiaceae	10	0.69	2.34
Nauclea latifolia	Shrub	Rubiaceae	28	1.93	2.44
Newboldia laevis	Tree	Bignoniaceae	8	0.55	1.77
Olax subsecupioides	Tree	Olacaceae	18	1.24	2.61
Parquetina nigrescens	Shrub	Ascelpiadaceae	34	2.34	3.15
Phyllantus amarus	Herb	Euphorbiaceae	2	0.14	0.57
Psidium guajava	Tree	Myrtaceae	6	0.41	1.21
Pueraria phaseloides	Herb	Fabaceae	72	4.95	3.41
Rhaphiostylis beninensis	Shrub	Icacinaceae	14	0.96	1.98
Rinorea dentate	Tree	Violaceae	3	0.21	1.11
Rouvolfia vomitora	Shrub	Apocynaceae	29	2.00	2.48
Cyperus spp	Grass	Cyperaceae	64	4.40	3.65
Smilax anceps	Shrub	Smilacaceae	8	0.55	1.77
sphenocentrum jollyanum	Shrub	Menispermaceae	60	4.13	2.51
Spondias mombin	Tree	Anacardiaceae	15	1.03	2.01
Sporobolus pyramidalis	Grass	Poaceae	27	1.86	1.91
Sterculia oblongata	Tree	Sterculiaceae	47	3.23	5.09

Tabernaemontana pachysiphon	Tree	Apocynaceae	45	3.10	2.01
Trema orientalis	Tree	Ulmaceae	4	0.28	0.64
Triumfetta cordifolia	Herb	Tiliaceae	56	3.85	2.88
Uapaca togensis	Tree	Euphorbiaceae	17	1.17	3.08
Voacanga Africana	Tree	Apocynaceae	16	1.10	2.54
Walteria indica	Shrub	Malvaceae	130	8.94	7.86
Xylia xylocarpa	Tree	Mimosaceae	5	0.34	1.17
			2992	205.85	200.00

4.19.6 Species composition

A total of Seventy-nine (79) plant species comprising of 42, tree species, 16 shrubs, 17 herbs, 3 grasses and one climber belonging to Thirty-nine (39) taxonomic families were encountered within the location (Table 4.40) the floristic composition of the locations is similar to findings of Anning *et al*., 2008, Addo-Fordjour e*t al*., 2009, Oladoye *et al.*, 2014, 2015.
Taxonomic families with the highest number of species include, *Apocynaceae* (8), *Euphorbiaceae* (5), *Fabaceae* (5) and *Sterculaceae* (4)

Table 4.40: Checklists of flora species in the study locations

Species	**form**	**Family**
Landolphia oweriensis	climber	Apocynaceae
Cyperus spp	Grass	Cyperaceae
Imperata cylindrica	Grass	Poaceae
Sporobolus pyramidalis	Grass	Poaceae
Agelaea obliqua	herb	Connaraceae
Amanranthus hybridus	herb	Amaranthaceae
Anchomanes difformis	herb	Araceae
Aspilia africana	herb	Asteraceae
Asystasia gigentica	herb	Acanthaceae
Carica papaya	Herb	Caricaceae
Celosia argentea	herb	Amaranthaceae
Corchorus olitotius	Herb	Malvaceae
Cyrtosperma senegalense	herb	Araceae
Eugenia trifoliolata	herb	Myrtaceae
Mariscus alternifolia	herb	Cyperaceae
Mimosa pudica	herb	Mimosaceae
Mucuna prureriens	herb	*Fabaceae*

Musa paradisiaca	Herb	Musaceae
Phyllantus amarus	Herb	Euphorbiaceae
Pueraria phaseloides	Herb	Fabaceae
Triumfetta cordifolia	herb	Tiliaceae
Anthonothata macrophylla	Shrub	Fabaceae
Brysocaprus coccinea	shrub	Connaraceae
Cajanus cajan	Shrub	Fabaceae
Carpolobia lutea	Shrub	Polygalaceae
Chromolaena odorata	Shrub	Asteraceae
Cnestis ferruginea	Shrub	Connaraceae
Curviera truncata	Shrub	Zerenidae
Dalbergiella welwitschii	Shrub	Leguminosae
Dissotis rotundifolia	Shrub	Melastomataceae
Icacina trichantha	Shrub	Icacinaceae
Ipomea invoculata	Shrub	Convolvulaceae
Manihot esculentum	Shrub	Euphorbiaceae
Microdesmis puberula	Shrub	Pandaceae
Nauclea latifolia	shrub	Rubiaceae
Parquetina nigrescens	Shrub	Ascelpiadaceae
Rhaphiostylis beninensis	shrub	Icacinaceae
Rouvolfia vomitora	Shrub	Apocynaceae
Smilax anceps	Shrub	Smilacaceae
Sphenocentrum jollyanum	Shrub	Menispermaceae
Walteria indica	Shrub	Malvaceae
Alafia baterii	tree	Apocynaceae
Albizia ferruginea	tree	Mimosaceae
Albizia lebbeck	Tree	Mimosaceae
Albizia zygia	tree	Mimosaceae
Alchornia cordifolia	tree	Euphorbiaceae
Alstonia boonei	tree	Apocynaceae
Anthocleista vogelii	Tree	Loganiaceae
Baphia nitida	Tree	Fabaceae
Blighia unijugata	Tree	Sapindaceae
Bridelia micrantha	tree	Euphorbiaceae
Ceiba petandra	tree	Malvaceae
Celtis zenkeri	tree	Ulmaseae
Chrisopyhlum albidum	Tree	Sapotaceae
Chrysophyllum albidum	tree	Sapotaceae

Cleistopholis patens	tree	Annonaceae
Cola gigantean	tree	Sterculiaceae
Diospyros	tree	Loganiaceae
Elaeis guineensis	tree	Palmae
Ficus exaperata	tree	Moraceae
Ficus sur	tree	Moraceae
Harungana madagascariensis	tree	Hypericaceae
Holarrhena floribunda	Tree	Apocynaceae
Icus polita	tree	Moraceae
Mitragyna ciliata	Tree	Rubiaceae
Musanga Cecropioides	tree	Cecropiaceae
Musanga cecropioides	tree	Cecropiaceae
Newboldia laevis	Tree	Bignoniaceae
Olax subsecupioides	Tree	Olacaceae
Psidium guajava	Tree	Myrtaceae
Raphia sudanica	tree	Palmae
Rauvolvia vomitoria	tree	Apocynaceae
Rinorea dentata	tree	Violaceae
Spondias mombin	tree	Anacardiaceae
Sterculia oblongata	tree	Sterculiaceae
Sterculia tragacantha	tree	Sterculiaceae
Tabeneamontana pachysiphion	tree	Apocynaceae
Terminalia ivorensis	tree	Combretaceae
Trema orientalis	Tree	Ulmaceae
Uapaca togensis	Tree	Euphorbiaceae
Voacanga africana	tree	Apocynaceae
Xylia xylocarpa	tree	Mimosaceae
Malacanta alnifolia	Tree	Sterculiaceae

4.19.7 Life form of the Plants in the Area

The results revealed that tree formed the dominant life form in the study area which accounted for 53.85% followed by Herb (21.79%), Shrub (20.51%), Grass and Climbers accounted for 3.85 % and 1.28% respectively (Table 4.41). Some of the tree species encountered include *Sterculia oblongata*, *Anthocleista vogelli*, *Albizia zygia*, *Musanga Cecropioides*, *Terminali ivorensis*, *Tabernaemontana pachysiphon*, *Raphia sudanica*, *Cleistopholis patens*, *Albizia ferruginea*, *Albizia zygia*.

Table 4.41: Life form of the Plants in the Location

Form	No	Percentage
climber	1	1.28
grass	3	3.85
herb	17	21.79
shrub	16	20.51
tree	42	53.85
	79	**100.00**

Source: EAECL Field Work, 2019/2020

4.19.8 Species Diversity

Species diversity reveals how diverse in term of species availability of a habitat. Simpson_1-D and equitability was also computed for each of the location. Result as shown in (Table 4.42) indicated that plot 9 recorded highest diversity (0.91) and equitability (0.86)

Table 4.42 present the species diversity, no of species per plot, and dominance of the plots sampled.

Plot 5 has the highest number of species and highest number of individuals (32; 606), followed by plot 7 (31;424), plot 1 contain 31 species and 331 individuals, the least number of species was found in plot 10 with only one species of (*Raphia sudanica)* amd 38 individuals.

Dominace and equitablity index are expression of whether the plant species are well distributed within and across the plots so the lower the dominance the higher the equitability hence responsible for low dominance which ranges from 0.09 to 1.00, lowest dominance was found in plot 9, followed by plot 7, plot 8 had the highest dominance of 0.19 and equitability index of 0.67.

Table 4.42: Diversity Indices per sampled Location

Location	No of Species	Individuals	Dominance_D	Simpson_1-D	Equitability_J
Plot 1	30	331	0.11	0.89	0.81
Plot 2	29	511	0.17	0.83	0.71
Plot 3	29	279	0.10	0.90	0.81
Plot 4	18	243	0.18	0.82	0.74
Plot 5	32	606	0.10	0.90	0.80
Plot 6	28	424	0.13	0.87	0.74
Plot 7	31	310	0.10	0.90	0.82
Plot 8	25	405	0.19	0.81	0.67
Plot 9	24	242	0.09	0.91	0.86
plot10	1	38	1.00	0.00	0.00

Source: EAECL Field Work, 2019/2020

4.19.9 IUCN Status of the Flora

IUCN Red List is set as precise criteria to evaluate and classify species in terms of high risk of global extinction. The general aim is to provide an explicit and objective framework for conservation of the species to the public and policy makers, as well as help the international community reduce activities leading to species extinction. This is because the Red lists are among the most widely used conservation tools globally.

The IUCN status of the plant resources for the studied area was evaluated using IUCN version 2017 .3 criterion. The results showed that majority of the plant species encountered do not fall to the categorization of IUCN Red lists while some are carrying Least Concerned (LC) recognition. However, the following species (Table 4.43) were identified within the IUCN Red list classification.

Raphia sudanica is the only species that is listed as Near Threatened (NT).

Table 4.43.: IUCN Status of identified plant species

Species	Life form	Family	IUCN Status
Funtumia elastica	Tree	Apocynaceae	This taxon has not yet been assessed for the IUCN Red List, but is in the Catalogue of Life
Albizia ferruginea	Tree	Mimosaceae	Vulnerable
Albizia zygia	Tree	Mimosaceae	This taxon has not yet been assessed for the IUCN Red List, but is in the Catalogue of Life
Sterculia oblongata	Tree	Sterculiaceae	This taxon has not yet been assessed for the IUCN Red List, but is in the Catalogue of Life
Terminalia ivorensis	Tree	Combretaceae	Vulnerable
Raphia sudanica	Tree		Near Threatened

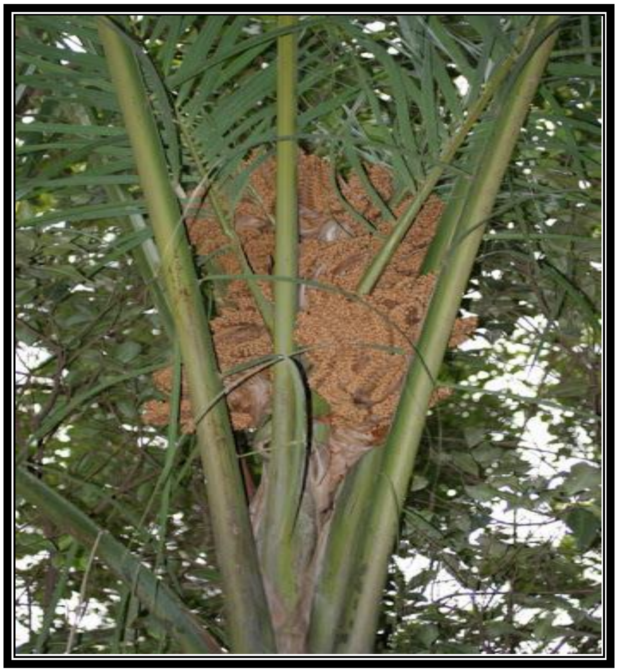


Plate 4.22 ***Raphia sudanica***

Plate 4.23: Young ***Albizia ferruginea*** **tree**

Plate 4.24 ***Terminalia ivorensis***

Plate 4.25 ***Musanga cercopodes***

4.19.10 Alien and Invasive species

Alien species are plant resources that are accidentally introduced into an area while invasive species also known as invasive exotics or simply exotics may or may not be alien except that they may out - compete other species and establish dominance in native habitats. International Union for the Conservation of Nature (IUCN) listed about 24 plant species that are alien to Nigeria while the global invasive database listed the occurrence of 29 invasive flora in Nigeria (Borokini 2011). *Chromolaena odorata* was the species censored in this study listed as alien to Nigeria while *Ficus exasperata Chromolaena odorata* and *Mimosa pudica* so listed as invasive to Nigeria was found in this study. As could be observed *Chromolaena odorata* censored in this study was listed as both alien and invasive species to Nigeria.

Plate 4.26: *Chromoleana odoranta*

Plate 4.27: *Ficus exasperata*

4.19.11 Ecosystem Services (Flora)

Ecosystem services are benefits humankind receives from ecosystems. They are generally categorized into four major types: provisioning services (food, fiber, freshwater); regulating services (pest regulation, pollination, water purification); supporting services (nutrient cycling, soil formation, photosynthesis); and cultural services (recreation, tourism, aesthetic values) (MEA, 2005). Ecosystem services are described as nature's contributions to people by the United Nations Inter-governmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), as they are the channel between nature and a good quality of life (Díaz et al., 2015; Pascual et al., 2017). Biodiversity underpins ecosystem functioning and the provision of ecosystem services is essential for human well-being (CBD, 2010).

Provisioning Services

Services that describe the material or energy outputs from ecosystems are termed provisional services. Provisional services offered by the floristic resources of the study area are organized into three groups namely; food/fibre/energy**,** medicinal attributes and Raw Materials. All the plant species censored in the study offers provisioning services but at varying degrees. They are applied to addressing carbon sequestration and storage, regulation of water flow, local climate regulation, erosion prevention and maintenance of soil fertility, and biological control. A total of Seventy-nine (79) plant species censored in the study offers Provisioning Services. Among these are species recorded to providing food/fibre/energy, sources of raw materials, Some of the species include *Albizia zygia, Ceiba pentandra, Eleais guineensis. Terminalia ivorensis, Raphia sudanica, Sterculia oblongata, Anthocleista vogelli, Albizia zygia, Musanga Cecropioides. Carica papaya and Manihot esculentus.* Nearly all the identified plants have medicinal purposes.

Supporting Services

Uapaca togoensis and Ceiba pentandra are used for habitat mediation by the people while all the listed plant species act as nutrient recycling especially the understorey species through litter fall and decomposition.

Cultural Services

These are the non material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. IFC (2012) grouped this services into Cultural diversity, Spiritual and religious values, Knowledge systems, Educational values, Inspiration, Aesthetic values, Social relations, Sense of place, Cultural heritage values and Recreation and ecotourism.

Raphia sudanica, Blighia sapida, Ceiba pentandra, zygia, some of the species censored in the project area that serves cultural values. They are applied to addressing spiritual/religious values, and aesthetic values

4. 19.12 Human Activities and Threat to Vegetation

The various anthropogenic activities in the study area include crop farming, lumbering operation, gathering and collection of non-timber forest products (firewood, leaves, rattan, raffia and palm wine. Substantial portion of the forest vegetation has been cleared and converted to oil palm and raffia plantation while other areas suffered slash-and-burn to make way for cultivation of agricultural crops such as cassava, pepper, maize, plantain, banana and leafy vegetables for subsistence of the local people.

The forest is highly desirable to commercial timber activities because of their high stocking level of commercially valuable species. Therefore logging activities are notable human engagement in the study area. There is evidence of indiscriminate and uncontrolled tree felling in the forests, an activity which had drastically degrade the forest leaving it with trees of very small diameter sizes. The primary threats of the human activities to the vegetation in the study area are deforestation, habitat degradation, loss of plant and animal diversity and change in plant community structure (Plates 4.28 - 4.31).

Plate 4.28 Showing fuelwood piled up

Plate 4.29: Showing Charcoal Production Site

Plate 4.30: Showing land cleared with slash and in burn for farming Activities

Plate 4.31: Planks sawned from Lumbering the Area

4.19.13 Plant Pathology

The plants encountered in the study area are generally healthy except for pockets of pathological problems like chlorotic and necrotic leaf spot diseases recorded which were caused by *cercospora* spp. There was no devastation effects of insect or animal pest observed in the study area. Few of the common diseases observed were in the agricultural fields and they include cassava mosaic caused by virus, yellow sigatoka caused by fungus and Oil palm curvularia leaf blight caused by fungus (Table 4.44). It is important to note that the plant communities in the study area are generally in a normal state of health. The disease severity indices revealed that the few diseases encountered in agricultural fields was of very light infections. There was no evidence of endemic vegetation problems. It is pertinent to remark that none of the diseases encountered was unusual either in nature or severity. The few diseases observed are common and are comparable in nature and intensity to those on plant species in similar ecotypes in Nigeria.

Table: 4.44 Pathology Status of Plant Species in the Study Area

Plant species	Disease	Causative organisms
Cassava (*Manihot esculanta)*	Cassava Mosaic	Cassava Mosaic Virus
Plantain *(Musa paradisiaca)*	Yellow Sigatoka	Fungus (*Pseudocercospora musicola)*
Oil Palm (Elaeis guineensis)	Curvularia Leaf Blight	Fungus *Curvularia oryzae*

Plate 4.32 Cassava infested with Cassava Mosaic Virus **Plate 4.33 Plantain infested with Yellow Sigatoka**

4.20 FAUNA STUDIES

The area at present is a mix of degraded forest, farmlands, secondary forest and riparian forest which may account for low population of animals found during the exercise. Farming, hunting and ravaging activities frequent collection of firewood and felling activities in the area suspected to be major factors for inability of the wild fauna to thrive and triumph abundantly in the area. It is expected that the population of wild fauna population in the area should have increased much more than what is there at present. This is not the case because of various forms of Perturbation and Persecuting activities of people within the community on animals. If hunting had been kept at bay all this while, the area should be flourishing with abundant population of wild vertebrates, but presently, farming, charcoal processing, fuel wood collection, logging have delineated the animal population to the extent that hardly can animal be sighted directly except bird and other ones whose availability can be felt through indices of their presence. It was noticed that the area still harbor representative samples of rodents, small and medium-sized ungulates and carnivores as predators of primates and birds. Extensive survey of insects and other invertebrates were not carried out but biological activities of soil arthropods and worms were visibly observed. Butterfly, crickets, termites, ants and several other insect groups were also observed in the site.

The results of the fauna study are presented for each parameter (Species richness, species diversity, Species abundance, Conservation status and Ecosystem services) across the three Animalia groups of mammals, aves and reptilian.

4.20.1 Sampling method

Inventory of the site was conducted in plotless sampling points where fauna inventory was carried out. Both direct sighting, observation indices of presence. In addition, information was obtained through interviews with hunters, dealers in animal products,

Plate 4.34 Faeces of Grasscutter in the project site **Plate 4.35 Faeces of Antelope in the Project Site**

4.20.2 Fauna Composition

The survey showed a total of 261 wildlife species including the mammals, birds and reptiles.

- **Insects**

Insects population is the key to ecological balance of any ecosystem particularly the trophic levels. In particular they forage on terrestrial and aquatic weeds while they also serve as food (prey) for other carnivorous invertebrates and vertebrates including birds

The result of the survey showed that out of the 8 diurnal insect species listed, the largest number was observed in Hymenoptera Order accounting for 50%. This was followed by Diptera with 37.5% and Lepidoptera with 12.7% (Table 4.45). The observed species of insect include: Spider (*Hysteroccrates laticeps*), ants (*Camponotus pennyslavanis*), Grasshopper (*Zonocerus variegatus*), (Caelifera), Wasps (*Polistes galicus*), termites (*Cryptotermes brevis*) and Butterfly (Lepidoptera).

Plate 4.36: Grasshopper (*Zonocerus variegatus*).

Table 4.45: Diurnal Insects in Study area

S/N	Order	Family	Scientific Name	Common Name
1	Hymenoptera	Apidae	*Apis millifera*	Bee
2			*Orthetram branchiale*	Dragonfly
3	Lepidoptera	Papilimoidae	*Macrosomana spp*	True butterfly
4	Hymenoptera	Formicidae	*Eciton burchelii*	Soldier Ant
5	Diptera	Culicidae	*Anopheles spp*	Mosquito
6	Hymenoptera	Vespidae	*Vespula germanica*	Wasp
7	Hymenoptera	Formicidae	*Solenopsis germinate*	Red Ant
8.			*Mantis religiosa*	Praying Mantis

9.			*Simulium sp*	Blackfly
			Glossina sp	Tse-tse fly

Source: EAECL Field Work, 2019/2020

a. *Mammals*

Mammals encountered in the project site are listed in Table 4.46. Bush buck (1), Sitatunga (1) Grass cutter (18), were the most abundant of all the mammals found. Other mammals found include: Mona monkey, Palm squirrel, Fruit bat, but in low quantity. All the species encountered in the studies are common and are not listed in the IUCN Red list of endangered species.

b. *Birds/ Aves*

Birds recorded are listed in Table 4.47, they include: wood pecker, Laughing dove**,** Cattle egret, Village weavers etc. Most of these species are classified as least concerned and are not threatened by the proposed project directly. Presence of some birds was as a result of farmlands within the project location. 23 species of bird have be reported identified at Murtala Mohammed Bontanical Garden 3.38 km west of the project location.

c. *Amphibians*

The observed species include frog (*Afrixalus nigeriensis, Rana sp, Ptychodena sp.*), (Toad *Bufo regularis, Amitophrnus supercillaris*),

Plate 4.37: ***Ptychodena sp.*** **(long-legged frog)**

Table 4.46: Fauna species in the study Location

Common name	Local Name	Scientific name	Fauna Type	IUCN Status	Frequency	Abundance

Bush Buck	Igala	*Tragelahpus scriptus*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	1	0.53
Sitatunga		*Tragelaphus spekei*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	1	0.59
Fruit Bat	Adan	*Rousethus smithii*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	7	3.72
Cane Rat	Oya	*Thryonomys gregarianus*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	3	1.73
Red-necked Cobra	Oka	*Naja melanolenca*	Reptile	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	1	0.53
Maxwells duiker	Etu	*Cephalophus maxwellii*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	2	1.06
Mona monkey	Igimire	*Cercopithecus mona*	Mammal	Least concern	4	2.12
Ground squirrels		*Xerus erythropus*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	25	13.3
Grass Cutter		*Thryonomis swinderianus*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	18	9.57
Civet cat	Eta	*Civettictis civetta*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	1	0.53
Palm Squarrel	Okere	*Epixerus ebii*	Mammal	Least concern	28	16.7
Pangolin	Akika	*Manis tricuspis*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	2	1.06
Porcupine	Lili	*Atherus africanus*	Mammal	This taxon has not yet been assessed for the IUCN Red List,	2	1.06

				and also is not in the Catalogue of Life		
Green mamba	Sebe	*Dendroaspis angusticeps*	Reptile	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	4	2.13
Monitor Lizard	Agilinti	*Varanus varius*	Rpetile	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	5	
Woodpecker		*Dendropicos fuscescens*	Ave	Least concern	6	3.19
Grey heron		*Ardea cinera*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	3	1.59
Cattle Egret	Lekeleke	*Ardeola ibis*	Ave	Least concern	14	7.45
Village Weaver Bird		*Ploceus cucllatus*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	25	1..29
Barn Owl		*Tyto alba*	Ave	Least concern	1	0.53
Grey Plantain Eater		*Crinifer piscato*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	20	10.6
Vulture	Igun	*Gypohierax angolensis*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	2	1.06
Laughing dove		*Stretopelia senegalensis*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	8	4.25
Black kite		*Mitrus migrans*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	10	5.32
Total					**188**	

Source: EAECL Field Work, 2020.

Table 4.47 Bird Spcies Reported in Murtala Botanical Garden 3.38 Km Radius West of the Project Site

SN	Biological Name	Common Name

1	*Polyboroides typus*	African Harrier-Hawk
2	*Terpsiphone viridis*	African Paradise Flycatcher
3	*Tockus fasciatus*	African Pied Hornbill
4	*Ceyx pictus*	African Pygmy Kingfisher
5	*Lonchura bicolor*	Black-and-White Mannikin
6	*Merops gularis*	Black Bee-Eater
7	*Cuculus clamosus*	Black Cuckoo
8	*Milvus migrans*	Black Kite
9	*Ploceus nigricollis*	Black-Necked Weaver
10	*Turtur afer*	Blue-Spotted Wood Dove
11	*Nectarinia cyanolaema*	Blue-Throated Brown Sunbird
12	*Hedydipna collaris*	Collared Sunbird
13	*Pycnonotus barbatus*	Common Bulbul
14	*Ploceus cucullatus*	Common Village Weaver
15	*Chrysococcyx caprius*	Didric Cuckoo
16	*Psalidoprocne obscura*	Fanti Saw-Wing
17	*Nectarinia verticalis*	Green Headed Sunbird
18	*Hylia prasina)*	Green Hylia
19	*Camaroptera brevicaudata*	Grey-Backed Camaroptera
20	*Nigrita canicapillus*	Grey-Crowned Negrofinch
21	*Chrysococcyx klaas*	Klaas Cuckoo
22	*Streptopelia senegalensis*	Laughing Dove
23	*Merops pusillus*	Little Bee-Eater
24	*Andropadus virens*	Little Greenbul
25	*Nectarinia olivacea*	Olive-Bellied Sunbird
26	*Estrilda melpoda*	Orange-Cheeked Waxbill
27	*Corvus albus*	Pied Crow
28	*Bycanistes fistulator*	Piping Hornbill
29	*Streptopelia semitorquata*	Red-Eyed Dove
30	*Malimbus scutatus*	Red-Vented Malimbe
31	*Chlorocichla simplex*	Simple Greenbul
32	*Pogoniulus scolopaceus*	Speckled Tinkerbird
33	*Thescelocichla leucopleura*	Swamp Palm Bulbul
34	*Nectarinia venusta*	Variable Sunbird
35	*Ploceus nigerrimus*	Vieillot's Weaver
36	*Nicator chloris*	Western/Yellow-Spotted Nicator
37	*Myrmecocichla albifrons*	White-Fronted Black-Chat
38	*Pogoniulus chrysoconus*	Yellow-Fronted Tinkerbird
39	*Yellow-Fronted Tinkerbird*	. Yellow Wagtail

4.20.3 Species abundance per community

Analysis on abundance per communities was conducted across all fauna groups. Results obtained from the analysis are presented in Table 4.48. From the result, Plot-8, Plot-2 and Plot-10 had the highest number of individuals while Plot-3 had the least individuals. This reduction in species individuals in most of the sample communities, habitat and sections indicates the level of disturbance. From the aforementioned fact, it is anticipated that, during the different phases of the proposed project, fauna populations will be impacted.

Table 4.48: Species Abundance Per Communities

Fauna	Plot-1	Plot-2	Plot-3	Plot-4	Plot-5	Plot-6	Plot-7	Plot-8	Plot-9	Plot-10	total
Mammal	4	10	4	3	6	8	6	15	3	10	**69**
Aves	7	11	6	10	11	10	10	20	8	20	**113**
Reptile	2	0	0	0	1	0	0	1	2	0	**6**
Total	**13**	**21**	**10**	**13**	**18**	**18**	**16**	**36**	**13**	**30**	**188**

Source: EAECL Field Work, 2020

4.20.4 Species Diversity Indices

Shannon weiner and equitability indices were used to evaluate species diversity in the study. This index is used in accessing the degree of richness of all groups. The diversity indices for the entire study area and plot were conducted across all faunal groups. As presented in Table 4.49, plot 1 had the highest Shannon index followed by plot 9 and least was plot 4. However, plot 2 is the most evenly distributed section of them all with the highest equitability index.

Table 4.49: Species richness for each of the study sections

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot9	Plot 10
Shannon_H	0.98	0.69	0.67	0.54	0.83	0.69	0.66	0.79	0.92	0.64
Equitability_J	0.90	1.00	0.97	0.78	0.75	0.99	0.95	0.72	0.84	0.92

Source: EAECL Field Work, 2010/2020

4.20.4.1 Diversity indices for each study section

The avian group recorded highest number in plot 10. The highest Shannon index was recorded at plot 1 while plot 2 recorded the highest equitability index**.** Table 4.50 presents the result of diversity indices for each section.

Table 4.50: Diversity indices for each section

Fauna	Plot1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10
Mammal	4	10	4	3	6	8	6	15	3	10
Ave	7	11	6	10	11	10	10	20	8	20
Reptile	2	0	0	0	1	0	0	1	2	0
Shannon_H	0.98	0.69	0.67	0.54	0.83	0.69	0.66	0.79	0.92	0.64
Equitability_J	0.90	1.00	0.97	0.78	0.75	0.99	0.95	0.72	0.84	0.92

Source: EAECL survey, 2020

4.20.5 Ecosystem services of the Fauna species

Analysis on the ecosystem services provided by the fauna species across the fauna group was conducted. The ecosystem services reviewed are provisional services (food and energy, medicine, raw material), and cultural services. Details of the ecosystem services are presented in Table 4.51 and 4.52. A total of 13 fauna species were reviewed as offering ecosystem services. A breakdown of the number of species with respect to fauna group revealed that the mammalian taxon with 5 species was the group with the highest number of species offering ecosystem services, this was followed by reptiles with 3 species and amphibian with 1 species Table 4.53 However, some species provides more than one ecosystem services.

Table 4.51 Faunal Cultural Services

Biological Name	Common Name	Local Name	Spiritual/cultural Use	Part Used	Respondent
Cephalophus maxwelli	Maxwell's duiker	Etu	Protection	Intestine/ horn/Skin	2
Thryonomys swinderianus	cane rat	Oya		Whole/hair	6
Varanus varius	Monitor Lizard	Agilinti		Whole	2
Civettictis civetta	African civet	Eta	Favour, Boost Business	Intestine/ horn/skin	2
Tragelaphus scriptus	Bush Buck	Igala	Boost Business	Whole/foot	3
Manis tricuspis	Pangolin	Akika	Respect/good behaviour	Skin	3

Source EAECL Field Work 2020

Table 4.52 Faunal Provisioning Services

Biological Name	Common Name	Local Name	Therapeutic Purposes	Part Used	Respondent
Dendroaspis angusticeps	Mamba	Sebe	Inflammation	Head	1
			Pile / haemorrhoids	Intestine	2
Naja melanolenca	Cobra	Oka	All illnesses	Teeth	3
Manis tricuspis	Pangolin	Akika	Anaemia	Head/tail/skin	3
			Healing of old wounds		2
Civettictis civetta	African	Eta	.Madness	Whole	4

	civet				
Varanus varius	Monitor Lizard	Agilinti	Stomach ulcers	Whole	3
Cephalophus maxwelli	Maxwell's duiker	Etu	Stomach ulcers	Horn/ intestine/ skin	2
Bufo regularis	African common toad	Opolo	Bedwetting	. Whole	1
			Madness	Legs/whole	2

Source EAECL Field Work 2020

Table 4.53: Number of Faunal Species rendering Ecosystem services in the Project Area

Ecosystem services	Mammals	Aves	Reptiles	Amphibia
Provisioning	3	-	3	1
Cultural	5	-	1	-
Total	8	-	4	1

4.21 HYDROBIOLOGY

4.21.1 Overview

Phytoplanktons are essential and fundamental to the primary production in aquatic ecological systems and are at the base of food chain which serves as food for other higher animals in the system. The composition and diversity of phytoplankton in aquatic ecological system is an index of its healthy status. Diversity is the variety and variability among living organisms and the ecological complexes in which they occur (Pielou, 1994). Diversity index is to obtain a quantitative estimate of biological variability that can be used to compare biological entities, composed of discrete components, in space or time. They exist in all aquatic ecosystems (Lee, 2008). According to Sverdrup *et al*., (2006), oceanic phytoplankton contributes about half of the atmospheric oxygen present on earth. However, their survival, growth, distribution and diversity in time and space are influenced by water quality parameters in with they inhabit. In some cases, the presence and abundance of some species are used as index of eutrophication and water pollution. The construction of the proposed project is changes in these properties can lead to degradation of ecosystems services and loss of biological diversity. The acquired data will serve as base line information on which the future data can be compared with over time during monitoring to reflect the impact of the project on the aquatic environment. Three hydrobiological parameters, phytoplankton, zooplankton and benthos were considered.

4.21.2 Sampling methods

a. Zooplankton

Zooplankton samples were collected on each occasion at site with 55µm mesh size standard plankton net towed in the water for 5 - 10 minutes. The net was thoroughly washed after each tow so that any planktonic material adhering to the mesh of the filtering cone is removed into the collecting bottle to prevent contamination from the previous hauls. Thereafter, the net was pulled up, debris and other extraneous materials were removed, and sample transferred into 250 ml well labelled plastic containers with screw cap. Each sample was preserved with 4% buffered formalin prior to laboratory microscopic observations.

b. *Phytoplankton*

Phytoplankton samples were collected on each occasion at site with a 55µm mesh size standard plankton net towed in the water for 5 - 10 minutes at low speed. The net was thoroughly washed after each tow so that any planktonic material adhering to the mesh of the filtering cone is removed into the collecting bottle to prevent contamination from the previous hauls. Thereafter, the net was pulled up, debris and other extraneous materials were removed, and sample transferred into 250 ml well labelled plastic containers with screw cap. Each sample was preserved with 4% unbuffered formalin to preserve and prevent shrinkage of the organisms prior to laboratory microscopic observations.

Plate 4.38 Phytoplankton sampling

Plate 4.39 Benthic Sampling.

c. *Benthos*

The Eckman grab was used in taking composite samples of profundal benthic fauna. Grabbed sediment samples were washed with water through a 0.55 µm mesh size sieve (Plate 4.14 and 4.39). The sieved contents were preserved in 4% formalin in labelled jars for further analysis in the laboratory.

4.21.3 Summary Results of Hydrobiology

4.21.3.1 Phytoplankton Characteristics

Phytoplankton Spectrum

Table 4.54a and 4.54b present checklists of phytoplankton species and their classification of surface water samples at the streams and lagoon within the proposed project area in wet and dry seasonss. Four major algal groups were represented and they were the Bacillariophyta (Diatoms), Chlorophyta (Green algae), Cyanophyta (Blue green algae), and Euglenoids.

The dominant group of phytoplankton was the Diatoms, followed by the Blue-green algae and then the Chlorophytes and Euglenoids in both seasons. In wet season, the Diatoms recorded 55%; Blue-green algae 29%; Chlorophytes 10%; and Euglenoids recorded 6%. In the dry season, the Diatoms recorded 60%; Blue-green algae 20%; Chlorophytes 11%; and Euglenoids recorded 9% (Figure 4.37 and 4.38).

Bacillariophyta

The bacillariophyta were the predominant group for the duration of the study in terms of phytoplankton species diversity. Species encountered were *Amphiprora alata, Actinoptycus splendens, Aulacoseira granulata, Aulacoseira granulatavar. angustissma, Camplylodiscus sp., Aulacoseira granulatavar, Chaetoceros decipens, Coscinodiscus centralis, Coscinodiscus eccentricus, Coscinodiscus radiatus, Melosira nummuloides, Melosiramonili formis, Odontella aurita, Odontella regia, Odontella laevis, Odontella sinensis and Skeletonema coastasum* were *centric diatoms.* The *pennate diatoms were Gyrosigma balticum, Gyrosigma spenceri, Gyrosigma scalproides, Nitzschia closterium, Pleurosigma angulatum, Synedra crystalline* and *Synedra ulna.*

Chlorophyta

Species of green algae encountered were *Closterium ehenrenbergii*, *Gonatozygon sp.*, *Gonatozygon monotaeni*, *Scenedesmus obliquus* and *Scenedesmus quadriquada* were species recorded.

Cyanophyta

Species encountered were *Microcystis aureginosa, Merismopedia gluca, Anabaena spiroides, and Oscillatoria tenius for this study.*

Euglenoids

The Euglenoids recorded two species*: Phacus curvicauda, Euglena acus, Phacus acuminatus and Trachelomonas hispida.*

Table 4.55 tabulates the phytoplankton community’s eco-mathematical indices (biological indices). In all a total of thirty-five (35) species were recorded at the 19 points in the streams and lagoons in the wet season study and thirty-six (36) species were recorded at the 10 points in the lagoons in dry season study. Total number of species recorded ranged between 14 and 28 in wet season and between 16 and 24 in dry season. Figure 4-34 shows a graphical relationship between Total Number of Species (S) and Total Abundance of the species (N). C1 recorded the highest number of species (28 species in wet season and 24 species in dry season) while SW 7 and SW15 recorded 14 species and 16 species in wet and dry season respectively. Furthermore, C1 recorded the highest number of individuals in wet season (515 individuals per ml), and SW10 and SW12 recorded highest number of individual species in the dry season (265 individuals per ml) while, SW7 and SW17 recorded 150 individuals per ml and 190 individuals per ml in wet and dry seasons respectively. The Logarithm of Species diversity recorded ranged from 1.15 to 1.45, while Log of phytoplankton abundance was between 2.18 and 2.71. Whereas Shannon-Wiener Index (Hs) was between 2.36 and 3.15, Menhinick Index (D) was between 0.86 and 1.65.

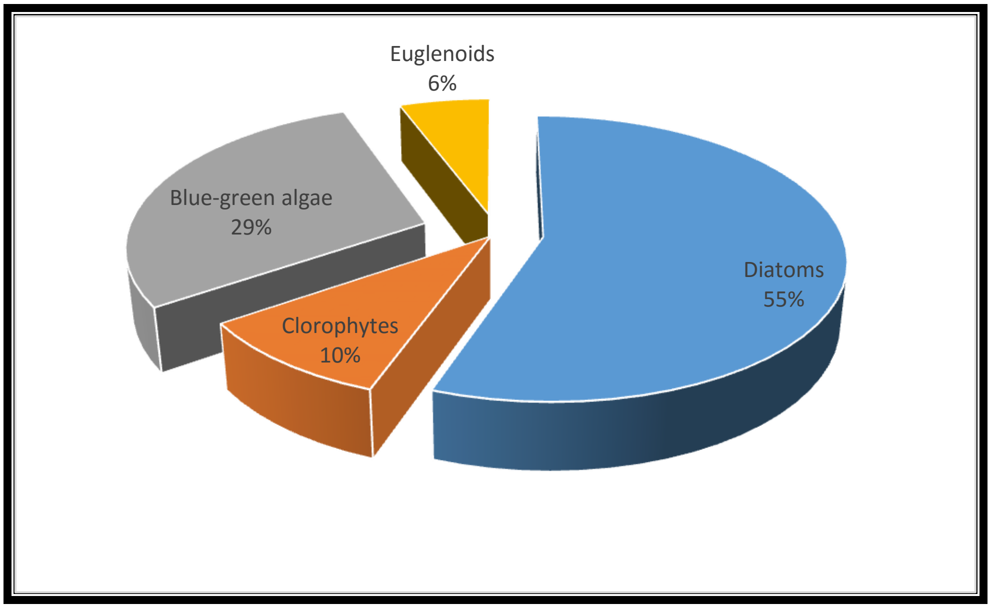


Figure 4-32: Percentage Occurrence of Major Phytoplankton Groups in wet season

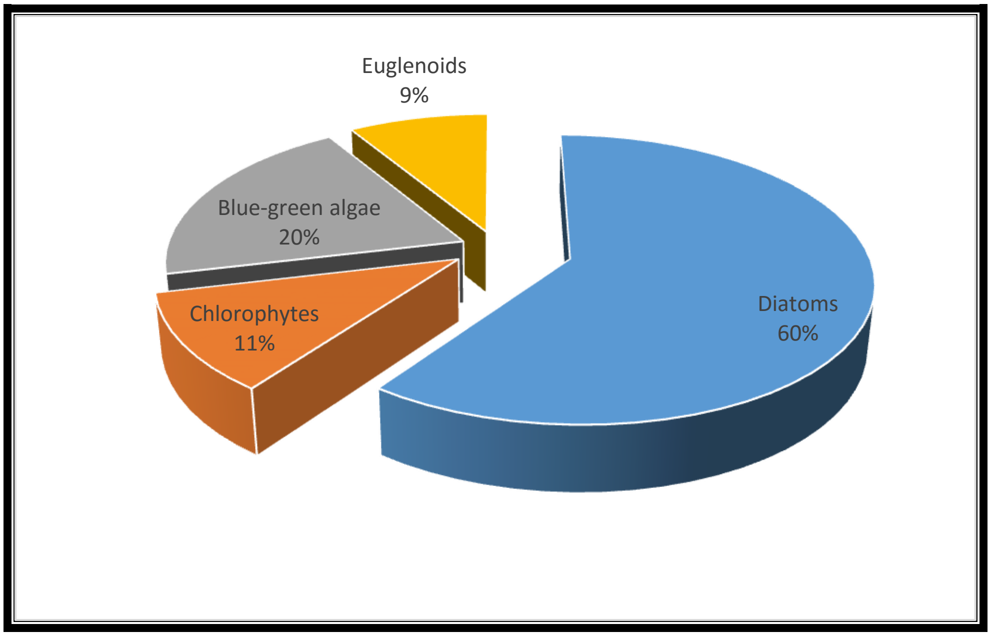


Figure 4-33: Percentage Occurrence of Major Phytoplankton Groups in dry season

Margalef Index (d) values were from 2.50 to 4.32, Equitability on the other hand was between 0.86 and 0.97 and Simpson's Index ranged between 0.05 and 2.07. Graphical representations of the ecological indices are shown in Figure 4.38. The key species occurring for the study were *Gyrosigma balticum*, *Odontella sinensis* and *Camplylodiscus sp* , *Microcystis aureginosa* , *Merismopedia gluca*, *Coscinodis cuscentralis* in terms of occurrence and abundance.

Table 4.54a: Composition and abundance distribution of phytoplankton per ml

ZOOPLANKTON TAXA	Wet Season																		
	SW 1	SW 2	SW 3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW1 7	SWC1	SWC2
BACILLARIOPHYTA																			
ORDER 1: CENTRALES																			
Amphiprora alata	20	-		-		15			30		10	-	-		5		10	10	20
Actinoptycus splendens	-	-	10	10			5	10		10	25	10	10		10	-	-	30	45
Aulacoseira granulatavar. angustissma		-		15	20	-		25	5		20	-	-	-	10		15	10	15
Aulacoseira granulata	20	20	20	5		5							30		10	-	10	30	40
Odontella laevis		20	-	-	-	10	30	-	20	-			10	30				5	20
Camplylodiscus sp	5	-	5	-	5	15	5	-	10	15	-	5	45	-	45	5	90	20	20
Chaetoceros decipens	-	20	-	-	-		10	20	20	30	-	30	20	-	10	10	20	10	25
Coscinodiscuscentralis	5	10	30	-	5	20	5	30	30	-	30	40		10	-	20	-	25	40
Coscinodiscus eccentricus	-	-	-	-	10	30	-		-	10	10	10	30	-	-	40	5	-	-

Coscinodiscus radiates	-	-	-	5	5	5	10		10	-	-	45	-	40	15	-	20	20	15
Melosira nummuloides	-	-	5	10	5	10	5	10	15	-	30	20	5	10	10	20	10	20	10
Melosiramon iliformis	10	5	-	5	10	5		-	-			20	10	-	20	-	15	-	-
Odontella aurita		-	30	15	-	-	5	25	-	-	20		-	-	15		-	30	25
Odontella sinensis	20	-	5	10	10	5	10	20	20		30	20	20	20		40	5	-	20
Skeletonema coastasum		20	-	-	5	10	-	-	30	-	-	10	20	-	-	-	10	30	-
ORDER 11: PENNALES																			
Gyrosigma balticum	*25*	-	30	15	-	-	-	25	25	-	20	25	-	30	15	20	-	30	25
Gyrosigma spenceri		20	20	-	-	5	-	20	20	-	-	5	-	20	-	-	5		20
Gyrosigma scalproides		20	-	-	-	10	-	-	-	-	-	10	20	-	-	-	10		-
Nitzschia closterium	*5*	-	-	-	5	15	5	-	40	15	-	5	-	50	-	5	15	5	-
Pleurosigma elongatum	-	-	30	15		-	-	-	-	5	-	25	-	30	15	20	-	30	25
Synedra crystalline		20	-	-	-	5		20	-	10	-	20	-	-	10	-	5	30	20

Synedra ulna	*10*	20	-	5	-	10	30	-	30	-	-	10	20	-	-	-	10	30	-
DIVISION: CHLOROPHYTA																			
CLASS: CHLOROPHYCEAE																			
ORDER: CHLOROCOCCALES																			
Scenedesmus obliquus	-	5	-	-	-	5	-	-	5	5	-	-	5	-	-	10	-	-	-
Scenedesmus quadriquada	-	-	-	5	-	5	-	15	5	20	-	-	10	-	-	5	-	10	-
ORDER: ZYGNEMATALES																			
Closterium ehrenbergii	5	5	15	10	-	5	-	5	10	-	-	10	5	-	10	10	5	-	-
Gonatozygon monotaenium	15	-	-		15	-	5	-	5	10	5	15	20	15	10	20	15	5	10
Gonatozygon sp	5	-	5	10	5	-	-	-	-	10	30	25	20	10	5	10	5	15	5
DIVISION: CYANOPHYTA																			
CLASS: CYANOPHYCEAE																			
ORDER I: CHROOCOCALES																			

Microcystis aureginosa	20	30	15	10	5	40	20	-	10	15	15	-	80	30	15	20	-	30	45
Merismopedia gluca	5	-	10	-	30	15	-	20	5	50	20	15	10	20	-	100	50	10	15
ORDER II: HOMOGONALES																			
Anabaena spiroides	20	-	40	-	10	20	-	20	30	10	40	30	10	20	15	10	40	40	5
Oscillatoria tenius	-	50	-	10	15	20	-	40	100	10	10	20	5	5	10	30	5	15	20
DIVISION: EUGLENOPOPHYTA																			
CLASS – EUGLENOPHYCEAE																			
ORDER – EUGLENALES																			
Euglena acus	10	5	-	-	15	10	5	10	-	5	15	-	5	5	10	-	-	10	10
Phacus curvicauda	-	-	15	-	-	-	-	5	-	-	5	-	5	-	-	5	-	5	-
Phacus acuminatus	5	-	5	-	-	10	-	5	-	-	5	-	5	-	-	-	-	5	-
Trachelomonas hispida	10	-	5	-	-	20	-	5	10	-	10	10	5	-	-	20	-	5	-

Source: EAECL EIA Field Work 2019/2020

Table 4-54b: Composition and abundance distribution of phytoplankton per ml

	Dry Season									
	SW10	**SW11**	**SW12**	**SW13**	**SW14**	**SW15**	**SW16**	**SW17**	**SW C1**	**SW C2**
DIVISION: BACILLARIOPHYTA										
CLASS: BACILLARIOPHYCEAE										
ORDER 1: CENTRALES										
Amphiprora alata	10	20	-	-	-	10	-	10	10	10
Actinoptycus splendens	5	10	-	10	5	-	10	-	20	15
Aulacoseira granulatavar.angustissma		30	-	-	-	10	20	10	10	10
Aulacoseira granulata	5		20	-	30	10	-	10	5	
Odontella laevis	-	10	5	10	-	5	5	5	5	10
Camplylodiscus sp	15	-	20	15	-	25	-	30		
Odontella regia	-	10	10	-	-		-	5	5	10
Chaetoceros decipens	-	20		5	5	-	-	-		
Coscinodis cuscentralis	20	-	20	-	-	-	20			5
Coscinodiscus eccentricus	-	20	5	-	-	-	-	20		
Coscinodiscus radiates	10	-	-	-		-	5		20	5
Melosira nummuloides		20		5	-	-	-	15	5	
Melosiramonili formis	25	-	20		-		15		-	5
Odontella aurita	20				20	20	30		5	5
Odontella sinensis		-	20	10	20	-	-	-	10	
Skeletonema coastasum										
ORDER 11: PENNALES		5	20		-	30	15		-	
Gyrosigma balticum		10			20	20		10		20
Gyrosigma spenceri	10	-	10		20	-	-	-	10	
Gyrosigma scalproides		15	-	5	-		-	5	15	5
Nitzschia closterium	5		20	25	-		15	20	-	5
Pleurosigma elongatum		10			10	20			5	

Synedra crystalline	10	-	10	10	20	-	-	-	10	-
DIVISION: CHLOROPHYTA										
CLASS: CHLOROPHYCEAE										
ORDER: CHLOROCOCCALES	15	-	-	5	5	5	-	5	-	-
Scenedesmus obliquus	10	-	-	5	10	5	-	5	5	-
Scenedesmus quadriquada										
ORDER: ZYGNEMATALES	5	-	5	-	5	5	10	5	-	5
Closterium ehrenbergii	5	5	-	-	-	-	10	-	10	5
Gonatozygon monotaenium	-	-	10	-	-	-	-	10	5	10
Gonatozygon sp										
DIVISION: CYANOPHYTA										
CLASS: CYANOPHYCEAE										
ORDER I: CHROOCOCALES	40	-	50	15	30	15	20	-	10	15
Microcystis aureginosa	10	30	10	-	20	10	-	-	10	15
Merismopedia gluca										
ORDER II: HOMOGONALES	20	-	10	10	20	5	10	10	10	20
Anabaena spiroides	20	5	-	30	10	-	5	-	5	5
Oscillatoria tenius										
DIVISION: EUGLENOPOPHYTA										
CLASS – EUGLENOPHYCEAE										
ORDER – EUGLENALES	5	-	-	10	5	5	-	10	-	10
Euglena acus	-	-	-	5	-	-	10	-	5	-
Phacus curvicauda	-	10	-	15	-	-	5	5	5	-
Phacus acuminatus	-	10	-	5	-	-	20	-	5	-

Table 4-55: Phytoplankton community composition parameter

		Total Abundance (N)	Total Species Diversity (S)	Log of Total Abundance	Log of Total Species Diversity	Shannon-Wiener Index (Hs)	Menhinick Index (D)	Margalef Index (d)	Equitability Index (j)	Simpson's Index ©
Wet Season	SW1	190	16	2.28	1.21	2.61	1.16	2.86	0.94	0.08
	SW2	270	15	2.44	1.18	2.52	0.91	2.5	0.93	0.09
	SW3	295	18	2.47	1.26	2.69	1.02	2.96	0.93	0.07
	SW4	155	16	2.2	1.21	2.7	1.29	2.97	0.97	0.06
	SW5	175	17	2.25	1.24	2.65	1.29	3.1	0.93	0.08
	SW6	325	26	2.52	1.42	3.06	1.44	4.32	0.94	0.05
	SW7	150	14	2.18	1.15	2.36	1.14	2.59	0.89	0.11
	SW8	330	20	2.52	1.31	2.83	1.09	3.27	0.94	0.06
	SW9	485	25	2.69	1.4	2.93	1.09	3.83	0.91	2.07
	SW10	230	16	2.37	1.21	2.55	1.06	2.76	0.92	0.09
	SW11	350	19	2.55	1.28	2.79	1.02	3.07	0.95	0.06
	SW12	435	24	2.64	1.39	3.02	1.15	3.79	0.95	0.05
	SW13	425	26	2.63	1.42	2.93	1.23	4.1	0.9	0.07
	SW14	345	16	2.54	1.21	2.61	0.86	2.57	0.94	0.08
	SW15	265	20	2.43	1.31	2.86	1.23	3.41	0.95	0.06
	SW16	420	20	2.63	1.31	2.65	0.98	3.15	0.88	0.1
	SW17	375	22	2.58	1.35	2.66	1.4	3.54	0.86	0.1
	SW C1	515	28	2.72	1.45	3.15	1.23	4.32	0.94	0.05
	SW C2	495	23	2.7	1.37	3	1.03	3.55	0.96	0.05
Dry Season	SW10	265	21	2.43	1.33	2.86	1.27	3.56	0.94	0.06
	SW11	240	17	2.39	1.24	2.69	1.1	2.92	0.95	0.07
	SW12	265	17	2.43	1.24	2.65	1.04	2.87	0.93	0.06
	SW13	195	18	2.3	1.26	2.71	1.29	3.22	0.94	0.07
	SW14	255	17	2.41	1.24	2.67	1.06	2.89	0.94	0.07
	SW15	200	16	2.31	1.21	2.58	1.13	2.83	0.93	0.08

	SW16	225	17	2.36	1.24	2.7	1.13	2.95	0.95	0.07
	SW17	190	18	2.28	1.26	2.72	1.31	3.24	0.94	0.07
	SW C1	205	24	2.32	1.39	3.06	1.68	4.32	0.96	0.05
	SW C2	190	20	2.28	1.31	2.87	1.45	3.62	0.96	0.06

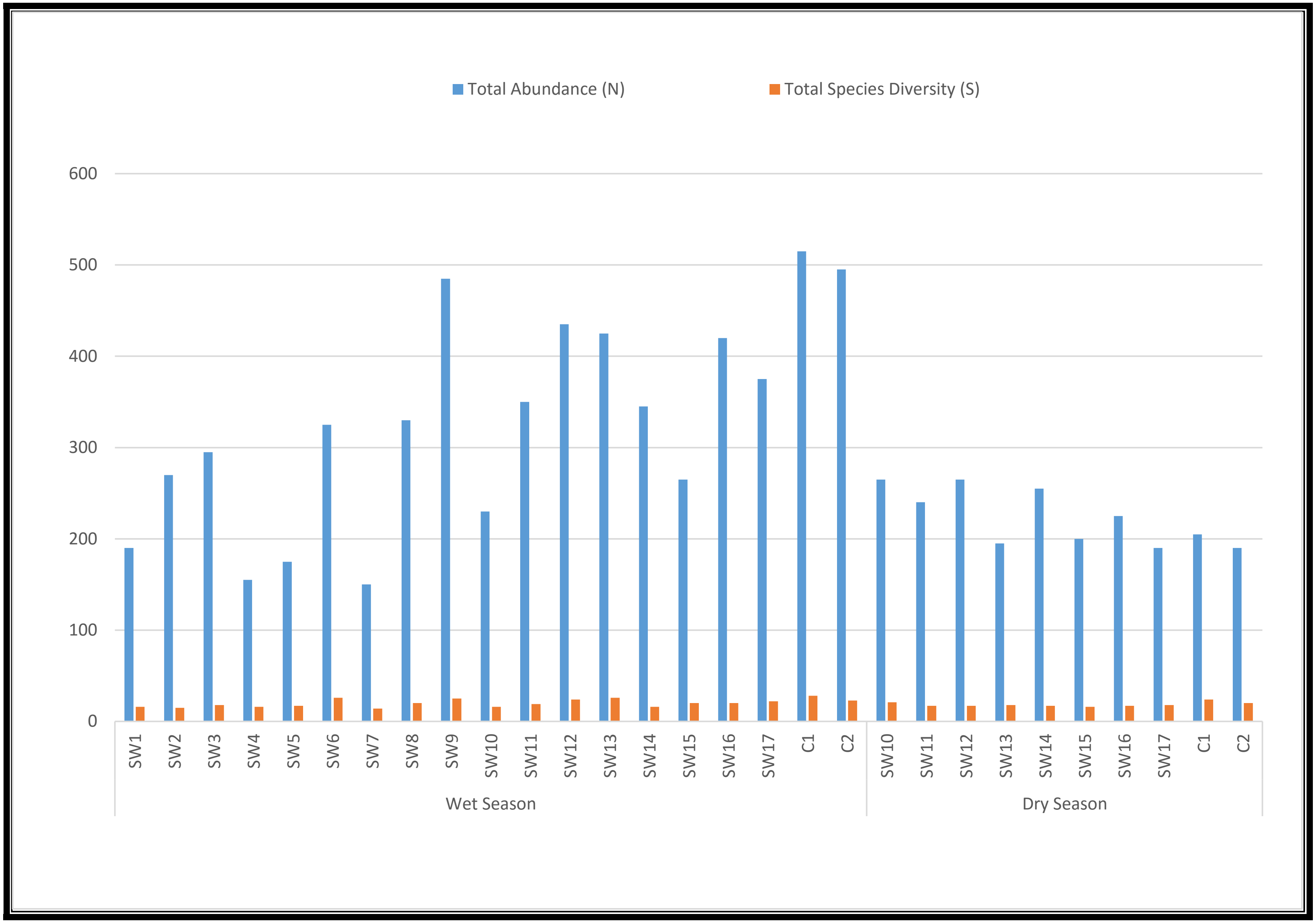


Figure 4-34: Phytoplankton Total Number of Species (S) and Abundance (N)

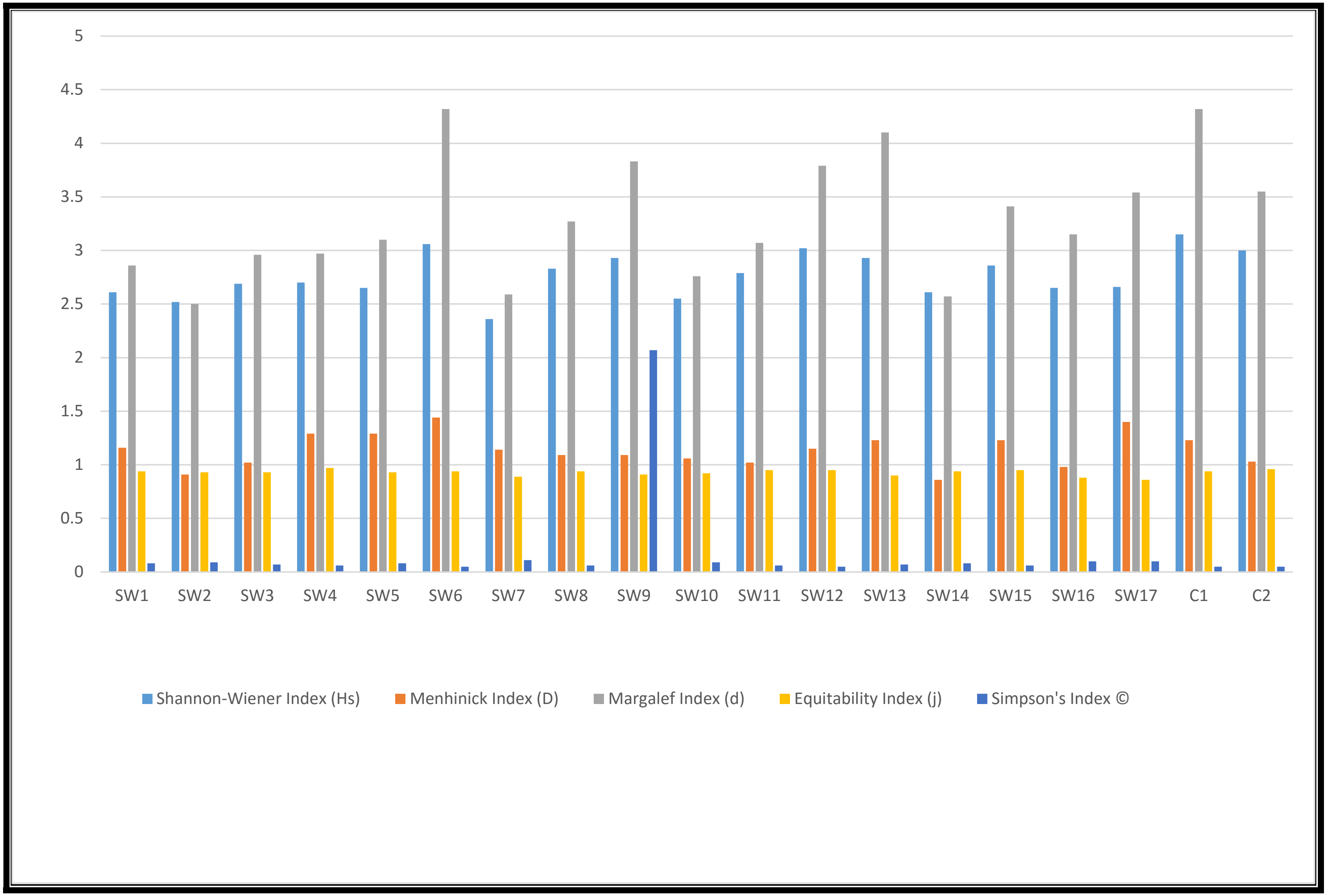


Figure 4-35: Phytoplankton Ecological Indices for wet season

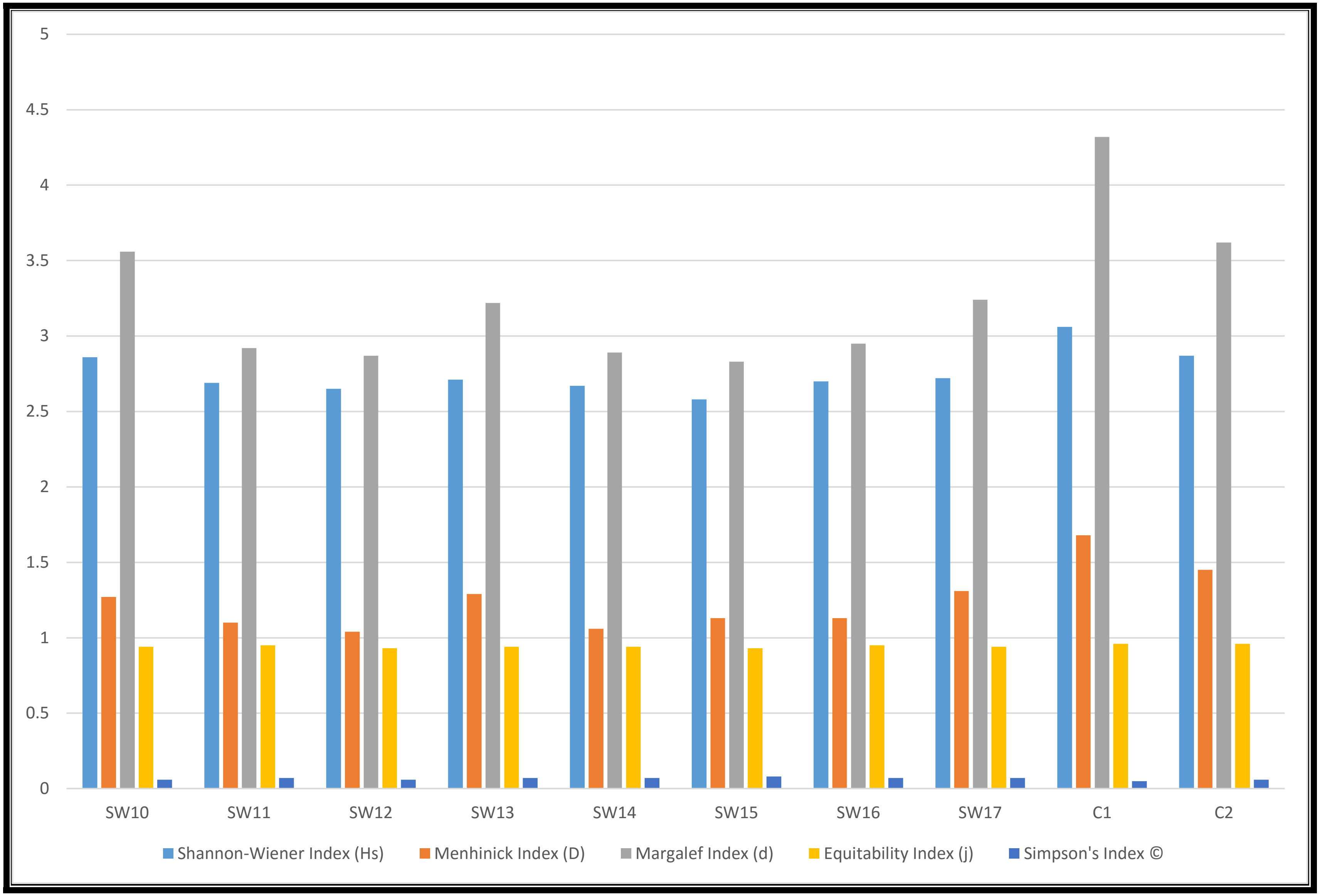


Figure 4-36: Phytoplankton Ecological Indices for dry season

The diatoms were the notable group among the *phytoplankton* identified in the water body. The changes or variation in species of *phytoplankton* and *zooplankton* from station to station recorded for this study were likely reflections of the variety of species available in the region and the variation of species from point to point.
The species recorded for this plankton analysis are common indicators of freshwater situations. Additionally acidic water conditions are also quite likely as reflected by the bio-indicator species recorded. High levels of nutrients probable in the form of nitrates, phosphates and sulphates (or other nitrogen and phosphorus based compounds) are likely implicated. The high densities of *Gyrosigma balticum*, *Odontella sinensis* and *Camplylodiscus sp.*

4.21.3.2 Zooplankton Characteristics

Zooplankton essential role in the food web and also influence the functioning and productivity of aquatic ecosystems through their impact on the nutrient dynamics. The composition and abundance of zooplankton vary in aquatic environments. This makes their biomass ecologically very important because of its uses for monitoring eutrophication, pollution, global warming and environmental disturbances. Also, their abundance can be altered by spatio-temporal variations in hydrochemical parameters and physical forces in aquatic ecosystems (Bianchi *et al.*, 2003). Molinero *et al.* (2005) reported that zooplankton are important indicators of change in aquatic systems and climate change. Most of the sampled surface waters were poor in zooplankton composition.

Zooplankton Spectrum

The zooplankton spectrum study recorded 3 (three) groups of species for the zooplankton (Holoplankton and Meroplankton forms). They were Phylum – Arthropoda, Phylum – Rotifera and Juvenile stages. The dominant group of zooplankton was the Phylum – Anthroda, followed by the Phylum – Rotifera and then the Juvenile Stages. Whereas the Anthropoda recorded 52% (8 species), Rotifera recorded 44% (7 species), Juvenile stages reported 4% (Figure 4-37) in the wet season and 54% for Anthropoda, 44% for Rofifera and 2% for Juvenile stages (Figure 4-38) in the dry season. The juvenile stages were represented by one form namely: Rotiferan egg.
The diversity and distribution of zooplankton per ml per station is shown in Table 4-56 whereas Table 4-57 tabulates the zooplankton community's eco-mathematical indices (biological indices). In all a total of 16 species / forms were recorded at the 10 points inclusive of 2 control points. Total number of species recorded per station ranged between 8 and 16. Figure 4-39 shows a graphical relationship between Total Number of Species (S) and Total Abundance of the species (N). SW C2 recorded the highest number of species (16 species) in both seasons while SW 17 and SW 12 recorded 12 and 8 species in wet and dry seasons respectively. Furthermore, SW C2 recorded the highest number of individuals (450 individuals per ml in wet season and 265 individuals per ml in dry season), while SW 17 recorded 205 individuals per ml in wet season and SW13 recorded 145 individuals in dry season. Log of Species diversity recorded ranged from 0.90 to 1.20; Log of zooplankton abundance ranged between 2.16 and 2.65; Shannon-Wiener Index (Hs) was between 2.01 and 2.69; Menhinick Index (D) was between 0.64 and 0.98; Margalef Index (d) values were from 1.39 to 2.69; Equitability was between 0.90 and 0.98; and Simpson's Dominance Index was between 0.07 and 0.14. Graphical representations of the ecological indices are show in Figure 4.45 and 4.46. *Bosmina* sp., *Macrothrix sp.*, and *Simocephalus sp.* were the key species occurring in terms of occurrence and abundance.

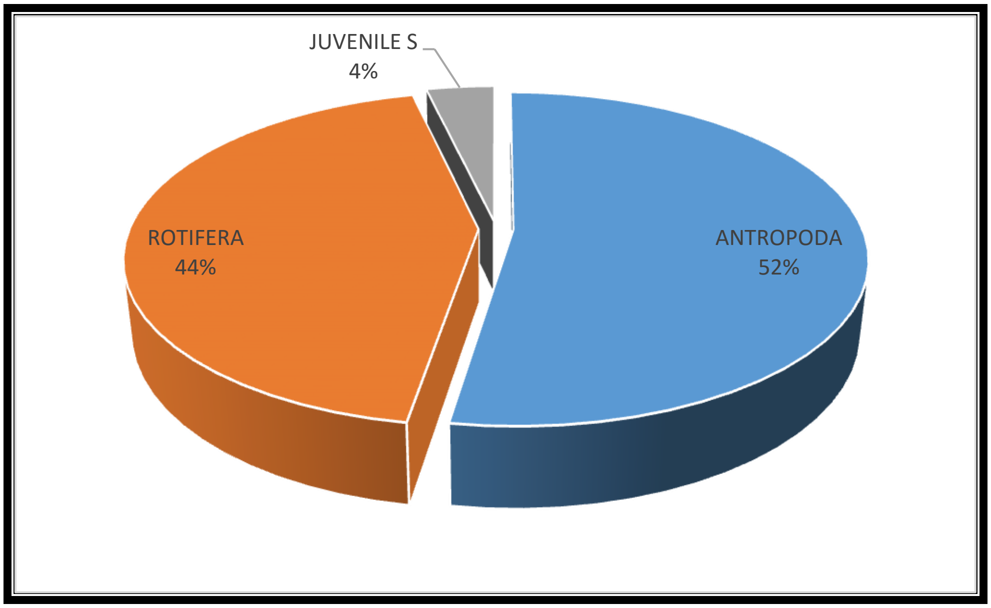


Figure 4-37: Percentage Occurrence of Zooplankton Phylum and Juvenile Stages for Wet Season
Source: EAECL FIELD WORK 2019/2020

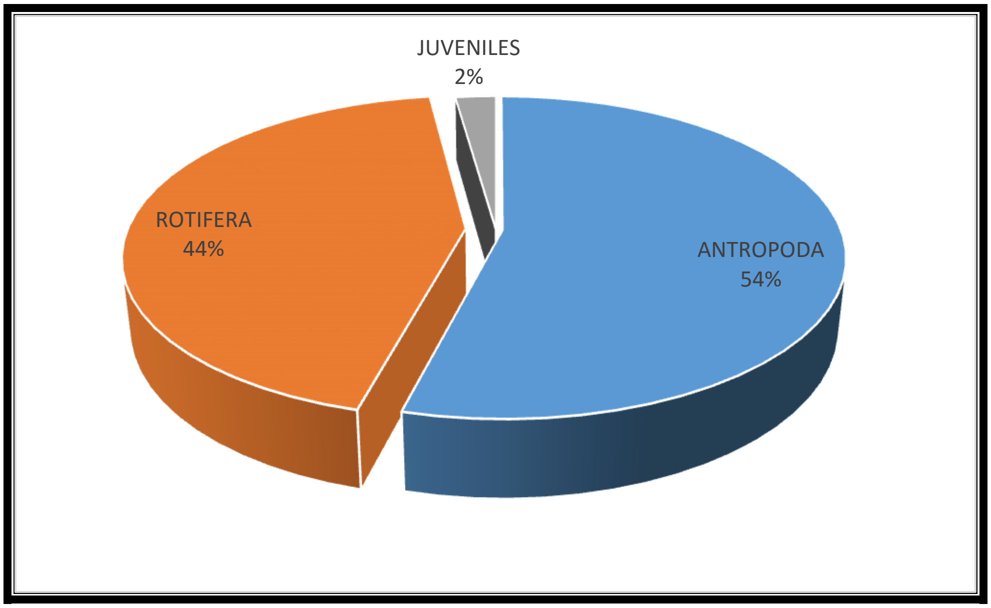


Figure 4-38: Percentage Occurrence of Zooplankton Phylum and Juvenile Stages for Dry Season
Source: EAECL FIELD WORK 2019/2020

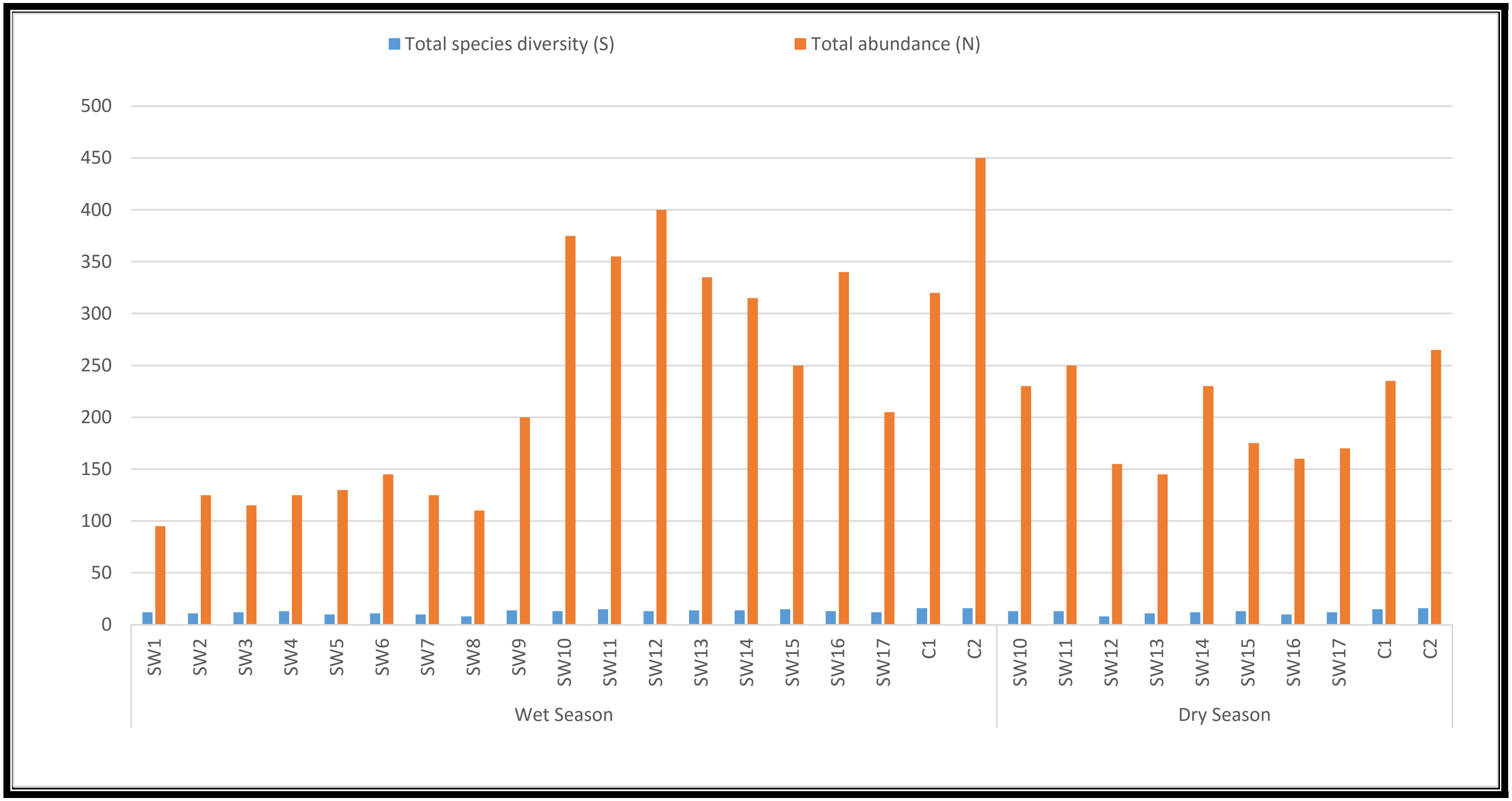


Figure 4-39: Zooplankton Total Number of Species (S) and Abundance (N) for both seasons
Source: EAECL FIELD WORK 2019/2020

Table 4-56: Composition and Abundance Distribution of Zooplankton per ml

ZOOPLANKTON TAXA		PHYLUM: ANTROPODA	*Diaphnia* sp. I	*Diaphnia* sp. II	*Eucyclops* sp.	*Cyclops strenus* Fisher sp	*Diaptomus* sp.	Macrothrix sp.	Bosmina sp.	*Simocephalus* sp.	PHYLUM: ROTIFERA	Keratella sp	Trichocerca sp	*Chromogaster* sp	Brachionus sp	*Lecane* sp.	*Monostyla* sp.	*Tetrasiphon hydrocoral*	JUVENILE STAGES	Rotiferan egg	Total species diversity (S)	Total abundance (N)
Wet Season	SW1		10	10	-	10	5	-	-	15		5	-	10	5	5	5	5		10	12	95
	SW2		5	-	10	-	15	10	-	5		10	-	15	10	-	15	15		15	11	125
	SW3		5	-	5	10	20	-	10	5		10	10	10	10	10	-	10		-	12	115
	SW4		-	5	10	20	15	15	-	5		5	5	5	5	-	5	20		10	13	125
	SW5		-	25	5	5	30	-	20	-		-	10	-	5	20	5	5		-	10	130
	SW6		10	-	15	-	5	5	-	15		10	20	10	15	-	20	20		-	11	145
	SW7		5	15	-	15	10	10	20	10		-	5	-	-	10	-	-		25	10	125
	SW8		20	30	-	10	-	-	-	-		5	-	10	-	5	-	10		20	8	110
	SW9		10	10	-	5	30	20	10	30		10	20	10	10	5	15	10		5	14	200
	SW10		10	-	30	10	50	50	-	15		10	-	55	15	50	20	10		5	13	375
	SW11		10	30	10	25	20	30	40	-		20	30	10	15	20	30	50		15	15	355
	SW12		30	40	-	10	-	40	50	50		40	45	-	20	15	20	30		10	13	400
	SW13		20	55	-	10	-	30	10	45		30	55	30	15	10	10	10		5	14	335
	SW14		20	10	20	30	-	50	30	-		25	10	25	30	20	20	20		5	14	315
	SW15		10	-	15	10	10	10	45	45		10	10	15	15	10	10	15		20	15	250
	SW16		10	20	20	-	30	-	55	55		15	20	20	20	30	25	20		-	13	340
	SW17		20	-	10	-	15	10	45	10		30	15	10	-	15	10	15		-	12	205
	C1		10	25	10	30	10	30	50	20		10	25	10	30	10	30	10		10	16	320
	C2		25	40	20	45	15	40	20	20		55	30	20	45	15	30	20		10	16	450
Dry Season	SW10		-	-	30	5	40	30	-	15		20	10	15	10	20	20	10		5	13	230
	SW11		10	20	20	10	30	30	20	-		30	20	10	10	30	-	10		-	13	250
	SW12		10	20	-	-	-	20	30	20		-	15	-	-	10	-	30		-	8	155

	SW13		5	30	-	10	-	-	20	15		10	15	10	15	-	-	10		5	11	145
	SW14		-	5	20	20	-	30	40	-		5	10	25	30	20	-	20		5	12	230
	SW15		10	-	10	-	10	10	15	25		10	-	15	15	10	10	15		20	13	175
	SW16		-	-	30	10	20	-	-	-		5	10	20	20	10	25	10		-	10	160
	SW17		5	-	10	10	10	10	40	30		-	10	10	-	15	10	10		-	12	170
	SW C1		5	15	10	20	10	20	30	30		10	15	10	10	10	30	10		-	15	235
	SW C2		10	10	10	15	10	40	20	20		20	10	20	15	15	20	20		10	16	265

Source: EAECL EIA Field Work 2019/2020

Table 4-57: Zooplankton Community Composition Parameter

	Bio-Indices	Total species diversity (S)	Total abundance (N)	Log of Species diversity (Log S)	Log of abundance (Log N)	Shannon-Wiener Index (Hs)	Menhinick Index (D)	Margalef Index (d)	Equitability Index (j)	Simpson's Index
Wet Season	SW1	12	95	1.08	1.98	2.41	1.23	2.42	0.97	0.09
	SW2	11	125	1.04	2.1	2.34	0.98	2.07	0.97	0.09
	SW3	12	115	1.08	2.06	2.41	1.12	2.32	0.97	0.09
	SW4	13	125	1.11	2.1	2.4	1.16	2.49	0.94	0.1
	SW5	10	130	1	2.11	2.97	0.88	1.85	0.89	0.14
	SW6	11	145	1.04	2.16	2.31	0.91	2.01	0.96	0.1
	SW7	10	125	1	2.1	2.19	0.89	1.86	0.95	0.12
	SW8	8	110	0.9	2.04	2.75	0.76	1..49	0.91	0.16
	SW9	14	200	1.15	2.3	2.49	1	2.47	0.94	0.09
	SW10	13	375	1.11	2.57	2.33	0.67	2.02	0.9	0.11
	SW11	15	355	1.18	2.55	2.45	0.74	2.33	0.91	0.1
	SW12	13	400	1.11	2.6	2.45	0.65	2	0.96	0.09
	SW13	14	335	1.15	2.52	2.41	0.76	2.24	0.91	0.1
	SW14	14	315	1.15	2.49	2.53	0.79	2.26	0.96	0.08
	SW15	15	250	1.18	2.4	2.52	0.95	2.54	0.93	0.09

	SW16	13	340	1.11	2.53	2.45	0.7	2.06	0.96	0.09
	SW17	12	205	1.08	2.31	2.34	0.83	2.07	0.94	0.11
	C1	16	320	1.2	2.5	2.62	0.89	2.6	0.94	0.08
	C2	16	450	1.2	2.65	2.67	0.75	2.46	0.96	0.07
Dry Season	SW10	13	230	1.11	2.36	2.4	0.86	2.21	0.94	0.1
	SW11	13	250	1.11	2.4	2.47	0.82	2.17	0.96	0.09
	SW12	8	155	0.9	2.19	2.01	0.64	1.39	0.97	0.14
	SW13	11	145	1.04	2.16	2.27	0.91	2.01	0.94	0.11
	SW14	12	230	1.08	2.36	2.31	0.79	2.02	0.93	0.11
	SW15	13	175	1.11	2.24	2.51	0.98	2.32	0.98	0.08
	SW16	10	160	1	2.2	2.2	0.78	1.76	0.95	0.12
	SW17	12	170	1.08	2.23	2.3	0.92	2.14	0.92	0.12
	C1	15	235	1.18	2.37	2.58	0.98	2.56	0.95	0.08
	C2	16	265	1.2	2.42	2.69	0.98	2.69	0.97	0.07

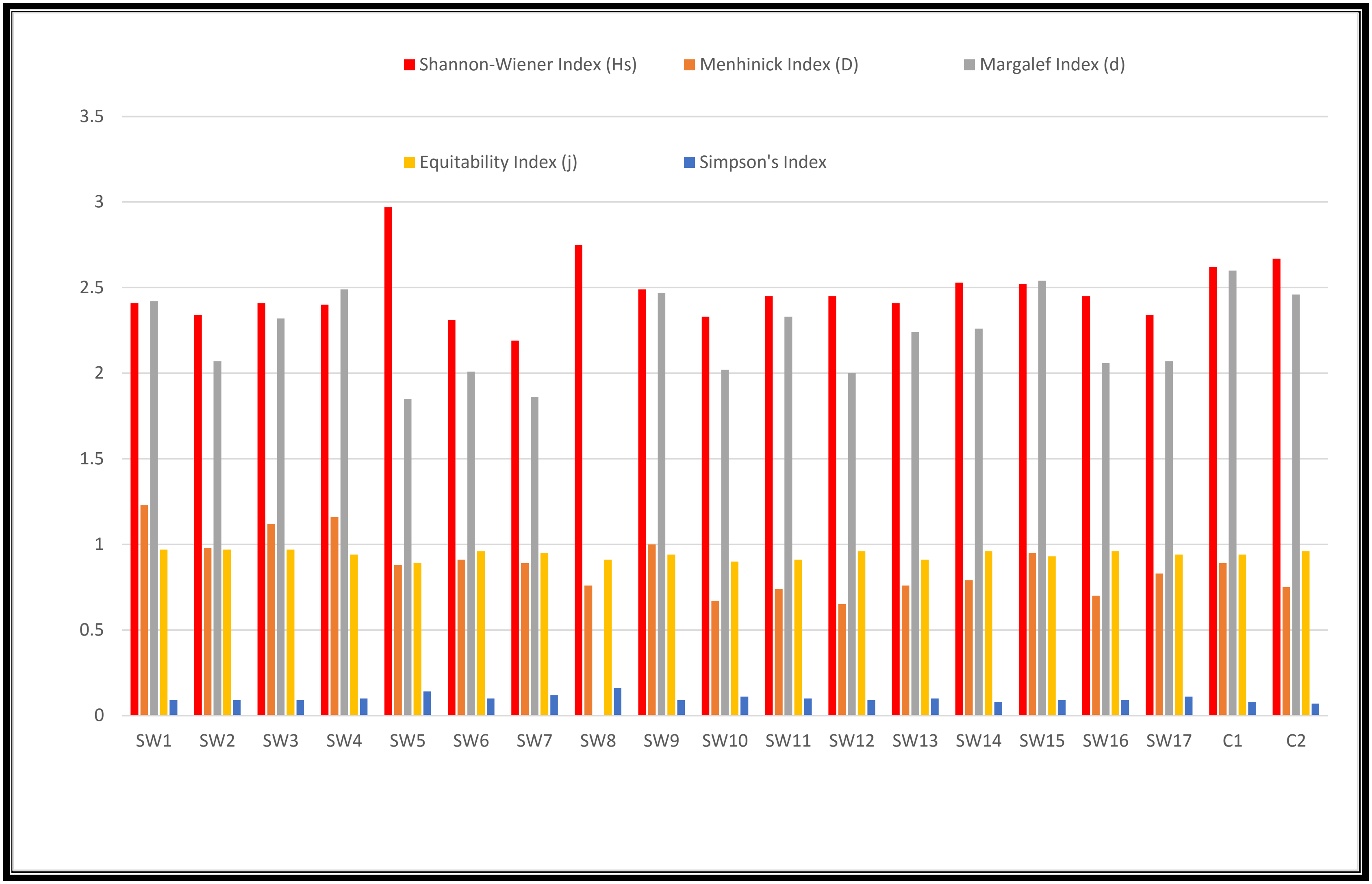


Figure 4-40: Zooplankton Ecological Indices for wet season
Source: EAECL EIA Field Work 2019/2020

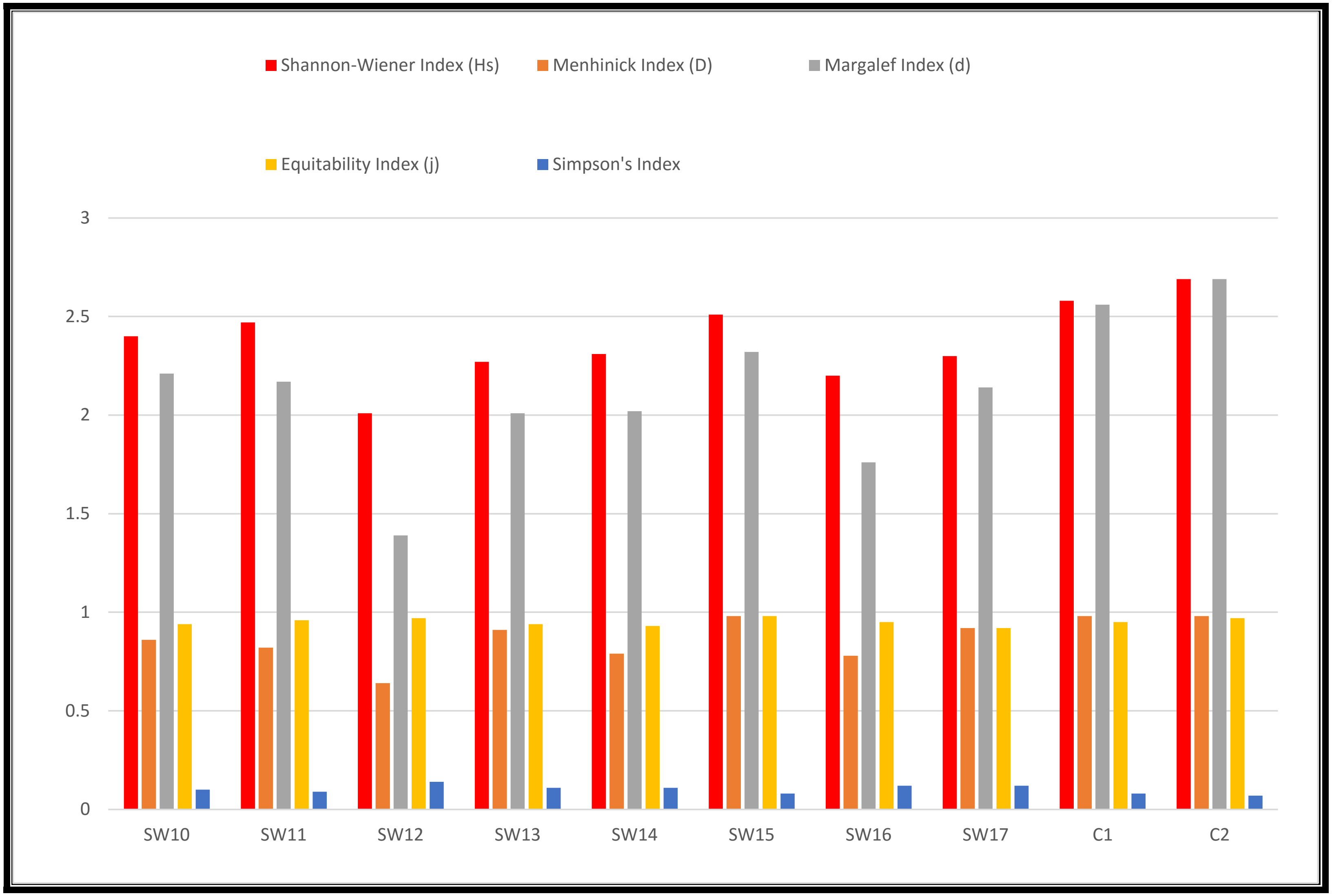


Figure 4-41: Zooplankton Ecological Indices for dry season
Source: EAECL EIA Field Work 2019/202

4.21.3.3 Benthic Macrofauna Characteristics

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

The summary of species composition and abundance of macrobenthic fauna in all sampled station SW10 to SW17 and 2 control stations is presented in Table 4.58 and Figure 4-47. The macrobenthic fauna consisted of 3 taxa belonging mainly to two phyla, viz: phylum mollusca (2 taxa) and insect (1 taxa). The biological indices of the benthic community within the environment are presented in Table 4-58 and Figure 4-42. The percentage distribution indicated that class gastropoda dominated followed distantly by class insect and the least class bivalvia as shown in Figure 4-44 and 4.45 for wet and dry seasons. The species frequency distribution in the study area is presented in Figure 4.42 and the dominant species include *Melonoides tuberculata, Chironomus sp* and *Aloidis trigona.* In wet season, SW13 and SW12 have the highest of species diversity indicating a more stable environment and SW13 the highest number of individual while in dry season, SW13 has the highest number of individual and SW12, SW13, SW15 and SW17 have the highest species divesity (Figure 4-42).

Species diversity and abundance was generally low across the study area with stations indicating a stressed environment. The dominant species *Melonoides tuberculata* and *Chironomus sp.* in the area have been reported to be pollution tolerant species and associated with deterioration of water quality.

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

Table 4.58: Composition and Abundance Distribution of Benthos

	Wet season										**Dry season**									
ORGANISMS / PHYLA	SW 10	SW 11	SW 12	SW 13	SW 14	SW 15	SW 16	SW 17	SW C1	SW C2	SW 10	SW 11	SW 12	SW 13	SW 14	SW 15	SW 16	SW 17	SW C1	SW C2
MOLLUS A																				
Gastropoda																				
Melanoides tuberculata	2	1	3	6	5	2	4	3	5	7	1	2	1	3	2	2	3	3	3	4
Bivalvia																				
Aloidis trigona			1	1									1			1				
INSECTA																				
Chironomous sp	2	3	1	2		3	1	2	1		1			2				1	1	1
Total species diversity (S)	2	2	3	3	1	2	2	2	2	1	1	1	2	2	1	2	1	2	2	2
Total Abundance (N)	4	4	5	9	5	5	5	5	6	7	2	2	2	5	2	3	3	4	4	5

Source: EAECL Field work 2019/2020

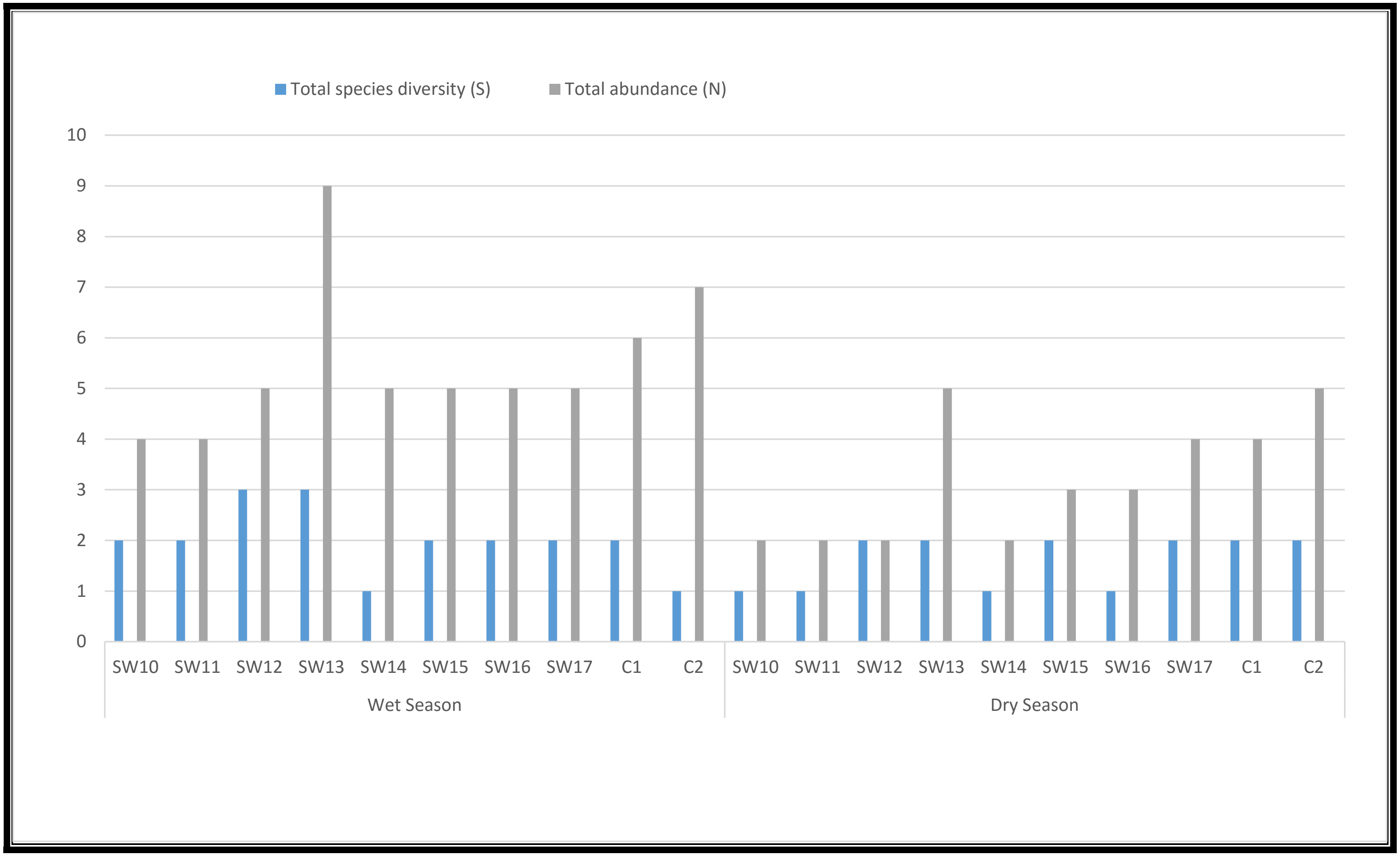


Figure 4.42-: Total Number of Species Diversity (S) and Abundance (N)
Source: EAECL Field work, 2019/2020

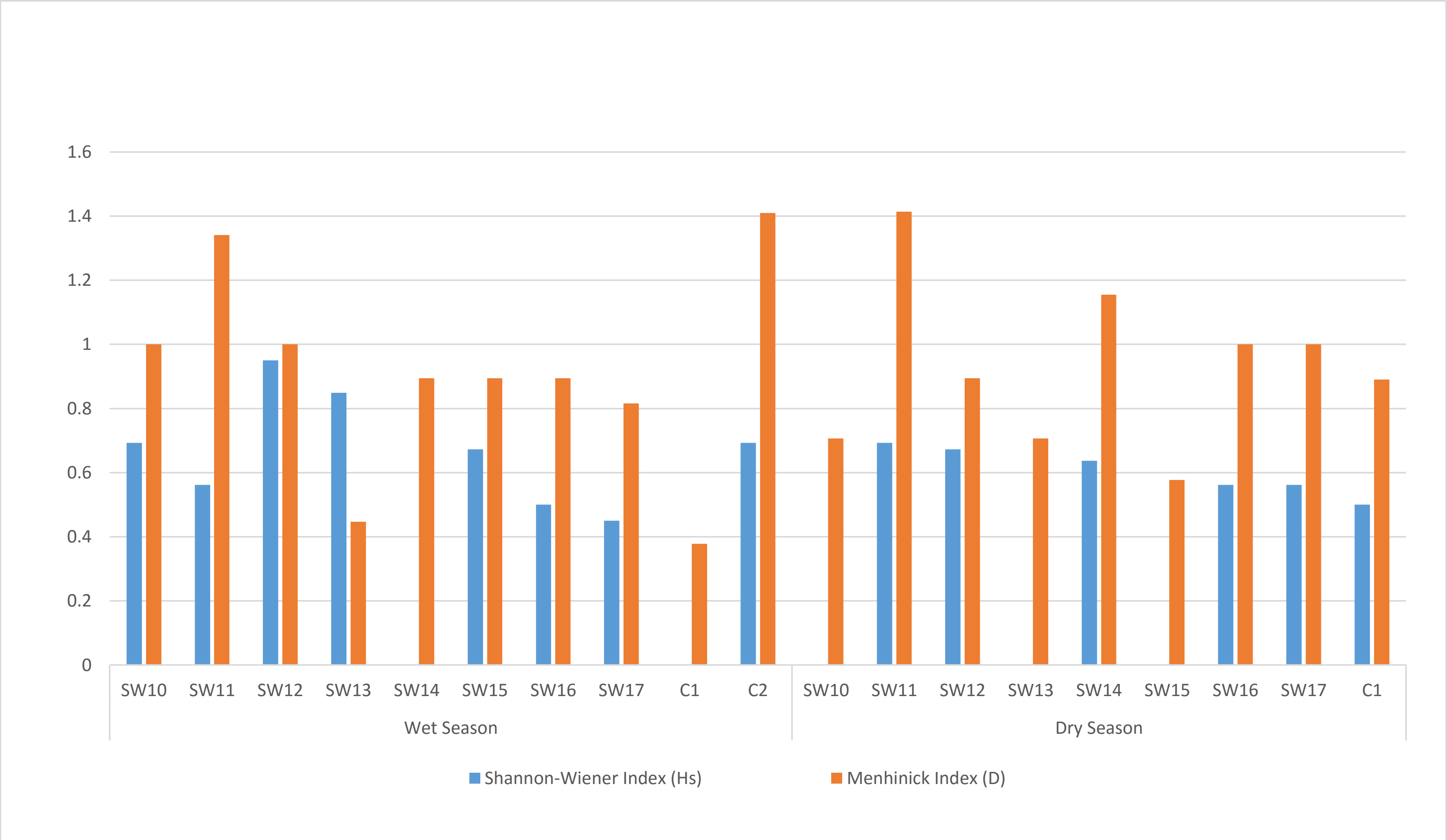
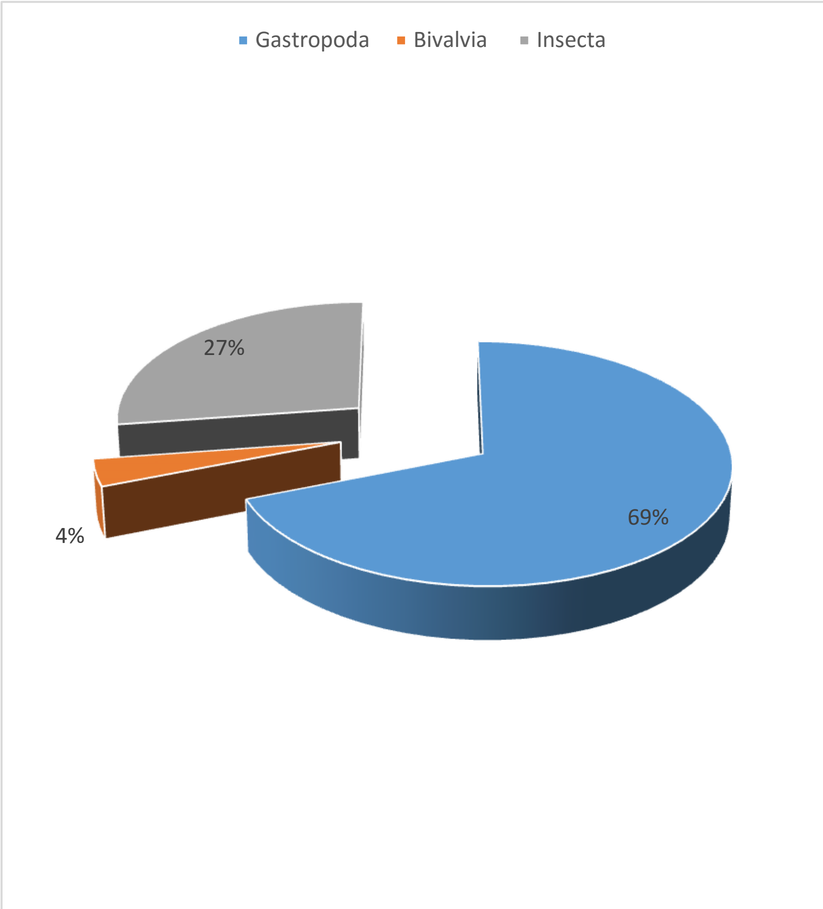


Figure 4.43: Benthos Ecological Indices
Source: EAECL Field Work 2019/2020



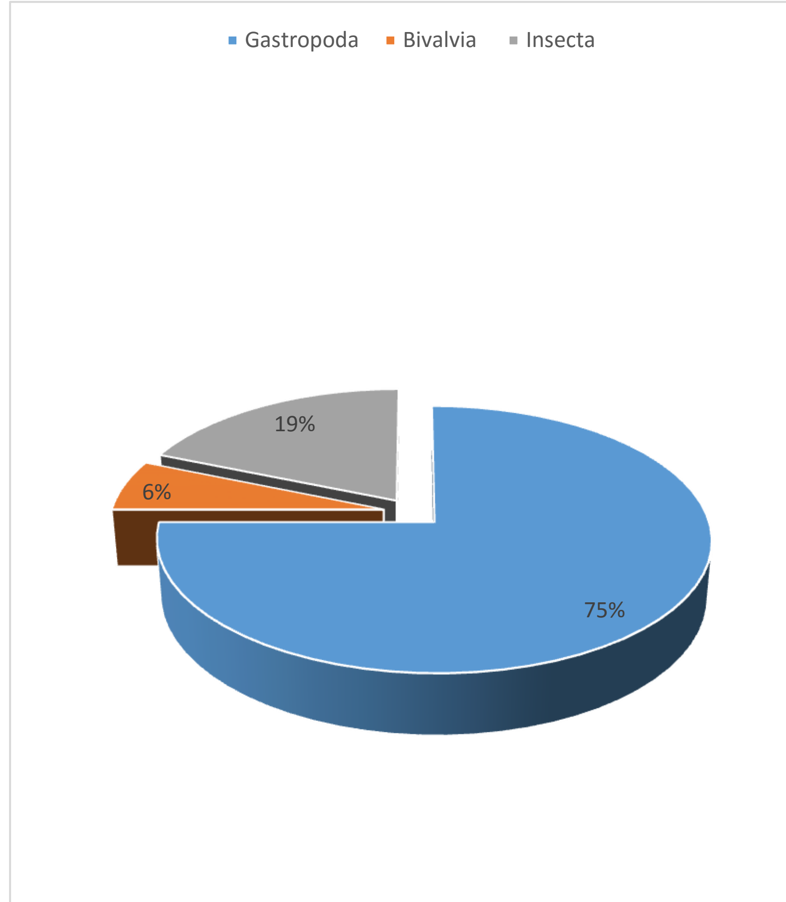


Figure 4.44: Percentage Distribution of Macrobenthos Community in wet season   Figure 4-45: Percentage Distribution of Macrobenthos Community in dry season

Table 4.59: Benthic Community Composition Parampeter of Sampling points SW10- 17 and two control points for wet and dry seasons

	Wet Season										Dry Season									
ORGANISMS / PHYLA	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW17	SW C1	SW C2	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW17	SW C1	WS C2
Total species diversity (S)	2	2	3	3	1	2	2	2	2	1	1	1	2	2	1	2	1	2	2	2
Total abundance (N)	4	4	5	9	5	5	5	5	6	7	2	2	2	5	2	3	3	4	4	5
Log of species diversity (Log S)	0.301	0.301	0.477	0.477	0	0.301	0.301	0.301	0.301	0	0	0	0.301	0.301	0	0.301	0	0.301	0.301	0.301
Log of abundance (Log N)	0.602	0.602	0.699	0.954	0.699	0.699	0.699	0.699	0.778	0.845	0.301	0.301	0.301	0.699	0.301	0.477	0.477	0.602	0.602	0.699
Shannon-Wiener Index (Hs)	0.693	0.562	0.950	0.849	0	0.673	0.500	0.673	0.450	0	0.693	0	0.693	0.673	0	0.637	0	0.562	0.562	0.500
Menhinick Index (D)	1.000	1.000	1.341	1.000	0.447	0.894	0.894	0.894	0.816	0.378	1.41	0.707	1.414	0.894	0.707	1.155	0.577	1.000	1.000	0.89
Margalef Index (d)	0.721	0.721	1.243	0.910	0	0.621	0.621	0.621	0.558	0	1.44	0	1.443	0.621	0	0.910	0	0.721	0.721	0.62
Equitability Index (j)	1.000	1.00	0.865	0.773	0	0.971	0.722	0.971	0.650	0	1.000	0	1.000	0.722	0	0.918	0	1.000	1.000	0.722

4.21.4 Fishery Studies

A number of fish species were identified and photographs taken as part of primary data source for Epe Lagoon and Lekki Lagoon. Secondary data source was from literature review of past fish studies conducted within the same Epe lagoon. Fishes recorded were identified obtained from the catches of local fishermen at Oluwo Royal market fish landing station located close to Epe Lagoon about 7 km from the project site. The fishes identified in Lekki Lagoon where the catches of local fishermen at landing point at Eyin-Osa village which is about 5.64 km from the project site

.

Epe lagoon lies between latitudes 03050’-04010’N and longitudes 005030’ –005040’E is fed by River Oshun, it has a surface area of more than 243 km^2 (about 225 km2) and a maximum depth of 6 m though a large area of the lagoon is relatively shallow with a minimum depth of 1 m, and the vegetation surrounding the Lagoon is of the mangrove swampy type.

Epe lagoon is sandwiched between two other lagoons, the Lekki lagoon (freshwater) in the east and Lagos lagoon (brackish water) in the west. The lagoon opens into the Gulf of Guinea (the sea) via the Lagos Harbour.

Lekki Lagoon supports a major fishery in Nigeria. The lagoon lies between longitudes 4 00’ and 4 15’E and between latitudes 6 25’ and 6 37’ N. It has a surface area of about 247km2 with a maximum depth of 6.4m; a greater part of the lagoon is shallow and less than 3.0m deep. The Lekki lagoon is part of an intricate system of waterways made up of lagoons and creeks that are found along the coast of south-western Nigeria from the Dahomey border to the Niger Delta stretching over a distance of about 200km. It is fed by the River Oshun and Saga discharging into north-western parts of the lagoon. Lekki lagoon experiences both dry and rainy seasons typical of the southern part of Nigeria. The vegetation around the lagoon is characterized by shrub and raphia palms (*Raphia sudanica)* and oil palms, (*Elaeis guinieensis)*

Generally, fishing activities are well known and a common practice among inhabitants of the study area. The type of fishing here is mainly artisanal, in terms of scale, where the catch is usually for family consumption and a few for sale. Fishing gears commonly used for fishing in the area include; hand pole and hook (Poro), setnets (Atamu), cast nets (obiriki), gillnets (atafo), lift-nets (Awo Salapore), bamboo traps (Oparun), long line (Ewoolokun) and traditional basket traps (Igun/Ogun) **Plate 4.40**. These gears are typical for use by artisanal fishermen and similar to the ones reported in Dangote Refinery EIA, 2015.

Fish processing within the study area is basically traditional. Traditional smoking kiln or earthen ovens are often used to smoke fish. The smoked fish is consumed within the family unit and/ or sold at the local markets directly to wholesale buyers. Fishes reported in the area are presented in **Table 4.60**. Also presented are common, biological and local names as well as ranking based on 2015 International Union for the Conservation of Nature (IUCN) Red List of Threatened Species, version 2. Pictorial evidence of fishes observed in the market area are presented in **Plates 4.41-4.45** The major aquatic macrofauna were fishes. Discussions with the villagers revealed the presence of Fish catch in the study area has been observed to be decreasing over the years. This may be due to intense fishing, climate change and use of indiscriminate fishing methods.

Plate 4.40 Traditional basket traps

Table 4.60: Fish Composition within the study area.

Biological Name	Common Name	Local Name	Abundance Score
Schilbe mystus	African Butter Fish	Asan/Dibawe	D
Tilapia guineensis	Tilapia	Epia/Ajikoro	C
Sarotherodon melanotheron		Epia	C
Hemichromis fasciatus	Jewewl Fish	Koro/Akokoro	C
Chromido guntheri		Efolo	C
Pellonulla leonensis		Agbodo/Efolo	C
Ethmalosa fimbriata		Agbodo/Efolo	C
Mormyrus rume	Elephant Fish	Lele	D
Chrysichthys nigrodigitatus	Silver Catfish	Obokun	C
Chrysichthys filamentosus		Pinsin/Obokun	C
Clariasis heriensis		Aro	C
Clarias gariepinus	African Catfish	Aso	D
Heterobranchus longifilis	Mud Catfish	Aso	C
Brycinus longipinnis			R
Distichodus rostratus			R
Elop slacerta		Asugbon	R
Synodontis clarias			R
Synodontis nigrita	Cat Fish	Okokoniko	R
Sphyraena barracuda		Kuta	R
Caranx hippos	Crevalle jack	Owere	R

R = Rare; C = Common; A = Abundance; D = Dorminant.

Other species of fishes identified in Epe and Lekki lagoon by Soyinka et al, 2012 and Saliu, 2015 are *Battygobius soporator*, *Elops lacerta*, *Cynoglossus senegalensis Gymnorchus nitoticus, Heterotis nitoticus, Hepsetus odoe, Polypterus senegalus Malapterus electricus, Marcusenius cyprinoides Clarias isheriensis, Erpetoichthys calabaricus, Parachana obsura Polydactylus quadrifilis*, *Pomadasys jubelini*, *Xenomystus nigri and Synodontis cupterus*

Plate 4.41 ***Clarias gariepinus***

Plate 4.42 ***Chrysicthys nigroditatus***

Plate 4.43 ***Heterotis spp***

Plate 4.44: Synodontis nigrita

Plate 4.45 *Chromido guntheri*

4.21.5 Ecosystem Services of the Fish Species

Analysis on the ecosystem services provided by the fish species across the fish group was conducted. The ecosystem services reviewed are provisional services (food and medicine) and cultural services. Details of the provisional services are presented in Table 4.61. A total of 4 fish species were reviewed as offering ecosystem services

Provisioning Services

Services that describe the material or energy outputs from ecosystems are termed provisional services. Provisional services offered by the floristic resources of the study area are organized into three groups namely; food/fibre/energy**,** medicinal attributes and Raw Materials.

Table 4.61 Health conditions requiring fish as part of healing recipes

Biological Name	Common Name	Local Name	Health Condition
Clarias gariepinus	African Cat Fish	Aso	• Tuberculosis • Epilepsy • Chicken pox • Laxative • Blood flukes • Gonorrhea • Gyneacological disorders • Goitre • Fevers • General antidote
Heterobranchus longifilis	Mudfish	Aso	• Aphrodisiac
Chrysichthys nigrodigitatus	Silver Catfish	Obokun	• Increase sperm potency • Increase pregnancy probability
Tilapia guineensis	Tilapia	Epia/Ajikoro	• Aphrodisiac • Chicken pox

Source: Akindayo, 2007

Cultural services

These are the non material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. IFC (2012) grouped this services into Cultural diversity, Spiritual and religious values, Knowledge systems, Educational values, Inspiration, Aesthetic values, Social relations, Sense of place, Cultural heritage values and Recreation and ecotourism. African catfish (*Clarias gariepinus)* is used for preparing concoction to Increase spiritual acuity.

4.22 SOCIO-ECONOMIC AND HEALTH STUDIES

4.22.1 Human Environment

The human environment is a very crucial aspect of the environment that must not be neglected because development is for man. This aspect of the environment entails the socio-cultural milieus, artifacts, belief systems and values of the people in communities. Considering their perceptions, feelings and concerns will go a long way to shape their response to development projects in their areas.

4.22.2 Introduction

4.22.2.1 Political context

Nigeria is a Federal Republic made up of 36 States and a Federal Capital Territory. Nigeria became an independent state in 1960 and a republic in 1963. It started off with three regions namely Eastern, Northern and Western regions until a fourth; the Mid-West region was created in 1963. Nigeria experienced the first military coup in 1966, and a thirty-month civil war from 1967 to 1970. The military government created 12 states from the four regions in 1967. Between 1967 and 1996, the 12 states were further divided into 19, then 21 and finally 36 states. Lagos state was created on the 27th May 1967 by virtue of the state creation and Transitional Provisions Decree No.14 of 1967. Lagos state is known as the financial hub of Nigeria.

4.22.2.2 Country Location and Administrative structure

Nigeria lies between latitudes 4^{o} and 14^{o} north of the equator and longitudes 3^{o} and 15^{o} east of the Greenwich meridian on the west coast of Africa. It covers a total area of 923,766 square kilometres consisting of 910,768 square kilometres of land and 13,000 square kilometres of water with the coast line stretching up to 853 kilometres. The entire country is divided into 36 states and federal capital territory. These are further sub-divided into 774 local government areas which form the third tier of government while the central and state governments form the first and second tier respectively. The third tier consists of the Local Government Areas. The country practices a presidential system of government consisting three arms of government: the executive, the legislature and the judiciary (Nigerian 1999 Constitution). The executive consists of both elected and appointed members, while members of legislature, both at federal and state levels are elected. This pattern is similar to what obtains at the Local Government level, except that there is no third arm (the judiciary) at the LGA level. Another major difference between the central government structure and that of the state is the presence of two legislative chambers at the center (i.e. the Senate and the House of Representatives), while the states have just one.

The LGA administration is run by an elected Executive Chairman and appointees of the Chairman representing the executive arm of local government administration. There is also the legislature made up of ten Counselors elected from the wards in the LGA. The Chairman is the chief security officer of the LGA and the office is important in the operations of the proposed project.

The communities have a well-defined hierarchical political structure with traditional leadership through Kings (Oba) or Baale, chiefs and community Heads. The traditional authority structures are similar in all the communities. This governance structure is graphically represented in Figure 4.3.4

At the community level, the traditional authority structure hardly varies from one community to another with the traditional head (King or Baale) and chiefs jointly administering their political, economic and social affairs. Authority in each community is at two levels. The first is the traditional ruling council composed of the village chiefs and headed by the village head (the "Baale"). The second is the Community Development Association (CDA) comprising of an elected Chairman and some Executive Members. All CDAs operate under the leadership of one Community Development Secretary (CDS) who is coordinates the activities of all CDAs in the area. The Community Development Association (CDA) mobilizes the different sections and interest groups in the Community for development purposes. The CDA reports to the CDS who takes issues to Council of Elders. There is also a Youth Organization with elected Chairman and members in each community.

Three broad groups are identifiable in each of the communities – male elders, youths and women. The role of male elders is traditional governance of the communities. They dominate the political arena and the decision-making positions, while the youth leaders are usually at the bottom rungs of the ladder of authority. The traditional role of the youths includes constituting a labour force in development projects, security of the community and to enforce law and order. Traditionally, there is a limit to the involvement of women in the political governance of these local settlements. Generally, women play a subdued role in the communities, usually placed at the background. Each of the communities has a patriarchal familial arrangement. There is also the women group led by the women leader (Iya lode) who organizes and co-ordinates the activities and role of women in the community. The children as well as the non-indigenes or visitors are at the base of the governance system. The system rewards good and hardworking people and reprimands troublesome and unprogressive individuals. The communities have very high respect for the Baale who is the overall ruler.

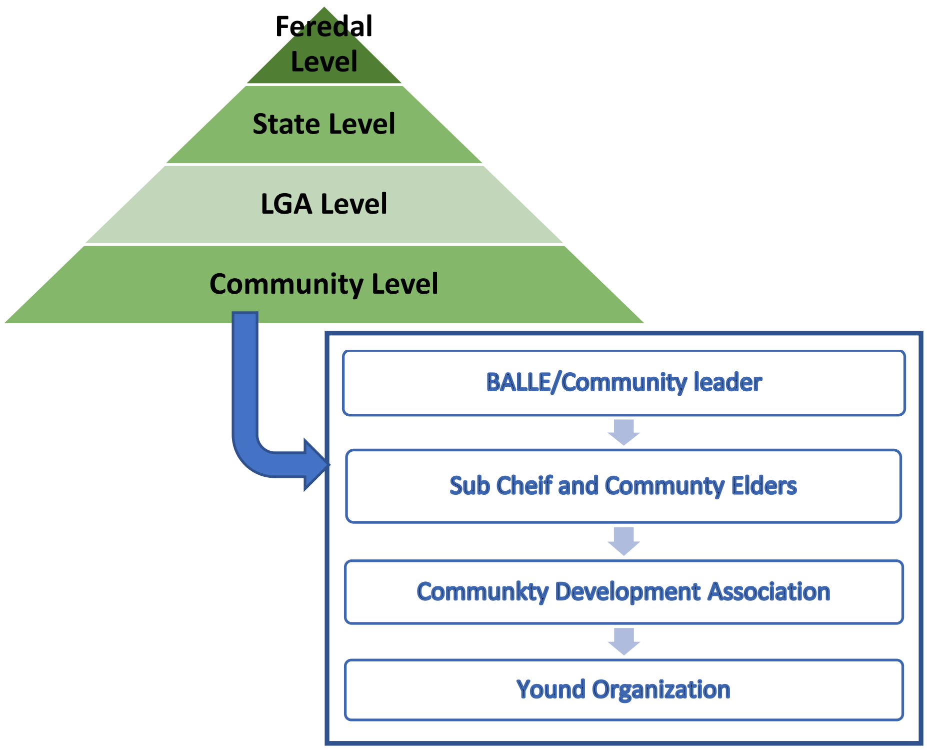


Fig. 4.45: Governance Structure of the Communities in the project Area

4.22.3 Socio-Economic Baseline

4.22.3.1 Methodology

Data accumulation for the baseline information starts with some reviews and desktop studies of various reports on Nigeria. This provides the context within which the baseline information about Lagos State, the affected Local Government Area (LGA) and the immediate settlements around the project site will be appreciated. Finally, mostly data in statistical representation and charts, reflected in this EIA, were obtained from structured consultations with the traditional rulers, community heads, and officials of the LGA as well as members of the affected communities.

Human environmental baseline data was gathered using a combination of desktop studies and field surveys. It covers the following social components: demography, land-uses, land ownership, administrative and socio-cultural institutions, infrastructures, economics and livelihood, cultural heritage and health.

The baseline socio-economic and health status of the project area was assessed using questionnaire and interview guide were employed to collect information from about 30% of the people in the affected communities. Due the smallness of the settlement (hamlets) and their scattered nature, Focus group discussion was the principal method of data gathering. In each settlement, the community members gather with their leader (Baale) or approved representative of the Baale to respond to issues posed to them. Foremost, the introduction of EIA team was done, followed by intimating them with the purpose of the team's visit and the discussion of the proposed project and their perception of positive and negative impacts. In addition, one Hundred and Sixty-Two (162) community members and leaders were randomly selected and interviewed using a standard questionnaire and interview guide between November 28 - 30, 2019 and February 26 - 28, 2020.

4.22.3.1.1 Stakeholder Engagement and Consultation

The first visit was to the Epe LGA in order to collect official information that provided the link to the Baales and guidance for conducting community engagement. After securing contact with the communities' leaders, the Elders, Youth leaders and women leaders were contacted. Various meetings were held with these groups on the proposed project and need for the socio-economic studies. They were then mobilized to co-operate and participate in the survey. The process of consultations with members of the communities continued throughout the study and is even to continue in the course of construction and operation of the garment plant in the communities.

Plate 4.46 Consultation at youth leader at Idomu   Plate 4.47 Consultation with some communities Baales

Plate 4.48 Consultation at Epe LGA   Plate 4.49 Consultation with a Leader in Idomu

Plate 4.50 Consultation with a leader at Iya Aja

a Recruitment and Training of Field Assistants

With the approval of the community leaders, educated and literate members of the communities were recruited and trained as field assistants to conduct the study team round the communities. They also assisted in the administration of questionnaire and focus group discussion.

b Socio-economic data collection

This was done mainly by the use of a well-structured questionnaire which addressed all the socio-economic issues e.g. occupation, income, marital status and marriage practice, educational status, historical data, natural resources management, social groups, land use and on infrastructures like housing, markets, schools, hospital type of water, electricity, roads and other baseline socio-economic data.

c Health Data Collection

The administered health questionnaires contained questions addressing the socio-demographic data; housing; infrastructure and physical environment; health and well-being including current prevalent communicable and non-communicable diseases; health seeking behaviours, nutritional status; occupational health, lifestyle and social habits as they affects health. Other health related parameters such as common diseases, immunization status, and physical assessment were elicited from secondary sources.

d. ***Sampling Technique:***

The socio-economic and health questionnaires were administered to the households. A cross sectional stratified random survey method was employed. Copies of questionnaire were administered to available adult population that gave consent to participate in the survey. A total of 62 copies of questionnaire were randomly administered to adults in the different communities. The study team ensured that the entire communities were covered.

e. ***Focus Group Discussions (FGD)***

These were held separately with male elders, youths and women groups. All socio-economic and health issues and how they have been affected by previous development projects as well as what is to be expected in the current project were discussed. The concerns of the communities, and possible ways of mitigating against the identified possible negative impacts due to the negative environmental effects that may arise in the construction, operation and closure of the garment factory in the neighbouring communities were also discussed. One hundred members were involved in the different FGDs that were conducted.

a

b

C

d

e

f

g **h**

Plate 4.51a - h: Focus Group discussion withadult men and women (a-Idomu, b-Yegunda, c-Mausa, d-Agbon, e-Oloso, f-Ofin, g-Eyin-Osa, h-Imafo)

a. ***Study of infrastructures and other environmental Issues***

A walk-through the communities was conducted so as to identify the available infrastructures in the communities e.g. Electricity, Schools, Roads, Hospitals/Clinics and Markets. Also, observations were made on the environmental living conditions, noting the following: types of housing, environmental sanitation, source and quality of water supply, evidence of erosion and flooding and general environmental degradation.

b. ***Social and Health hazards:***

The social and health hazards identified during the studies and the overall possible impact of constructing and operating a garment industry on the communities were assessed and rated in accordance with Hazard identification and inventorization (HAZID) and Hazards and Effects Management process (HEMP) practices in development projects. Recommendations of the possible environmental management to mitigate the observed hazards as well as the negative impact remediation measures were accordingly proffered.

4.22.3.2 Overview of project area

Following the 2006 census, the National Population Commission (NPC) published the population of Nigeria as 140,431,790 comprising 71,345,488 males and 69,086,302 females. The NPC estimated annual population growth at 3.2% (NDHS, 2008). The current population, projected at 3.2% annual growth and using the exponential model is 180,735,714, with a density is 198.6 per square kilometer. A higher male population and sex ratio of 103 was recorded for the country. Children (age 0-14) constituted 41.8% of the population while those less than 20 years were 52.3% and those less than 25 years 61.9%. The elderly (65 years and above) were 3.2% of the population. The age dependency ratio was 82.0. Given these proportions, the population of Nigeria is quite young. Average household size in Nigeria is 4.9 (NBS 2012).

According to the 2006 census, Lagos State has a population of 10,694,915 (NBS, 2012), with a projected population of 12,130,986.7 for the year 2015 (NBS, 2012). The population density of Lagos state is 3304.55 square kilometers. In Lagos State, children aged (0-14 years) constituted

30.3% of the population, those from (15-44 years) constitute 49.3%, (45-64 years) constitute 15.28% while 2.8% of the population are 65 years and above. The age dependency ratio of the population in the state is 70.9%.

Table 4.62: Relevant livelihood indices in the project state

<table>
<tr><th>Livelihood Indices</th><th colspan="2">Lagos State</th></tr>
<tr><td>Population</td><td colspan="2">10,694,915</td></tr>
<tr><td>Literacy</td><td colspan="2">80.5</td></tr>
<tr><td rowspan="2">Youth Literacy in any language</td><td>Male</td><td>Female</td></tr>
<tr><td>99.4</td><td>99.3</td></tr>
<tr><td rowspan="2">Adult literacy in English language</td><td>Male</td><td>Female</td></tr>
<tr><td>95.8</td><td>92.3</td></tr>
<tr><td>Infant Mortality</td><td colspan="2">45</td></tr>
<tr><td>Life expectancy</td><td colspan="2">51 years</td></tr>
</table>

Source: NBS (2012)

4.22.3.3 Host Local Government Area

The affected Local Government Area is Epe LGA in Lagos state. In Lagos State, the State Government has further divided the Local Government Areas into Local Council Development Authorities (LCDAs). However, these LCDAs are not been recognized by the Federal Government but most of the indigene are used to the LCDA as most of them mention them in the course of discussion.

4.22.3.4 Host Communities

A combination of information from communities' heads and high resolution imagery of the project area show that 15 No settlements are within the spatial boundary of the proposed project area (5 km radius). The information and location of affected communities is presented in table 4.63 and Figure 4.47. One communities (Gere not listed in Table 4.63 refused to participate in the consultation exercise after several attempts through various avenues available to engage them)

Field campaign and information gathering were conducted in each of the fourteen settlements except Gere. With the assistance of the Baale of Eyin-Osa, who is also the secretary of the Council of Baales in Epe, the study team was able to use all the means of transport available (land- vehicle and motorcycle, and water- engine powered boat) to reach all the communities.

Table 4.63: Affected Communities in Epe LGA

State	LGA	Community	Coordinates	
			Longitude	Latitude
Lagos	Epe	Adenowo-Mawusa	4.0051	6.5639
		Eyin Osa	3.9770	6.5671
		Idomu Oloja	3.9747	6.5177
		Ijayo Ogunbote	4.0512	6.5086
		Imafon	4.0499	6.5384

		Iya Aja	3.9875	6.5363
		Jaguna	3.9706	6.5403
		Ofin	4.0461	6.5359
		Oke Oko-Mawusa	4.0051	6.5639
		Oke-Egan	4.0071	6.5211
		Oloso	3.9898	6.5099
		Yeguda	4.0243	6.5063
		Idiroko	4.0034	6.5286
		Ogbon	4.0321	6.5363

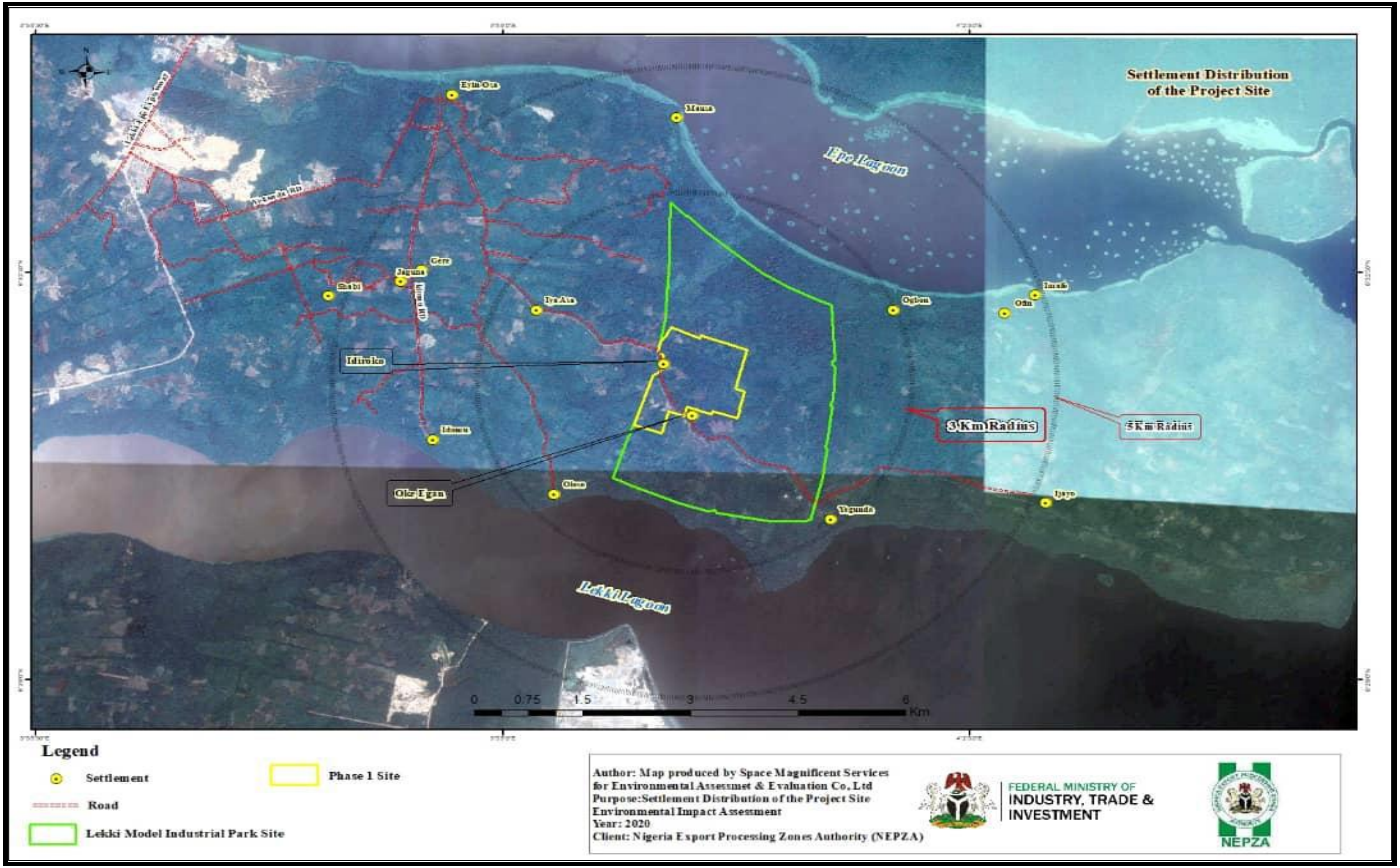


Figure 4.46: Map showing communities around the Proposed Project.

Houshold Characteristics of the study area

The population of Epe Local government area has increased steadily over the years, going by the figures recorded from 1991, 2006 and 2016. People in the communities of the LGA were 101,464 in 1991, 181734 in 2006 and 250,300 in 2016. The rate of population change within theses periods was 3.25% per annum. With an area of 965 km^2, the population density was 259.4 persons per km^2. The structure of the population (2006) showed the children aged 0-19 had the highest proportion (48.1%) of the population Table 4.64. This was followed by ages 20 – 39 years (31.7%), ages 40 – 59 years accounted for 14.3% and the least were people 60 years and above (5.9%). Males were slightly more (50.6%) than the females in the area. The family size is moderate with an average of about 7-8 persons per house

Table 4.64: Age and gender compisition of Population

Age Distribution	Persons	Cummulative	Percent
0-9 years	45,138		
10-19 years	42,275	87,413	48.10%
20-29 years	35,067		
30-39 years	22,520	57,587	31.70%
40-49 years	16,390		
50-59 years	9,525	25,915	14.30%
60-69 years	5,670		
70-79 years	3,010		
80+ years	2,139	10,819	5.90%
Gender			
Males	91,925		50.60%
Females	89,809		

Source: 2006 Census

4.22.4 *Demographic Characteristics of the sampled population*

A total of 100 household were interviewed in the project area which include Adenowo-mauwusa, Eyin Osa, Idomu Oloja, Ijayo Ogunbote, Imafon, Iya Aja, Jaguna, Ofin, Oke Oko-mauwusa, Oke-Egan,, Oloso, Yeguda, Idiroko and Agbon.

Based on the interactions with members of the communities, it was observed that majority of the people residing in the communities are between 45 and 65 years (>25%) while those above 65 year of age were the least (<19%) represented in the project area. According to participants in focus group discussions, a significant number of youths and children live in Epe town for purposes of education and job. Many of the adults also commute between Epe and the villages/hamlets.

The field survey revealed that the household population structure is made up of 68.3% male and 31.6% female (Table 4.65). The high proportion of males encountered in the project are can be adduced to the fact that many of the men are farmers while their wives engagein trading activities in the nearby Epe town. This will enable the families to enjoy multiple treams of income into their purses/finances.

Table 4.65: Sex composition of the respondents

Village name	Female	Male	Total
Adenowo-mauwusa	0	2	2
Eyin Osa	6	16	22
Idomu Oloja	0	1	1
Ijayo Ogunbote	8	7	15
Imafon	0	1	1
Iya Aja	0	1	1
Jaguna	5	0	5
Ofin	0	4	4
Oke Oko-mauwusa	0	2	2
Oke-Egan	0	4	4
Oloso	0	1	1
Yeguda	0	1	1
Idiroko	0	1	1
Agbon	0	1	1
Total	19	42	61

4.22.5 *Martial status of head of houshold*

Apart from 78 people that participated in the FGD, all respondents in the questionnaire interview were married across the age-groups. Most of the young people expressed their opinions during the FGDs. Among them, 61% of the 41 married males practiced monogamy while about 12% married two or more wives. About 27% of the respondents are widows and widowers. This third category were largely elderly people who by reason of age have lost their partners.

Monogamy is fast becoming more dominant in Yoruba communities recently due to increase in the influence of westernization, the Christian faith and the poor economy making it difficult for a man to care for more than one wife and several children. However, members of the communities marry at an early age of about 19 years old. The older men claimed that the several wives and children enabled them to maintain their farms and to support their farming and fishing occupations to feed and maintain the family.

Table 4.66 Nature of Marriage in Households

Status of Respondent	Frequency	Percent
Head of Family	42	68.3
Wife	19	31.7
Total	61	100.0
No of wives		
Monogamy	25	61.0
Polygamy	6	12.2
Others (widows etc.)	11	26.8
*Total	41	100.0

*** Males only**

Source: EAECL, 2019/2020

4.22.6 *Houshold size*

Information on household size of the communities in the project area is presented in Table 4.67. As could be seen in the Table, the dominant household sizes in the project area are those made up of 6-10 persons, accounting for 40.0% of the households. This was followed by those made up of 1-5 persons (18.3%). About 10.0% and 8.3% households have family sizes of between 11-15 persons and more than 15 persons respectively. The predominance of large family size compared to typical urban setting shows a marked disparity. The rural dwellers maintain large family sizes to secure additional hands during farm work and fish processing, which are their main occupations.

Table 4.67: Number of people in the sampled households

Village name	1-5 people	6-10 people	11-15 people	16 people and above	Total
Adenowo-mauwusa	0	1	0	1	2
Eyin Osa	9	13	0	0	22
Idomu Oloja	0	1	0	0	1
Ijayo Ogunbote	0	0	0	1	1
Imafo	0	0	0	1	1
Iya Aja	0	0	1	0	1
Jaguna	0	5	0	0	5
Ofin	1	2	0	1	4
Oke Oko-mauwusa	0	0	1	1	2
Oke-Egan	0	2	2	0	4
Oloso	0	0	1	0	1
Yeguda	0	0	1	0	1
Idiroko	1	0	0	0	1
Agbon	0	0	0	1	1
Total	11	24	6	5	47

Source: EAECL Field work 2020

4.22.7 *Ethnic Compostion*

A high proportion (96%) of the communities' residents were of the Yoruba ethnic group and speak the Yoruba language with the Ijebu dialect. The inhabitants claimed that they were born in their communities and have lived all their life in the communities. The settlements are largely rural with few houses; predominantly hamlets and villages. The house units appear nucleated with houses facing each other within the forest. The houses are also crowded together living very little spaces between them. This kind of settlement afford the people the necessary security making it difficult for thieves, invaders and outsiders to single out a house for an attack. At one call, the whole community can rise almost at once. In almost all cases there are no fences separating one building from another. Whatever affects one household immediately affects the whole community. The communities clearly demonstrate a very good example of communal living.

The communities also have the same culture and tradition of the Yoruba people in general. This is clearly demonstrated in their marriage, burial, traditional religious practices and in their general living habits and conditions. Religious festivals are celeberated regardless of the affliations of the people; confirming the rural nature of the communities. Only two respondents are from other ethnic groups apart from Yoruba.

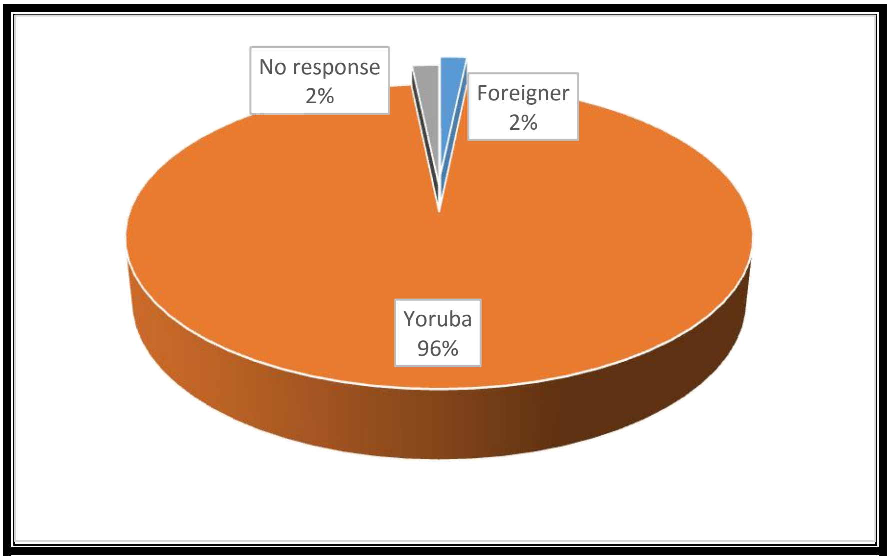


Fig 4.47: Ethnic groups of respondents in the project area

4.22.8 *Religion*

The inhabitants in all the communities of study belong to three religious affiliations, namely: Islam, Christianity, and Traditional religion. Most of the respondents (87%) claim Islam as their primary religion, fewer people showed affiliation to Christianity. Among those that claimed traditional religion (3%), there is involvement in any of the other two particularly during Festivals and celebrations. While respondents claimed Islam and Christianity, there were scant places of their worship found. The traditional worshippers have more shrines dedicated for their religious activities. On the average only about 10% are the traditional religion worshippers in all the communities, studied and these traditionalists maintain and still retain the shrines in the communities.

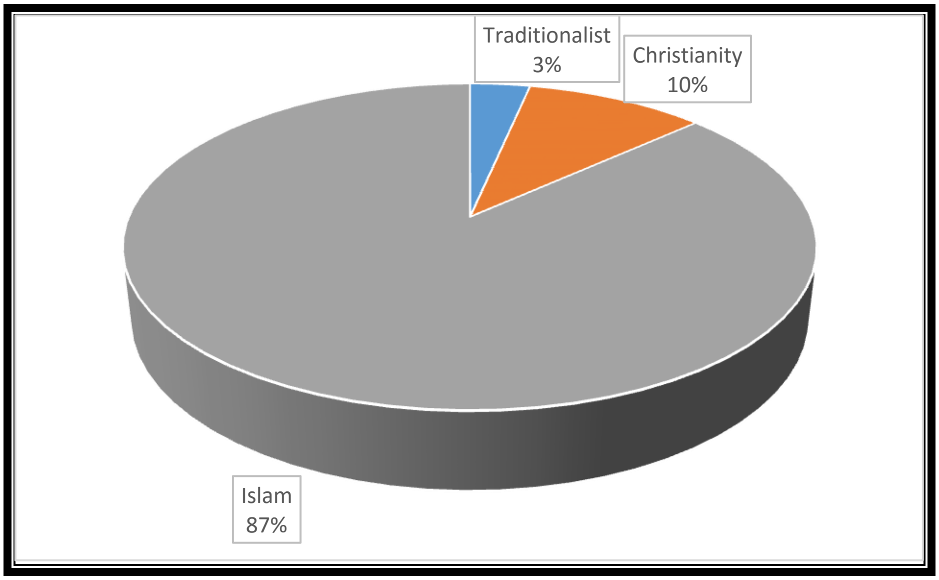


Figure 4.48: Distribution of respondents according to religion

Plate 4.52: A structure used for church meeting in Idomu community

Those that still adhere to traditional religion have their shrines located in the community. Despite the presence of the three religions, the people have no religion crisis and they live together peacefully.

Some of the major shrines are as follow:

- Ojubo
- Ojubo-Ire
- Oju-ota
- Oju-Aye
- Iroko
- Ogun (god of iron)
- Oju Orisa Ala
- Oshumade
- Oshala
- Igboro
- Oju Osun (eyes of the river god)
- Oshi-ilu
- Aponropon- Sharosharo
- Egungun
- Ogunyemoja
- Oya
- Egun (god of Masquerade)
- Sango (god of thunder)
- Esu

Plate 4.53: Ogun shrine

Plate 4.54: Esu shrine

Plate 4.55: Oshi-ilu Shrine

Plate4.56: Ojubo-Ire

4.22.9 *Traditional style*

All the communities studied claimed that their ancestors migrated from Ijebuland in Ogun State to settle in their present day communities. They claimed that their forefathers were great farmers and till date farming is still their main occupation. The quest to acquire more expanded land for farming and to acquire more independence and freedom influenced their forefathers' migrations. The migration thus afforded the people the opportunity to acquire the land on which they settled for agricultural, hunting and development purposes.

Traditionally, the first settler became the head of the community where they settled and in most cases the community is named after him. So most communities bear the name of the founder or first settler or the location in relation to the lagoon among others.

The major festivals of the communities are the "Ojude Oba", which is popular among the Ijebus and New Yam Festival whereby they celebrate the harvest and the dawn of new farming year. It is marked by eating, drinking and various dances with the traditional ruler chairmaning the occasion. They are also said to make sacrifices to their gods for provision, protection and blessings.

The other major festivals are the worshippings of their gods at their various shrines. The days set aside for each of these festivals are usually determined and announced by the traditional rulers (the Baale and the chiefs) and the chief priest of the various shrines. The information is announced to the people by the town crier (information officer).
The communities also observe and celebrate other modern day festivals like the Christmas, New Year, Independence Day and Easter celebrations. The Muslims also celebrate Muslim festivals and holidays (e.g. Eid el kabir, Eid el malud) as it happens in other parts of Nigeria.
Marriage and Burial ceremonies are also marked in their Yoruba traditional ways as has always been the case. These ceremonies are marked with various cultural dances and traditional rites and have not changed since the advent of modern day developments. The culture and tradition of these communities are very rich and admirable.

4.23 ECONOMIC ENVIRONMENT

4.23.1 Occupation

The major occupations of the people of the communities are fishing and farming, which accounted for 95.0% of all occupation categories. According to the respondents, these two occupations are done pari parsu on daily basis. The two constitute the source of foodfor the family and also cash for the family expenses. Fish is sold either at the landing site, in the village to middle women or taking to Epe smoked or fresh. In addition to farming and fishing, 3.3% of the respondents practice hunting of wild animals.
Common crops grown in the area: Cassava, Cashew, Mango, Plantain, Vegetables, Plantain/Banana, Cocoa, Maize, Yam, and Cocoyam.
Respondents claimed the surrounding forest (pristine or secondary regrowth) has diverse animals which included Antelope, Grasscutter, Rabbit, “Igala”, Monkey, Porcupine etc (terrestrial animals); Bat and Birds etc. The third category of occupation added trading (1.7%) to fishing and farming. Trading here will involve the purchase of farm produce and fish from others and conveying such to Epe or elsewhere for sale. Generally, the residents combine several occcupations to main food security and cash flow so to improve their quality of life.

Table 4.68: Major Occupation of the Respondents in the Project Area

Major Occupatn	**Frequency**	**Percent**	**Cumulative Percent**
Fishing, Farming	58	93.3	95.0
Fishing, Farming, Hunting	2	3.3	98.3
Fishing, Farming, Trading	1	1.7	100.0
Total	**61**	**100.0**	
Place of Fishing			
Lagoon	17	28.3	31.7
Nearby river	35	56.7	88.3
Open sea fishing	7	11.7	100.0
Total	**61**	**100.0**	

Moreover, the communities' members carryout some secondary activities which are normally done during spare time. These activities are shown in Table 4.69. Outstanding among them are logging of timber, boat construction, broom and local basket making, grinding of cassava for garri processing, and production of palm oil. These activities are considered as minor since they are carried out during the residents spare time with no monetary value attached. This is due to the fact that the products are used personally in the home and to support the main occupation.

To note that locally made baskets and broom are used in the rural home rather than the plastic evolution found in the urban areas. The ingenuity of the residents should be appreciated as they dig their fishing canoes from the abundant forest wood. Similarly, most of their houses are made of wood from the forest and raffia palm materials.

Table 4.69: Semi-Industrial activities of communities' members

Semi-industrial activity	Frequency	Percent
Boat building, Dug-out Canoe	5	8.4
Cassava grinding machine, Making of broom	11	18.1
Making of mats/broom and palm oil	2	3.4
Mat/baskets, cane-chair, palm oil and tailoring	1	1.7
Palm oil and logging	1	1.7
Timber logging/lumbering	8	13.3
Timber logging/lumbering, and boat building	15	25.0
Timber logging, boat building, and mat/baskets making	16	28.4
Total	60	100.0

From the assessment of the communities' residents, both fishes in the lagoon, sea and rivers are still abundant except for less than 5.0% that indicated a decline (Table 4.70). Similarly, the same percentage of the respondents claimed crop production has been declining in output in the recent time. While this may not be due to declining soil fertility, the drastic reduction in the number of rural residents and the absconding of youths from the rural laborious work for urban less strainous job may be responsible.

Table 4.70: Status of Fish and Crop yield in the Project area

Fish abundance	Frequency	Percent
It has declined steadily	3	3.3
It has increased steadily	45	73.3
No response	14	23.3
Total	62	100.0
Crop yield		
It has declined steadily	2	3.3
It has increased steadily	56	93.3
No response	2	3.3
Total	**62**	**100.0**

Plate 4.57: Women processing garri from cassava at Jaguna

Plate 4.58: A fisherman arriving from the Lagoon

Plate 4.59: Fishing net prepared ready for Fishing in the community

Plate 4.60: Fishing net being mended and tratched for fishing

Plate 4.61: Fishing being made ready for Fishing Expedition

Plate 4.62: A young Cassava farmland in the community

Plate 4.63: A mature Cassava farmland in the community

Plate 4.64 Local cassava presser in Jaguna

Plate 4.65: A plantain farm in Jaguna community

4.23.2 Industry

Only cottage industry is common in the project area apart from Yegunda that has more stable buildings. The industries included boat making from forest wood and cassava pressing machine. Due to the rural nature of the communities, there wre no standard industries in the area. Garri processing is done manually. This can be mechanized to achieve large production except that the women folk that are pre-occupied may be out of job if no alternative is provided.

4.23.3 Income

The average monthly income in the communities was poor and most people earned about ₦20,000 monthly (Table 4.71). The breakdown of the income levels from respondents was as follows: between ₦5,000 and ₦15,00 per month (8.3%); ₦20,000 (55%) and ₦80,000 (1.7%). A good proportion of the residents were not able to estimate their monthly income (35%), these people are predominantly subsistent farmers who combine such with some craft making. It appears that respondents in Eyin Osa who engage largely in fishing earned relatively fair salary and were able to estimate because they sell their catch.

The respondents claimed that they do not actually keep records of their incomes but simply spend money as it comes. They claimed to spend their income on feeding, paying rents, clothing, children's education, medical care, transportation and general living expenses. They do not own many possessions and claimed not to really save any money since the money was not even enough to spend. To live sustainably on the average nowadays, particularly in the modern day when goods and services are very expensive, an individual has to earn sufficiently in the neighbourhood of at least ₦50,000 monthly.

Table 4.71: Income level of the sampled community members

Village name	No specific income	> ₦5,000	₦5,000 - ₦10,000	₦10,000 - ₦15,000	₦20,000	₦80,000	Total
Adenowo-mauwusa	1	1	0	0	1	0	3
Eyin Osa	0	0	0	0	22	0	22
Idomu Oloja	0	0	0	0	0	1	1
Ijayo Ogunbote	14	0	0	1	0	0	15
Imafon	1	0	0	0	0	0	1
Iya Aja	0	0	1	0	0	0	1
Jaguna	0	0	0	1	4	0	5
Ofin	4	0	0	0	0	0	4
Oke Oko-mauwusa	0	0	0	0	1	0	1
Oke-Egan	0	0	0	0	4	0	4
Oloso	1	0	1	0	0	0	2
Yeguda	0	0	0	0	1	0	1
Idiroko	0	0	0	0	1	0	1
Agbon	1	0	0	0	0	0	0
Total	22	1	2	2	34	1	62

4.23.4 Education Level

The Educational status showed that about 53% of respondents have had at least primary education and can speak (i.e. communicate orally) as well as read and write using Yoruba Language. As shown in table 4.72, respondents that have had secondary and tertiary education were few (19%). About 30% of the residents had no formal eduction. Though many of the respondents can communicate in Pigin English, perhaps due to their interaction with city resident, the predominance of people without formal education is typical of rural area. The only exception to this was at Yegunda that has a bit of big village rather than hamlets. Generally, the people were well informed on socio-economic and health issues relating to the overall development of the community.

Table 4.72: Educational attainment of the sampled community members

Village name	No formal education	Primary	Secondary	OND	HND	Degree	Total
Adenowo-mauwusa	0	2	1	0	0	0	3
Eyin Osa	0	21	0	0	0	1	22
Idomu Oloja	0	1	0	0	0	0	1
Ijayo Ogunbote	14	0	0	0	0	1	15
Imafon	0	0	0	0	0	1	1
Iya Aja	0	1	0	0	0	0	1
Jaguna	1	4	0	0	0	0	5
Ofin	3	0	0	1	0	0	4
Oke Oko-mauwusa	0	0	0	0	0	1	1
Oke-Egan	0	2	3	0	0	0	5
Oloso	0	1	0	0	0	0	1
Yeguda	0	0	0	0	1	0	1
Idiroko	0	0	0	1	0	0	1
Agbon	0	0	0	1	0	0	1
Total	18	32	4	3	1	4	62

4.23.5 Existing Infrastructures

In terms of social infrastructural facilities, which include educational facilities, water infrastructure, electricity, health and security apparatus in the communities, the project area lack these basic facilities.

4.23.5.1 Educational facility

Most communities do not have schools except Yegunda that has a primary and Secondary school. The children live and reside in epe town to attend schools, especially the primary and secondary. The come to the villages on weekend arising from the distance between the communities and Epe town. Apart from the risk of children commuting between the communities and Epe, the available untarred roads are largely impassable during the rainy season. Primary, secondary and tertiary institutions are available in Epe, the LGA headquarters of the area.

4.23.5.2 Water

Inhabitants of the impacted community obtain domestic water from rivers, streams and the Lagoon (98.3%) while only one person claimed the existence of borehole water in Yegunda. Further interaction showed that the borehole facility is dysfunctional. Hand dug hole which is less than a standard well exist in Oke-Egan, Idiroko and Idomu. It is common knowledge that satchet water codenamed “pure water” is commonly used for drinking purposes, but the poor roads and scathered nature of the small villages may contribute to the inavaialability in the communities. The cost of satchet water may also hinder the respondents from patronizing the sellers in view of their poor income status.

Table 4.73: Available Facilities in the Project Impacted Area

Main water source	Frequency	Percent	Cumulative Percent
River	52	86.7	90.0
Sea water	5	8.3	98.3
Well	1	1.7	100.0
Total	60	100.0	
Access to community			
By water with canoe	20	33.3	36.7
Foot path only	11	18.3	55.0
Foothpath	15	25.0	80.0
Untarred road	12	20.0	100.0
Total	60	100.0	
Facility in community			
Dysfunctional borehole	3	5.0	6.7
None	45	75.0	81.7
Primary and Secondary Schools	11	18.3	100.0
Total	60	100.0	
Energy source			
Wood	57	95.0	98.3
Wood, kerosene lamp	1	1.7	100.0
Total	60	100.0	

4.23.5.3 Electricity

Most of the communities have no electricity supply from the National Grid of EKO Electricity. As shown in Table 4.73, 95% of the respondents use energy from wood for the basic energy supplies. Less than 25 used kerosene to power lamps that will illuminate their residence. This is a major problem in the community. By implication, information dissemination through the television and radio may be difficult for the residents of these places to access.

The predominant use of biomass fuel is known to pose multiple problems to the environment and human health. These include the destruction of floral richness, reduction of fauna habitats, increase in greenhouse emission, pollution through the release of smoke during combustion and harm to human health, particularly women and children that are regularly exposed to fuelwood smoke.

4.23.5.4 Transportation facility

Apart from the major roads that linked Lagos and Epe, there is no tarred road in the project impacted area. As evident from Table 4.73, there are untarred and narrow roads that meander through the forest cover across the communities. These roads are largely impassable during the wet season due to streams that cross the roads, hence it is a common experience to see vehicles sinking at such spots. Other oncoming vehicles must wait on such occasions for evacuation of the trapped vehicle for other users to use the road. Two vehicles cannot meet in opposite direction; one must wait for the other were the road is wide enough to accommodate the two at the same time (See plate 4.66).

The study team on this assessment had several of such experiences during the wet season sampling. It was indeed a harrowing experience, which was also witnessed by the officials of the Ministry of Environment. To visit communities like Mausa, Ofin and Agbon, water transport was the best. Though better, the cost of water transport is very exorbitant particularly the general income status of the people is very low.

Trekking which is a old method of transport will possibly be appropriate means of transportation in the project only for the drudgery associated (both time and energy waste). Also, the use of two-stoke motocycle will be another alternative but for the limitation of the load that can be conveyed; particularly, farm produce. This will automatically translate to huge cost that will be unbearable for the rural residents.

Plate 4.66: Nature of Land Transport to the communities in the Project area

Plate 4.67: A visit to Ofin, Mausa and Ogbon communities by Water (Team members on Safety Jacket)

4.23.5.5 Health care facility

The communities had no Primary Health Care Centre nor private clinic for care provision to the people. All the communities' members visit Epe town for proper medical care. For Instance, Eyin Osa community is an island. Sick people are usually conveyed in paddled canoe to Epe General Hospital. Depending on the means of transport used, most residents will require not less than one hour to reach the nearest health care centre in Epe. This implies that only health conditions considered to be very serious will make the residents to visit hospitals; they will generally use self medication, traditional herbal remedies for most of their health issues, which may aggravate or become irreversible before turning to hospitals for care.

4.23.5.6 Security facility

There were no police post or station across the length and breadth of the communities. The nearest point where police presence was seen was at an onging project site in Alaro City phase 1. As expected, the security personnel sighted there were to provide protection for the workers on-site. This type of privately arranged security will not accept to provide any cover for the community protection.

As expected, the communities rely largely on local community policing (vigilante groups) or solely rely on tradition medium in tackling crime. The practice of good neighbourliness as held in rural areas is generally relied upon for security of lives and properties (everyone watching over the others things).

4.23.5.7 Waste management

Residents of the communities simply dump their refuse at specific designated places at the back of their homes for final disposal by burning or burying. Most of the people (99%) use open defecation in the bush while a few (1.0%) use the river water. There was no pit-toilet or modern day water cistern flush toilets in the communities. Surprisingly, the people of the impacted communities are generally clean and the entire communities were also seen to be neat.

4.23.5.8 Needed Infrastructures in the Cummunities

Residents of the communities realizing the dare need of infrastructure in the communities expressed their desire for the provision of these basic facilities as shown in Table 4.74 below. A cursory look at the list of needed facilities in the project area depicts the crude nature of living and hardship faced by residents in the area. Recurring among the infrastructure needs are potable water, hospital, primary and secondary school, tarred road and employment. NEPZA and other companies that will site their projects in the area should consider these identified projects by the communities under the Corporate Social Responsibility (CSR).

Table 4.74: Infrastructures Needs Identified by the Communities

Needed facilities	Frequency	Percent
Electricity, Pipe borne water, Tarred road, Clinic, Local market, Community hall	12	19.3
Electriity, Clinic, Borehole, Road	24	38.7
Road, School, Clinic, Employment	5	8.1
School, Borehole, Electricity, Health centre	13	21.0
School, Borehole, Health centre, Road	1	1.6
Grinding machine and Road	1	1.6
School, Clinic, Company, Insect control	1	1.6
No response	5	8.1
Total	**62**	**100.0**

4.24 COMMUNITY HEALTH

4.24.1 Adult Health Problems

The most common health problem identified among the adult population is malaria (35%), followed by measles and malaria (25%) while the least identified diasease is cough and malaria. As shown in Fig 4.50, all the resident reported malaria as a common health problem in the area. This is no surprise as the tropic is home to mosquitoes that transmit plasmodium, which is the causative organism of malaria.

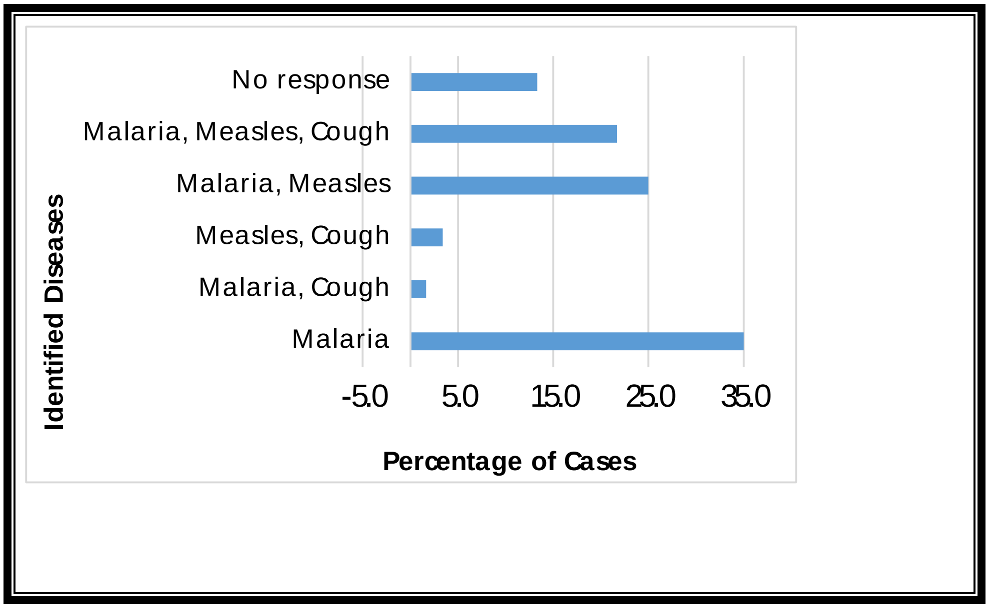


Figure 4.49: Prevalent Diseases among residents of the Project area

4.24.2 Children Health Problems

While the malaria disease is common to all age groups in the project area, the occurrence of measles and cough are prevalent among the children. The housing condition and the level of protection or exposure to hazardous environmental and weather may be responsible for this. The absence of health facilities in the area precluded the engagement of clinic data or hospital record of diagnosed and treated diseases in the area.

The diseases recorded are those that have been endemic in the communities as far back as they can remember and no modern development projects were said to have adversely affected the health of the people.

4.24.3 Knowledge, Attitude and practices on health issues

The results showed that the inhabitants know very well the nature and causes of the common diseases they suffer. They also know how such diseases can be prevented or controlled but their major constraint has been their poor financial status (poverty) and lack of good medical care in the communities. Most people obtain herbs to treat themselves (through self-medication) when sick and most pregnant women go to Traditional Birth Attendants (TBA’s) to deliver their babies rather than go to the hospitals.

On environmental issues on health, the people agreed that poor toilet facilities, poor sanitation and living conditions, poor waste disposal methods, poor housing and poor personal hygiene, all contribute to poor health in the communities. It well established that adverse environmental conditions induce poor health outcomes.

4.24.4 Knowledge and awareness of respondents on environmental issues

Most respondents (44.3%), especially those who live near lagoon identified flooding and shoreline erosion as a major environmental challenge in the project area. Virtually all the respondents mentioned poor infrastructure in the area as a huge problem to them. Water pollution by oil or feaces is also recognized as an environmental concern (9.9%).

These problems among others may be responsible for the declining number of residents, particularly young able bodied people in the rural area. This is capable of negatively affecting and already affecting crop production and food security in most of the rural areas.

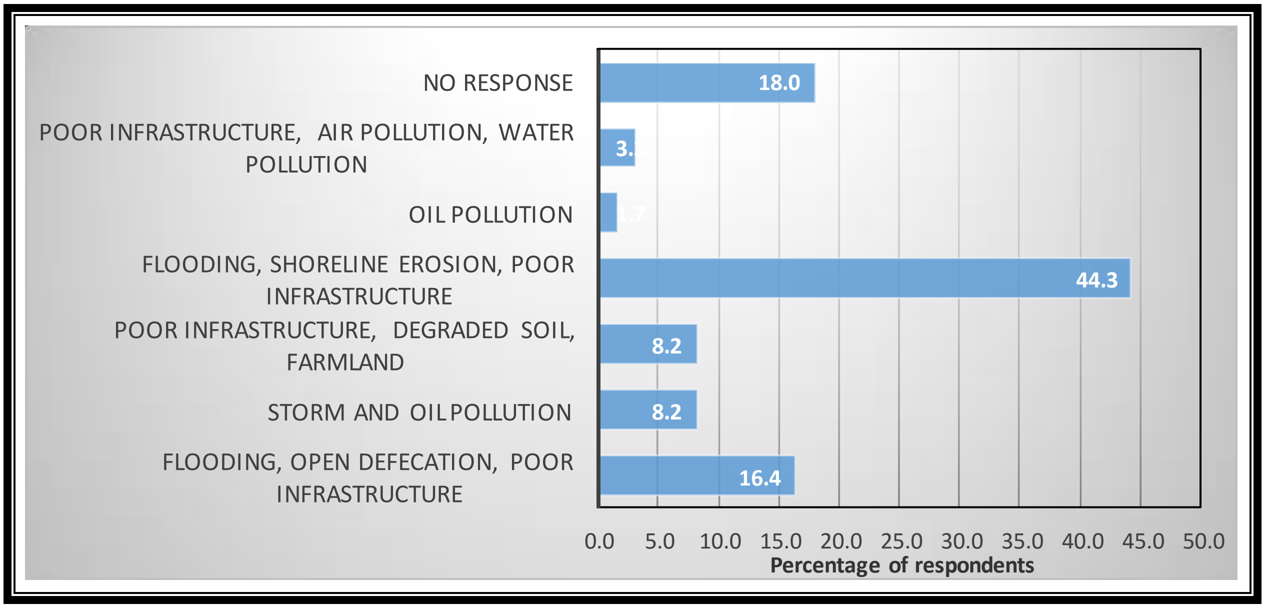


Figure 4.50: Perceived environmental problems in the Project impacted area

4.24.5 Nutritional status of the respondents.

The food items consumed by the respondents in the communities are cultivated in the area. Cassava, usually processed into "garri" is a staple food item in the area. Other include yam, rice, plantain and banana. Vegetables and fruits are also found growing in the communities: cashew, pineapple, orange and pawpaw. Animal protein foods are fish, shrimps, snails and bush meat from antelopes, grasscutter and giant rats. Animals such as domestic fowls and ducks are also reared for meat. The people also eat lots of vegetables and fruits (e.g. vegetables are used for production of the local common soup).

4.24.6 Housing and Living Conditions

In the host communities of study most of the houses (90%) were personally owed by the residents. They are largely traditional houses constructed with wood and raffia palm fond as roofing material. The floors were predominantly unpaved, wood/sticks used as wall and in some occasions, used as ceiling material. Very few of the building had aluminium zinc as roof in the communities. The traditional skill of wooving raffia leaves is well demonstrated in the area.

While this type of traditional house will provide good ventilation for the residents, it will expose them to mosquito bite, which will make them susceptible to malaria disease. Malaria as well known is an endemic tropical disease which is currently being prevented with insecticide treated net. The building arrangement as witnessed in the community will preclude the useof this net. Other problem which could be prevalent in the area is scorpion and snake bite, wild animal attack among others.

Table 4.75: Housing condition and characteristics in the Communities

Type of house	Frequency	Percent
Family compound	2	3.3
House built on stilts (wood pole)	17	28.3
Personal traditional house	41	68.3
Age of house		
< 10 years	8	13.3
10 - 20 years	18	28.4
21 - 30 years	9	15.4
> 40 years	15	23.3
House stability		
Stable	5	8.0
Unstable	54	87.0
No response	3	5.0
Wall materials		
Bamboo and wood	11	17.7
Planks	2	3.2
Plywood	40	64.6
Sticks with mortar/Raffia stick	9	14.5
Roof materials		
Aluminium	1	1.7
Bamboo	12	20.0
Thatch	47	77.0
Zinc	1	1.7
Floor material		
Mud finish	35	56.5
Unpaved	14	23.3
Wood finish	12	20.0
Ceiling type		
Mats	1	1.7
Palm frond	1	1.7
Not ceiled	15	24.6
Plywood	44	72.1
Total	**61**	**100.0**

Plate 4.68: A newly constructued residential Building in the Area

Plate 4.69: General structure of housing unit in the Area

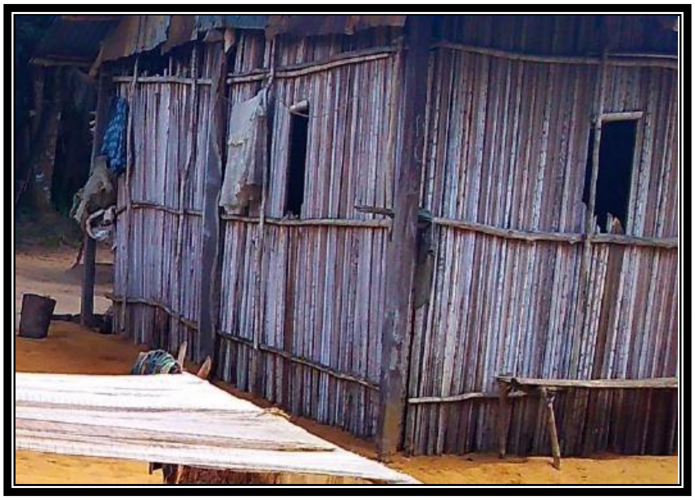


Plate 4.70: A Building constructed from Raffia stem

Plate 4.71: Typical Floor and wall structure of buildings in the area

4.24.7 Indigenous People

IFC Performance Standard 7 recognizes Indigenous Peoples as social groups with identities that are distinct from mainstream groups in national societies. Indigenous people are not applicable in Nigeria. However, the Federal Government recognises ethnicity. Nigeria has three largest ethnic groups that include the Yoruba, Hausa–Fulani and Igbo, representing 71 percent of the population. The project is located in South-west Nigeria and the people living in this region are mainly the Yoruba ethnic group.

4.24.8 Land Use

The Textile and Garment industry will be sited in disturbed forest, farmlands and scattered settlement areas. Farming accounted for more than 50% of land use in the locations followed by fallow land and abandoned farmland. This pointed to the fact that the locations had more of farming population than other activities.

4.24.9 Property Ownership

Land is owned by families and by the communities under the care of the community head (i.e. the Baale and Chiefs). Land reserved for development is under the care or custodian of the village head and paramount ruler. This is because land is a very scarce commodity and requires good protection for generations yet unborn. The community agrees that all land belong to the Federal Government of Nigeria who have the right to acquire any land for use by Government in the interest of the people. The community members have always complained that only little land available for farming is often taken by government paying the appropriate compensation.

Families and individual land owners keep their land by cultivating it yearly to prevent its acquisition by other people. At the time of study there were no cases of land dispute and land tenureship in the communities (Fig. 4.52). The people expressed their desire for development projects that will benefit them, but frow at land-take without adequate compensation.

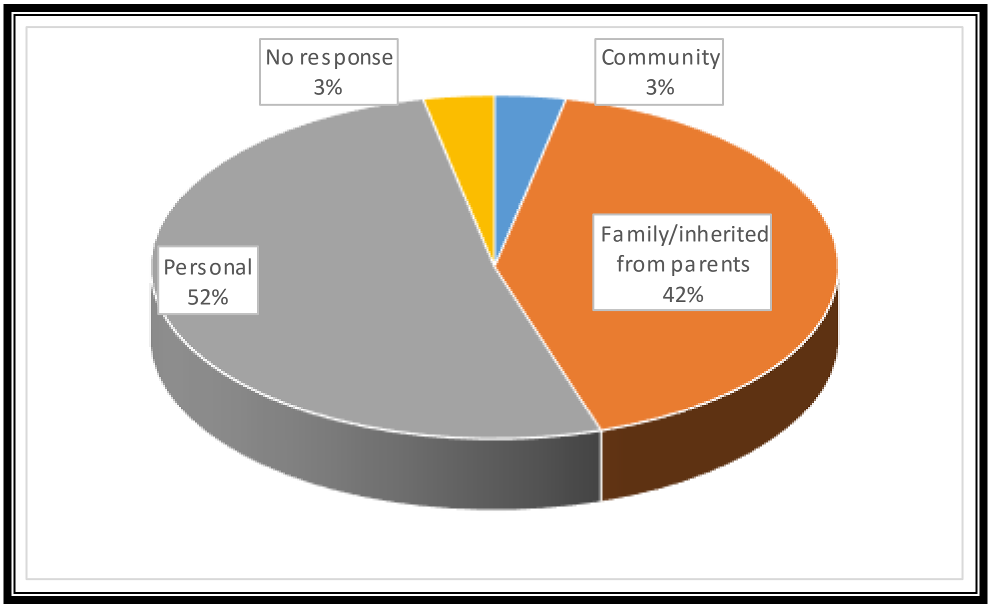


Figure 4.51: Nature of Land ownership by the communities in the project area

4.24.10 Cultural Heritage

There are archaeological and sacred sites, such as traditional burial grounds and shrines in the communities. These sites are highly valued by the people and considered sacred and encroachment in such areas would attract serious resentment from the communities. The people celebrate several traditional festivals, the observance of which is believed to be for the general well-being of the people (see Plates 72 - 75).

There are shrines believed to meet the need of its people by providing children for the barren, protection from evil, good luck in life endeavor, etc. It is cultural belief to bury their loved ones in front of their houses except in the following cases: if the person died in the river/lagoon, thunder strike or in the course of doing forbidden things then the corpse of such a person is buried according to traditional rites. Burial of such people can take place by the river-side or in the evil forest which is out of reach to strangers.

As shown in Fig. 4.53, all the respondents agreed that shrines meant for traditional worship is sacred to them. Apart from religious ground that has series of prohibitions, such as non-admittance of women, there are also sacred forest.

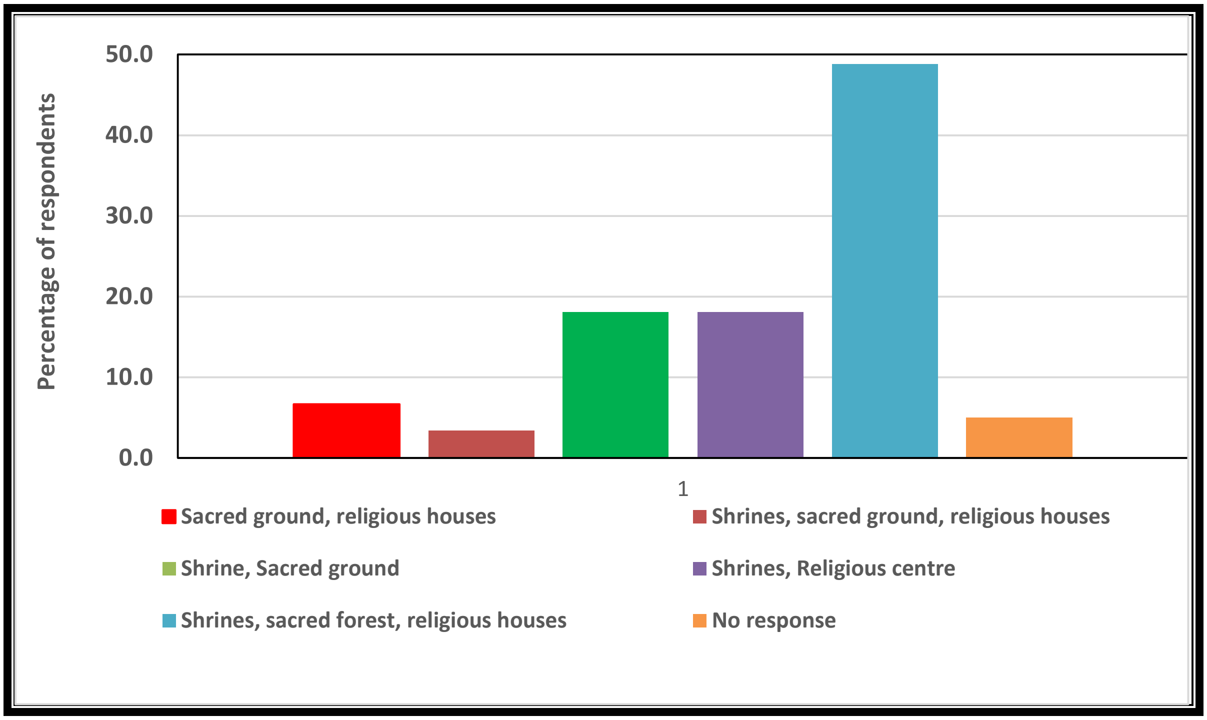


Figure 4.52 : Sacred and Cultural heritage identified by the respondents in the Area

Plate 4.72: Sacred place for Soponno

Plate 4.73: Sacred place of Ogun shrine

Plate 4.74: Sacred Esu Shrine **Plate 4.75: Sango Shrine at Yegunda**

4.25 CONCERNS ABOUT AND EXPECTATIONS OF THE RESPONDENTS FROM THE PROJECT

Various interactions with the communities' residents revealed that the people are happy to see development projects in their area since it will lead to community development. They are concerned arising from their previous experience of project elsewhere that the proposed Textile and Garment industry will have some negative impacts. They are concerned that the project will lead to land take, destruction of their farmlands, pollution of the fishing grounds (Table 4.76).

On the positive side, the communities are optimistic that the proposed project will meet their aspirations of development in economic, social and cultural areas. The expressed eagerness to welcome the project with the desire that employment will be created for their youths, good road constructed to ease the current transportation problem, provision of electricity, potable water, hospital/clinic and schools for thier children. Building of community halls is considered since it will aid their social bonding and cultural festivals. In all, the provision of employment was paramount to the youths and the elders Table 4.77.

Table 4.76: Community concerns about the proposed Textile and Garment Industrial Park

Impact of Project	Frequency	Percent
Damage of agricultural land	11	18.3
Damage to agricultural land, pollution of fishing ground, hindrance to sand dredging	2	1.7
Damage of agricultural land	2	3.3
Hindrance to sand dredging, Flooding	2	1.7
Loss of land	10	16.7
Loss of land, damage of agricultural land	15	23.3
Pollution of fishing ground	4	6.7
No response	14	21.7
Total	60	100.0

Table 4.77: Positive Expectations of the Community Residents

Expected benefits	Frequency	Percent
Employment of indigenes	4	5.0
Employment of indigenes, electricity, potable water, schools	4	6.7
Employment of indigenes, provision of primary and secondary schools	12	20.0
Employment of indigenes, roads	1	1.7
Employment of indigenes, scholarship of indigenes, provision of electricity, provision of school	2	1.7
Employment of indigenes, scholarships for indigenes, provision of electricity, provision of water	11	18.3
Employment, scholarship for indigenes, electricity, potable water, schools, health centre	24	40.0
No response	2	3.3
Total	**60**	**100.0**

4.26 CONSULTATION OF STAKEHOLDERS

This section outlines the public information and consultation process that has been designed and implemented in order to facilitate the informed participation of the project affected persons (PAPs), communities and other stakeholders affected by or with interest in the project. As such, consultation objectives, activities and outcomes are reported.

4.26.1 General Objectives

General stakeholder engagement objectives of this study were to:

Inform stakeholders on the proposed infrastructures and activities and seek their informed opinion about the socio-environmental risks and opportunities potentially associated with the project as well as take the measures and actions in order to manage the anticipated impacts;

Obtain feedback from stakeholders on issues of concern and expectations in order to optimize the project

Generate a social and institutional dialogue in order to assess and strengthen the project's social acceptability;

Help to consolidate, through the EIA process, the efforts made by NEPZA in order to establish lasting relationships with affected communities and other stakeholders.

4.26.2 Stakeholder Information and Consultation Rounds

Three stakeholder information and consultation rounds were planned, and two has been implemented through the development of the EIA/EMP study of this project. They were planned according to key stages, or decision moments, throughout the study where the informed participation of stakeholders were likely to make the most significant contribution to the on-going analysis.

These included the scoping stage (1st round), the initial community sensitization, consultation at affected Local Government and the documentation of the affected communities (2nd round). The third round of consultations is scheduled for the disclosure of the EIA and EMP preliminary results (3rd round).

Table 4.78 outlines the studies' stakeholder engagement process and presents, for each consultation round, the specific engagement objectives, target groups and implementation periods.

Table 4.78: Stakeholder Consultation Implementation

ROUND	OBJECTIVES	TARGET GROUPS	IMPLEMENTATION PERIOD
STAGE 1: Environmental and Social Scoping	• Present the project and the EIA process to key authorities; • Identify key issues, concerns and expectations related to the project and study area; • Complete the stakeholders' list and validate the general approach for consultations.	• NEPZA • Concerned ministries • State and LGA Administration • Customary Chief's of areas affected by the project	October 2019
STAGE 2: EIA Study	• Involve key stakeholders in the analysis of the « hot spots » identified. • Identify the concerns and expectations of affected commumnities	• NEPZA • Concerned ministries • Local authorities • State-level and LGA-level authorities and technical services. • Affected people and their leaders. • Women representatives. • Customary chiefs.	November 2019 February 2020
STAGE 3: Disclosure of Preliminary Results (EIA)	• Present, validate and enhance preliminary EIA and EMP results. • Ensure compliance of the proposed measures with the requirements of regulatory authorities; • Evaluate the social acceptability of the project and its proposed measures.	• NEPZA • Concerned ministries at national and state levels. • Local authorities and community leaders from affected LGAs. • NGOs.	To be determined

4.26.3 Stake Holder Identification and Mapping

Target stakeholder groups for the stakeholder engagement process include:

- Concerned agencies and organisations at State and National levels – (Secondary stakeholder)
- State-level (Lagos) agencies – (Secondary stakeholder)

- Customary authorities in communities that will be affected by the Industry - Obas, Baales and Village Heads across the area – (Primary stakeholder)
- Industrial and commercial actors affected Industry (NEPZA) – (Secondary stakeholder)

The next few paragraphs will discuss the identified stakeholders for the industry as well as indication of their stake in the project.

4.26.3.1 Government Authorities

Federal and State governments as well as Local government constitute important stakeholders within the projects engagement framework. Some are regulators who issue the necessary permits while others may provide information on demography, climatic conditions, etc. Engagement with these agencies must live throughout the project life span. During this scoping phase of this project, the following stakeholders were identified.

- Federal Ministry of Environment (FMEnv), Abuja;
- The Lagos State- Ministry of Environment;
- Nigerian Meteorological Agency (NIMET)
- Epe Local Government
- NGO (Nigeria Conservation Foundation (NCF))

The Project falls within Epe LGA of Lagos state. The consultants engaged with the relevant departments of the LGA and asked them to consider the project activities in the wider planning for the LGA. In addition, concerned Ministries and Ministerial Agencies within Lagos state and Federal Government will be engaged throughout the project lifecycle to ensure that they are kept informed and are given an opportunity to provide input in their respective planning areas

4.26.3.2 Communities and Traditional Institutions

Traditional institutions, their councils and the leaders of the social groups in the community (such as women, youths, market women and local farmers) are engaged on a continuous basis in a discussion of all aspects. Meetings with these groups follow local practices and norms and is held prior to any wider communication in the villages in order to respect the traditional structures. The Project affected communities so far identified are listed in Table 4.63

4.26.3.3 Vulnerable Groups

Typical Corporate Social Responsibility (CSR) initiatives are designed to favour these groups as much as practicable. Women have been identified as vulnerable group for the project, due to their economic vulnerability and inability to participate in decision-making processes within the traditional context. Women in the project area are not always able to attend or speak freely at open meetings and/or may have household restrictions on when they are able to attend such meetings. However, the project holds meetings where women leaders were present and places convenient to the women in each community. Focus group discussions were also held with women. Women leaders were given opportunity to present the needs/request of all the women in the community during meeting which most times borders around provision of credit facility/ soft loan to enhance their means of livelihood.

Other potential vulnerable groups identified as part of the EIA include the elderly, youth and migrant farmers/fishermen. Vulnerability of these groups is also based on reduced opportunities to participate in local decision-making, as well as their economic vulnerability, particularly with regard to employment. As such, engagement activities have been designed to ensure representation of these groups among stakeholders, and to seek to understand potential project interactions with their livelihood opportunities and agency within the communities. The elderlies were duly represented in the meeting by their designated spokespersons; the youth leaders were eyes of the entire community youth members on issues that borders mostly employment during the project take off.

It is important to note that stakeholder identification is an ongoing process, and thus stakeholders will continue to be identified during different stages of the project. Table 4.79 presents the main stakeholder groups

Table 4.79: List of identified stakeholders

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Host Communities	• Communities close to the project site; • Other communities within the project area of influence; • Vulnerable groups within these communities; and • Workforce recruited from the communities.	• Village Head ('Baale'); • Community Development Association; • Religious leaders; • Village elders; and • Epe LGA
Institutional Stakeholders	• Social infrastructure, like schools, health facilities and emergency services.	• Political Parties; and • Project investors (NEPZA).
Regulatory Authorities		• Federal Ministry of Environment; • LagosState Ministry of Environment • National Environmental Standards and Regulations Enforcement Agency (NESREA)
Other Groups		• Other projects in the area

Table 4.80 below gives an overview of the stakeholder groups and their concerns, expectations and influence on the Project.

Table 4.80: Stakeholder Mapping

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
Primary	Other communities within the Project area of influence.	Directly impacted by cumulative impacts and risks from Lafarge's site with past impacts and risks.	Additional impacts and risks to existing situation.	Support in social infrastructure and employment at the site.	Protest and/or causing delays.
Primary	Construction labour force recruited from the communities.	Temporary employment and income from construction activities.	Labour and Working Standard risks and employment opportunities.	Employment and good wages.	Protests if employment opportunities are disappointing.
Secondary	Community.	- Discussion of	- Youth	- Youth	Protest and/or

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
		community concerns; - Discussion with the vulnerable groups, women and youths; and - The need for a grievance mechanism throughout the project.	empowerment; - Provision of basic social amenities and infrastructure; and - Influx of workers.	empowerment; - Provision of basic social amenities and infrastructures.	causing delays.
Secondary	Federal Ministry of Environment.	- Registration of the Project; - Scope of data collection and ToR approval; - Issues concerning site visits; - EIA process and scope of the EIA - Approval for one season waiver.	No concerns on the status of the project.	Submission of Draft Report and processing fee payment.	EIA Permit.
Secondary	NEPZA		-	-	Permit and Execution of the project.
Secondary	Lagos State Ministry of Environment; and	Compliance monitoring of approved EMP.	Environmental degradation.	Compliance with approved EMP.	Project execution.
Secondary	National Environmental Standards and Regulations Enforcement Agency (NESREA).	Compliance monitoring of approved EMP.	Environmental degradation.	Compliance with approved EMP.	Project execution.
Secondary	Local Government Area	- Engagement with affected communities; - Potential positive impacts (employment opportunities for local people); and - Community	Environmental degradation and community development programme implementation.	Compliance with approved EMP and implementation of community projects.	Project Execution.

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
		Development.			

The host Local Government Area is Epe and the host communities include those listed in Table 4.63. Pre-entry consultations were held with the Executive Councils, Elders of the host communities between November 2019 and February 2020. During these periods discussions and consultations enabled the stakeholders to be informed of the intent of the proponent and a collection of the views of the people about the proposed project.

4.26.3.4 Consultation Activities

The summary of consultation activity conducted to date are summarized in below table.

Table 4.81: Stakeholder Engagement Activities to Date

Stakeholder Engagement	Engagement Activity	Stakeholders	Venue	Date	Specific Discussion Areas
Government Agencies – Federal, State and Local Government Authority Regulatory Authorities.	Meeting with Federal, State and Local Council Officials.	Federal Ministry of Environment Abuja.	Abuja & Lagos State	November 2019	• Registration of the Project; • Scope of data collection and ToR approval; • Issues concerning site verification; • EIA process and scope of the EIA; • Approval for one season waiver; • Approval for the transmission lines; • Initial consultation/ sensitization on the project.
		Lagos State	Lagos NCF Lekki	November 2019	
		Epe LGA	LGA Secretariat	November 2019	

4.26.3.5 First Stage Consultations

The first consultation round took the combined format of individual semi-structured interviews with community members and customary chiefs as well as group meetings with institutional stakeholders (organisations at national, state and LGA levels). This approach has proved to be useful to better define the scope and framework of the EIA study.

The objectives of these meetings are as follows;

- Present the project and the EIA process to the communities and relevant agencies;
- Identify key issues, concerns and expectations of the communities and agencies related to the project and study area;

- Identify current practices and requirements of each agency related to the project;
- Complete the stakeholders' list and validate the general approach for consultations;
- Identify relevant information sources and collect available data and reports.

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4.26.3.6 Activities Performed in Lagos State

The activities carried out as part of the stakeholders' engagement in Lagos State are:

- Meeting between NEPZA Representatives.
- Meetings at State level in Lagos with relevant State Ministries, Agencies and affected LGA.
- Meetings at Local Government and community level, held in the Local Government/ community within the project area in Epe.

Table 4.80 show list of the stakeholders met in Lagos State during the consultations.

Table 4.82: Stakeholder Groups Consulted

Stakeholder Group	Type of Stakeholder	Location of Meeting	Date
Communities Leaders	Primary	Epe LGA Secretariat	Nov. 2019
Epe LGA officials	Secondary	Epe LGA Secretariat	Nov. 2019
Nigeria Conservation Foundation		NCF Lekki	Nov. 2019
Ministry of Environment Lagos	Regulatory	NCF Lekki	Nov. 2019

Plate 4:76: Scoping Meeting with FMEnv. Representatives, Official of Lagos State Ministry of Environment, NEPZA Representative and Community Representative.

4.26.4 Outcome of the Consultation

4.26.4.1 Outcomes and Results Obtained in Stage 1

The following results were achieved from the consultations

- The communities understood the objectives and requirements of the project and pledged support and cooperation
- The relevant agencies are aware of the project and the EIA process (team, objectives and schedules);
- The requirements of Lagos State and Regulations relevant to the project were highlighted by the agencies and understood by NEPZA and its consultants.
- The main stakeholders' concerns and expectations were documented and have been considered for inclusion in the scope of the studies;
- A preliminary list of stakeholders was completed and the orientations of the Stakeholder Engagement Framework was enhanced;

CHAPTER FIVE

5.0 POTENTIAL AND ASSOCIATED IMPACTS

5.1 INTRODUCTION

This chapter presents the methods used in identifying, screening, analyzing and ranking of potential and associated environmental, social and health impacts of the proposed Textile and Garment Industrial Park and associated facilities project as well as the results from the entire process.

The use of appropriate impact identification and prediction methods is crucial for good EIA. A number of methods have been developed over the years for impacts assessment, while new approaches continue to emerge. Every method has merits and demerits; however, all good methods have certain elements in common, which are widely accepted as essential for good EIA.

The Scientific Committee on the Problems of the Environment (SCOPE, 1979) suggested that the following qualities should be considered while choosing Impact assessment methods:

Comprehensiveness

This implies that the method should be able to detect the full range of important elements and combinations of elements, directing attention to novel or unsuspected effects or impacts, as well as to the expected ones.

Selectivity

This has to do with the ability of the method to focus attention on major factors. It is often desirable to eliminate as early as possible (i.e., during identification) impacts that would dissipate effort if included in the final analysis. Although screening at the identification stage requires some pre-determination of the importance of an impact. Lindblom (1959), Beer (1967), and Holling (1978) provide some guidelines on how to deal with this issue.

Mutually exclusive

This quality ensures that double counting of impacts or effects are avoided. However, experience has shown that this is difficult because of the many interrelationships existing in the environment.

Yield to Confidence limits

Subjective approaches to uncertainty are common in many existing methods and can sometimes lead to quite useful predictions. However, explicit procedures are generally more acceptable, as their internal assumptions are open to critical examination, analysis, and, if desirable, alteration.

Objectivity

The objectivity of impact assessments has been well emphasized by many regulators including the FMEnv. Objectivity minimizes the possibility that the predictions automatically support the preconceived notions of the promoter and/or assessor. Such pre-judgments are usually caused by a lack of knowledge of local conditions or insensitivity to public opinion. A second merit of objectivity is to ensure comparability of EIA predictions amongst similar types of actions. An ideal prediction method contains no bias.

Prediction of Interactions
Environmental, social, and economic processes often contain feedback mechanisms. A change in the magnitude of an environmental effect or impact indicator could produce unsuspected amplifications or dampening in other parts of the system.

In view of the foregoing and as clearly stated by Canter (1996), there is no universal methodology that can be applied to all project types in all environmental settings. The United Nations Environmental Programme (UNEP, 1996) also emphasizes the need to use tools from existing methodologies that best suit the specific project situation. Lohani *et al.* (1997), further pointed out that since no single method will meet all the necessary criteria of an EIA, the objective should be to select an array of methods that collectively meet assessment needs. They further state that of the variety of techniques and methods available, only a few are applicable to developing countries.

Generally, impact assessment methods fall under seven types of approaches:

1. The Leopold matrix approach
2. The Battelle environmental evaluation system
3. Checklists
4. Matrices
5. Flowcharts and Networks
6. Mathematical/Statistical and computer models
7. Overlays using maps and GIS

Each approach has merits and demerits. In selecting an overall impact assessment methodology for the power plant project, a number of widely used methods were reviewed and qualities considered appropriate, were incorporated in the assessment.

The major steps in the impact assessment methodology selected for this project are as presented in Figure 5.1.

5.2 Impact Assessment Methodology

The assessment of project impacts and their significance is required both for the environmental management of the project and to communicate project information to stakeholders. These requirements could be addressed using the following approaches;

Activity led assessment of Impacts and development of mitigation measures- this approach is often suitable for the implementation of management actions; for instance, a proponent will want to understand what all the noisy activities are, as well as their impacts in order to provide adequate noise control mechanisms.

Resource/Receptor or key issues led assessment of Impacts and development of mitigation measures - this approach is often more suitable for stakeholders; for instance, environmental quality regulators may require that all impacts on biodiversity be discussed together.

The approach adopted in this impact assessment was geared towards addressing both requirements. The methodology used for the proposed power plant construction and operation activities is summarized in Figure 5.1, while a description of the process and the results obtained on application of the method are described in the following sections. In order to effectively carry out the impact assessment and prediction, the following inputs and approaches were relied upon:

- Superimposing project components on existing environmental conditions to identify potential impact areas and critical issues;
- Field investigations;
- Consultation with experts, stakeholders and nearby communities;
- Development and maintenance of a comprehensive database on the biophysical and socio-economic characteristics of the environment of the project area;
- Experience from similar projects worldwide;
- Discussions with project proponents and design contractors;
- Published and unpublished documents providing guidance on performing Impact analysis.

Step 1

Identification and description of project phases associated activities and their possible interaction with environmental, social and health components

Step 2

Preliminary identification of potential impacts on biophysical, social and health components of the environment.

Step 3

Screening for impact importance; elimination of activity/environment interactions producing no effects. Selection of focus impacts for further assessment.

Step 4

Detailed assessment of selected focus impacts under the following bases:

Nature: Positive or Negative; direct or indirect

Magnitude: Qualitative and Quantitative

Extent: Qualitative and Quantitative

Frequency

Location sensitivity

Cumulative effects

Duration; including reversibility and irreversibility

Step 5

Final assessment and assignment of overall impact significance levels based on level four results and application of objective impact severity criteria and likelihood. Identification of impacts that requires mitigation.

Figure 5.1: Schematic of the Impact Assessment Methodology

5.2.1 Project Environmental Overview

The process adopted in the identification and assessment of the potential and associated impacts of the proposed Textile and Garment Industrial Park considered various phases of the project, namely:

Pre-construction:- this will include mobilization of materials and personnel, community engagement, permit to work, site preparation activities etc;

Construction/Installation:- Soil excavation, foundations and tower construction, and other associated earthen works etc;

Commissioning and Operation/Maintenance:- project inspection, turnover, commissioning as well as operations and subsequent maintenance activities;

Decommissioning:- disusing/abandoning of project facilities

5.2.2 Identification of Impacts and Activities Interactions

Details of the plant construction, operations and decommissioning activities that could engender environmental impacts are as follows:

- Site preparation (Bush clearing/creation of access road and camping)
- Mobilization of construction elements
- Recruitment and community engagement
- On-site fabrication (metal works etc.)
- Building foundation (trenching and piling)
- Building of structures
- Waste management
- Fuel storage/hazardous material handling
- Fire/explosion (unplanned activity)
- Incident/Accidents (Unplanned activity e.g. fall from height)
- Commissioning/Testing
- Industrial operations
- Plant maintenance
- Power generation
- Plant decommissioning
- Emissions (particulates and gases)
- Abandonment/Restoration

At this stage of the impact assessment, a wide range of environmental components which project activities may possibly interact were considered. The components that were not relevant to the project were not considered. The environmental components considered are presented in Table 5.1.

Table 5.1: Components of Environmental Aspects prone to Project Activities

Aspect	Components
Biophysical	Atmospheric elements: Air Quality, GHG emissions, etc.
	Noise level
	Aquatic Ecology: Biota, Water and Sediment
	Terrestrial: Geology, topography, soil quality, vegetation, Wildlife
	Ecosystem

Human, Socio-economic and Cultural	Land-use pattern
	Local population level
	Socio-economic systems
	Socio-cultural Systems
	Basic Amenities and Infrastructure
	Transportation System
	Environmental justice
	Aesthetics

The construction and operation activities of the proposed Textile and Garment Industrial Park were examined for their potential impact which could result in changes to the environmental components (Table 5.1) using impact indicators/indices as presented in Table 5.2.

Table 5.2: Environmental Components and their Impact Indicators

Aspect	Environmental Component	Impact Indicators
Biophysical	Atmospheric elements	Gaseous emissions (like: NO_x, SO_x PM, CO) that contaminates ambient air quality and contribute to atmospheric impacts both at local and regional level.
	Noise levels	Increase in ambient noise level
	Aquatic Ecology	Changes in the baseline physico-chemical and biological properties of surface water; Changes in the Physico-chemical properties of sediment; Changes in community composition and abundance of aquatic biota including; microbes, plankton, macrobenthos, fishes, mammals, reptiles, amphibians, bird species, etc.
	Geology	Changes in geology structure
	Soil	Changes in physico-chemical and biological properties of soil
	Topography	Changes in land terrain and topography
	Vegetation	Changes to vegetation population, health, species abundance and diversity and impact on endangered and economic species
	Wildlife	Changes in wildlife distribution and abundance
	Ecosystem	Changes in ecosystem level of impacts such as: animal and plant communities, nutrient balance, loss of habitats etc.
Human, Socio-economic and Cultural	Land-use pattern	Changes in land-use patterns such as agriculture, fishing, logging, hunting, etc,
	Local Population level	Immigration and in-migration of workers and other people
	Socio-economic system	Changes in employment opportunities, income differentials, inflation, difference in per capita income,

Aspect	Environmental Component	Impact Indicators
		inequality of benefits to local population, etc.
	Socio-cultural system	Changes in social structure, organisation and cultural heritage, practices and beliefs, natural resources, rights of access, changes in value system influenced by foreigners, etc.
	Basic Amenities and Infrastructure	Access to goods and services such as housing, education, healthcare, water, fuel, electricity, sewage and waste disposal, consumer goods brought into the region, etc.
	Transportation System	Changes in transport systems and associated effects such as noise, accidents risk, changes in existing facilities, etc.
	Environmental Justice	Conflicts in choice making between development and protection of natural resources, recreational use, historical and cultural resources, tourism, etc.
	Aesthetics	Presence of unsightly structures.

5.2.3 Preliminary Identification and Screening of Environmental Impacts

In line with widely recommended impact assessment approaches (FMEnv, 1995; UNEP, 1996; Canter, 1996; Lohani *et al*., 1997) the first level of impact assessment involved preliminary identification and screening of potential environmental impacts from anticipated activity-environment interactions based on understanding of the activities and nature of interaction with environmental components.

To further guide the identification and screening of impacts using the matrix, impact indicators or indices were developed for each of the environmental components' interaction. Impact indicators are observable or measurable parameters of each environmental component that can be directly or indirectly linked to changes in environmental conditions. Table 5.2 gives a list of the typical impact indicators that were used for this impact assessment study.

A modified Leopold matrix (Leopold, 1971) was used for the identification and screening. The matrix arrays project activities against environmental (biophysical and socio-economic) components, and supports a methodical comprehensive and objective identification of impacts each activity could have on the environmental components. The matrix consists of a horizontal list of biophysical and socio-economic environmental components that could be affected by the proposed activities versus a vertical list of project activities, which represent environmental aspects, or sources of impacts associated with each project phase.

Entries in the matrix cells represent the nature and preliminary ranking of the impacts. Ranking of the severity is based on the colour code shown in Table 5.3 below.

Table 5.3: Impact Ranking Matrix

+	Positive Impact
0	Negligible/No Impact
1	Minor Impact
2	Moderate Impact
3	Major Impact

The impact ranking categories are defined as follows:

Positive Impact - this is impact that adds a measurable benefit to the environment.

Negligible Impact - this impact may occur but based on experience, available scientific information and expert knowledge will have very insignificant effect on the environment.

Minor Impact - this impact could either affect a large (as defined below) or moderate (less than 40%) amount of an affected resource and has mid to long-term effect, but is most likely reversible.

Major Impact - this impact would affect a large (higher than 40%) amount of a resource and/or has a relatively long-term effect.

In this preliminary screening, all potential impacts, whether likely or unlikely, are considered. The likelihood of an impact is further assessed in the detailed impact evaluation.

The result of the preliminary impact identification and screening is presents in Table 5.4.

Table 5.4: Modified Leopold Matrix – Preliminary Impact Identification and Screening Results

Impact Ranking Scale

+	Positive Impact
0	Negligible/No Impact
1	Minor Impact
2	Moderate Impact
3	Major Impact

PROJECT ACTIVITY	ENVIRONMENTAL COMPONENT																
	Biophysical									Socio-economics, Human and Cultural							
	Air Quality	Noise	Soil Quality	Topography	Vegetation	Wildlife	Aquatic Ecology	Geology and Hydrogeology	Ecosystem	Land Use	Local population	Socio-economic System	Socio-cultural	Basic Amenities and Infrastructure	Transport System	Environment Justice	Aesthetics and Visual Intrusion
Mobilization of workers	0	0	0	0	0	0	0	0	0	0	3	+	1	1	2	1	0
Site clearing	1	1	2	0	3	3	1	0	2	2	0	+	3	0	0	1	1
Construction of access Road	2	2	1	2	2	1	1	1	2	2	2	+	2	+	+	+	2
Wastes and emissions handling	2	0	2	0	0	0	2	0	0	1	0	0	0	0	0	1	2
Buildings Foundation formation (Excavation, Trenching and Pilling)	1	3	3	2	1	1	1	1	1	2	0	0	0	0	0	1	1
Haulage of equipment	1	1	1	0	1	1	0	0	0	0	0	0	0	0	2	1	1
Power generation	2	2	1	0	0	1	2	0	1	0	0	0	0	1	0	1	
Plant operation and maintenance	1	1	2	0	0	1	2	0	1	0	0	0	1	+	1	1	1
Decommissioning	2	2	1	1	0	2	0	0	0	+	+	3	1	2	1	0	1

Identification and screening of impacts relied on the following:

- Documented impacts of similar projects in similar environments
- Consultation with thematic experts
- Professional judgment.

5.3 CHECKLIST OF ASSOCIATED AND POTENTIAL IMPACTS

Table 5.5: Checklist of Associated and Potential Impacts

Project Activity/ Environmental Aspect	Associated and Potential Impacts
PRE-CONSTRUCTION • Permitting • Land Acquisition • Mobilisation • Recruitment • Site Preparation	Economic loss arising from clearing of farm lands and crops
	Employment opportunities arising from recruitment of skilled and unskilled transmission line personnel
	Business opportunities for local contractors through sub-contracting activities
	Local support services from road side supply markets and shops etc.
	Skill acquisition and enhancements to local indigenes and workforce.
	Influx of people (migrant workers, sub-contractors and suppliers) and 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
	Community agitation over unidentified stakeholder, leadership tussles etc.
	Increased traffic during mobilization on road with risk of accidents leading to injury/death and loss of asset
	Conflicts/community agitations over employment issues (quota and methods)
	Nuisance (noise and vibrations) due to movement from heavy duty equipment and vehicles affecting site workers and wildlife
	Increase of dust particles and vehicular emissions
	Disturbance of the vegetative cover/ loss of forest products (fuel wood, timber, medicinal plants) due to site clearing and preparation
	Waste Disposal • Wood, sand, paper, domestic waste • Waste from laydown area and camp site (material and wood)
	Contamination of surface water as a result of siltation caused by increased erosion during site preparation
	Visual intrusion as a result of alterations from accidental ignition of onsite diesel storage tanks
	Waste Disposal • Scrap metal, wood, sand, concrete, iron rods, paper • Used oil and replace/obsolete equipment parts that may contaminate soil/ground water

Project Activity/ Environmental Aspect	**Associated and Potential Impacts**
DEMOBILISATION • Demobilization after construction phase	Workplace accidents from burns, cuts, bruises, trips and falls, object at height leading to injury of fatalities.
	Soil/groundwater contamination resulting from accidental leakages and spill of hazardous substances (diesel, lubricants, hydraulic oil etc.)
	Traffic congestion during transportation of demobilized equipment and personnel
	Generation of dust and automobile/heavy duty equipment emissions
	Reclamation of marshaling yards and laydown areas
	Waste disposal (scrap metal, wood, sand, concrete, paper)
	Reclamation and restriction of access roads to prevent unauthorized uses
	Reclamation and restoration of plant building construction areas
	Loss of employment and business opportunities due to completion of construction phase
	Illegal access to building site leading to accident, sabotage, asset damage and loss
	Surface runoff and erosion resulting in sedimentation problems
OPERATIONS: • Building inspection and checks • Power generation/ servicing • Transportation of raw materials and finished product • Textile processing/ production • Plant maintenance • industrial waste discharges • Emergence of small-scale enterprises • Green Buffer development around each industrial plot, Industrial Park boundary • Recruitment of workers	Risk of injury from fall from height/trip or being hit by object
	Air pollution by gaseous emission (CO, SO_2, NO_2) and particulates from power generator
	Soil contamination resulting from accidental leakages and spill of hazardous substances from generator servicing (diesel, spent oil etc.)
	Generation of dust and gaseous pollutants from automobile emissions
	Increase in noise level nuisance from vehicles plying the access roads
	Traffic congestion along the Lekki -Epe road
	Metallic materials generation from plant parts, retrofitting/upgrade of parts during plant servicing
	Potential for land contamination from industrial waste disposal
	Pollution of surface water bodies by wastewater generated from industrial waste discharges
	Change in Land Use of nearby areas
	Recreational facility
	Improved Ecology, Air Quality and Aesthetics
	Acquisition of skills by individuals to be employed

Project Activity/ Environmental Aspect	Associated and Potential Impacts
DECOMMISSIONING /ABANDONMENT: • Removal of electrical cables and wires • Demolition of buildings for facilities retrieval • Waste generation • Transportation of Plant components for sale/ another site	Risk of accident and injury to workers during demolition of structures
	Increased dust and vehicular emissions during haulage of plant components from site by heavy-duty vehicles
	Increased sedimentation process close to river banks and floodplains along the building sites
	Risk of soil and adjoining surface water contamination from accidental oil and hazardous substance leakages
	Traffic obstruction from transportation of decommissioned structures and equipment
	Availability of land for alternative uses such as community hall

5.4 IMPACT IDENTIFICATION AND CHARACTERIZATION

Impacts can be induced during the construction of the facility, and later during its operation. In the case of Textile and Garment Industrial Park, the main potential receptors are soil, surface water bodies, groundwater, flora and fauna, occupational health, in addition to socio-economic and cultural amenities.

Impact assessment defines the criteria and processes against which potential project impacts can be measured and mitigated. A multidisciplinary team comprising engineers, scientist, environmentalists etc. were involved in the identification and characterization of impacts of the Textile and Garment Industrial Park project.

5.4.1 Impact Identification

The existing baseline description of the environment and the various project aspects/ activities were used to develop a checklist of potential and associated impact of the proposed Textile and Garment Industrial Park on the biophysical and socio-economic environment. The World Bank Environmental Assessment Source book on Industrial set-up and FMEnv. EIA Sectoral Guidelines for Infrastructures were used as reference in developing the checklist (Table 5.5). The risk implications considered include the level of closeness of human settlement/ habitat to the Industrial Park, the settlement characteristics, type of human activities as well as the level of sensitivities of the project environment to possible accidents from the industrial production cum power generation for production.

5.4.2 Characterization Of Associated And Potential Impacts

The checklist approach was adopted; this involved categorizing the project into activities/phases and then the project environment into various components.

The interaction between these two elements (the project and environment) may lead to changes in the environment as shown below:

ENVIRONMENT + PROJECT ⟶ CHANGED ENVIRONMENT

This change may be direct or indirect, adverse or beneficial, cumulative or residual, long term or short term as described below.

Direct impact (D) – These are impacts resulting directly (direct cause-effect consequence) from a project activity.

Indirect impacts (I) – These are impacts that are at least one stop removed from a project activity. They do not follow directly from a project activity.

Beneficial Impacts (B) - These are impacts that would produce positive effect on the biophysical or socio-economic environment

Adverse Impact (A) – Adverse impacts are those that would produce negative effect on the biophysical or socio-economic environment.

Long term Impact (L) – These are impacts whose effects remain even after a specific project activity (e.g. permanent vegetation loss due to forest clearing)

Short term impact (S) - These are impacts whose effects will last only within the period of a specific project activity (e.g. noise due to construction activities).

Reversible Impacts (RV) - can be addressed on the application of adequate mitigation measures.

Irreversible Impacts (IRV) - These are impacts whose effects are such that the subject (impacted component) cannot be returned to its original state even after adequate mitigation measures are applied.

Cumulative impact (C) - These are impacts resulting from interaction between on-going project activities with other activities, taking place simultaneously.
Residual Impact (R) - These are impacts that would still remain after mitigation measures have been applied.

Table 5.6: Characterization of some potential and associated adverse and beneficial impacts of the proposed project.

Project Activity/ Environmental Aspect	Associated and Potential Impacts	Impact Characterization									
		Direct	Indirect	Adverse	Beneficial	Reversible	Irreversible	Cumulative	Residual	Long Term	Short Term
PRE-CONSTRUCTION -Permittin -Mobilization -Recruitment -Site Preparation	Economic loss arising from clearing of farm lands and plantations.	*		*		*			*		*
	Employment opportunities arising from recruitment of skilled and unskilled personnel	*	*		*	*					*
	Business opportunities for local contractors through sub-contracting activities	*	*		*	*					*
	Local support services from road side supply markets and shops etc	*	*		*				*		*
	Skill acquisition and enhancements to local	*	*		*		*			*	

	indigenes and workforce.										
	Influx of people (migrant workers, sub-contractors and suppliers) and 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 a	*	*	*		*		*	*		*
	Community agitation over unidentified stakeholder, leadership tussles etc.	*		*		*			*		*
	Conflicts/community agitations over employment issues (quota and methods)	*		*		*			*		*
	Noise and vibrations due to movement from heavy duty equipment and vehicles affecting site workers, residents and wildlife	*		*		*		*			*
	Increase of dust particles and vehicular emissions	*		*		*		*			*
	Increased traffic during mobilization on road with risk of accidents leading to injury/death and loss of asset	*		*		*	*	*	*	*	*
	Disturbance of the vegetative cover/ loss of forest products (fuel wood, timber, medicinal plants) due to site clearing and preparation	*		*			*	*	*	*	
	Waste from wood, sand, paper; domestic waste from laydown area and camp site (material and wood)	*		*		*	*		*		*
	Contamination of surface water as a result of siltation caused by increased erosion during site preparation	*		*		*	*	*	*	*	*
Project Activity/ Environmental Aspect	**Associated and Potential Impacts**	**Impact characterization**									
		Direct	**Indirect**	**Adverse**	**Beneficial**	**Reversible**	**Irreversible**	**Cumulative**	**Residual**	**Long Term**	**Short Term**

CONSTRUCTION / INSTALLATION: -Building/ Drainage Foundation (trenching, Piling etc. -Building erection -Cabling and Conductor wire stringing -Painting and coating -Transportation and logistics etc. -Commissioning /Testing -Turnover -Waste management -Logistics.	Workplace accidents from burns, bruises, trips and falls, object at height leading to injury/ fatalities.	*		*		*	*		*	*	*
	Employment of local labour 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	*	*		*	*	*			*	
	Generation of dust and automobile/heavy duty equipment emissions from construction earthworks.	*		*		*		*			*
	Flora/habitat loss and disturbance through vegetation clearing and earthworks along access roads and building sites.	*		*		*	*	*	*	*	*
	Fauna disturbance and displacement as a result of migration away from construction area (e.g. birds)	*		*		*			*		*
	Soil/groundwater contamination resulting from accidental leakages and spill of hazardous substances (diesel, lubricants, hydraulic oil etc.)	*		*		*				*	*
	Risks injury/death and loss of assets resulting from accidents associated with road transportation to and from construction sites	*		*		*					*
	Traffic congestion along Lekki – Epe road during haulage of plant components to site for installation	*		*		*					*
	Risk of injury from fall from height and building collapse due to unstable geotechnical conditions	*		*		*	*	*	*	*	*

	Reduction in wildlife population as a result of poaching due to easier access created by access roads	*		*		*		*			*
	Inhalation by onsite workers of cement dust and toxic fumes during foundation works and welding for building components	*	*	*		*					*
	Noise nuisance from construction activities e.g. Piling resulting to irritation in humans and temporal migration of sensitive mammals	*	*	*		*		*	*	*	*
	Inhalation by onsite workers of cement dust and toxic fumes during foundation works and welding of tower components	*		*		*			*		*
	Visual intrusion as a result of alterations from accidental ignition of onsite diesel storage tanks	*		*		*					*
	Waste Disposal • Scrap metal, wood, sand, concrete, paper • Spent-oil and replaced /obsolete equipment parts that may contaminate soil/ground water • Waste from laydown area and building sites causing unsightliness	*		*		*		*	*		*

Project Activity/ Environmental Aspect	**Associated and Potential Impacts**	**Impact Characterization**									
		Direct	**Indirect**	**Adverse**	**Beneficial**	**Reversible**	**Irreversibl**	**Cumulativ**	**Residual**	**Long Term**	**Short Term**
DEMOBILISATION -Demobilization after construction phase	Workplace accidents from burns, cuts, bruises, trips and falls, object at height leading to injury of fatalities.	*		*		*	*		*	*	*
	Soil/groundwater contamination resulting from accidental leakages and spill of hazardous	*		*		*				*	*

Project Activity/ Environmental Aspect	**Associated and Potential Impacts**	**Impact Characterization**									
		Direct	**Indirect**	**Adverse**	**Beneficial**	**Reversible**	**Irreversible**	**Cumulative**	**Residual**	**Long Term**	**Short Term**
	substances (diesel, lubricants, hydraulic oil etc.)										
	Traffic congestion during transportation of demobilized equipment and personnel	*		*		*		*			*
	Generation of dust on Yegunda Earth Road) and automobile/heavy duty equipment emissions	*		*		*		*			*
	Reclamation of marshaling yards and laydown areas	*			*	*			*	*	
	Waste disposal (scrap metal, wood, sand, concrete, paper)	*		*		*		*			*
	Reclamation and restriction of access roads to prevent unauthorized uses	*			*	*		*	*	*	
	Loss of employment and business opportunities due to completion of construction phase	*	*	*		*		*	*	*	*
	Illegal access to building site leading to accident, asset damage and loss	*	*	*		*	*		*	*	*
	Surface runoff and erosion resulting in sedimentation problems	*		*		*				*	
OPERATION •Building inspection and checks •Power generation/ servicing •Transportation of raw materials and finished product •Textile processing/ production •Plant maintenance	Risk of injury from fall from height/trip or being hit by an object	*		*			*			*	*
	Air pollution by gaseous emission (CO, SO_2, NO_2) and particulates from power generator	*		*			*	*	*	*	*
	Soil contamination resulting from accidental leakages and spill of hazardous substances from generator servicing (diesel, spent oil etc.)	*		*			*	*	*	*	*
	Generation of dust and gaseous pollutants from automobile emissions	*		*			*	*	*	*	*
	Increase in noise level nuisance	*		*			*	*	*	*	*

Project Activity/ Environmental Aspect	Associated and Potential Impacts	Impact Characterization									
		Direct	**Indirect**	**Adverse**	**Beneficial**	**Reversible**	**Irreversible**	**Cumulative**	**Residual**	**Long Term**	**Short Term**
•Industrial waste discharges • Water consumption •Emergence of small-scale enterprises •Green Buffer development around each industrial plot, Industrial Park boundary •Recruitment of workers	from vehicles plying the access roads										
	Traffic congestion along the Lekki -Epe road	*		*		*			*	*	*
	Reduction of water tables and source of water for production processes	*		*		*			*	*	*
	Metallic materials generation from plant parts, retrofitting/upgrade of parts during plant servicing	*		*	*	*				*	*
	Potential for land contamination from industrial waste disposal	*		*		*			*	*	*
	Pollution of surface waterbodies by wastewater generated from industrial waste discharges	*		*			*	*	*	*	*
	Change in Land Use of nearby areas	*		*		*	*	*	*	*	*
	Recreational facility from lawns/parks/green areas	*		*			*		*	*	
	Improved Ecology, Air Quality and Aesthetics	*			*	*		*		*	*
	Acquisition of skills by individuals to be employed as operators	*	*		*		*	*	*	*	*
DECOMMISSIONING /ABANDONMENT •Removal of electrical cables and wires, water and sewage treatment plant pipelines. •Demolition of buildings for facilities retrieval •Waste generation •Transportation of Plant components for sale/another site	Risk of accident and injury to workers during demolition of structures	*		*			*			*	*
	Increased dust and vehicular emissions during haulage of plant components from site by heavy-duty vehicles	*		*			*		*	*	*
	Increased sedimentation process close to river banks and floodplains along the building sites	*		*		*		*	*	*	*
	Risk of soil and adjoining surface water contamination from accidental oil and hazardous substance leakages	*		*		*		*	*	*	*
	Traffic obstruction from transportation of	*		*		*		*			*

Project Activity/ Environmental Aspect	Associated and Potential Impacts	Impact Characterization									
		Direct	**Indirect**	**Adverse**	**Beneficial**	**Reversible**	**Irreversibl**	**Cumulativ**	**Residual**	**Long Term**	**Short Term**
	decommissioned structures and equipment										
	Abandoned structures possibly taken-over by miscreants/criminals		*	*		*					*
	Availability of land for alternative uses such as community hall	*			*		*			*	*

5.5 IMPACT EVALUATION

The potential and associated impacts identified and characterized were evaluated. The evaluation which was based on clearly defined criteria (legal/regulatory requirements, risk, frequency of occurrence, importance and public interest/concern) was used to determine the significance of the impacts. The criteria and scale adopted for the evaluation are described below.

Legal/Regulatory Requirements rating: The proposed project activities that resulted in impacts were weighed against existing legal/regulatory provisions to determine the requirement or otherwise for permits prior to the execution of such activities (Table 5.7). Such legal/regulatory requirements were identified from the laws/guidelines, which have been reviewed in chapter one of this report. The weighting scale used is as follows:

Table 5.7: Legal/Regulatory Requirements Criterion

Condition	**Rating**
No legal/regulatory requirement for carrying out project activity	Low (0)
Legal/regulatory requirement exist for carrying out activity	Medium (3)
A permit is required prior to carrying out project activity which may result in impact on the environment	High (5)

Risk Posed by Impact

The health, safety and environmental risks associated with each impact were assessed and ranked as "low", "medium" or "high", using the Risk Assessment Matrix (Figure 5.2). Three criteria (consequence, probability of occurrence and severity) were used as basis for ranking the risks of the impacts. Risk was measured based on risk assessment matrix (RAM).

Table 5.8: Risk Assessment Matrix

Increasing Severity

Consequence					Increasing Probability →				
					A	**B**	**C**	**D**	**E**
Severity	**People**	**Asset Damage**	**Environmental Effect**	**Reputation**	**Practically Impossible**	**Not Likely to Occur**	**Possibility of Occurring Sometime**	**Possibility of Isolated Incidents**	**Possibility of Repeated Incidents**
1	Slight injury	Slight	Slight	Slight	**Low Risk**				
2	Minor injury	Minor	Minor	Limited					
3	Major injury	Localized	Localized	Considerable			**Medium Risk**		
4	Serious injury	Major	Major	National					
5	Multiple fatalities	Extensive	Massive	International					**High Risk**

The risks (measure of the likelihood and magnitude of an adverse effect) associated with Textile and Garment Industrial Park projects were evaluated in terms of:

- risk to human health;
- risk to the biophysico-chemical environment

Based on the matrix above, the weighting used was as follows:

Table 5.9: Risk Attribute Matrix

Risk	**Attribute – Environmental, Human Health, Safety and Reputation**
Low (0)	This means that no further mitigation may be required
Medium (3)	This means that the impact can be mitigated with additional controls and modifications
High (5)	This means that the impact requires avoidance or major control/mitigation

Frequency of Impacts Occurrence

Evaluation of the frequency of occurrence was rated as "high", "medium" or "low" based on the historical records of accidents/incidents, consultation with experts and professional judgment. The frequency criterion is summarized below:

Table 5.10: Frequency Criterion

Frequency	Attribute – Environmental, Human Health and Safety
High (5)	• Major degradation in quality in terms of scale (>1% of study area or habitat within the study area), appearance, duration (beyond duration of project) • Irreversible or only slowly recoverable (change lasting more than 1 year) degradation of environmental ecosystem level (population, abundance, diversity, productivity) • High frequency of impact (occur continuously and almost throughout the project execution period) • Geographic extent of impact (e.g. encompassing areas beyond the project area)
Medium (3)	• Degradation in quality in terms of scale (>0.1% of study area, habitat), appearance, duration (a few months) • Effect beyond naturally occurring impacts variability • Slow reversibility (change lasting a few months before recovery), lasting residual impact • Potential for cumulative impact • Intermittent frequency of impact (occur in only a few occasions during the project execution period) • Limited geographic extent of impact (large area within project area)
Low (1)	• Minor degradation in quality in terms of scale (<0.1% of study area, habitat, very localized), appearance, duration (a few days to a month) • Effect within range of naturally occurring impacts, changes, dynamics • Rapid reversibility (change lasting only a few weeks before recovery), no lasting residual impact of significance • No potential for significant cumulative impact • Low frequency of impact (occur in just about one occasion during the project execution period) • Only very localised geographic extent of impact (e.g. not more than a few meters from impact source point)

Importance of Impact

The importance of environmental component in respect of identified potential impact was also determined and rated as "high", "medium" or "low". The ratings were based on consensus of opinions among consulted experts including project engineers and other stakeholders in the proposed project. The importance criterion is summarized thus:

Table 5.11: Importance Criterion

Importance	Attribute – Environmental, Human Health and Safety
High (5)	• Highly undesirable outcome (e.g., impairment of endangered, protected habitat, species) • Detrimental, extended flora and fauna behavioural change (breeding, spawning, molting) • Major reduction or disruption in value, function or service of impacted resource

	• Impact during environmentally sensitive period • Continuous non-compliance with international best practices
Medium (3)	• Negative outcome (e.g., loss time injury from minor burns) • Measurable reduction or disruption in value, function or service of impacted resource • Potential for non-compliance with international best practices
Low (2)	• Non-detectable impact (e.g., emissions from automobile equipment) • Alteration in value, function or service of impacted resource that are not obvious • Within compliance, no controls required

Public Interest/Perception
Here, the interest/perception of the public on the proposed project and the identified potential/ associated impacts were determined through consultation with proposed project stakeholders. The ratings of "high", "medium" or "low" were assigned based on consensus of opinions among consulted stakeholders. The public perception/interest criterion is summarized below:

Table 5.12: Public perception /interest criterion

Public Perception	Attribute – Environmental and Human Health
High (5)	• Elevated incremental risk to human health, acute and/or chronic • Possibility of life endangerment for community inhabitants and site personnel • Major reduction in social, cultural, economic value • Continuous non-compliance with international best practices • Any major public concern among population in the project region
Medium (3)	• Limited incremental risk to human health, acute and/or chronic • Unlikely life endangerment for community inhabitants and site personnel • Some reduction in social, cultural, economic value • Possibility of adverse perception among population • Potential for non-compliance
Low (1)	• No known risk to human health, acute and/or chronic • No known risk of life endangered for community inhabitants and site personnel • Minor reduction in social, cultural, economic value • Unlikely adverse perception among population

Consequence / Likelihood Evaluation
This impact assessment evaluates potentially significant impacts and prioritizes those potential impacts that require mitigation. Each potential impact is assigned a level of significance that reflects the significance of the consequence that could occur without consideration of control and/or mitigation measures, although reasonable best practices and planned control measures are assumed to be in place.
Tables 5.12 and 5.13 provide definitions for the impact significance designations for environmental and worker/public consequences as well as environmental and worker/public likelihood of occurrence respectively. Potential impacts may stem directly from the proposed project or from secondary and cumulative effects.

Table 5.13: Consequence Criterion

Consequence	Severity Rating	Example – Environmental	Example – Workers / Public
Negligible	1	• Dropped objects • Small quantities of chemical or fuel spilled (<100 litres)	• Slight injury (no medical/ first aid treatment required)
Minor	2	• Small chemical, fuel spill (about 1 tonnes)	• Minor injury (lost time) • Minor exposure to toxic environment
Moderate	3	• Vehicle damaged; fuel spilled (<100 tonnes) • Moderate oil, fuel, chemical spill (50 tonnes) • Shoreline erosion	• Major injury (lost time) • Major exposure to toxic environment
Major	4	• Fuel and hazardous chemical leaks, significant volume or ignited, less than 15-day duration • Tanker lost,1500 tonnes of diesel spilled	• Single fatality • Multiple major injuries • Bandits attack, multiple injuries, kidnapping
Severe	5	• Major explosion, • Major fuel liquid release, 15-90 days duration	• Multiple fatalities

Table 5.14: Likelihood Criterion

Likelihood / Probability Rating	Attribute – Environmental / Socioeconomic (workers/public)
A	• No known occurrence in Textile industry (>1,000 equipment years)
B	• Has occurred in Textile industry (1,000 – 100 equipment years)
C	• Incident has occurred at NEPZA projects (100 – 10 equipment years)
D	• Happens several times/year at NEPZA projects sites (10 - 1 equipment years)
E	• Happens several times/year at NEPZA projects sites (<1 equipment years)

This consequence criterion (Table 5.12) is combined with a probability of occurrence (Table 5.13) to assess the potential significance of the routine or accidental impacts. Specifically, the process followed in this assessment resulted in categorizing the identified potential impacts into High, Medium and Low risk categories as shown in Figure 5.3 below.

			Likelihood of Occurrence				
			A	B	C	D	E
			No known occurrence in Textile industry (>1,000 equipment years)	Has occurred in Textile industry (1,000– 100 equipment years)	Incident has occurred at NEPZA project sites (100 – 10 equipment years)	Happens several times/year at NEPZA project sites (10–1 equipment years)	Happens several times/year in NEPZA project sites (<1 equipment years)
Severity	1	Negligible	**1A**	**1B**	**1C**	**1D**	**1E**
	2	Minor	**2A**	**2B**	**2C**	**2D**	**2E**
	3	Moderate	**3A**	**3B**	**3C**	**3D**	**3E**
	4	Major	**4A**	**4B**	**4C**	**4D**	**4E**
	5	Sever e		**5B**	**5C**	**5D**	**5E**

Low Risk	**Medium Risk**	**High Risk**

Table 5.15: Consequence / Probability Risk Assessment Matrix

5.6 RESULTS OF THE IMPACT ASSESSMENT

For each of the three main project phases (pre-construction/construction, Operation and Demobilization), the potential impacts and benefits were described using characterization and criteria listed above – for example: extent, duration, intensity, nature etc. (Table 5.2) and Legal, risk, frequency, importance etc. The impacts were then assessed in terms of their significance (major, medium, or minor).

The levels of significance for potential impacts of the proposed project were assigned as those impacts to which the following conditions apply.

- Major significance =Impacts for which (L+R+F+I+P) is ≥15 with a consequence / likelihood rating of: 3E, 4D, 4E, 5C, 5D and 5E.
- Medium significance = Impacts for which (L+R+F+I+P) is between 10 - 14 with a consequence / likelihood rating of: 2D, 2E, 3C, 3D, 4B, 4C, 5A, 5B.
- Minor significance = Impacts for which (L+R+F+I+P) is ≤ 9 with a consequence / likelihood rating of: 1A, 1B, 1C, 1D, 1E, 2A, 2B, 2C, 3A, 3B, 4A.

Table 5.16: Impacts Measures and Ratings

Project Activity/ Environmental Aspect	Associated and Potential Impacts	ASSESSMENT CRITERIA						
		Legal	Risk	Frequency	Importance	Public	Likelihood/ Consequence	Impact Significance Category
PRE-CONSTRUCTION								
Permitting & Land Acquisition •Consultations •Acquisition of license to operate •Stakeholder identification •Land Acquisition	Acceptance and co-operation/ participation from stakeholders leading to peaceful and timely execution of the project	-	-	-	-	-	-	**Beneficial**
	Uncertainty and misunderstanding due to a lack of information and communication.	Low (0)	Low (1)	Low (1)	Med (3)	High (5)	3D	Medium (10/3D)
	Exclusion of vulnerable groups from consultations which may lead to strife	Low (1)	Low (1)	Low (1)	Med (3)	Med (3)	3D	**Medium (9/3D)**
	Community agitations over land disputes, wrong stakeholder identification, leadership tussles, etc.	Low (0)	High (5)	Low (1)	High (5)	High (5)	4D	**Major (16/4D)**
Transport of Personnel and Construction Elements • Lekki – Epe Highway • Ijubu-Ode – Epe road • Inland water ways (Lagoon ferrying from parts of Lagos). • Yegunda Earth Road	Increased traffic during mobilization on road with risks of accidents leading to injury/death and loss of asset.	Low (0)	Med (3)	Low (0)	High (5)	High (5)	4C	**Major (13/4C)**
	Nuisance (noise and vibrations) due to movement from heavy duty equipment and vehicles affecting public and wildlife.	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Increase of dust particles and vehicular emissions.	Low (0)	Med (3)	Low (1)	Low (1)	Low (1)	2C	**Minor (6/2C)**
	Work place accidents/incidents from the use of cranes, forklifts, etc. during loading and offloading of materials/equipment.	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Obstruction of/damage to existing roads due to increased usage during mobilization.	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Interference with other road users along mobilization route.	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3D)**
	Leakage of fuel or lube oil onto land or into water bodies during transportation and storage may lead to increased chemical hazard.	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3D)**
Recruitment of Labour	Employment opportunities arising from recruitment of technical and non- technical workers	-	-	-	-	-	-	**Beneficial**
	Skill acquisition and enhancements to local indigenes and workforce.	-	-	-	-	-	-	**Beneficial**
	Influx of people (migrant workers,	Low	Med	Med	Med	High	3D	**Medium**

Project Activity/ Environmental Aspect	Associated and Potential Impacts	ASSESSMENT CRITERIA						
		Legal	Risk	Frequency	Importance	Public	Likelihood/ Consequence	Impact Significance Category
	sub-contractors and suppliers) and increased pressure on existing social infrastructure	(0)	(3)	(3)	(3)	(5)		**(14/3D)**
	Increase of communicable diseases due to influx of people and poor living conditions around pre-construction sites	Low (0)	High (5)	Med (3)	Med (3)	Med (3)	3D	**Medium (14/3D)**
	Increase in social vices (like theft, prostitution) resulting from increased number of people	Low (0)	High (5)	Med (3)	Med (3)	Med (3)	3D	**Medium (14/3D)**
Site Preparation •Access roads creation •Site clearing •Camping and campsites	Conflicts/community agitations over employment issues (quotas and methods)	Low (0)	High (5)	Low (1)	High (5)	High (5)	4D	**Major (16/4D)**
	Economic loss arising from clearing of farm lands	Low (5)	High (5)	Low (1)	High (5)	High (5)	4D	**Major (20/4D)**
	Business opportunities for local contractors through sub-contracting activities	-	-	-	-	-	-	**Beneficial**
	Local support services from road side supply markets and shops etc.	-	-	-	-	-	-	**Beneficial**
	Employment opportunities for local labourers used for land clearing purposes during site preparation	-	-	-	-	-	-	**Beneficial**
	Contamination of surface water as a result of siltation caused by increased erosion, during site preparation.	Low (0)	Med (3)	Low (1)	Med (3)	High (5)	3D	**Medium 12/3D**
	Contamination of nearby surface water (Lagoon) as a result of siltation caused by increased run-off during site preparation.	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Disturbance of the vegetation cover/ loss of forest products (fuel wood, timber, medicinal plants) due to site clearing and preparation.	Low (0)	Med (3)	Med (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**
	Loss/disturbance of wildlife due to habitat loss/fragmentation from vegetation clearing at site and access roads	Low (0)	Med (3)	Med (3)	High (5)	Med (3)	3D	**Medium (14/3D)**
	Soil compaction leading to erosion, destabilization from excavation and surface runoff resulting in sedimentation	Low (0)	Med (3)	Med (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**

Project Activity/ Environmental Aspect	Associated and Potential Impacts	ASSESSMENT CRITERIA						
		Legal	Risk	Frequency	Importance	Public	Likelihood/ Consequence	Impact Significance Category
	problems.							
	Opening up of wildlife habitats/ increase in poaching due to an easier access for the local population and some workers.	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3D	**Medium (10/3D)**
	Waste from wood, sand, paper; domestic waste from laydown area and camp site (material and wood)	Low (0)	Med (3)	Low (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**
CONSTRUCTION/INSTALLATION								
Foundation/ Earth Works •On-site geotechnical testings •Building foundations •Gutter/Drainage channels cuttings •Pilings and trenching, -. .Building erection etc	Generation of dust and automobile / heavy duty equipment emissions from construction earth works.	Low (0)	Low (1)	Med (3)	Med (3)	Low (1)	2D	**Minor (8/2D)**
	Flora/habitat loss and disturbance through vegetation clearing and earthworks on building site and access roads	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Fauna disturbance and displacement as a result of migration away from construction activity area (e.g. impact on bird life)	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Potential building collapse as a result of unsuitable geotechnical conditions	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Alteration of rivers/stream course and regime due to construction	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Reduction in wildlife population as a result of poaching due to easier access created access roads	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Noise nuisance from construction activities (e.g. piling) resulting to temporary migration of sensitive mammals and human discomfort	Low (0)	Low (1)	Med (3)	Low (1)	Med (3)	2D	**Minor (8/2D)**
	Inhalation by onsite workers of cement dust during building erection	Low (0)	High (5)	Low (1)	High (5)	Med (3)	3D	Medium (14/3D)
Cabling and Conductor wire stringing -Laying of electrical cables -insulators and fittings -Testing and energizing	Risk of electrocution and burns (to onsite workers) during electrical installation processes	Low (0)	High (5)	Low (1)	High (5)	Med (3)	3D	**Major (14/3D)**
Fabrication and Metal works	Workplace accidents from burns, cuts, bruises, trips and falls,	Low (0)	High (5)	Low (1)	High (5)	High (5)	4D	**Major (16/4D)**

Project Activity/ Environmental Aspect	**Associated and Potential Impacts**	**ASSESSMENT CRITERIA**						
		Legal	**Risk**	**Frequency**	**Importance**	**Public**	**Likelihood/ Consequence**	**Impact Significance Category**
•Cutting, bending and welding for steel roof/components •Painting	objects at height, leading to injury or fatalities.							
	Employment of local labour and skills acquisition for workers taking advantage of new opportunities	-	-	-	-	-	-	**Beneficial**
	Noise and attendant vibration effects from fabrication and associated welding equipment	Low (0)	Low (1)	Med (3)	Low (1)	Med (3)	2D	**Minor (8/2D)**
	Inhalation by onsite workers of fumes during welding of steel components	Low (0)	High (5)	Low (1)	High (5)	Med (3)	3D	Medium (14/3D)
	Generation of metal scraps from steel elements associated with fabrication of building roof	Low (0)	Med (3)	Low (1)	Med (3)	Med (5)	3D	**Medium (12/3D)**
	Increased business and economic activities as well as diversification of income sources due to supply contracting and sub-contracting	-	-	-	-	-	-	**Beneficial**
	Soil/groundwater contamination resulting from accidental leakages and spills of hazardous substances (diesel, cleaning agents, lubricants, hydraulic oil)	Low (0)	Med (3)	Med (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**
	Increased jobs and job opportunities from local labour hire and sub- contracting to indigenous suppliers.	-	-	-	-	-	-	**Beneficial**
	Induced secondary development within the neighbouring host communities from increased economic activities.	-	-	-	-	-	-	**Beneficial**
Transportation and logistics -Daily movement of some workers -Movement of building materials and other fittings -Traffic of supplying vehicles	Traffic congestion along Lekki – Epe express way and Yegunda Road during haulage of plant components to site for installation	Low (0)	Med (3)	Low (1)	Med (3)	Med (5)	3C	**Medium (10/3C)**
	Workplace accidents/incidents (trip/falls etc) from heights during building installations, wiring and bolt/nuts tightening activities.	Low (0)	High (5)	Low (0)	High (5)	High (5)	4C	**Major (16/4C)**
	Risks of injury/death and loss of assets resulting from accidents associated with road transportation to and from construction sites	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Risks of fire/explosions resulting from accidental ignition of onsite diesel storage tanks	Low (0)	Med (5)	Low (3)	Low (3)	Low (1)	3C	**Medium (12/3C)**

Project Activity/ Environmental Aspect	Associated and Potential Impacts	ASSESSMENT CRITERIA						
		Legal	**Risk**	**Frequency**	**Importance**	**Public**	**Likelihood/ Consequence**	**Impact Significance Category**
Waste management -Construction waste -domestic waste from camp	•Waste Disposal from scrap metal, wood, sand, concrete, paper, domestic waste •Spent-oil and replaced/obsolete equipment parts that may contaminate soil/groundwater •Waste from laydown area and building sites	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
Commissioning/ Testing -Plant testing -Energizing from the power generator	Risk of electrocution and Explosion, injury from mechanical damage site manager and others during testing	Low (0)	High (3)	Low (1)	High (5)	Med (3)	**2C**	**Minor 12/2D**
DEMOBILISATION								
Demobilisation after construction -Withdrawal of construction equipment from site -Withdrawal of construction workers -Compaction of the site surrounding -Return of Construction vehicles	Illegal access to plant site leading to accident, asset damage, and loss	Low (0)	High (5)	Low (1)	Med (3)	Med (3)	3C	**Medium (12/3C)**
	Workplace accidents from burns, bruises, trips and falls, object at height leading to injury of fatalities.	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Traffic congestion during transportation of demobilized equipment and personnel	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Generation of dust and automobile/heavy duty equipment emissions	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Reclamation of marshaling yards and laydown areas	-	-	-	-	-	-	**Beneficial**
	Waste disposal (scrap metal, wood, sand, concrete, paper)	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Loss of employment and business opportunities due to completion of construction phase	Low (0)	Med (3)	Low (1)	Med (3)	Med (5)	3C	**Medium (12/3C)**
	Surface runoff and erosion resulting in sedimentation problems	Low (0)	Med (3)	Low (1)	Med (3)	Low (1)	2C	**Low (8/2C)**

Project Activity/ Environmental Aspect	Associated and Potential Impacts	ASSESSMENT CRITERIA						
		Legal	Risk	Frequency	Importance	Public	Likelihood/ Consequen	Impact Significance Category
	OPERATION/MAINTENANCE							
OPERATION •Building inspection and checks •Power generation/ servicing •Transportation of raw materials and finished product •Textile processing/ production •Plant maintenance •Industrial waste discharges	Risk of injury from fall from height or being hit by an object	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Medium (10/3C)**
	Limited knowledge on safety measures and behaviour associated with industrial operation that can lead to accidents	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Air pollution by gaseous emission (CO, SO_2, NO_2) and particulates from vehicles that supply raw materials and transport finished products.	Low (0)	Med (3)	Med (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**
	Soil contamination resulting from accidental leakages and spill of hazardous substances from generator servicing (diesel, spent oil etc.)	Low (0)	Med (3)	Med (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**
	Generation of dust and gaseous pollutants from automobile emissions and textile production processes.	Low (0)	Med (3)	Med (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**
	Increase in noise level nuisance from vehicles supplying raw materials and carrying away finished textile products.	Low (0)	Low (1)	Med (3)	Low (1)	Med (3)	2C	**Minor (8/2C)**
	Metallic materials generation from plant parts, retrofitting/upgrade of parts during processing units servicing	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
• Water consumption	Reduction of water tables and source of water for production processes	Low (0)	High (5)	Low (0)	High (5)	High (5)	4C	**Major (16/4C)**
	Potential for land contamination from industrial waste disposal	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Pollution of surface waterbodies by wastewater discharges	Low (0)	High (5)	Low (1)	High (5)	High (5)	5C	**Major (16/5C)**
•Recruitment of workers	Community/individuals' dissatisfaction with the conduct of the proponent regarding recruitment of labour	Low (0)	High (5)	Med (3)	High (5)	High (5)	5C	**Major (18/5C)**
•Green Buffer development around each industrial plot, Industrial Park boundary	Change in Land Use of nearby areas	Low (0)	Med (3)	Low (1)	Med (3)	Med (3)	3C	**Major (10/3C)**
	Recreational facility from lawns/parks/green areas	-	-	-	-	-	-	**Beneficial**
•Emergence of small-scale	Improved Ecology and Aesthetics with proper landscape and beautification	-	-	-	-	-	-	**Beneficial**

Project Activity/ Environmental Aspect	Associated and Potential Impacts	ASSESSMENT CRITERIA						
		Legal	Risk	Frequency	Importance	Public	Likelihood/ Consequence	Impact Significance Category
enterprises	Acquisition of skills by individuals to be employed as operators. Emergence of small businesses	-	-	-	-	-	-	**Beneficial**

Project Activity/Environmental Aspect	Associated and Potential Impacts	ASSESSMENT CRITERIA						
		Legal	Risk	Frequency	Importance	Public	Likelihood/ Consequence	Impact Significance Category
DECOMMISSIONING/ABANDONMENT								
Decommissioning / Abandonment •Removal of electrical cables and wires, water and Sewage Treatment Plant pipelines •Demolition of buildings for facilities retrieval •Waste generation •Transportation of Plant components for sale/another site	Risk of accident and injury to workers during demolition of structures	Low (0)	Med (3)	Low (1)	High (5)	Med (3)	3D	**Medium (12/3D)**
	Increased dust and vehicular emissions during haulage of plant components from site by heavy-duty vehicles	Low (0)	High (5)	Low (1)	High (5)	High (5)	4C	**Major (16/4C)**
	Risk of soil and adjoining surface water contamination from accidental oil and hazardous substance leakages	Low (0)	Med (3)	Med (3)	Med (3)	Low (1)	2D	**Minor (10/2D)**
	Traffic obstruction from transportation of decommissioned structures and equipment	Low (0)	Med (3)	Med (3)	Med (3)	Med (3)	3D	**Medium (12/3D)**
	Availability of land for alternative uses	-	-	-	-	-	-	**Beneficial**
	Loss of employment	Low (0)	High (5)	Low (1)	High (5)	High (5)	4C	**Major (16/4C)**

5.7 DETAILED DESCRIPTION OF SIGNIFICANT POTENTIAL IMPACTS OF THE PROPOSED TEXTILE AND GARMENT INDUSTRIAL PARK PROJECT

The discussions presented in this section are intended to provide a concise insight into the nature and level of significance of the identified impacts as well as a description of mitigation measures outlined in the various phases of the development.

Construction Phase

This refers to all construction and construction-related activities that will occur within the study area until the EPC contractor leaves the area. The construction activities will take approximately Twenty Four Months (2 years). The first phase will involve the pre-construction activities.
The construction phase will be treated as an integrated whole, as dictated by the nature of the activities and impacts under discussion.

The activities at the construction phase include Campsite/Base camp establishment, comprising prefabricated buildings, workshops and temporary offices, off-site borrow pit excavation for obtaining laterite/clay, off-site river dredging for sand or off-site source for sand, carriage/haulage of base course materials from sources to site, by pay loaders, tippers and self-loaders, gas and water pipelines trenching, laying, backfilling, onsite and offsite facilities construction and installations- production units, generators, water and wastewater treatment plants and installation of electrical cables and fittings - surface and underground, drainage construction, road construction, recreational facilities etc.

Operational and Maintenance Phase

The operation activities can be divided into textile and garment production processes such as, fiber preparation, yarn spinning, slashing/sizing, weaving, knitting, tufting, desizing, scouring, bleaching, singeing, mercerizing, heat setting, dyeing, printing and finishing.

Treating and discharge of liquid effluents, Other activities are discharges of liquid wastes/waste wasters/effluents, emissions of gaseous wastes, security, water demand and use, management of solid wastes and office and administrative activities transportation of raw and finished textile items, maintenance/servicing of onsite facilities/utilities etc.

Decommissioning Phase

The proposed Textile and Garment industrial park being a very crucial product provider that will last generations, it is not envisaged that the plant will be decommissioned any time earlier than 100 years. The activities at decommissioning phase include shutdown of processes, laying off of personnel. Removal of equipment and surface/underground facilities, remediation and restoration of polluted /impacted site, disposal of wastes.

5.7.1 Socioeconomic and Cultural impacts

The socio-economic and health assessment provided the baseline social profile of the study area. The proposed industrial plant will be located within the north-eastern quadrant of the Lekki Free trade zone in Epe local Government area of Lagos State. The baseline social profile of Epe LGA and affected communities are discussed in chapter four of this report.

Construction Phase

Demography

The inflow of workers who choose to reside along in Epe during the construction phase of the development may not have any impact on the demography of the area. The numbers of workers anticipated to be employed during the construction phase is estimated at about 500 workers who will be directly or indirectly employed in this phase. This number of workers will have an impact on demography on the communities which currently rural and sparsely populated. There is no evidence of overcrowding; hence, no serious negative impact is envisaged on the demography of the area. No mitigation measure is proposed.

Employment Opportunities

Based on the results of the socio-economic assessment, the unemployment rate in the area is low to average. The local residents are however anticipating increase in job availability that the development of the industry will bring. Any available jobs will provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the regional and national levels. The impact is beneficial.

Employment of casual unskilled labour would occur, for short-term contracts or for the entire construction phase. This could result in a positive spin-off during the construction phase as any level of employment in this region of moderate unemployment and low wage levels will have a beneficial social spinoff. The impact is beneficial.

Contracting
During the construction phase, there will be provision for sub-contracting to local supplies. Supplies will include raw materials that meet standards as required for the construction of the industrial park facilities. Equal opportunities will be given to sub-contractors from the host communities and Epe LGA. This is a positive impact.

Information Dissemination
Improper dissemination of information about the project and its activities may pose a risk. This is because lack of information and improper sensitization of stakeholders such as men and women groups, religious groups, vulnerable groups (e.g. aged and widowed) youths, etc about the project may result in local agitation. This impact is assessed as medium.

Community Agitations
During labour recruitment and prior to full construction activities, there is potential for conflicts between neighbouring communities or individuals over employment quota systems, sub-contracting procedures or recruitment methodology. This will pose major significant impact on the project construction phase.

Socio-cultural Conflicts
Other potential socio-economic impacts are expected to arise from socio-cultural conflicts between the construction workforce and natives due to contrast in believes and religion. Particularly, the possible desecration of numerous traditional shrine/groves in the project area. Another challenge in this direction is increased demand on existing infrastructures due to influx of people to project area. These impacts have been ranked with a medium to major significance level.

Visual Effects
Erection of industrial (high rising) buildings and perimeter fence in the project area may create visual intrusion by altering the normal topographical view of the landscape. This impact has been ranked with a minor significance level.

Loss of Land
Utilization of land for the industrial textile/garment production and associated facilities may result in temporary and permanent loss of land, some of which are regarded as farmland. The impact was ranked with a major significance.

Loss of Income
Completion of the construction phase of the project will lead to loss of employment to construction workers and small business opportunities. This impact has been assessed with a medium significance level.

Operational and Maintenance Phase
Community Agitations
After the construction phase of the project there exist the possibility of community or groups of individuals or individual dissatisfaction with the conduct of the proponent regarding recruitment of labour as well as general conduct during the construction and extend to operation. This impact could result in strife thereby affecting the operations of the Textile and Garment industrial Park. This impact has been assessed to have a major significant level.

Unauthorized Access

Prior to the operation of the industrial complex (demobilization), unchecked and unauthorized encroachment by locals or individuals into the project premises may lead to land use conflict and possible accidents. This impact significant is ranked as medium.

5.7.2 Biodiversity Impact

It is expected that the project development activities will remove about 46.62 hectares of forest and its flora and fauna components. The development may have a major, long-term, irreversible negative impact on the floral composition.

Results from biodiversity studies conducted in the area shows the following ecological zones; secondary forest regrowth, degraded forest, riparian vegetation and cultivated farmlands. It is expected that the project development activities will remove about 46.62 hectares of forest and its flora and fauna components. The IUCN status of the plant resources for the studied area was evaluated using IUCN version 2017 .3 criterion. The results showed that majority of the plant species encountered do not fall to the categorization of IUCN Red lists. However, the identified species that are vulnerable are as follows; *Albizia ferruginea*. *Raphia sudanica* present in the project site is near threatened (NT).

Based on the vegetation and faunal investigations, the most sensitive ecological zones are considered to be the rivers/floodplain. In addition, the vegetation zones that were identified within the project area are well represented outside of the study area, and are thus not considered threatened ecosystems.

Data on the floristic composition and fauna assemblage in the project site and in the immediate vicinity within the project area indicate presence of a varied assemblage of forest resources and plant species, some of which are of economic and ecosystem services (ethno-botanical) importance (Table 4.38, chapter 4) to the people of the communities.

The main impacts of clearing the vegetation may however, be secondary and will affect the species that depend on the area for survival through habitat loss, fragmentation and the impacts of edge effects. This will be further discussed in the sections below.

Construction Phase:

The construction phase is the most destructive part of the planned development on vegetation. During the construction phase various impacts could cause loss and disturbance of vegetation and animal habitats.

Vegetation Clearing

Selective clearing will be combined with total clearance where necessary within the project area and access roads so as to the minimum ecological footprint during the construction phase. Total vegetal removal will be done only to allow for foundations of buildings and gutters, and placement of perimeter fence.

The impacts on vegetation and habitat loss due to vegetation clearing and other site preparation activities are put at a medium significant level.

Erosion

Erosion may take place when vegetation is removed, due to trampling of ground by vehicular and human traffic, and where vegetation is cleared for construction activities. Areas of particular concern would be along the access roads, areas in which the lay-down areas are place and disturbed areas around the buildings. Impacts resulting from erosion around building areas, access roads, etc have been ranked with a medium significance.

River Bank Disturbances

Damage to hydrological systems could occur where buildings are erected close or within the rivers, and/or when construction camps are placed within river banks. Water bodies/rivers are sensitive to disturbance and therefore should the afore-mentioned impacts occur, they would be on medium significance. Fortunately, rivers are relatively small in area except for the presence of Lagoon to the north and south of the project area. It is not anticipated that any facility will be erected on streams or lagoon beds at all. The industrial park is designed to ensure that it spans in-between the two lagoons (Epe and Lekki Lagoon). Similarly, if the construction camps are not built directly next to rivers, there will be no impact. However, specific mitigation measures have been included to ameliorate any possible impacts.

Wildlife Disturbance

During construction there is expected faunal disturbance along the entire length of the access road and the project site, in which sensitive ground dwelling animals like the ground squirrels, grass cutters, porcupine etc and those that rtender ecosystem services (Tables 4.46, 4.51 and 4.52 in chapter 4) will move out of the area during construction. This is likely short termed, and once construction is finished, some fauna will recolonise the area. The impact is anticipated to be medium.

In terms of birds, the migratory path may be obstructed and breeding site removed. The field study did not identify any peculiar bird breeding areas/migration routes within the project site. The impact is low and therefore no mitigation is provided.

Operational and Maintenance Phase:

During this phase, the impacts on the vegetation and habitat of the fauna would be relatively low.

Fauna Disturbance from Gaseous/Dust emission

Emission of particulates and noxious gases into the surrounding environment may result in some form of flora growth impairment and fauna disturbance. In the majority of situations, the fauna species will simply move into the large expanses of nearby forest vegetation. Impact significance on ecosystem is low.

5.7.3 Hydrology and Aquatic Systems

The activities involved in these phases of the development may cause a negative short to long-term impact on the surface hydrology and ground water quality in the project area. This will be as a result of activities which are capable of altering river course and possibly affect speed of water flow. The hydrological system of the project area includes seasonal river/stream and Lagoons. Water bodies are also exposed to anthropogenic impacts, including water pollution, and shoreline contamination by hydrocarbon and oil/grease.

Construction Phase

Sedimentation of streams/rivers

Clearance of existing vegetation will expose the upper layers of the soil horizon to soil erosion. The transport of eroded soil into the surface water resources, especially the rivers will impact on water quality. The movement of construction vehicles and personnel can also result in the onset of erosion and associated sedimentation of streams and rivers. The stockpiling of excavated earth and construction materials can result in contamination of runoff, through erosion of stockpiles. On the overall, impacts resulting to sedimentation problems as a result of soil erosion are adjudged to have a medium significance.

Aquatic Life disturbance

The riparian zone is an important corridor for the movement of wildlife, and as such the construction activities may impact on the movement of certain fauna species within the Riparian and wetlands. The construction related activities that will result in a deterioration of the water quality, will ultimately influence aquatic species such as macro-invertebrates, fish, amphibians and water-birds. This impact would however be limited in terms of duration and is ranked at a medium significance level.

Surface water pollution
Hydrocarbons-based fuels or lubricants spilled from construction vehicles, construction materials that are not properly stockpiled, and litter deposited by construction workers may be washed into the surface water bodies. Should appropriate toilet facilities not be provided for construction workers at the construction camps, surface water resources and surroundings will be contaminated by untreated sewage effluents, lubricants and other hazardous substances from accidental leaks and spillages. Depending on the nature of the contaminant the impact could range from either medium significance to major significance categories.

Operation and Maintenance Phase
The operation of the proposed industrial park and associated facilities would not result in a substantial increase in hydrological and aquatic systems disruption during the operational phase. Accidental discharge of untreated wastewater from industrial processing is capable of degrading the quality of nearby streams and Lekki Lagoon during this phase.

5.7.4 Air Quality and Noise Pollution
Air pollution is a major criterion for the design and citing of facilities within the industrial park. Pollution arising from the operation of the industrial facilities and the consequent environmental and health effects could lead to human health problems and environmental quality degradation. The baseline data on the level of noise and pollutant gases along the access road and project site has been assessed and found to be compliant to set regulatory limits for their natural environment (Tables 4.4.5 and 4.6 in chapter 4).

Gaseous Emission

Construction Phase
The construction of the proposed Industrial Park will generate some amounts of pollutant gases (SO_x, NO_x, CO, VOCs, etc) from fuel combustion (light fuel oil) used for supply trucks and heavy duty equipment. Such pollutants will include airborne particulates that would especially result during dry/windy conditions as a result of equipment movements and localised earthworks. Emissions during construction activities will be localised and short termed, impact will therefore be minor.
In addition, it is expected that there would be increase in dust particles (SPM) along earthed access roads and also during facilities construction activities. Increase in SPM levels will specifically result from vehicular movements and construction earthworks (excavations, trenching, etc). These are expected to last for a short term and have a minor significance ranking.

Operation and Maintenance Phase
It is known that data about emissions of air due to textile processes are not easily accessible, but many processes in textile cause air emissions. The secondary important pollutant in the textile after waste disposal is gaseous emissions. Air emissions include dust and lint, oil fumes, acid vapor, solvent mists, odor and boiler exhausts. If textile materials contain oil, plasticizers and other materials, they degrade when exposed to high temperatures, and forms fog. The stenter frame is the most common source of it. Formaldehyde also called methanal, and acetic acid are important emission sources, too. During wool carbonization, corrosive acid fumes are generated and volatilization of acids occur. Solvent vapors which include toxic chemicals such as

kerosene or mineral turpentine oil, formaldehyde, chlorofluorohydrocarbons, mono- and dichlorobenzene, ethyl acetate, hexane, styrene etc. come up after dyeing and printing processes. Oil mists or solvent vapors connect with odor. For example, carriers used for polyester dyeing, dye reduction in sulfur dyeing of cotton with hydrosulphite and bleaching with sodium hypochlorite cause odor.

In textile enterprises, sulfur and nitrogen oxides usually emerge due to the boilers operations. The other important air emission sources in textile processing are anti-crease finishing, drying, printing, dyeing and wastewater treatment facilities.

Dust and lint emissions associated with textile manufacturing occur during natural fiber and synthetic staple processing and yarn manufacturing. Fiber (especially cotton) handling and storage are sources of dust, particularly within work areas. The main sources are bale breakers, automatic feeders, separators and openers, mechanical conveyors, pickers, and cards.

Dust and emissions generation during operations is envisaged to be moderate and mitigation measure has been recommended.

Table 5:17 Air emissions released from different textile production processes.

Process	Source	Pollutant
Energy production	Emissions from boiler	Particulates, NO_x, SO_2
Coating, drying, curing	Emissions from high temperature ovens	Volatile organic components
Cotton handling activities	Emissions from preparation, carding, combing, fabric manufacturing	Particulates
Sizing	Emissions from using sizing compound	Nitrogen oxides, sulphur oxide, carbon monoxide
Bleaching	Emissions from using chlorine compound	Chlorine, chlorine dioxide
Dyeing	Disperse dyeing using carriers, sulphur dyeing, aniline dyeing	Carriers, H_2S, Aniline vapors
Printing	Emission	Hydrocarbons, ammonia
Finishing	Resin finishing, heat setting of synthetic fabrics	Formaldehyde, carriers, polymers-lubricating oils
Chemical storage	Emissions from storage tanks for commodity and chemicals	VOCs
Waste water treatment	Emissions from treatment tanks and vessels	VOCs, toxic emissions

Source: Moustafa, 2008.

Noise

Noise has the potential to damage health, to detract from the quality of life, and to disturb or affect wildlife. During the studies the baseline noise levels along the project area were within acceptable limits (Table 4.9 in chapter 4). Results from measurements were within acceptable limits.

Construction Phase

The construction period could result in a temporary increase of the noise levels due to construction and delivery vehicles moving to and from the site as well as general installation activities. Noise and attendant vibration effects from fabrication and associated construction equipment. Increase in traffic flow within the study area could increase the nuisance levels in terms of noise generation.

The table below presents noise levels of some construction equipment/ machinery that may likely to be used during construction.

Table 5.18: Typical Noise Levels of Construction Equipment

Equipment	Noise Level (dB(A)) from 50ft of Source
Cranes	83
Backhoes	80
Loaders	84
Dozers	85
Scrappers	89
Trenchers	97
Grader	85
Compactor	82
Concrete mixer	85
Jack Hammer	88
Saw	76
Shovel	82
Truck	88

Source: Workers Compensation Board Report, 2000

At a distance of 50 feets (equivalent to 15 meters), the above noise level from use of machinery is expected. During site preparation and construction activities, work equipment will result in increased noise level and vibration in the area, although noise would not cause a major disturbance to the local inhabitants except Idiroko and Oke-Egan community that are very close to the project site boundary 0.505 km and 0.534km radius from the project site respectively. However workers at the site would be impacted.

The proposed construction time frames for this project estimates that all construction will take place over a period of 24 months. The construction activity will be undertaken during daytime. Construction activities will be concentrated and done sequentially so that no area is prone to extensive duration of noise impacts.

The impact from increase in noise levels are evaluated and ranked to pose minor significance levels during construction period as they will be short termed.

Operation Phase

A one minute exposure to a sound level over 100dBA can cause permanent hearing loss. In a textile factory high noise level occurs in units where knitting and weaving are made and this can cause about 80% of hearing loss in people working there. The main sources of noise in textile plants are associated with yarn processing (e.g. texturizing and twisting and doubling) and woven fabric production. Some noise will also be generated from vehicles supplying raw material inputs and those taking away already finished products from the industrial park.

Noise impact during the operational phase of the project is expected to exceed the WHO/IFC regulatory limit of 70dB (A), but would be controlled by installing noise reducing devices, see Chapter Six, Noise impact is placed as minor significant at operation.

Waste Generation

Operation

Solid wastes

As discussed in Chapter Three, wastes from the project are grouped into solid wastes, liquid (wastewater) and air emissions. Most of the solid wastes originate from the dry process while the wet process yield only small amount of solid wastes. The majority of solid wastes are made of pieces of fabrics and packaging materials. Solid wastes are not found to be hazardous in general. However, the emptied chemical containers may contain traces of harmful substances. Solis waste generated would include; wood, metals, food remains, glass, refuse, spoil etc. Liquid wastes include sewage, waste chemicals and oily water.

Table 5.19: Types and Sources of Solid Wastes in Textile Manufacturing

Source	Type of Solid Waste
Mechanical operations of cotton and synthesis	
Yarn Preparation	Fibres and Yarns
Knitting	Fibres and Yarns
Weaving	Fibres Yarns and Cloth scraps
Dyeing and Finishing of woven fabrics	
Sizing, desizing, mercerizing, bleaching, washing and chemical finishing	Cloth scraps
Mechanical finishing	Flock
Dyeing and/printing	Dye containers
Dyeing and/printing (applied finish)	Chemical containers
Dyeing and finishing of knitted fabrics	Cloth scraps, dye and chemical containers
Dyeing and Finishing of Carpets	
Tufting	Yarns and Sweepings
Selvage trim	Selvage
Fluff and Shear	Flock
Dyeing Printing and Finishing	Dye and chemical containers

Groundwater and Soil Quality

Operation Phase

The operational phase of the project is expected to have effect or bearing on the water aquifer of the area and soil over time. Water for drinking and domestic use may be sourced from the ground using constructed boreholes. Over time the recharge rate of the water level beneath the soil may be disrupted. Analysis shows that the depth to the groundwater table in the project site is shallow with the aquifer sand layer being very close to the surface. The depth to groundwater in the project area is between 2.8m and 4.4m.

Also diesel and oil leakage from vehicle movement, stored oil, maintenance workshops and from processing machines are likely to seep into the soil if not handled properly and may find its way into the ground water where they become nuisance. The possibility of this occurring is rather low, hence has been ranked medium.

5.7.5 Health, Safety and Security Aspects

Construction Phase

In any civil works, public as well as construction staff Health Safety and Environment risks can arise from various constructions activities such as earth works, operation, and movement of heavy equipment and vehicles, storage of hazardous materials, traffic, waste disposal etc.

Because of the long duration of the construction phase, such activities need to be controlled and consequently the associated risks reduced to as low as reasonably practicable (ALARP).

Transportation Related Aspects

Construction and transportation activities will increase traffic congestion, risk of injuries, criminal attack as well as damage to assets. These impacts are expected to be of medium to major significance depending on the severity of the impact. Accidents arising from road trips (transport of materials and personnel) along mobilization routes may result in injury or loss of life of personnel as well as damage to company assets. The possibility of criminal attack on expatriate or local personnel during the construction of the project is likely. This may also result to injuries or fatality. These impacts are ranked from minor to medium significance.

Workplace Accidents

The probability of an accident occurring at the project site during the phases of the development is high. This is due to the intense use of machinery and other heavy-duty equipment used especially in the construction phase.

Work related incidents and accidents resulting from trips, falls, object at height during construction activities are likely to occur. These impacts pose a medium to major significance ranking all depending on the severity of the impact. In this project, the impact is ranked as a medium significant impact.

Communicable Diseases

Construction activities have the potential to create new malaria vector (mosquito) habitats. An influx of workers with no or partial immunity to malaria parasite (*Plasmodium sp*.) increases the risk of serious illness which may result to absenteeism or hospitalization/death. This impact if not managed is expected to pose a major significance characteristic.

Influx of resident and non-resident workers into the project area also increases the risks of sexually transmitted diseases (STDs) and could impact adversely on the spread of these illnesses especially relating to Acquired Immunodeficiency Syndrome (AIDS). This impact, if left unmanaged may result in long term health issues which may eventually lead to fatality. Impact arising from this is ranked as major.

Fires and Explosions

Fire and explosions may be described as technological hazards, which can cause serious injury or result in loss of lives and damage to properties and the environment. Flammable substances including diesel and motor oil may be stored or used on the project site for heavy-duty equipment. These substances are precursors for fires and explosions. Envisaged impacts from accidental explosions resulting in fire have been ranked with a medium significance level.

Waste Handling and Disposal

A significant amount of solid waste (including, wood, metal scarps, office and domestic wastes, etc.) will be generated in this phase of the project. The methods put in place for handling and disposing of these wastes to be generated play an important role in the significance of impacts expected from wastes management. Waste handling and disposal have been assessed to pose a medium impact to the environment.

Operation Phase

Collapse of Building and Electrocution

There exists the possibility of building collapse as a result of unsuitable geotechnical conditions of underlying geological structure. With the available geotechnical test done on the site, the possibility is low. Similarly, there is possibility of electrical accident which could range from shock and burns to fatality. This is a medium significant impact.

Workplace Accidents

The probability of an accident occurring at the project site during the phases of the development is high. This is due to the intense use of machinery and other heavy-duty equipment used especially in the construction phase.

Water Consumption

Water consumption in textile manufacturing has a significant environmental impact, in terms of freshwater needs, wastewater/sludge production, and energy used in heating. In the textile industry, used water is in each stage of the wet finishing to transport chemicals to textiles and to be washed the material before moving to the next step. Apart from these processes in textiles, there is also water consumption during cooling water, boiler, steam drying and cleaning. Average water spending of a medium sized textile factory producing around 8,000kg fabric/day is 1.6 million liters, approximately. Of these, 16% are spent in dyeing and half of it is consumed in printing. Depending on the dye used in the dyeing, 30-50 liters of water per kilogram of fabric is consumed. Totally, during yarn dyeing, about 60 liters of water is spent per kg of yarn. Wastewater released during the dyeing process constitutes about 1/5 of total wastewater. To obtain the required fastness values and to clean the machines, water is needed, too. The amount of water spent for fabric manufactured to cover a sofa is about 500 gallons. During conventional dyeing and finishing processes of 1000 kgs of fabric, about two hundred thousand kilograms of water is contaminated and in these stages, a great deal of steam and hot water is consumed for energy. Water consumption impact is rated medium to major due to seasonal variation of volume of water from the water intake source at Osun River that recharges Epe Lagoon.

Table 5.20: Water required by cotton textile industry for wet process

Process	Water Consumption (L/1000kg of product)
Sizing	500-8200
Desizing	2500-21000
Scouring	20000-45000
Bleaching	2500-25000
Mercerizing	17000-32000
Dyeing	10000-300000
Printing	8000-16000

Source: *Ntuli et al*, 2009

5.7.6 Decommissioning Impacts

The decommissioning phase refers to all the activities which relate to the proposed Textile/garment industrial park when it is no longer in use. Potential issues that relate to the decommissioning phase refers to impacts such as the buildings been abandoned, lack of rehabilitation of the access roads, overgrown vegetation within the park etc. This impact is ranked as a medium category type.

During the decommissioning phase, the demolition activities are likely to have similar impacts on the environment as was identified for the construction/demobilization phase. These include potential impacts such as sedimentation in surface water, visual impact, dust and noise pollution, loss of employment, a risk of fires and explosions, safety, security and traffic impacts etc. Impacts arising from decommissioning activities have been ranked with significance levels of minor to major.

5.7.7 Cumulative Impacts

Defining Cumulative Impacts

In theory, any development such as the proposed Project may be taking place at the same time as other developments, causing impacts affecting the same resources or receptors, such that the impacts on these resources and receptors from all potential development will be cumulative. According to the Performance Standard, cumulative impacts can be defined as impacts that:

> **"*result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.*"**

Generally, Cumulative Impacts are considered to be impacts that act with impacts from other projects such that:

- The sum of the impacts is greater than the parts; or
- The sum of the impacts reaches a threshold level such that the impact becomes significant.

The types of cumulative impacts that may be relevance are detailed in Table 5.21 below:

Table 5.21: Types of Cumulative Impacts Relevant to the Project

Accumulative: the overall effect of different types of impacts at the same location. An example would be fugitive dust emissions, construction noise and construction traffic all impacting the local communities as a nuisance/ disturbance.
Interactive: where two different types of impacts (which may not singly be important) react with each other to create a new impact (that might be important) (e.g. water abstraction from a watercourse might exacerbate the impacts caused by increased sediment loading).
Additive or In-combination: where impacts from the primary activity (i.e. the construction and operation of the Project) are added to impacts from third party activities e.g. other major projects in the vicinity of the Project which are already occurring, planned or may happen in the foreseeable future).

Performance Standard suggests that in identifying cumulative impacts, "cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities".

Identification of Relevant Development(s)

The focus of the cumulative impact assessment is on the combination effects of the Project with potential future development in the immediate area around the Project site. Our assessment cumulative impacts regarding the potential project in view, depends on the status of other projects and the level of data available to characterize the magnitude of the impacts. In view of the paucity of available information regarding such future developments, this assessment follows a generic pattern and focuses on key issues and sensitivities for this project and how these might be influenced by cumulative impacts with a combination of other developments. Consultations with local and state authorities and identification of relevant and significant developments via searches of relevant documents provided invaluable assistant in this assessment. The main developments identified within 10km radius from the site are:

- Proposed Lekki Deep Sea Port close to Dangote Refinery Site
- Dangote Petroleum Refinery under construction in the south East Quadrant of Lekki Free Trade zone
- Proposed Fertilizer Plant in the south East Quadrant of Lekki Free Trade zone
- Alaro City Project under construction in the North West Quadrant of Lekki Free Trade Zone
- Proposed Petrochemical Plant in the South East Quadrant of Lekki Free Trade Zone
- Proposed Lekki International Airport
- Lekki Labor City,
- Light Industries, Logistics and Real Estate project in the South West Quadrant of Lekki Free Trade Zone.
- International Exhibition City etc.

The potential cumulative impacts that have been identified relating to other proposed and on-going projects in the area listed in this section are discussed as follows;

These projects are expected to cumulatively impact on the project area. NEPZA shall make adjustment to the EMP document as required and proffer additional mitigation measures if necessary during the operation phase of this project.

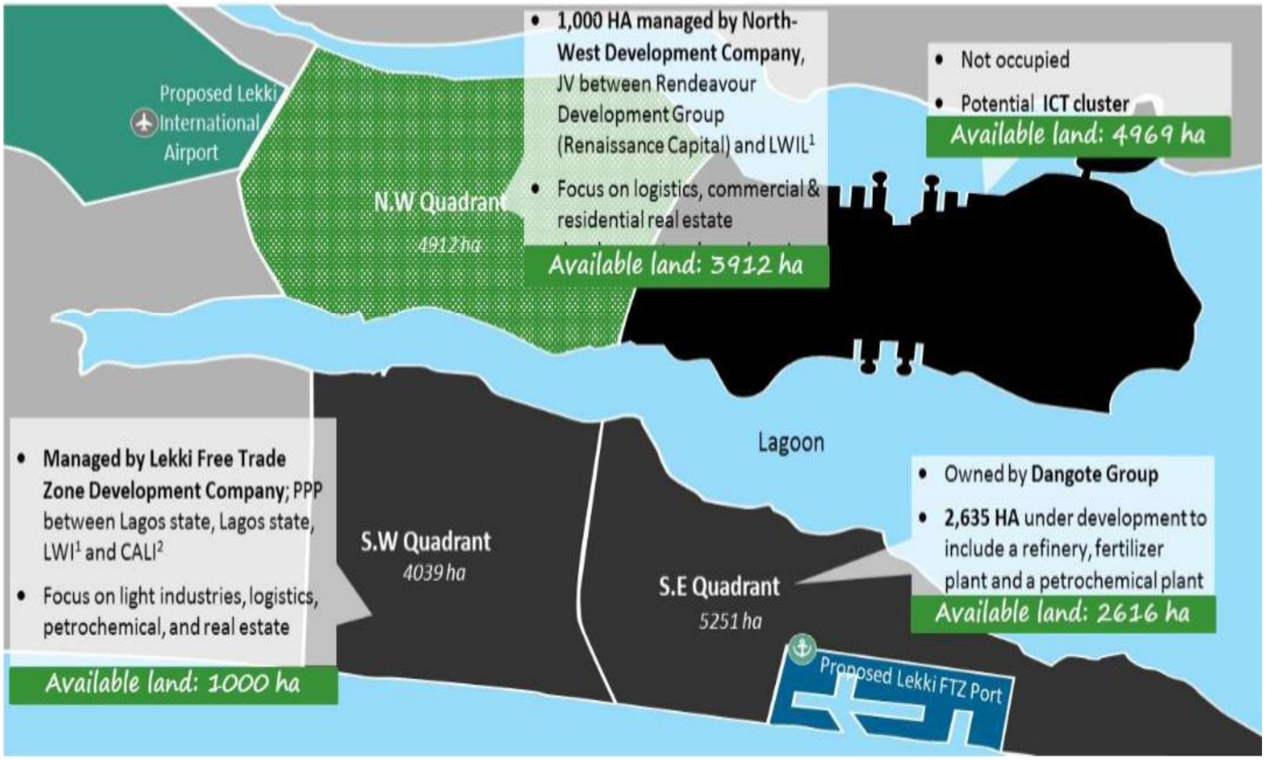

Figure 5.2: Proposed and on-going projects within 10km radius from the project site

Cumulative impact

Air Quality and Noise

Given the findings of impact assessment and distance (<5km) of the on-going Dangote Refinery project in the South East Quadrant and on-going Alaro City project in the North West Quadrant from the project site in the North East Quadrant, it appears likely that the cumulative impact on noise and air quality will be significant. Also the cumulative impact of the construction and operational phase of the proposed Lekki International Airport and the proposed Lekki Deep Seaport which are (<10km) from the project site will be moderately significant. It should however be noted that this statement is based on professional judgment only.

Traffic

The construction phase will require large amounts of material and equipment to be transported to the Project site. It is expected that the on-going Dangote Petroleum Refinery Project, ongoing construction of Alaro City project, proposed Lekki International Airport Project and other proposed project in the Lekki Free Trade Zone earlier outlined will use similar transport route (Lekki – Epe express way) which will place pressure on the road especially during the construction phases of the projects.

Given the foregoing, there is increased potential for accidents and disruption to the road traffic for local and other users associated with the increase in traffic movements from overlapping construction traffic. It is expected that the traffic management plan to be developed for the project will consider other traffic movements associated with the development of the project in view which will help to mitigate this impact. However, in overall consideration, this impact is considered to be moderate due to the high likelihood of accidents occurring.

Surface Water

All the liquid waste (waste water) that will be generated during the operational phase of the proposed Textile and Garment Industrial Park and Dangote Petroleum refinery will be discharged into the Lekki Lagoon thus there is need for treatment and monitoring of the effluent discharged effluent before and after treatment. The cumulative impact will be significant.

Economy Employment and Skills

The operation of the various considered projects earlier outlined is proposed to occur simultaneously with the project in view. As such, the economic, employment and skills development opportunities will be greater for all the projects combined than a single project.

It should be noted that expectations regarding economic development, employment and skills development will be high amongst stakeholders in the local communities and as such, in the event that one project does not meet expectations, there is the potential for all projects within the area to be the target of this negative outcome.

Based on the above, the cumulative impacts of the various proposed industrial projects on the economy, employment opportunities and skills development within the communities is expected to be positive and beneficial.

5.8 RISK AND HAZARD ASSESSMENT

5.8.1 Overview

Risk assessment is the determination of quantitative or qualitative estimate of risk related to a concrete situation and a recognized threat (also called hazard). The assessment of the risks and hazards associated with the proposed project involves the following steps:

- Identification of hazards/risks
- Likelihood of occurrence
- Consequence/severity of the hazards

Table 5.22: Risk Assessment for Environmental Consequences

Consequence category	Consideration			
	Safety/Health	**Public duration**	**Environmental Impact**	**Final Impact**
I	Fatalities/Serious Impact on Public	Large Community	Major/Extended Duration/Full Scale Response	High
II	Serious injury to Personnel/Limited Impact on Public	Small Community	Serious/Significant Resources Commitments	Medium
III	Medical Treatment for Personnel/No Impact on Public	Minor	Moderate/Limited Response of Short Duration	Low
IV	Minor Impact on personnel	Minimal to None	Minor/Little or No Response Needed	None

The risk assessment matrix is then developed as presented in the Table 5.23 below.

Table 5.23: Risk assessment matrix

0-5 = Low Risk		**Severity of the potential injury/damage**				
6-10 = Moderate Risk **11-15 = High Risk** **16-25 = Extremely High (Unacceptable Risk)**		Insignificant damage to Property, Equipment or Minor Injury **1**	Non-Reportable Injury, Minor loss of Process or slight damage to Property **2**	Reportable Injury moderate loss of Process or limited damage to Property **3**	Major Injury, Single Fatality critical loss of Process/damage to Property **4**	Multiple Fatalities Catastrophic Loss of Business **5**
Likelihood of the Hazard Happening	Almost Certain 5	**5**	**10**	**15**	**20**	**25**
	Will probably occur 4	**4**	**8**	**12**	**16**	**20**
	Possible occur 3	**3**	**6**	**9**	**12**	**15**
	Remote possibility 2	**2**	**4**	**6**	**8**	**10**
	Extremely unlikely 1	**1**	**2**	**3**	**4**	**5**

5.8.2 Project Specific Risks and Hazards

The potential risks and hazards associated with the construction and operation of the proposed Textile and Garment production plant are described below:

5.8.2.1 Security Threat and Attack

Security systems are essential for a suitable operation of a Special Economic Zone in order to avoid damage and possibly theft and vandalism. The zone may be subject to sabotage or attack and thus result in less than optimal production capacity as a result of uprising. Although, the farmer – herders' conflict has become a country-wide incidence which calls for concern, the likelihood of such attack at the project site is considered to be of remote possibility. Although, the project site is in a forest zone, presence of natives who are anticipating this project further preclude the occurrence of any alien attack. The severity of such attack if it ever occur, would be a major injury to workforce and critical loss of process and damage to property. The risk significance is rated minor.

5.8.2.2 Occupational Hazards

The textiles sector contains many hazards and risks to workers, ranging from exposure to noise and dangerous substances, to manual handling and working with dangerous machinery. Each processing stage — from the production of materials to the manufacturing, finishing, colouring and packaging poses risks for workers, and some of these are particularly dangerous for women's health. Highlights of some of the key issues are:

Musculoskeletal disorders

Musculoskeletal disorders (MSDs) are the most common work-related health problem in Europe, with almost one in four workers reporting backache and one in five complaining of muscular pains. Manual handling, the lifting, holding, putting down, pushing, pulling, carrying or movement of a load, is the largest cause of injury in the textiles sector. Manual handling can cause either cumulative disorders from the gradual deterioration of the musculoskeletal system, such as lower back pain, or acute trauma such as cuts or fractures due to accidents. In the textiles sector, risk factors for MSDs include:

- Working in awkward postures, such as during spinning, cutting, product control, and packaging,
- Repetitive movements, such as during spinning, cutting, product control, and packaging,
- Fatigue from manual handling, during the storage, inspection, treatment, shipping, finishing, and cutting of textiles.

Exposure to chemical agents

Many different groups of chemical substances are used in the textiles sector, including dyes, solvents, optical brighteners, crease-resistance agents, flame retardants, heavy metals, pesticides, and antimicrobial agents. They are used in dyeing, printing, finishing, bleaching, washing, dry cleaning, weaving slashing/sizing, and spinning. Respiratory and skin sensitisers can be found in the textiles industry, for example textiles fibres, reactive dyes, synthetic fibres, and formaldehyde. The textile industry has been evaluated as a sector with an increased carcinogenic risk. Several studies have showed an increased risk of nasal, laryngeal and bladder cancer in women.

Exposure to dusts and fibres

The exposure of workers to dusts from material such as silk, cotton, wool, flax, hemp, sisal, and jute can occur during weaving, spinning, cutting, ginning, and packaging. Division of tasks along gender lines may mean that women are exposed to organic dusts more than men, with respiratory diseases being diagnosed more often in women than men. Exposure to fibres and yarns may cause nasal or bladder cancer.

Exposure to biological agents
In some activities, such as carding and willowing, workers may be exposed to biological agents such as anthrax, *clostridium tetani* (the causative agent for tetanus), and *coxiella burnetti* (which causes Q fever). Exposure to biological agents can result in allergies and respiratory disorders.

Exposure to physical agents
Workers may be exposed to noise and vibrations, for example during weaving, spinning, sewing, twisting, and cutting. Exposure to loud noise can result in permanent hearing damage such as noise-induced hearing loss and tinnitus. Exposure to vibration, particularly together with risk factors for MSDs, can lead to long-term harm. Activities related to the maintenance operations of industry specific equipment (e.g. cards, spinning machinery, looms, and stenters) may expose workers to physical impacts, particularly with reference to hot surfaces and moving equipment. Electromagnetic fields may also be found in some workplaces in the textiles sector.

Accidents in the textiles sector
The textiles sector has many hazards that can cause injury to workers, from transport in the workplace (lift truck), dangerous large work equipment and plant, to the risk of slips from a wet working environment. Workers being struck by objects, such as moving machinery parts and vehicles are a significant cause of injury in the sector. There also exists the risks of fire and explosions, for example from heating plants used for vapour generation.

Explosion
Organic dusts, including cotton dust, are combustible and present a potential explosion hazard. This hazard is most effectively controlled through the measures for prevention of dust accumulation as above. In addition, all possible sources of ignition where organic dusts may form clouds or accumulate should be removed. VOC use, such as solvents, may form potentially explosive mixtures in air. Electrical equipment in these areas should be rated for ignition prevention.

Heat
The most significant risk of exposure to heat and high humidity occurs during wet processing and dry finishing operations and is caused by the use of steam and hot fluids in these processes.

Psychosocial issues in the textiles sector
Work-related stress has been defined as being experienced when the demands of the work environment exceed the workers' ability to cope with or control them. Work-related stress may be an issue in some areas of the textiles sector, being associated for example with repetitive and fast paced work, and where the worker has no influence on how the job is done.

The likelihood of hazards occurring is considered to be possible while its severity may lead to reportable injury and limited damage to property. The overall significance is rated moderate.

5.8.2.3 Hazard to Public/Communities
Specific potential impacts during operations include odors that are produced by several sources in textile manufacturing. Odors are usually generated during dyeing and other finishing processes by oils, solvent vapors, formaldehyde, sulfur compounds, and ammonia. They should be adequately

controlled and contained, to avoid becoming a nuisance for the communities. An additional community health and safety issue concerns the use of chemicals and their potential risk to the health of consumers who purchase garments or home textiles produced by the textile industry. Specific consideration should be given to ensuring that these products are safe for human use. The manufacturer should avoid using allergenic dyestuffs and dyestuffs that form carcinogenic compounds. Adequate testing for pH, pesticides, heavy metals, formaldehyde, chlorinated phenols, chloro-organic carriers, and biologically active finishes should be conducted to assess textile characteristics according to the typical conditions of their use prior to entry into the market

A minor rating is assigned as .measures to tackle the potential impacts will be adhered to.

CHAPTER SIX

6.0 MITIGATION MEASURE

6.1 INTRODUCTION

The potential and associated impacts of the proposed Textile and Garment Industrial Park project have been evaluated, followed by a discussion on the impacts' significance in chapter five. However, the mitigation and enhancement measures for the adverse and beneficial impacts of the proposed project are presented in this chapter.

Mitigation measures are activities aimed at preventing, eliminating or minimizing the impacts and their effects to levels that are considered as low as reasonably practicable (ALARP). In proffering mitigation measures, the primary objectives include the following:

Prevention: methods aimed at impeding the occurrence of negative impacts, and/or preventing such occurrence from having harmful environmental/ social outcomes.

Reduction: limiting or reducing the degree, extent, magnitude, or duration of adverse impacts. Reduction can be achieved by scaling down, relocating, or redesigning elements of the project.

Control: ensuring that residual associated impacts are reduced to a level as low as reasonably practicable. The following were taken into consideration in developing the proffered mitigation measures for the predicted impacts of the proposed project activities:

- Best Available Technology (BAT) for sustainable development.
- Environmental laws in Nigeria, with emphasis on permissible limits for waste streams (FMEnv (formerly FEPA), 1991);
- View some concerns of stakeholders as expressed during extensive consultations carried out during the study.
- Feasibility of application of the proposed mitigation measures in Nigeria;

6.2 METHODOLOGY

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

	LOW	MEDIUM	HIGH
High	Formal Control	Physical Control	Avoidance
Medium	Training	Formal Control	Physical Control
Low	Informal Control	Training	Formal Control

Likelihood of Occurrence

Figure 6.1: Mitigation Definition Criteria

Informal Control

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

Formal Control

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

Definition of Mitigation Measures

Mitigation measures are developed to avoid, reduce, remedy or compensate for any negative impacts identified and to create or enhance positive impacts such as environmental and social benefits. In this context, the term "mitigation measures" include operational controls as well as management actions. These measures are often established through industry standards and may include:

- Changes to the design of the project during the design process (e.g. changing the development approach);
- Engineering controls and other physical measures applied (e.g. wastewater treatment facilities);
- Operational plans and procedures (e.g. waste management plans); and
- The provision of like-for-like replacement, restoration or compensation.

The definition of the impact significance are as follows;

Definition of Impact Significance
The Impact significance are defined as follows;
Major significance: Here a change in design is usually required to avoid or reduce these.

Moderate significance: Here specific mitigation measures such as engineering controls are usually required to reduce these impacts to ALARP levels. This approach takes into account the technical and financial feasibility of mitigation measures.

Minor significance: These are usually managed through good industry practice, operational plans and procedures. In developing mitigation measures, the first focus is on measures that will prevent or minimize impacts through the design and management of the project rather than on reinstatement and compensation measures.

Assessing Residual Impacts

A residual impact is the impact that is predicted to remain once mitigation measures have been designed into the intended activity. Impact prediction takes into account any mitigation, control and operational management measures that are part of the project design and project plan. The residual impacts are described in terms of their significance in accordance with the categories identified in chapter 5.

Social, economic and biophysical impacts are inherently and inextricably interconnected. Change in any of these components of the environment will lead to changes in the other components. This examines how the local way of life might change as a result of the proposed potential changes of the project to local culture, livelihoods, health and well-being, personal and communal property rights.

6.3 MITIGATION REQUIRED FOR SIGNIFICANT IMPACTS

6.3.1 Socio-economic and Employment

1. **Land Acquisition and Community Expectation**

Construction Phase

The concerns of the neighbouring communities of cumulative effects of environmental and social impacts and their expectation of job provision within 5 km radius of the project site will need serious attention. By implementing a package of mitigation and enhancement measures, the concerns can be reduced to a manageable level for the majority of the community members. However, the Lekki Economic Trade zone has been previously acquired by the Lagos State Government, this will reduce/eliminate possible land tussle.

Notwithstanding, to reduce the effects which is largely limited to preparation/construction stage, a combination of the following measures should be applied to bring the impact to **minor**:

- Inform communities about details of construction activities (e.g. employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting
- Set-up and effectively monitor construction grievance mechanism
- Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this EMP.
- Engage communities in the monitoring activities to enhance transparency and involvement.
- Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities.
- Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan
- The cooperation of the community leaders and Epe LGA should be sought so as to avoid any complications.

6.3.2. Recruitment of Labour/Employment

Construction Phase

Recruitment of technical and non-technical workforce is a beneficial impact of the proposed project on Lagos State, Epe LGA and the host communities. Nevertheless, the following recommendations are necessary to help the communities to maximize the positive/**beneficial** outcomes.

- A Local Content Plan should be prepared and strictly adhered to in order to facilitate involvement of local labour.
- No hiring of short-term labour to be made at the site gate and be transparent to community leaders
- Only specialised professional workers will be recruited from outside the communities

Operation Phase

In the course of NEPZA recruiting industrial workers of different categories, there is the possibility of Community and individuals' dissatisfaction with the conduct of labour recruitment. This is a major impact which can be reduced to minor if the following measures are put in place:

- Engage communities in the recruitment of non-technical workforce so as to enhance transparency and involvement.

- Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities

6.3.3. **Cultural and Traditional Heritage**

Construction Phase

Considering the value placed on cultural and traditional milieu in the Yoruba context, project that will impact on society's values and traditional worship require huge community engagement in ameliorating the impacts. While Culture shock is rated as medium, land-take that will encroach on shrine location has major impact. The application of the following mitigation measures will reduce the impacts to minor.

- Avoid areas of cultural deity and shrine in the project area, where possible;
- The exact location and ceremony for relocation will be managed by the communities.
- Awareness and education campaign to be given to workers and also to community people on tolerance, coexistence of cultures
- Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.

Operation Phase

Arising from the rural and predominantly traditional nature of the host communities, conflict in respect of traditional festivals restraining human movement is a major issue and impact.

- The timing of operation/maintenance activities should be coordinated with the Communities to avoid interference between maintenance and the festivals.
- Accommodation should be provided for staff to forestall/ prevent movement on day when traditional festivals are held

The residual impact is negligible.

6.3.4 Community/ Workers' Health, Safety and Security

Construction Phase

It is extremely important to maintain health and safety of the host communities and workforce for sustenance of the proposed economic venture. The following mitigation measures should be implemented in order to reduce the potential adverse impacts and risks associated with construction activities on the community health, safety and security.

In order to mitigate work-place accidents:

- Develop an emergency response plan following NEPZA and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of Lagos State and Epe LGA
- Annual safety audit of facilities so as to minimize energy dissipation and material waste.
- Communicate safety awareness and risks of the electricity cables to communities and provide response measures. Put sign boards on high voltage areas.
- NEPZA should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height during maintenance and repair works, emergency prevention and management.
- Use personal protection equipment. Have medical emergency equipment at hand.

To minimize the occurrence of boat-mishap, the following should be engaged.

- Use of life-jacket by boat users should be made compulsory for workers.
- Arrange dedicated canoes for the workforce ferried by a professional sailor

Emergency for ill-health, malaria, STI/HIV and related health issues should be mitigated following these measures:

- Coordinate with medical posts and emergency services to prepare for water supply, waste management and incidents.
- Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.
- Aerial fumigation and use of Insecticide Treated Net should be promoted in the Workers camp
- Sex education in protected sex, risk of casual sex and counselling services should be provided.
  Provision should be made for workers to live off-site with their families

To address security of lives and properties, the following are appropriate mitigation measure:

- Make security plan and emergency response and contacts with security forces. Coordinate with NEPZA security measures for their site.
- Professional security outfit be engaged in protecting lives and properties within the park. This must be registered with the Nigerian Police/NSCDC etc.
- A Local Content Plan should be prepared to facilitate involvement of locals in the security network.
- Develop a code of behaviour for workers. All workers to receive training on community relations and code of behaviour.

Construction Phase

In order to minimize incidences during the plant operation, the following are mandatory to bring the impact to minor:

- A comprehensive HSE Policy of NEPZA must be displace openly, and enforced through monitoring within the Park;
- All staff must be trained and retrained on regular basis for HSE compliance;
- Develop a training program including a code of conduct for all workers;
- Well-equipped Clinic should be put up for emergence attention, while referral system should be arranged with a Secondary Hospital

6.3.5 Infrastructures

Construction Phase

With the influx of workers, there will be pressure on housing and other related facilities around the project area, including Epe town. The following mitigation measures are necessary to bring the impact to minor, except the damage to existing road that will remain medium:

- Coordinate with relevant agencies such as the Nigeria Police, NSCDC, etc. for traffic control.
- Schedule the movement of heavy-duty vehicles to off rush-hours in the area.
- Materials and manpower that could be conveyed through the Lagoon should be explored to reduce road traffic congestion.

Operation Phase

Although this impact is minor, the use of the following measure will reduce it to negligible:

- Engage the services of NPF/NSCDC for traffic controller if necessary;
- Schedule the movement of heavy-duty vehicles to off rush-hours.

6.3.6 Air Quality

Construction Phase

Impact due to Air pollutant emission

Regarding impacts of emissions from vehicles, equipment engines and power generator, the following mitigation measures are recommended:

- Cover properly loose materials and keep top layers moist
- Use binder material for erosion and dust control for long term exposed surfaces. Regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt. Spray surfaces prior to excavation
- Use covered trucks for the transportation of materials that release dust emissions.
- Speed limits on-site of 15 k/hr should be recommended and enforced
- Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations
- Stationary generators should be well maintained and located to facilitate dispersion

If the above measures are implemented accordingly, the residual air quality impacts can be considered to be negligible to minor.

Operation Phase

Air pollution by dust emission from cotton yarning, ammonium from cotton soaking and bleaching; and automobile activities will be mitigated as follows:

- Preference for usage of clean fuel like LPG, low sulphur diesel should be explored;
- Energy conservation should be adopted by opting the alternate energy options like solar power;
- Odour should be managed at the site using odour suppressant and planting flowering trees with fragrance

The mitigation measures and control methods for sources of dust emissions during textile production include:

- Enclosure of dust producing equipment,
- use of local exhaust ventilation;
- Use of dust extraction and recycling systems to remove dust from work areas;
- Installation of fabric filters to prevent outdoor emissions.

Green House Gas Emission

In consideration of the Climate Change under the construction phase, the impact of vegetation clearing and soil disturbance resulting to reduction of carbon sink ability of the environment and the use of equipment and vehicles during the construction has been computed to be negligible (Chapter 4). In addition, employing the following to mitigate the release of GHG gases shall further reduce the impact.

Use good international practice:

- Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations
- Use experienced drivers and fuel-efficient equipment, vehicles and machineries during construction activities.
- Restrict vegetation clearing and soil disturbance within and around project area.

Operation Phase

Accidental significant leaks from aging equipment, and gas losses occurring during equipment usage and servicing could be mitigated through the following:

- Machines using GHGs and ODS should be avoided and replaced with those using environmentally compliant or friendly gases
- Regular checking with auto-gas leak detector and maintenance of all plant and equipment to minimize the risk gas leakage

6.3.7 Noise/Vibration

Noise nuisance from construction activities and vibration arising from fabrication and associated welding equipment. The following measures are recommended to mitigate their negative impact:

- Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health and safety briefings
- Select 'low noise' equipment or methods of work
- Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources).
- Workers to wear hearing protection PPE (Ear plug and muff)
- Maintain and operate all vehicles and equipment's in accordance with manufacturers recommendations.
- Avoid mobile plant clustering near residences and other sensitive land uses.
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events
- Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO.
- Noisy activities should be restricted to day-time working hours

Operation phase

Noise from vehicular movement and power generator will be reduced to negligible level by applying the following:

- Machineries to be used should comply with the noise standards prescribed by FMEnv.
- Workers shall be given PPE (ear plugs) and enforce compliance;
- Temporary noise barriers should be provided near the high noise generating areas;
- Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings;
- Select 'low noise' equipment or methods of work;
- Regular maintenance/servicing of production machines and generators

6.3.8 Water Resources

Construction Phase

Construction of access roads to projected swamp and marshy areas for performing investigative field work, construction and installation facilities will impact the water resources. These impacts that ranged from medium to major will reduced to minor and negligible categories by engaging the following measures:

- Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas.
- Install oil/water separators and silt traps before effluent, leaves the site.

- Minimise bare ground and stockpiles to avoid silt runoff.
- Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).
- Ensure that processed wastewater is treated before discharging to nearby water bodies.
- Ensure that treated waste water is reused to minimize its discharge volume.
  put in place a dedicated waste management system to account for generated waste.
- Ensure an inventory of waste is developed and maintained
- Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains.
- Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages.
- Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques.

Operation Phase

Impact of accidental leaks from generator and storage facilities can be minimised to minor by engaging the following:

- Install oil/water separators and silt traps before effluent, leaves the site.
- Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).
- Conduct bioremediation of polluted soil immediately to inhibit further spread

Water Consumption

Water consumption in textile manufacturing has a major significant environmental impact, in terms of freshwater needs, wastewater/sludge production, and energy used in heating. Impacts can be minimised to minor by

- Reuse of dyebaths;
- Adoption of continuous horizontal washers and vertical spray washers or vertical, double-laced washers; ·
- Adoption of countercurrent washing (e.g. reuse the least contaminated water from the final wash for the next-to-last wash);
- Use of water flow–control devices to ensure that water only flows to a process when needed;
- Reuse of preparation and finishing water.

6.3.9 Vegetation/ Ecosystem services

Construction Phase

Vegetation clearance during construction leading to disturbance of animal habitat and fauna displacement/migration which is rate as medium impact will require mitigation measures as stated below for a reduction to mino**r** impact category.

- Site clearance activities to be restricted to the minimum required area.
- Avoid the use of heavy equipment that could cause siltation of the aquatic habitats
- Restrict removal of vegetation and trees to the boundary of project site only;
- Retain all native vegetation;
- Protect all vegetation not required to be removed against damage;
- Undertake quick re-vegetation of exposed soils with indigenous plant species; and
- Use erosion protection structures such as sediment traps, riprap and gabions.

Operation Phase

Arising from change in Land Use of nearby areas and the buffer zone during operation phase, which has major impart, the following measures will reduce it to minor:

- Maintain the industrial park in orderly condition and do not distribute material or vehicles over open spaces.

- Procure and distribute seedlings of local plant species for community members to grow in replacement of cleared plants

6.3.10 Waste generation and management

Construction phase

Waste generation in form of wood, sand, paper; domestic waste, metal scraps from steel elements, during construction phase is rated medium. A reduction to minor impact category will require the following measures:

- Develop and implement a site-specific Waste Management Plan (WMP) to prevent unregulated dumping of waste;
- Ensure that solid/hazardous wastes are stored in properly labelled and sealed containers, and placed away from direct sunlight, wind and rain; and
- Engage waste disposal managers (PSP) that are accredited by LAWMA
- Proper sorting and collection of metals for recycling and monetary gain should be encourage

Operation Phase

Industrial waste emanating from replacement of machine parts, retrofitting and routine servicing should be handled as follows so as to minimize the impacts:-

- Recyclable materials should be sorted and sold to scrap metal converters
- Put in place a dedicated waste management system to account for generated waste.

6.3.11 Soils, geology and land-use

Construction Phase

Soil compaction leading to erosion and the subsequent accumulation of the sediment in surface water bodies can be reduced from medium impact to minor and negligible impact categories. The following are required to achieve these:

- Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers.
- Protect excavated soil materials from erosion.
- Ensure that the land is physically restored (include revegetation where possible) during the rainy season subsequent to the construction activities.
- Use of existing track for transport of man and material to the extent possible.
- Construction of foundations to be undertaken in the dry season.

Operation Phase

Soil contamination resulting from accidental leakages and spill of hazardous substances from generator can be mediated as follows so as to reduce the medium impact to minor.

- Install oil/water separators and silt traps before effluent, leaves the site.
- Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas).
- Conduct bioremediation of polluted soil immediately to inhibit further spread

6.3.12 Visual/Aesthetics

Construction Phase

Disruption of the natural view of the local space due to erection of buildings should be mitigated so as to reduce the medium impact to minor category. This is largely an impact that will not progress into the operation stage of the industrial park lifecycle.

- Maintain construction site in orderly condition and do not distribute material over many sites before usage.
- Local plant species should be used for beautification and lawn establishment.

6.4 SUMMARY OF MITIGATION MEASURES

Tables 6.1a and 6.1b presents the summary of mitigation measures on various activities involved in the project development and the significant impacts associated with each of them on the environment and social concern at the Construction and Operation phases respectively.

Table 6.1a: Summary of Mitigation Measures on Project Activities and Significance of Potential Impacts during Construction and Installation

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
Permitting & Land Acquisition	Acceptance and co-operation/ participation from stakeholders leading to peaceful and timely execution of the project	Project Host communities (including Idiroko, Oke-Egan, Agbon, Ofin etc.)	**Beneficial**	Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting	**Beneficial**
	Uncertainty and misunderstanding due to a lack of information and communication.		**Medium**	Set-up and effectively monitor construction grievance mechanism	**Minor**
	Exclusion of vulnerable groups from consultations which may lead to strife		**Medium**	Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this EMP.	**Minor**
	Conflicts/community agitations over employment issues (quotas and methods)		**Major**	Engage communities in the monitoring activities to enhance transparency and involvement.	**Minor**
	Community agitations over land disputes, wrong stakeholder identification, leadership tussles, etc.		**Major**	Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities. Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan The cooperation of the community leaders and Epe LGA should be sought so as to avoid any complications.	**Minor**
Recruitment of Labour	Increased jobs and job opportunities from local labour hire and sub-contracting to indigenous suppliers.	Epe LGA, and Lagos and Ogun State	**Beneficial**	A Local Content Plan should be prepared and strictly adhered to in order to facilitate involvement of local labour. No hiring of short-term labour to be made at the site gate and be transparent to community leaders Only specialised professional workers will be recruited from outside the communities	**Beneficial**
	Business opportunities for local contractors through sub-contracting activities (supply markets and shops)	Epe LGA, and Lagos and Ogun State	**Beneficial**		**Beneficial**
	Increased business and economic activities as well as diversification of income sources due to supply	Epe LGA, and Lagos and Ogun	**Beneficial**		**Beneficial**

	contracting and sub-contracting	State and Nigeria			
	Induced secondary development within the neighbouring host communities from increased economic activities.		**Beneficial**		**Beneficial**
Cultural Heritage	Land-take that could encroach on traditional grove/shrines in the villages	Culture of Host communities and Epe LGA	**Major**	Avoid areas of cultural deity and shrine in the project site, where possible; The shrines of Ogun, Yemoja, Osun, Oro, and others will be relocated to outside the access road and project site where the local communities will continue to use them. The exact location and ceremony for relocation will be managed by the communities. Awareness and education campaign to be given to workers and also to community people on tolerance, coexistence of cultures Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.	**Minor**
	Culture shock due to difference in the culture of recruited workers and the culture of the host community		**Medium**		**Minor**
Community/ Workers' Health and Safety and Security	Risks of accidents leading to injury/death and loss of asset arising from increased traffic during mobilization on Lekki-Epe road and ferrying on the Lagoon	Lekki - Epe and Ijebu-Ode – Epe roads	**Major**	Use of life-jacket by boat users should be made compulsory for workers. Arrange dedicated canoes for the workforce ferried by a professional sailor Develop an emergency response plan following NEPZA and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of Lagos State and Epe LGA Annual safety audit of facilities so as to minimize energy dissipation and material waste. Communicate safety awareness and risks of the electricity cables to communities and provide response measures. Put sign boards on high voltage areas. NEPZA should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height during maintenance and repair works, emergency prevention and management.	**Minor**
	Work place accidents/incidents from the use of cranes, forklifts, etc. during loading and offloading of materials/equipment.	Construction workers, Host community	**Medium**		**Minor**
	Risk of electrocution and burns (to onsite workers) during electrical installation processes		**Major**		**Minor**
	Workplace accidents from burns, cuts, bruises, trips and falls, objects at height, leading to injury or fatalities.		**Major**		**Medium**
	Risks of fire/explosions resulting from accidental ignition of onsite diesel storage tanks		**Medium**		**Minor**
	Risks of injury/death and loss of		**Medium**		**Minor**

	assets resulting from accidents associated with road transportation to and from construction sites			Use personal protection equipment. Have medical emergency equipment at hand.	
	Bushy site conditions leading to increased malaria epidemic from uncontrolled mosquito breeding in swamp areas as well as water borne diseases e.g. diarrhoea associated with poor sanitary conditions		**Major**	Coordinate with medical posts and emergency services to prepare for water supply, waste management and incidents. Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited. Areal fumigation and use of Insecticide Treated Net should be promoted in the Workers camp Sex education in protected sex, risk of casual sex and counselling services should be provided. Provision should be made for workers to live off-site with their families.	**Negligible**
	Increase of communicable diseases due to influx of people and poor living conditions around pre-construction sites		**Medium**		**Minor**
	Increased cases of STI/HIV and AIDS due to influx of workers and social sex workers in to the communities hosting the project		**Major**		**Minor**
	Increase in social vices (like theft, prostitution) resulting from increased number of people	Epe LGA	**Medium**	Make security plan and emergency response and contacts with security forces. Coordinate with NEPZA security measures for their site. Professional security outfit be engaged in protecting lives and properties within the park. This must be registered with the Nigerian Police/NSCDC etc. A Local Content Plan should be prepared to facilitate involvement of locals in the security network. Develop a code of behaviours for workers. All workers to receive training on community relations and code of behaviour.	**Minor**
	Unauthorized access into the industrial park leading to loss, sabotage, damages during demobilization after construction		**Medium**		**Minor**
Infrastructures	Traffic congestion along Lekki – Epe road during haulage of plant components to site for installation	Lekki - Epe and Ijebu-Ode – Epe roads users	**Medium**	Coordinate with relevant agencies such as the Nigeria Police, NSCDC, etc. for traffic control. Schedule the movement of heavy-duty vehicles to off rush-hours in the area. Materials and manpower that could be conveyed through the Lagoon should be explored to reduce road traffic congestion.	**Minor**
	Interference with other road users along mobilization route.		**Medium**		**Minor**
	Obstruction of/damage to existing roads due to increased usage during mobilization.		**Medium**		**Medium**
	Traffic congestion during transportation of demobilized equipment and personnel		**Medium**		**Minor**
Air Quality	Generation of dust on Yeguda earth	Site workers,	**Medium**	Use good international practice:	**Minor**

	Road) and automobile/heavy duty equipment emissions	Host communities and Epe LGA		Cover properly loose materials and keep top layers moist Use binder material for erosion and dust control for long term exposed surfaces. Regular cleaning of equipment, drains and roads to avoid excessive buildup of dirt. Spray surfaces prior to excavation Use covered trucks for the transportation of materials that release dust emissions. Speed limits on-site of 15 k/h should be recommended and enforced Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations Stationary generators should be well maintained and located to facilitate dispersion	
	Increase of dust particles and vehicular emissions.		**Minor**		**Negligible**
	Generation of dust and gases (NO_2, SO_2, CO, VOCs etc.) automobile/ heavy duty equipment emissions from construction earth works.		**Minor**		**Negligible**
	Emission of cement dust and toxic fumes during foundation works and welding of steel components		**Medium**		**Negligible**
Climate change	Climate change effects of GHGs emission and removal of carbon sink (vegetation/soil)	Local and regional climate	**Minor**	Use good international practice: •Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations •Use experienced drivers and fuel-efficient equipment, vehicles and machineries during construction activities. •Restrict vegetation clearing and soil disturbance within and around project area.	**Negligible**
Noise/Vibration	Noise nuisance from construction activities (e.g. piling) resulting to temporary migration of sensitive mammals and human discomfort	Site workers, Host communities such as Idiroko, Ofin etc.	**Minor**	Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings Select 'low noise' equipment or methods of work Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources). Avoid dropping materials from height, where practicable Maintain and operate all vehicles and equipment's in accordance with manufacturers recommendations. Avoid mobile plant clustering near residences and other sensitive land uses. Ensure periods of respite are provided in the case of unavoidable maximum noise level events Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO.	**Negligible**
	Noise and attendant vibration effects from fabrication and associated welding equipment		**Medium**		**Minor**

				Noisy activities should be restricted to day-time working hours	
Water resources	Accidental discharge of untreated wastewater onto land or into water bodies during transportation and storage may lead biochemical hazard.	Surface and Ground water	**Major**	Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. Install oil/water separators and silt traps before effluent, leaves the site. Minimise bare ground and stockpiles to avoid silt runoff. Bunding of areas where hazardous substances are stored (e.g fuel, waste areas). ensure that processed wastewater is treated before discharging to nearby water bodies. -ensure that treated waste water is reused to minimize its discharge volume. -put in place a dedicated waste management system to account for generated waste. -ensure an inventory of waste is developed and maintained Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains. Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques.	**Minor**
	Contamination of surface water as a result of siltation caused by increased erosion, during site preparation.		**Medium**		**Minor**
	Contamination of nearby surface water (Lagoon) as a result of siltation caused by increased run-off during site preparation.		**Medium**		**Minor**
	Alteration of rivers/stream course and regime due to construction		**Medium**		**Negligible**
	Soil/groundwater contamination resulting from accidental leakages and spills of hazardous substances (diesel, cleaning agents, lubricants, hydraulic oil)		**Medium**		**Minor**
Vegetation/ Ecosystem	Disturbance of the vegetation cover/ loss of forest products (fuel wood, timber, medicinal plants) due to site clearing and preparation.	Host communities (Idiroko, Magbon, Ofin etc.) flora and fauna, habitat	**Medium**	Site clearance activities to be restricted to the minimum required area. Avoid the use of heavy equipment that could cause siltation of the aquatic habitats Restrict removal of vegetation and trees to the boundary of project site only; Retain all native vegetation; Protect all vegetation not required to be removed against damage; Undertake quick re-vegetation of exposed soils with indigenous plant species; and Use erosion protection structures such as sediment traps,	**Minor**
	Opening up of wildlife habitats/ increase in poaching due to an easier access for the local population and some workers.		**Medium**		**Minor**
	Flora/habitat loss and disturbance through vegetation clearing and earthworks on building site and access roads		**Medium**		**Minor**

	Fauna disturbance and displacement as a result of migration away from construction activity area (avifauna-bird life)		**Medium**	riprap and gabions.	**Medium**
Waste generation and management	Waste from wood, sand, paper; domestic waste from laydown area and camp site (material and wood)	Project site, Neighbourhood and Epe LGA	**Medium**	Develop and implement a site-specific Waste Management Plan (WMP) to prevent unregulated dumping of waste;	**Minor**
	Generation of metal scraps from steel elements associated with fabrication of building roof		**Medium**	Ensure that solid/hazardous wastes are stored in properly labelled and sealed containers, and placed away from direct sunlight, wind and rain; and Engage waste disposal managers (PSP) that are accredited by LAWMA	**Negligible**
	Waste Disposal from scrap metal, wood, sand, concrete, paper, domestic solid waste Waste from laydown area and building sites		**Medium**	Proper sorting and collection of metals for recycling and monetary gain should be encourage	**Beneficial**
Soils, geology and land-use	Soil compaction leading to erosion, destabilization from excavation and surface runoff resulting in sedimentation problems.	Host communities (Idiroko, Magbon, Ofin etc.)	**Medium**	Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers. Protect excavated soil materials from erosion.	**Minor**
	Surface runoff and soil erosion resulting in sedimentation problems		**Minor**	Ensure that the land is physically restored (include revegetation where possible) during the rainy season subsequent to the construction activities.	**Negligible**
	Potential building collapse as a result of unsuitable geotechnical conditions	Project site	**Medium**	Use of existing track for transport of man and material to the extent possible. Construction of foundations to be undertaken in the dry season.	**Minor**
Visual/Aesthetics	Disruption of the natural view of the local space due to erection of buildings	Host communities	**Medium**	Maintain construction site in orderly condition and do not distribute material over many sites before usage.	**Minor**
	Reclamation of marshaling yards and laydown areas	Project site	**Beneficial**	Local plant species should be used for beautification and lawn establishment	**Beneficial**

Table 6.1b: Summary of Mitigation Measures on Project Activities and Significance of Potential Impacts during Maintenance and Operation

<table>
<tr><th>Indicator</th><th>Potential impact</th><th>Receptor</th><th>Significance (pre-mitigation)</th><th>Mitigation or enhancement measures</th><th>Significance (post-mitigation)</th></tr>
<tr><td rowspan="2">Occupation Health and safety</td><td>Risk of injury from fall from height/trip or being hit by an object during Building inspection and checks</td><td>Project workforce</td><td>Medium</td><td rowspan="2">A comprehensive HSE Policy of NEPZA must be displace openly, and enforced through monitoring within the Park;
All staff must be trained and retrained on regular basis for HSE compliance;
Develop a training program including a code of conduct for all workers;
Well-equipped Clinic should be put up for emergence attention, while referral system should be arranged with a Secondary Hospital</td><td>Minor</td></tr>
<tr><td>Limited knowledge on safety measures and behaviour associated with industrial operation that can lead to accidents</td><td>Project workforce</td><td>Medium</td><td>Negligible</td></tr>
<tr><td rowspan="3">Air quality</td><td>Air pollution by gaseous emission (CO, SO_2, NO_2) and particulates from power generation/servicing; dust from cotton yarning</td><td rowspan="3">Project workforce/nearby villages</td><td>Medium</td><td rowspan="3">-Preference for usage of clean fuel like LPG, low sulphur diesel should be explored;
-Energy conservation should be adopted by opting the alternate energy options like solar power;
Odour should be managed at the site using odour suppressant and planting flowering trees with fragrance;
Power Generators and equipment should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission;
Air pollution monitoring should be carried out quarterly by the industries to check the air pollution level; Enclosure of dust producing equipment,
Use of local exhaust ventilation;
Use of dust extraction and recycling systems to remove dust from work areas;
Installation of fabric filters to prevent outdoor emissions.</td><td>Minor</td></tr>
<tr><td>Emission of ammonium (NH_3) from cotton processing/bleaching</td><td>Medium</td><td>Minor</td></tr>
<tr><td>Generation of dust and gaseous pollutants from automobile emissions and Textile production</td><td>Medium</td><td>Minor</td></tr>
</table>

Climate change	Accidental significant leaks from aging equipment, and gas losses occur during equipment usage and servicing.	Local and regional climate	**Minor**	Machines using GHGs and ODS should be avoided and replaced with those using environmentally compliant or friendly gases Regular checking and maintenance of all plant and equipment to minimize the risk gas leakage	**Negligible**
Noise	Increase in noise level nuisance from vehicles plying the access roads Noise generation from machineries and power generator (especially when ageing or poorly serviced)			Machineries to be used should comply with the noise standards prescribed by FMEnv. Workers shall be given PPE (ear plugs) and enforce compliance; Temporary noise barriers should be provided near the high noise generating areas; Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings; Select 'low noise' equipment or methods of work; Regular maintenance/servicing of machines and generator	**Negligible**
Geology/Soil	Soil contamination resulting from accidental leakages and spill of hazardous substances from generator servicing (diesel, spent oil etc.)	Soil	**Medium**	Install oil/water separators and silt traps before effluent, leaves the site. Bunding of areas where hazardous substances are stored (e.g. fuel, waste areas). Conduct bioremediation of polluted soil immediately to inhibit further spread	**Minor**
Infrastructures	Traffic congestion along the Lekki -Epe and Epe-Ijebu-Ode roads resulting from transportation of raw materials and finished product	Lekki - Epe and Epe - Ijebu-Ode roads	**Minor**	Engage the services of NPF/NSCDC for traffic controller if necessary; Schedule the movement of heavy-duty vehicles to off rush-hours in the area.	**Negligible**
	Pressure of the workforce on housing/health facilities in the area	Epe LGA	**Minor**	Housing project should be undertaken for workers either directly or through third party	**Minor**
Industrial waste discharges	Metallic materials generation from plant parts, retrofitting/upgrade of parts during plant servicing/maintenance	Land	**Medium**	Recyclable materials should be sorted and sold to scrap metal converters Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages.	Negligible
	Potential for land contamination from industrial waste disposal		**Medium**		**Minor**

	Pollution of surface water bodies by wastewater generated from industrial waste discharges	Water resources (Rivers/ Lagoon)	**Major**	Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. Ensure that processed wastewater is treated before discharging to nearby water bodies. Ensure that treated waste water is reused to minimize its discharge volume. Put in place a dedicated waste management system to account for generated waste**.**	**Minor**
Vegetation/Ecosystem	Change in Land Use of nearby areas and the buffer zone	Project communities and Epe LGA	**Major**	Maintain the industrial park in orderly condition and do not distribute material or vehicles over open spaces. Procure and distribute seedlings of local plant species for community members to grow in replacement of cleared plants	**Minor**
	Recreational facility from lawns/parks/green areas developed within and around the Industrial park	Project Communities	**Beneficial**	Use local plant species to establish the lawns/parks	**Beneficial**
	Improved Ecology and Aesthetics with proper landscape and beautification		**Beneficial**		**Beneficial**
Recruitment of workers	Community/individuals' dissatisfaction with the conduct of the proponent regarding recruitment of labour	Project workforce	**Major**	Engage communities in the recruitment of non-technical workforce so as to enhance transparency and involvement. Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities There should be no use of child labour (workers under age 18) and forced labour is not allowed; Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required; Provide proper work place facilities for water/sanitation/rest rooms; In the event of retrenchment needs, first viable	**Minor**

				alternatives are analyzed and then adverse impacts of retrenchment on workers are reduced as much as possible. A transparent retrenchment plan will be prepared; Develop worker's grievance redress mechanism, so that potential conflicts can be dealt with in an early and proper way	
Economy & Employment	Acquisition of skills by individuals to be employed as operators.	Project workforce	**Beneficial**		**Beneficial**
	Emergence of small-scale enterprises and entrepreneurs through Sub-contracting/Supplies	Epe LGA, and Lagos and Ogun State and Nigeria	**Beneficial**		**Beneficial**
Cultural Heritage	Conflict between work schedule and traditional festival that restrict human movement	Project communities and Epe LGA	**Major**	Consult with local communities on festivals and potentials for interference with construction works. If required cease works on the specific dates. Residential quarters should be built for workers on essential duties Accommodation should be provided for staff to forestall/ prevent movement on day when traditional festivals are held	**Negligible**
Water consumption	Reduction of water tables and source of water for production processes	River Oshun and Groundwater	**Major**	Water conservation measures should be practiced e.g. Waste water should be recycled for reuse. Rain water harvesting. Reuse of dye baths. Adoption of continuous horizontal washers and vertical spray washers or vertical, double-laced washers. Adoption of counter current washing (e.g. reuse the least contaminated water from the final wash for the next-to-last wash). Use of water flow–control devices to ensure that water only flows to a process when needed. Reuse of preparation and finishing water.	**Minor**

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 INTRODUCTION

This chapter provides the ESMP for the proposed Textile and Garment Industrial Park. Elements of this plan will be taken forward and incorporated into a comprehensive project Environmental and Social Management System (ESMS) that will be used to deliver the Project's HSE regulatory compliance objectives and other related commitments.

This ESMP is a delivery mechanism for environmental and social mitigation and enhancement measures made in the ESIA Report. The purpose of the ESMP is to ensure that these recommendations are translated into practical management actions which can be adequately resourced and integrated into the Project phases. The ESMP is, therefore, a management tool used to ensure that undue or reasonably avoidable adverse impacts of construction and operation are prevented or reduced and that the positive benefits of the Projects are enhanced (Lochner, 2005).

The ESMP has been developed to meet international standards on environmental and social management performance, specifically those set out by the FMEnv, AfDB, World Bank/IFC, Equator Principles. The ESMP covers project activities during construction and operation and will be subject to thorough reviews prior to the commencement of activities to ensure completeness. The ESMP does not include measures for activities related to equipment and facility fabrication being done offsite. It should be noted that this provides the outline requirements for environmental management. Provision will be made for updating the outline ESMP once the detailed project design is complete and for adapting the ESMP to relevant project stages as part of the overall ESMS (Figure 7.1).

The plan details the mitigation and enhancement measures NEPZA have committed to implement through the life of the Project and includes desired outcomes; performance indicators; targets or acceptance criteria; monitoring and timing for actions and responsibilities. NEPZA will have principal responsibility for all measures outlined in the ESMP for the construction phase. It is responsible for the implementation of the measures in the operation phase. Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organisations have responsibility for mitigation or enhancement measures, this is clearly indicated in Tables 7.4 and 7.5. Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.

7.2 OBJECTIVES OF ESMP

The ESMP is essential for successfully implementing the Project's social and environmental performance throughout the life of the Project. Having this framework in place ensures a systematic approach to bringing environmental and social considerations into decision making and day-to-day operations. It establishes a framework for tracking, evaluating and communicating environmental and social performance and helps ensure that environmental and social risks and liabilities are identified, minimised and managed. The ESMP will be a living document and will continue to develop during the design and construction phase to enable continuous improvement of the Project's social and environmental performance.

In particular, the objectives of the ESMP are to:

- promote environmental and social management and communicate the aims and goals of the ESMP;
- ensure that all workers, subcontractors and others involved in the Project meet legal and other requirements with regard to environmental and social management;
- incorporate environmental and social management into project design and operating procedures;
- address concerns and issues raised in the ESIA's stakeholder consultation process and those that will likely continue to arise during the Project's lifetime;
- serve as an action plan for environmental and social management for the Project;
- provide a framework for implementing project environmental and social commitments (i.e. mitigation measures identified in the ESIA); and
- prepare and maintain records of project environmental and social performance (i.e. monitoring, audits and non-compliance tracking).

The Environmental and Social Management Plan (ESMP) of the facility will include the following:-

- Health, Safety and Environment Department
- Pollution control
- Dust control
- Use of best available technology
- Removal of solid waste
- Monitoring programme
- Audit (three years interval)
- Environmental training and awareness program.

Environmental and Social Management Plan is an implementation plan to mitigate and offset the potential adverse environmental and social impacts of the project and enhance the positive impacts. Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted to minimize the adverse impacts. Process of implementing mitigation and compensatory measures, execution, agencies responsible for their implementation and indicative costs is discussed in this chapter.

The potential impacts of the proposed project have been identified, analyzed and expansively discussed in Chapter Five of this Report. The results of the impact assessment indicated that majority of the negative impacts will occur during the construction phase of the project and can be easily managed through the implementation of the proffered mitigation measures. However, considering the importance of adequate implementation of the management actions to the overall sustainability of the proposed project, this project specific ESMP has been developed with a focus to ensure that all recommended mitigation measures are transformed into practical management actions, which can be adequately resourced and integrated into the Project phases.

The development of the ESMP follows existing international and national standards on environmental and social management performance. It encompasses the entire project life cycle - pre-construction, construction, operation and decommissioning phases of the project. Nigeria Export Processing Zones Authority (NEPZA) is therefore committed to implement throughout the life cycle of the project, all mitigation, and enhancement measures. These include desired outcomes, performance indicators, monitoring, and timing for actions and responsibilities, which shall be principally monitored by NEPZA and its delegated contractors, where appropriate. Such delegation of responsibility shall be adequately documented as part of contractual agreements to guarantee absolute compliance and commitment on the part of the contractor to implement the ESMP.

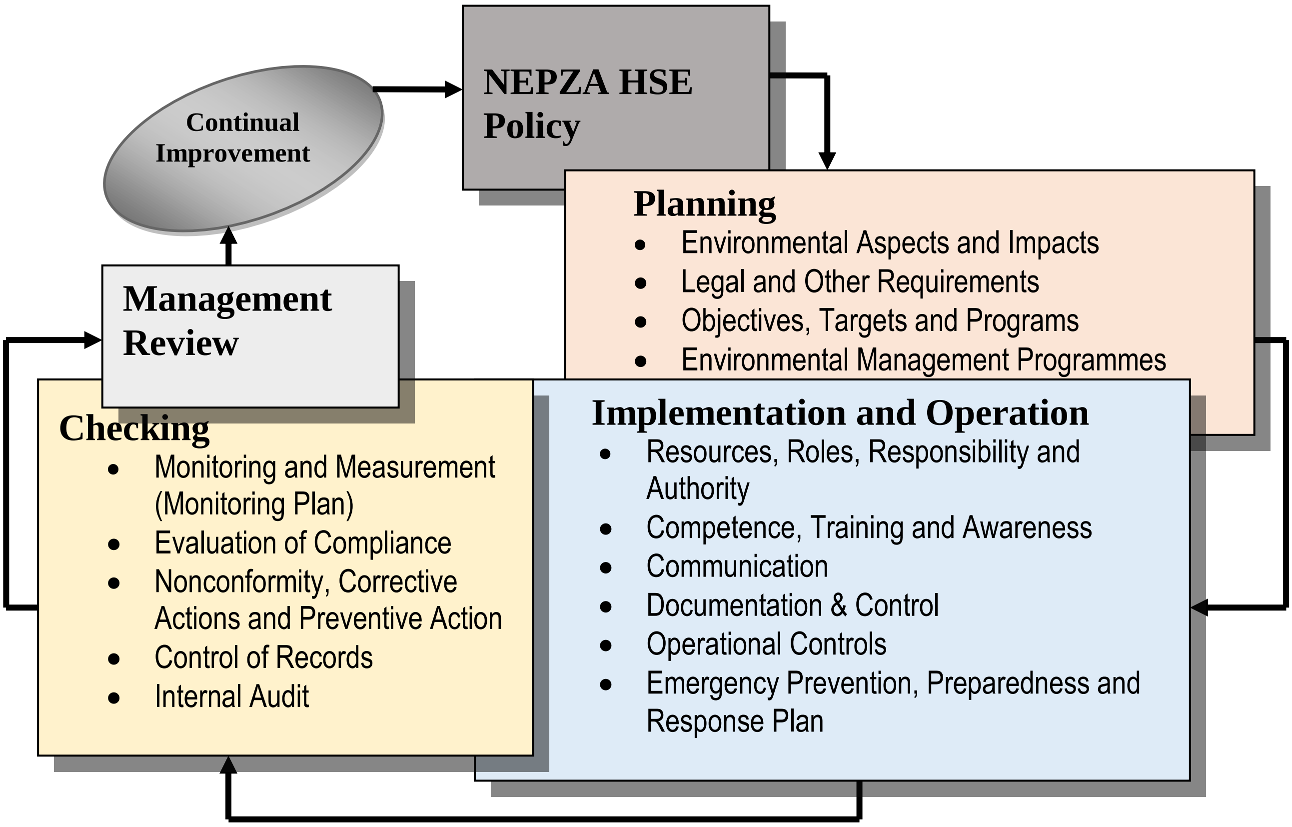

Figure 7.1: ISO 14001 Approach for Developing an Environmental Management System.

7.3 IMPLEMENTATION AND OPERATION

7.3.1 Environmental and Social Management Organization & Institutional Arrangement

The commitment and capacity of the EPC and operation/maintenance (O&M) contractors, alongside statutory stakeholders (institutions) will determine the successful and effective implementation of the management program. Therefore, the responsibilities of persons and institutions that will be involved in the implementation, monitoring and review of the ESMP are defined below:

7.3.1.1 Environmental and Social Management Organization

The selected EPC and O&M contractors shall provide adequate human and financial resources on an ongoing basis to achieve effective implementation of the ESMP and assure continuous improvement of environmental performance. Personnel within each establishment (including management representatives) shall be designated well defined responsibility and authority for environmental and social issues. The environmental and social management personnel will comprise the following; NEPZA Project Manager (PM) and Health, Safety and Environment (HSE) Manager/Consultant as well as the EPC/O&M contractor's PM, HSE Manager, HSE Officers, Community Liaison Officer (CLO) and subcontractors.
The organizational structure showing authorities and communication structure for the environmental and social management of the proposed project is presented in Figure 7.2.

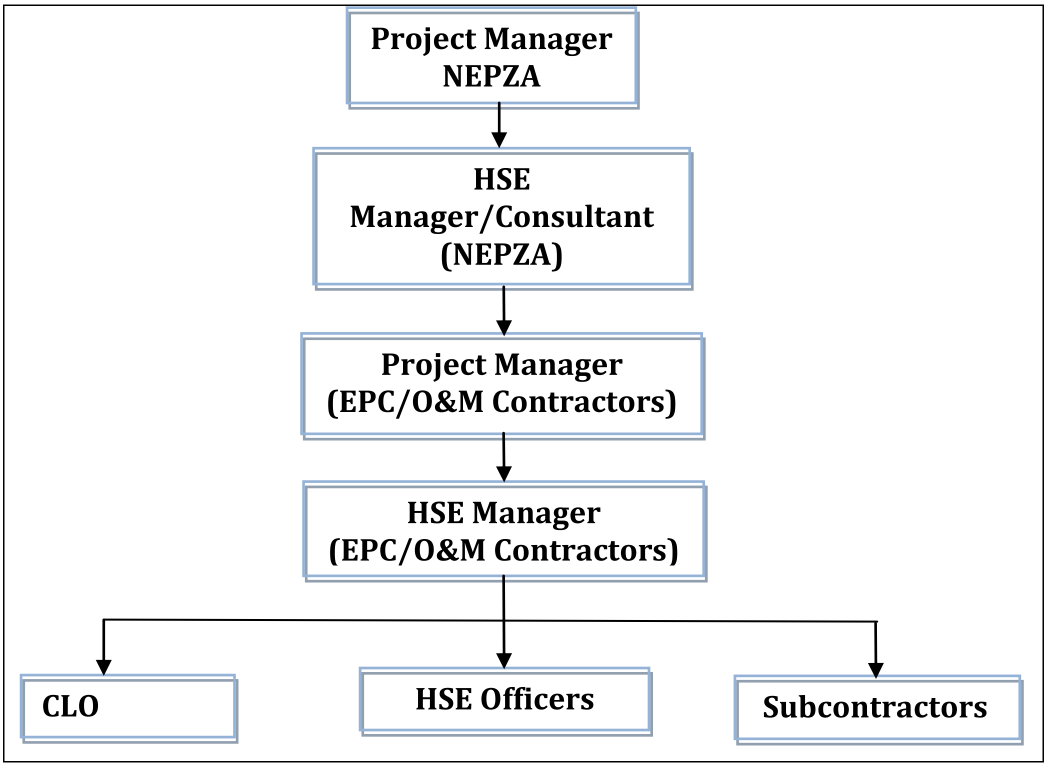

Figure 7.2: Organizational of the Environmental and Social Management of the Proposed Project

The roles and responsibilities of the key stakeholders involved in the development, implementation and review of the ESMP are described below:

- **NEPZA Project Manager (PM)**

The project manager shall carry out all task required for the implementation of the ESMP and ensuring that the environmental and social requirements are contented. This shall include:

- Ensuring the integration of the required environmental and social management measures and obligations in tender documents and contracts.
- Making crucial decision on the implementation of the ESMP
- Approve environmental and social management programs, procedures and protocols developed by the EPC contractor.
- Liaising directly with FMEnv, NESREA, SME and other relevant authorities with respect to the implementation of the ESMP.

➢ **HSE Manager/ Consultant**

The HSE Manager/ Consultant shall be actively involved in providing feedback to the PM regarding all HSE matters during the construction phase of the project. The responsibility of the HSE manager shall include:

- Manage and monitor the full implementation of the ESMP to ensure that the environmental and social management measures are implemented effectively.
- Periodically review and update the ESMP to ensure it addresses emerging environmental and social issues with respect to changes in extant legislation.
- Communicate all modifications of the ESMP to the relevant stakeholders.
- Assist in the resolution of conflicts that may arise from construction related environmental and social issues.

- Compile and prepare periodic reports for approval of PM and onward submission to relevant authorities, Specifically:
  - Monitor the performance of the EPC Contractor (and Sub-contractors) and ensure compliance with the ESMP;
  - Validate the regular site inspection reports, which are to be prepared by the EPC Contractor;
  - Check the EPC Contractor's record of incidents and non-conformity as well as the corrective and preventive actions taken;
  - Check the EPC Contractor's public complaints register to ensure complaints are recorded and actions are taken appropriately; and
  - Conduct regular audits to ensure that the system for implementing the ESMP is operating effectively.
- Liaise between NEPZA, EPC Contractors, affected communities and relevant authorities on all environmental and social concerns.

- **EPC Contractor's Project Manager**

The Contractor Project Manager shall be responsible for onsite implementation of the ESMP. The EPC Contractor's PM is answerable to the project manager through the HSE Manager/ Consultant for all HSE issues related to the construction of the project. The Contractor's PM shall:

- Formulate detailed HSE plans for the project.
- Ensure that all subcontractors working under the main contractor comply with the requirements of the ESMP.
- Supervise implementation of all the measures in the ESMP and preparation of all required Monitoring Reports.
- Report in details all monitoring reports to the HSE Manager.

- **EPC Contractor's HSE Manager**

The Contractor shall appoint a certified HSE Manager delegated with the responsibility of coordinating all HSE activities of the contractor. This includes to:

- Prepare work plans for HSE Officers in line with the requirements of the ESMP.
- Provide inspections, delineates problem areas, and makes recommendation for solutions.
- Monitor the efficient implementation of the ESMP.
- Organize periodic HSE risk assessment exercises.
- Advise Project Manager on compliance with ESMP.
- Perform regular inspection of site to ensure adherence to management actions of the ESMP.
- Conduct investigation, and take part in the review of incidence of nonconformity with ESMP.

- **EPC Contractor's HSE Officers**

All responsibility performed by the HSE Officers shall be reported to the HSE Manager. These include:

- Carry out day-to-day HSE activities specified in the HSE Plan and ESMP.
- Provide inputs into the regular HSE report to be prepared by HSE Manager;
- Maintain all HSE records.
- Communicate all significant environmental and social impact during construction phase to the HSE Manager in time and managed accordingly.

- Conduct independent inspections to observe conformance with ESMP requirements and determine the effectiveness of individual elements of the plan.
- Establish contact with Subcontractors with the objective of maintaining good relations, coordination of accident prevention activities and compliance with the established OHS plan.
- Correct unsafe acts and unsafe conditions.
- Inspect safety equipment's (fire extinguishers, signage's), to ensure availability and conformance with ESMP requirements.
- Deliver regular HSE induction/orientation course, HSE awareness course, toolbox discussion etc. to all employees, including subcontractors in line with the requirement of ESMP.
- Assist in carrying out risk assessment and participate in accident investigations.

➢ **Community Liaison Officer (CLO)**

The CLO shall:

- Be the main contact between affected community representatives and the EPC Contractors.
- Assist in resolving all disputes between EPC contractors and the affected communities.

At the completion of the construction phase, delegated O&M contractor shall handle the operation of the project with respect. All legal requirements of the ESMP shall be provided to the O&M by NEPZA accordingly and the record of transfer shall be clearly communicated to relevant authorities and other stakeholders. Hence, during operation phase of the project, the roles of the EPC contractor highlighted above shall be transferred to the O&M contractor as applicable.

7.3.1.2 Institutional Responsibility

The responsibilities of all incorporated institutions in the implementation of this ESMP are defined herein.

➢ ***Federal Ministry of Environment (FMEnv)***

The FMEnv through the Environmental Assessment Department and relevant agencies will serve as the lead environmental regulator overseeing compliance requirements, granting consent and also monitoring and providing supervisory oversight for the project. These shall include:

- Providing comments (require revisions where necessary), approval and clearance for the ESMP and other environmental clearance.
- Ensure that corrective actions are taken for significant environmental and social impacts.
- Undertake periodic site visits to inspect and verify the nature and extent of impacts and the success or lack of the mitigation measures.

➢ ***Lagos State Ministry of Environment (LSME)***

The environmental compliance at the state level will be discharged by LSME through her statutory department (Department of Environmental Pollution and Waste Management) and agency (Lagos State Environmental Protection Agency 'LASEPA'; Lagos State Waste Management Authority 'LAWMA). In addition to other statutory functions, the ministry shall: -

- Ensure that all project activities comply with the State environmental laws and requirements.
- Carry out regular compliance monitoring and periodic inspection of all the stages of the project.

Table 7.1: Roles and Responsibilities of Relevant Institution

S/N	Category	Roles & Responsibilities
1.	Federal Ministry of Environment	• Lead role - provision of advice on screening, scoping, review of draft ESMP report (in liaison with State Ministry of Environment), receiving comments from stakeholders, public hearing of the project proposals, and convening a technical decision-making panel, environmental and social liability investigations, monitoring and evaluation process and criteria.
2.	NEPZA	• Disburse all required resources and coordinate all channels of project operation. • Collaboration with EPC/O&M contractors to ensure the implementation of the project ESMP. • Supervision of all HSE activities related to construction and operation phase of the project.
	Lagos State Ministry of Environment	• Overseer all environmental compliance at the State level • Review of draft ESMP report (in liaison with Federal Ministry of Environment) • Site assessment and monitoring of ESMP implementation.
3.	State Government MDAs (Ministry of Physical Planning, Urban Development, Bureau of Lands etc.	• Compliance overseer at State Level, on matters of land acquisition and compensation and other resettlement issues, • Other MDAs come in as and when relevant areas or resources under their jurisdiction or management are likely to be affected by or implicated projects. • They participate in the EA processes and in project decision-making that helps prevent or minimize impacts and to mitigate them. • Issuance of consent or approval for an aspect of a project; allow an area to be included in a project; or allow impact to a certain extent or impose restrictions or conditions, monitoring responsibility or supervisory oversight.
	LASEPA	• Inspection of project premises in order to ensure strict compliance with sanitation and waste management standards in the state. • Collaboration with other MDAs at the State and Federal level, NGOs and Donor Agencies in environmental protection and management especially in areas of waste recycling etc.
	Local Government	• Provision of oversight function across subproject in LGAs for ESMP compliance. • Monitoring of activities related to public health, sanitation, waste management amongst others.
	Affected Community	• Promote environmental awareness. • Review environmental and social performance report made available by NEPZA • Provide comments, advice and/or complaints on issues of nonconformity. • Attend public meetings organized by NEPZA to disseminate information and receive feedback.
	CDA	• Ensure community participation by mobilizing and sensitizing community

		members.
	NGOs/CSOs	• Assisting in their respective ways to ensure effective response actions, conducting scientific researches alongside government groups to devise sustainable environmental strategies and techniques.
	Others/General Public	• Identify issues that could disrupt the project and support project impacts and mitigation measures and awareness campaigns.

Training, Awareness and Competence

Training is essential for ensuring that the ESMP provisions are implemented efficiently and effectively. Therefore, NEPZA has the mandate to ensure that all persons that have roles to play in the implementation of the ESMP and management system are competent based on appropriate education, training or experience. Thus, NEPZA shall mandate EPC and O&M contractors to identify the training needs for their employees at each relevant function and level, with direct responsibilities for ESMP implementation. Consequently, the EPC and O&M contractors shall be required to develop training plans to include project specific training programs, with respect to the different aspects of the ESMP implementation, management and monitoring actions.

The contractors shall be required to undertake general HSE awareness for their project workforce and specific training for those whose work may significantly have impact on the environment. This is to ensure that they are fully aware of the relevant aspects of the ESMP and are able to fulfil their roles and functions. The contractors shall ensure among others to provide the following training to their personnel:

I. General Awareness HSE Training

- HSE Induction/Orientation Course for all workers to include (site safety rules, PPE requirements, Emergency Preparedness and Response)
- Daily toolbox talk for workers at the start of each day's job.
- Refresher HSE Courses as at when required.

II. Project Specific OHS Training

- Manual Handling Techniques
- Electrical Safety
- Work at Height Training
- First Aid Training (for Site First Aiders)
- Safe Driving Techniques (for drivers)
- General environmental aesthetic knowledge.

All training programs shall be:

a. Verified to ensure consistency with NEPZA policy and other applicable regulatory requirements.
b. Documented and kept as records.
c. Evaluated to determine their effectiveness.

Based on the assessment of the institutional capacities of the different agencies that will be involved in the implementation of the ESMP, two broad areas of capacity building have already been identified and recommended for relevant personnel of NEPZA's, EPC Contractors and Agencies for effective implementation of the ESMP. The proposed training program, course content and estimated costs are shown in Table 7.2.

Table 7.2: Proposed Training Program for the Implementation of ESMP

Capacity Building Activity	Proposed Topics	Objectives	Target Audience	Duration	Estimated Budget (N)
Module 1: Training on Environmental and Social Management Plan Implementation	• Overview of Environmental and Social Impact Assessment • Overview of Potential Impacts of Project • Environmental Pollution & Control • Environmental and Social Management Plan • Basic Environmental Management • Environmental Performance Monitoring – Monitoring Mitigation Measures in ESMP • Environmental Reporting	To enhance competence in environmental sustainability and regulatory practice	NEPZA representatives, relevant staff of FMEnv (EA Dept), LSMEnv, LASEPA, other relevant MDAs, LGA departments, EPC Contractors, NGOs.	5 days	5,500,000
Module 2: Training on Construction HSE	• Introduction to Construction HSE • Overview of Health and Safety Hazards in Construction • Incidents: Causation, Investigation & Reporting • Excavation Safety • Construction Site Inspection • Personal Protective Equipment	To promote safe & healthy working conditions as well as the health of workers and regulators who may be involved in monitoring during project implementation	NEPZA representatives, relevant staff of FMEnv (EA Dept), LSMEnv, LASEPA and other relevant MDAs, LGA departments, EPC Contractors, NGOs.	4 days	3,500,000
	TOTAL			**6 days**	**9,000,000**

7.4 STRATEGIC PLANS OF ACTION FOR ESMP

NEPZA is fully committed to providing resources of both human and specialized skills essential to the implementation and control of the ESMP. These resources shall be delegated by dedicated personnel competent on the basis of appropriate education, training, and experience to manage and oversee the Health, Safety and Environment (HSE) aspects of the project. The HSE personnel shall ensure that the EPC contractors and other subcontractors operate in accordance with the applicable national and international regulatory HSE requirements and plans. The HSE personnel shall also monitor implementation of environmental and social protection measures contained in this ESMP.

7.4.1 Communication

As a demonstration of its commitment to dealing with project related issues in a positive and proactive manner, NEPZA shall ensure that the EPC contractor, implement and maintain procedures for internal and external communications on environmental and social management issues.

- **Internal Communication**

Effective internal communication mechanisms for information dissemination between levels and functions within the organizations shall be implemented. The mechanism shall encourage information to flow top-down, bottom-up and across functional lines amongst those responsible for the implementation of the ESMP. Those with specific role within the ESMP include the Project Manager and HSE Manager/Consultant while those of EPC/O&M contractors include the Project Manager, HSE Manager, HSE Officers and CLO. The approach for internal communication shall include regular meetings, daily briefings with intranets services, telephone and periodic newsletters as appropriate.

- **External Communication**

NEPZA through her delegate shall also implement proactive, two-way communication with external parties to report on environmental and social performance and progress and to solicit, receive, document and respond to feedback from the public. Audience for external communication shall include the regulators such as FME, LSMEnv, LASEPA, affected communities and other stakeholders (relevant MDAs, LGA departments, EPC Contractors, NGOs). Appropriate approach and strategy that fits the interest of each identified external parties shall be adopted. On this basis, the project manager shall be responsible for external communications on environmental and social concerns of the project through the HSE Manager. Methods of communication may include meetings, periodic reports, press releases etc. Procedure for external communications shall specifically include measures to

- Receive and register external communications such as complaints, advice, and other specific information regarding the environmental and social concerns of the project from the public.
- Screen, assess and address all identified issues.
- Provide, track, and document responses, if any.
- Adjust the management program, as appropriate.

For effective external communication, a project specific Stakeholder's Engagement Plan (SEP) and Grievance Redress Mechanism (GRM) are designed and presented for the project.

7.4.2 Stakeholders Engagement

Stakeholder engagement is an integral part of the EIA process as well as throughout the project lifespan. The stakeholder engagement process is extensively discussed in Chapter Four of this Report. Affected communities and relevant stakeholders have been identified for informed and meaningful consultation from the early stages of the EIA process to ensure that the interests, concerns and inputs of affected communities and stakeholders are integrated into the overall project plan thus mainstreaming bottom up approach in the EIA study. The approach to ensure that stakeholder engagement continues throughout the EIA process and project life cycle to foster strategic partnerships and collaboration among NEPZA, EPC/O&M contractors, affected communities and other stakeholders.

7.4.3 Grievance Redress Mechanism

Grievance Redress Mechanism (GRM) provides the platform and procedures for effective handling of complaints and grievances that is aimed at avoiding prolong litigation, which may alter or delay project objectives and implementation. The proposed NEPZA Textile and Garment project is envisage to be confronted by grievances that may result from the following factors:

- Dispute over ownership of land or asset
- Failure to identify all affected landowners and categories of affected persons and

communities.
- Non-payment of compensation.
- Inadequate compensation or valuation of assets.
- Delay in disbursement of entitlement.
- Non-participation or engagement of affected persons and communities in compensation negotiation.
- Implementation of project before or without resolving resettlement matters.

❖ Existing Grievance Redress System in the Locality

All the concerned villages within the project area have common cultural procedures that govern now civil cases and grievances are resolved. Ward Heads adjudicate on cultural and civil matters that are within their ward jurisdiction. This includes hearing and settling of disputes and non-criminal cases. Issues that are not satisfactorily resolved at the ward level are taken to the Village Head (Baales) and subsequently to the District Head (Oba) in cases of disagreement among parties. It is only when a case is not resolved by the cabinet of counsellors and chairman of Epe LGA.

The stated local grievance redress channels, does not in any way impede the right of dissatisfied parties in any case from seeking for redress through judicial means.

❖ Composition of Grievance Redress Committee (GRC) under this Project

The essence of a special GRC for this project is to install a functional and effective GRM, which shall be a model of the traditional GRM system that will incorporate result oriented best practices. The GRC shall constitute NEPZA delegate in collaboration with the head of local authority covering the project area. The GRC shall serve as institutional machinery for monitoring and reviewing the progress of implementation of the compensation of affected person's, and to carry out post implementation of social audits.

The composition of the committee will include the following:

i. All the Village Heads (Baales) from the affected villages;
ii. A representative of the District Head (Oba) from all districts affected
iii. A representative of the project affected persons in each of the villages.
iv. Representative of the Local Government Councils

The main functions of the committee are:

- Disseminate the functioning of the grievance redressed procedure to all affected persons;
- Verify grievances and their merits;
- Recommend solutions to such grievances to NEPZA and her EPC/O&M contractors;
- Communicate the decisions to the Appellants;
- Ensure that all notices, forms, and other documentation required by Appellants are made available in Local language understood by the people;
- Ensure documentation of all received complaints and the progress of remediation; and
- Entrench a feedback system (making sure that affected persons are informed about the outcome of investigations and actions taken on each case.

❖ Grievance Redress Process

The phases of the grievance mechanism shall comprise of:

- Locate, receive, register and acknowledge complaint
- Screen and establish the foundation of the grievance
- Implement, Monitor and Evaluate a redress action

- Entrench a feedback system
- Advise for a judicial proceedings as last resort if necessary
- Document all process and outcome for future reference.

Table 7.3: Implementation Plan for Grievance Redress Process

S/No	Process	Description	Response Duration	Principal Stakeholder
1	Receipt of complaint	Document date of receipt, name of complainant, village, nature of complaint, inform NEPZA/EPC/ O&M	1day	Secretary to GRC at project level
2	Acknowledgement of grievance	By letter, email, phone	1-3 days	Secretary to GRC at project level
3	Screen and Establish the Merit of the Grievance	Site visitation, complainant location; Complain merit	7-14 days	GRC and the aggrieved affected person or his/her representative
4	Implement and monitor a redress action	Where complaint is justified, carry out compensation redress	21-30 days	NEPZA/EPC/O&M contractors.
5	Extra intervention for a dissatisfied scenario	Review the redress steps and conclusions, provide intervention solution	2-4 weeks of receiving status report	District head
6	Judicial adjudication	Take complaint to court of law	No fixed time	Complainant
7	Funding of grievance process	GRC logistics and training, redress compensation	No fixed time	NEPZA/EPC/O&M contractors.

7.5 DOCUMENTATION RECORD KEEPING AND CONTROL

Documentation and record keeping provide evidence of the ongoing mitigation/ monitoring activities and effectiveness of the ESMP. They are required to track performance and other data necessary to achieve and demonstrate compliance with the ESMP and applicable regulatory requirements. Major documents and records for filing will include amongst others:

- NEPZA's HSE Policy;
- EPC Contractor HSE Policy;
- EPC Contractor HSE Manuals;
- ESMP Implementation activity specification;
- Emergency response and preparedness procedures;
- Site instructions;
- Complaint records;
- Training records;
- Inspection, maintenance and equipment calibration records;
- Monitoring data and audit results;
- Pertinent contractor and supplier records;
- Identified problems and corrective actions taken;
- Incident reports; and
- Significant communications with regulators.

The effective control of these documents is essential to the successful implementation of this ESMP. Procedures for the identification, collection, indexing, filing, storage, maintenance, retrieval and retention of documents will therefore be established, implemented and maintained. Responsibilities shall be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured.

7.6 CHECKING AND CORRECTIVE ACTIONS

7.6.1 Monitoring

As part of the ESMP, a project specific monitoring plan has been designed. This plan establishes environmental and social action plans with well-defined desired outcomes and actions to address all significant impacts identified for the proposed project. The plan also includes measuring elements such as parameters to be measured, methods of measurement, location of measurement, performance indicators (targets or acceptance criteria) that can be tracked over defined time periods, and with estimates of the resources and responsibilities for monitoring.

Recognizing the dynamic nature of the project, the monitoring plan is designed to be responsive to changes in circumstances, noncompliance issues, unforeseen events, and the outcome of reviews. The environmental monitoring activities shall be based on direct/indirect indicators of emissions, effluents, and resource use applicable to the project. Monitoring frequency incorporated shall be sufficient to provide representative data for the parameters being monitored. Monitoring data shall be analysed, documented and reviewed at regular intervals, to ensure it meet with regulatory standard.

For effective monitoring, the following measures shall be taken:

- Monitoring shall be conducted by trained HSE Officers and other competent professionals;
- Measuring equipment will be accurately calibrated;
- Quality control of sampling undertaken will be ensured;
- Accredited laboratories will be used;
- Certified methods of testing will be employed and where legal specifications exist for testing and sampling methods, these will be put into consideration.

Result of the monitoring outcome shall be documented, and preventive/corrective actions with respect to the result shall be clearly listed for onward implementation. All monitoring inspections and/or audits shall be in accordance to indicators specified in the monitoring plan and shall be conducted by NEPZA through her EPC Contractor as well as external monitoring by regulators and other relevant third parties.

7.6.2 Reporting Procedures

Reporting is essential for conveying information from the monitoring activities. The following reporting procedures have been developed in order to ensure that NEPZA is able to receive feedback from the implementation of the ESMP on an ongoing basis and to take rapid corrective actions if there are issues of non-conformance:

- Monthly Progress and Monitoring Report: to be prepared by the EPC Contractor's HSE manager, providing relevant information on all monitoring activities, and on any specific events, as the case may be. These reports are to be made available to NEPZA management and FMEnv/ LSMEnv/LASEPA at their request.
- Quarterly Reports: to be prepared by the EPC Contractor, summarizing all observations of the period. Reports will also be made available to NEPZA and FMEnv/LSMEnv/LASEPA accordingly.

- Quarterly Report by NEPZA: based on the EPC Contractor's reports on activities. The report shall be made available to FMEnv/LSMEnv/LASEPA and financial institutions upon request. The quarterly monitoring report will contain the following aspects of the ESMP implementation:
    1. Brief introduction to activities
    2. Objectives and scope of monitoring
    3. Monitoring parameters
    4. Field observations and analysis
    5. Percentage of safeguard compliance
    6. Non-compliance issues, gaps and weaknesses
    7. Recommendations for corrective measures
    8. Data, analysis results and pictures
- Occupational hazard report shall be prepared in the case of incidents irrespective of whether or not these give rise to "accidents" involving actual injury, fatality, serious environmental impact or other serious damage. The procedure for investigating and reporting these incidents shall be included in the OHS Plan for the project.

7.6.3 Auditing

An audit is an environmental management tool employed to analyse the results obtained from monitoring activities and to assess whether objectives and targets have been met and whether there are variances from the ESMP and legal requirements. Audit for the proposed project shall be carried out at two levels, namely internal and external audit.

- **Internal Audit:** This shall be undertaken by NEPZA O&M contractor during operation phase to ensure there is absolute compliance with its HSE Policy, all the requirements of this EIA/ESMP, all applicable national laws, relevant international policies, guidelines and conventions. The procedure for conducting ESMP audits shall be developed by the project's HSE Manager to include processes for scheduling and reporting, as well as the timing and frequency of the audits. This procedure shall also address responsibilities and required resources. The HSE Manager shall be responsible for scheduling and ensuring execution of the audit, as well as for the verification of the implementation of corrective action.
- **External Audit:** This shall be undertaken by the O&M contractor. The frequency of external audit shall be determined by regulators and may likely be carried out every three years once the Textile and garment project commences operation in fulfilment of the law.

NEPZA/O&M contractor shall ensure competent personnel are engaged to carry out audits. An independent HSE consultant may be engaged to undertake the audits. In addition, the audit programme shall be documented and issues identified shall be reported and corrected. NEPZA shall also design and implement a follow-up system in order to ensure the shortcomings identified are corrected.

7.6.4 Nonconformity, Corrective Action and Preventive Action

It is expected that efficient monitoring, auditing and other measurement activities designed as part of the ESMP will identify some deficiencies.

To deal with issues of non-conformity, NEPZA/O&M contractor shall establish a process to ensure that:

- All nonconformities issues are identified and investigated;
- Root causes are identified;
- Corrective and preventive actions are identified and implemented; and,
- Actions are tracked and their effectiveness are verified.

During construction, issues relating to nonconformities and other system deficiencies shall be analysed to detect patterns or trends, which will aid prevention of future problems. NEPZA shall focus on correcting existing problems and preventing future problems or reoccurrence as preventing problems is generally more environmentally, socially and economically sound than fixing them after they occur (or after they reoccur). The project's HSE Manager shall record and document the results of corrective and preventive actions taken and shall monitor the effectiveness of the corrective and preventive actions. The HSE Manager shall present report of non-conformity, corrective action and preventative action to the project manager. During operation, all issues relating to non-conformities and other system deficiencies shall be subject to O&M contractor's management system.

7.7 MANAGEMENT REVIEW AND REVISION OF ESMP

This ESMP is designed to be a dynamic and flexible plan that shall be subject to periodic review by top management to improve overall environmental and social performance of the project. NEPZA HSE Manager/Consultant shall compile reports with inputs from EPC contractor's HSE manager. Such reports shall be submitted to the project manager for review and approval. The following are major sources of the information to be documented for management review:

- Outcome of audits including issues of nonconformity, corrective and preventive actions.
- Outcome of monitoring activities.
- Suggestions from independent consultants.
- Suggestions from project implementation team.
- Suggestions from EPC contractor and subcontractors.
- Major complaints from affected communities and other stakeholders.

Following approval, PM shall present the report to the top management. All issues discussed, decisions reached, action items, timing and delegated responsibilities shall be documented. In addition, responsibility for follow-up on all action items arising from management review shall be delegated to ensure prompt implementation. EPC contractor is also expected to carry out review and revision in line with its management system. During operation, management review and revision of management system shall be the responsibility of the O&M contractor.

7.7.1 Facilities Surveillance

This is a vital system maintenance requirement for the environmental sustainability of the project. NEPZA shall ensure the EPC contractor and subcontractors carry out constant equipment and facilities surveillance to detect on time, the malfunctioning or deterioration of equipment and/or facilities. The surveillance shall aim at taking prompt corrective/repair measures on detected faults.

7.7.2 Emerging Issues and Management

There may be changes to the original project implementation plans or project activities due to unanticipated situations. Adaptive changes may also occur during the course of final design, commissioning, or even operations. NEPZA shall implement a formal procedure to manage changes in the project that will apply to all project activities. The objective of the procedure is to ensure that the impact of changes on the community and workers health and safety, the environment, Textile/Garment plant facility and associated equipment are identified and assessed prior to changes being implemented. The management of change procedures will ensure that:

- Proposed changes have a sound technical, safety, environmental, social and commercial and industrial justification;
- Changes are reviewed by competent personnel and the impact of changes is reflected in documentation, including operating procedures and drawings;
- Hazards resulting from changes that alter the conditions assessed in the EIA have been identified and assessed and the impact(s) of changes do not adversely affect the management of health and safety of workers, community members and the environment;
- Changes are communicated to personnel who are provided with the necessary skills, via training, to effectively implement them; and

7.7.3 Environmental Monitoring Plan

Additional detailed policies and plans will be developed to support the implementation of this ESMP. The timing of the development of the plans may be staged, ensuring that the appropriate focus is provided for construction and operational activities. They will be finalized by NEPZA, where appropriate in consultation with the Federal Ministries of Environment, Lagos State Ministry of Environment (LSMEnv), Lagos State Environmental Protection Agency (LASEPA), Lagos State Waste Management Authority (LAWMA), Epe LG Authority and other key stakeholders. NEPZA shall ensure Regulators also participate in monitoring of Socio- economic/ Health and safety issues. The environmental management plans for this project may include the following:

- Waste Management Plan;
- Spill Prevention and Emergency Response Plan;
- Emergency Response Plan;
- Traffic Management Plan;
- Erosion Control Plan;
- Occupational Health and Safety Plan;
- Security Plan;
- Local Employment and Procurement Policy;
- Employment Management Plan;
- Integrated Vegetation Management Plan; and
- Site Closure and Restoration Plan.

7.8 WASTE MANAGEMENT

It is the goal of NEPZA to design, construct, and operate the proposed project in a sustainable manner. To this end, effective waste management practices shall be implemented through the entire life cycle of the project. Waste management principles and priorities shall be based on an integrated approach, which involves using a combination of techniques and programs to manage wastes and employing the principle of Reduce, Repair, Reuse, Recycle/Recover and Disposal. The priority of the approach shall be on waste reduction while the least principle shall be disposal. The general information required, as minimum, for adequate definition of waste shall include:

- Waste stream identification
- Proper waste categorization
- Waste segregation
- Appropriate handling and disposal practice
- Recommended management practice

All wastes generated from the project shall be identified at generation point and categorized in respect to its hazard potentials as non-hazardous or hazardous. In line with the principle of waste management, EPC and O&M contractors shall avoid the generation of hazardous and non-hazardous waste materials to its minimal extent. Where waste generation is not avoidable, they shall reduce the generation of waste, reuse or recycle waste in a manner that is safe for human health and the environment. Where waste cannot be reused or recycled, the contractors shall dispose waste through an approved waste contractor.

Hazardous materials will inevitably be used as raw material during project implementation and operation. The EPC contractor shall avoid generation of hazardous waste to the extent possible by seeking to substitute highly hazardous materials with less hazardous ones during project design or going into agreement with product manufacturers for recycling opportunities. Where avoidance is not possible, the EPC/O&M contractors shall minimize and control the release of hazardous materials. To achieve this, the production, transportation, handling, storage, and use of hazardous materials for project activities shall be assessed. The contractors shall avoid the use of chemicals and hazardous materials subject to international bans or phase-outs due to their high toxicity to living organisms, environmental persistence, potential for bioaccumulation, or potential for depletion of the ozone layer. In the case of hazardous waste, contractors shall adopt Good International Industry Practice alternatives for its environmentally sound disposal while adhering to the limitations applicable to its transboundary movement.

- **Waste Streams and Management**

Waste generation is inevitable in each phase of project life cycle (Preconstruction, Construction, Operation, and Decommissioning). Table 7.4 presents overview of waste stream in all phases of the project and specifies proactive management approach to prevent environmental pollution and degradation. Third parties waste contractors that are reputable and legitimate enterprises and licensed by FMEnv, LSMEnv, LASEPA, LAWMA and other relevant government regulatory agencies, shall conduct hazardous and non-hazardous waste disposal. The EPC/O&M contractors shall obtain consignment note to the final destination. They shall also ascertain that disposal sites are licensed and being operated to acceptable standards.

Table 7.4: Waste Streams and Management.

S/NO	SOURCE	WASTE TYPE	WASTE STREAMS	MANAGEMENT
A			**PRE-CONSTRUCTION**	
1	Movement of vehicles on earth road and engine exhaust	Gaseous Emission and Particulates	CO_x, SO_x, NO_x, CO, Particulate Matter	• Use water suppression to prevent dust emission • Maintain vehicles and machineries to reduce emission • Maintain low speed to reduce dust and gaseous emission.
2	Installation of temporary workers camp, offices and workshops	Non-Hazardous solid waste	• Vegetal Waste /Overburden waste • Industrial Waste: Metal scraps, packaging waste	• Vegetal waste shall be supplied to farmers for use as compost. • Woody vegetal shall be supplied to host communities for domestic uses including as fuel wood for cooking. • Overburden waste shall be stockpiled for backfilling of pit and levelling of landscape. • Segregated and stored on site to be collected at least once a month for reuse or recycle through licensed third-party facilities.
3	Spills of oil and fuels from vehicles and equipment	Hazardous liquid waste	Spent oil and used grease from repairs of mechanical device	Stored and reuse/ sold to vendors were available in much quantity
4	Workers' camp	Domestic and Sanitary	• Food remnant, kitchen wastes. Food packaging etc. • Domestic Sewage	• To be transferred to locals for use as compost and animal feeds. • Plastic and other packaging to be recycled through licensed recycling third parties. • Use of Mobile toilets and transferred to licensed carrier for disposal
B			**CONSTRUCTION**	
1	Movement of vehicles on earth road and engine exhaust	Emission	CO_x, SO_x, NO_x, CO, Dust	See A1
2	Construction of access roads, civil works on site, installation of equipment.	Non-Hazardous /Industrial	• Waste Packaging such as Scrap wood, scrap metal, steel, glass, plastic, paper and cardboard, empty metal containers**,** excess concrete,	• Segregated and kept securely in closed containers on site. To be transferred to approved recycling third parties for reuse/recycling. • Non-recyclables to be removed by approved

	Workers' camp/offices		broken equipment, or components • Domestic-type waste: waste paper and food scraps, metal cans	LASEPA waste contractor for onward disposal at approved sites. • To be transferred to locals for use as compost and animal feed. • Plastic and other packaging to be recycled through licensed recycling third parties.
3	Civil works on site, construction of different complexes/building section	Hazardous Waste	**Solid Wastes:** Domestic-type waste: wastepaper and food scraps, metal cans, Material waste (pipes, planks, empty metal containers**,** excess concrete, broken equipment etc.)	See B2
			Liquid Waste: spent lubricating oils, hydraulic fluids, brake fluids, battery electrolyte, and dielectric fluids, chemical cleaning agents, paints, primers, thinners, and corrosion control coatings; sealants and adhesives etc.	Stored on site in closed containers with secondary containment and evacuated by an accredited waste management contractor with off-site permitted hazardous waste treatment, storage, or disposal facilities
	Civil works	Waste Water	Waste water from equipment washing and concrete production	Discharged to the ground as only very small quantity is envisaged at this stage.
4	Workers' camp	Domestic and Sanitary	• Food remnant, kitchen wastes. Food packaging etc. • Domestic Sewage	See A4
C	**OPERATION**			
1	Movement of vehicles on unpaved surface and engine exhaust	Emission	CO_x, SO_x, NO_x, CO, Dust	See A1
2	Maintenance of facilities	Non-Hazardous /Industrial	• Packaging waste, scrap metals, plastic, paper and cardboard, empty metal containers**,** broken equipment, or components • Domestic-type waste: wastepaper	• Segregated and kept securely in closed containers on site. To be transferred to approved recycling third parties for reuse/recycling. • Non-recyclables to be removed by approved LASEPA waste contractor for onward disposal at approved sites. • To be transferred to locals for use as compost and

	Workers' camp/offices		and food scraps, metal cans	animal feed. • Plastic and other packaging to be recycled through licensed recycling third parties.
3	Maintenance of facilities	Hazardous	Same as B3.	See B3

4	Textile and Garment Production ***Solid Wastes*** • Yarn Preparation • Knitting	Non-hazardous Non-hazardous	Fibres and Yarns Fibres and Yarns	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)
	• Weaving	Non-hazardous	Fibres Yarns and Cloth scraps	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)
	• Sizing, desizing, mercerizing, bleaching, washing and chemical finishing	Non-hazardous	Cloth scraps	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)
	• Mechanical finishing	Non-hazardous	Flock	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)
	• Dyeing and/printing	Hazardous	Dye containers	Segregated and kept securely in closed containers on site. To be transferred to approved recycling third parties for reuse/recycling
	• Dyeing and/printing (applied finish)	hazardous	Chemical containers	Segregated and kept securely in closed containers on site. To be transferred to approved recycling third parties for reuse/recycling
	• Dyeing and finishing of knitted fabrics	Non-hazardous/ Hazardous	Cloth scraps, dye and chemical containers	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)
	• Tufting	Non-hazardous	Yarns and Sweepings	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)

	• Selvage trim	Non-hazardous	Selvage	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)
	• Fluff and Shear	Non-hazardous	Flock	Recycled as a feedstock for other operations, including low-grade products, non-wovens, insulation, and geotextiles)
	• Dyeing Printing and Finishing	Hazardous	Dye and chemical containers	Segregated and kept securely in closed containers on site. To be transferred to approved recycling third parties for reuse/recycling
	Gaseous Wastes			
	• Emissions from boiler	Hazardous	Particulates, NO_x, SO_2	Air removed from the processes by the exhaust ventilation should be transported to a recovery system; Use of emissions control techniques (e.g. absorption and chemical scrubbing).
	• Emissions from high temperature ovens	Hazardous	Volatile organic components	Using appropriate control technologies (e.g. diversion of stack emissions through boilers; installation of scrubbers with activated carbon slurries; or incineration of extracted vapors in a combustion system).
	• Emissions from preparation, carding, combing, fabric manufacturing, bale breakers, automatic feeders, separators and openers	Hazardous	Dust (Particulates)	Enclosure of dust producing equipment, and use of local exhaust ventilation; Use of dust extraction and recycling systems to remove dust from work areas; Installation of fabric filters to prevent outdoor emissions.
	• Emissions from using sizing compound	Hazardous	Nitrogen oxides, sulphur oxide, carbon monoxide	Air removed from the processes by the exhaust ventilation should be transported to a recovery system; Use of emissions control techniques (e.g. absorption and chemical scrubbing).
	• Emissions from using chlorine compound	Hazardous	Chlorine, chlorine dioxide	Substituting cleaning solvents with less toxic solvents, particularly chlorinated solvents; Adopting water-based methods for removing oil and grease from fabric instead of using volatile solvents;
	• Disperse dyeing using carriers, sulphur dyeing, aniline dyeing	Hazardous	Carriers, H_2S, Aniline vapors	Use of emissions control techniques (e.g. absorption and chemical scrubbing) Air removed from the processes by the exhaust ventilation should be transported to a recovery system;

				Installation of activated carbon absorbers;
	• Emission from printing	Hazardous	Hydrocarbons, ammonia	Use of emissions control techniques (e.g. absorption and chemical scrubbing) Air removed from the processes by the exhaust ventilation should be transported to a recovery system;
	• Resin finishing, heat setting of synthetic fabrics	Hazardous	Formaldehyde, carriers, polymers-lubricating oils	Adopting water-based methods for removing oil and grease from fabric instead of using volatile solvents; Installing and modifying equipment to reduce solvent use;
	• Emissions from storage tanks for commodity and chemicals	Hazardous	VOCs	Recovery of VOCs through vapor recovery units, and use of a fully closed-loop system, especially if cleaning with halogenated organic solvents cannot be avoided (e.g. for fabrics that are heavily loaded with silicone oils);
	• Emissions from treatment tanks and vessels	Hazardous	VOCs, toxic emissions	Recovery of VOCs through vapor recovery units, and use of a fully closed-loop system, especially if cleaning with halogenated organic solvents cannot be avoided (e.g. for fabrics that are heavily loaded with silicone oils);
	• Emissions from dyeing and other finishing processes, and use of oils, solvent vapors, formaldehyde, sulfur compounds, and ammonia	Hazardous	Odor emissions	Routing of stack emissions through boilers to reduce odor emissions. Capturing and recovering the off-gases from the processes (e.g. installation of heat recovery systems); Installing and modifying equipment to reduce use of odorous chemicals; Substituting odor-intensive substances with less impacting compounds (e.g. sulfur containing dyestuffs and reducing agents with non-pre-reduced sulphide-free dyestuffs; sodium dithionite in dyeing after treatment with aliphatic short-chain sulfinic acid derivatives);
	Wastewater			
	Scouring Selection of more bioeliminable sizing agents (e.g. modified starches, certain galactomannans, polyvinyl alcohol, and certain polyacrylates);	Hazardous	Disinfectants, BOD COD, insecticide residues, NaOH, detergents, oils, knitting lubricants, spin finishes, spent solvents	Use of readily biodegradable detergents / surfactants that do not give rise to toxic metabolites. (e.g. APEO should be replaced with alcohol ethoxylates); Adoption of low volatile organic compound (VOC) emitting solvent wash for removal of water insoluble oils. Design of scouring systems to remove heavy settleable solids continuously; Treated in the Effluent Treatment Plant before discharge
	Bleaching	Hazardous	H_2O_2, stabilizers, high pH, adsorbable organic halogens e.g Trichloromethane	Reduce the use of sodium hypochlorite[6]; Control of stabilizers employed, using biodegradable products where possible and avoiding products with poorly

				bioeliminable complexing agents (e.g. ethylenediaminetetraacetic acid [EDTA], diethylenetriaminepentaacetic acid [DTPA]). Treated in the Effluent Treatment Plant before discharge
	Mercerising	Hazardous	High pH, NaOH	Recovery and reuse of alkali from mercerizing effluent, particularly rinsing water, Subject to color limitations that may apply to mercerized cloth woven from dyed yarn. Treated in the Effluent Treatment Plant before discharge
	Dyeing	Hazardous	Color pigments, Halogens, metals- (copper, chromium, zinc, cobalt, and nickel), amines, salt, surfactants, organic processing assistants, cationic materials, color, BOD, COD,	Use of disperse dyes that can be cleared in alkaline medium by hydrolytic solubilization instead of reduction; Adoption of low-salt dyeing techniques, especially for reactive dyes; Adoption of a pH-controlled drying process (use of pH controllable acid and basic dyes that allow control of pH); Use of machinery with automatic controllers of temperature and dyeing cycle parameters Treatment of dyeing wastewater at treatment plants using commonly available techniques, such as electrolysis, ultrafiltration and reverse osmosis, activated sludge, flocculation, and oxidation/reduction.
	Printing	Hazardous	Suspended solids, urea, solvents, color, metals, BOD, foam, VOCs, oil.	Use printing pastes with no or low VOC emissions (e.g., water-based, APEO-free, and reduced-ammonia-content printing pastes). Reuse rinsing water leftover from cleaning the printing belt; Reduce printing paste losses in rotary screen printing by minimizing the volume of printing paste supply and by recovering and recycling printing paste at the end of each run; Avoid the use of urea by controlled addition of moisture or by two-step printing methods; Treated in the Effluent Treatment Plant before discharge
	Desizing:	Hazardous	Organic matters and solids. BOD_5 and COD loads	Selection of raw material with low add-on techniques (e.g. pre-wetting of the warp yarn); Application of enzymatic or oxidative desizing with starch and modified starch sizing agents, followed by washing systems; Selection of more bioeliminable sizing agents (e.g. modified

				starches, certain galactomannans, polyvinyl alcohol, and certain polyacrylates);
D	**DECOMMISSIONING**			
1	Movement of vehicles on unpaved surface and engine exhaust	Hazardous	CO_x, SO_x, NO_x, CO, Dust	See A1
2	Demolition of structures	Non-hazardous	Concrete, scrap metals, woods, plastic,	Segregated and kept securely. To be transferred to approved recycling third parties for reuse/recycling. Non-recyclables to be removed by approved LASEPA waste contractor for onward disposal at approved sites.
3	Removal of Industrial plant and other equipment	Hazardous	Spent lubricating oils, hydraulic fluids, brake fluids, battery electrolyte, and dielectric fluids, chemical cleaning agents, paints, primers, thinners, and corrosion control coatings; sealants and adhesives etc.	Reuse materials in other construction site. Recycle materials through licensed third parties Waste materials shall be stored on site in closed containers with secondary containment and transferred to a registered waste contractor with off-site permitted hazardous waste treatment, storage, or disposal facilities.

Table 7.5: Environmental and Social Management Plan Checklists

Project Activity	Receptor affected	Environmental Aspect	Associated and Potential Impact	Residual Impact	Mitigation measures	Monitoring Requirements	Key Performance Indicators	Timing	Estimated Cost (N)	Responsible Parties
PRE-CONSTRUCTION										
Permitting & Land Acquisition •Consultations •Acquisition of license to operate •Stakeholder identification	Project Host communities	Socio-economics	Uncertainty and misunderstanding due to a lack of information and communication.	Low	- Inform communities about details of construction activities (e.g. employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting -Set-up and effectively monitor construction grievance mechanism -Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this EMP. -Engage communities in the monitoring activities to enhance transparency and involvement. - Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities. - Coordinate Stakeholder Engagement of all partners of	Continuous stakeholders engagement sessions • NEPZA to develop mechanism to advertise, identify and recruit suitable worker from the local community. *NEPZA to develop mechanism to communicate the skill requirement to eliminate unwanted expectations.	•Evidence of stakeholders engagement sessions •Report on stakeholders feedback/concerns -Audit of local labour engagement plan	Quarterly	300,000	NEPZA HR, HSE supervisor Part of CLO job descriptions
		Socio-	Exclusion of	Low						

		economics	vulnerable groups from consultations which may lead to strife		industrial site, prepare and implement Stakeholder Engagement Plan					
		Socio-economics	Community agitations over land disputes, wrong stakeholder identification, leadership tussles, etc.	Low						
Transport of Personnel and Construction Elements	Lekki-Epe, Yegunda road and Ijebu-Ode – Epe roads users	Safety	Increased traffic during mobilization on road with risks of accidents leading to injury/death and loss of asset.		-Coordinate with relevant agencies such as the Nigeria Police, LASTMA, NSCDC, etc. for traffic control -Schedule the movement of heavy-duty vehicles to off rush-hours in the area. - Materials and manpower that could be conveyed through the Lagoon should be explored to reduce road traffic congestion.	Accident record of all movement of personel and materials	Check compliance plan and record for traffic incidents	Quarterly	150,000	NEPZA HSE and Security Unit
	Site workers, Host communities close to the project ite eg Oke-Egan, Idiroko,	Noise	Nuisance (noise and vibrations) due to movement from heavy duty equipment and vehicles affecting public and wildlife	Low	Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings Select ‘low noise’ equipment or methods of work	Monitoring of noise levels routinely	Procure Sound level meter for acoustic level reading and recording	Daily Measurement if need be -Monthly measurement & review -Quarterly	80,000	FMEnv, LASMENv, Lagos State Min of health, and NEPZA HSE supervisor

	Oloso etc							formal reporting		
Site Preparation •Access roads creation •Site clearing •Camping and campsites			Economic loss arising from clearing of farm lands and crops	Low	Duly inform owner of such crops to harvest or remove them before commencing vegetation clearing. Ensure vegetation clearing is limited to minimum area required for work. Avoid forced eviction of farmers from their farmlands. Ensure all issues relating to compensation are handled in a transparent, consistent and equitable manner. Ensure adequate compensation is paid to owners of such crops	Review of effectiveness of compensation to determine timeliness and transition	No. of farm owners compensate d.	Quarterly	To be Included in the project budget	NEPZA and CLO
		Air Quality	Increase of dust particles and vehicular emissions.	Low	-Use good international practice: Cover properly loose materials and keep top layers moist Use binder material for erosion and dust control for long term exposed surfaces. Regular cleaning of equipment, drains and roads to avoid excessive buildup of dirt. Spray surfaces prior to excavation - Speed limits on-site of 15k/h should be recommended and enforced	Air quality indicators such as SPM, SOx, NOx, CO, VOC, would be measured according to approved Nigerian regulatory guidelines, IFC Performance Standard.	Monitor air quality in and around the project activity area.	Daily Measure ment if need be -Monthly measure ment & review - Quarterly formal reporting / audit	140,000/ Quarterly formal reporting	NEPZA HSE supervisor FMEnv
	Constructi on workers,	Health and Safety	Work place accidents/inciden ts from the use of	Low	NEPZA should follow their Occupational HSE plan following Nigerian and international	HSE key Performance indicators	Hazards observations , near	Impleme nted in the	Part of safety officer and	HSE Manager •Safety

	Host community		cranes, forklifts, etc. during loading and offloading of materials/equipment.		requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height during maintenance and repair works, emergency prevention and management. Use personal protection equipment. Have medical emergency equipment at hand.		misses, unsafe acts, zero PPE, incidence reports	construction phase.	HSE Manager's job description	Officer •FMEnv
	Lekki – Epe, Yegunda and Ijebu-Ode – Epe roads users	Socio-economic	Obstruction of/damage to existing roads due to increased usage during mobilization.	Low	-Schedule the movement of heavy-duty vehicles to off rush-hours in the area. - Materials and manpower that could be conveyed through the Lagoon should be explored to reduce road traffic congestion.	Accident record of all movement of personel and materials	Check compliance plan and record for traffic incidents	Regulalry during mobilisation	Same as transport of personel above	NEPZA HSE and Security Unit
			Interference with other road users along mobilization route.	Medium						
	Surface and Ground water	**Soil and Surface water**	Leakage of fuel or lube oil onto land or into water bodies during transportation and storage may lead to increased chemical hazard.	Low	-Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains. -Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. -Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. -Implement effective site drainage on the construction yard to allow for	Check limits of specific parameters in soil and water	-Visual inspection and photographic record -Soil quality monitoring form	Quarterly	200,000	HSE Manager •Safety Officer •FMEnv

					the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. -Install oil/water separators and silt traps before effluent, leaves the site.					
Recruitment of Labour	Epe LGA, and Lagos and Ogun States	**Socio-economics**	Employment opportunities arising from recruitment of technical and non- technical workers	Beneficial	A Local Content Plan should be prepared and strictly adhered to in order to facilitate involvement of local labour. No hiring of short-term labour to be made at the site gate and be transparent to community leaders	NEPZA to develop mechanism to advertise, identify and recruit suitable worker from the local community.	Evidence of stakeholders engagement sessions •Report on stakeholders feedback/concerns	Quarterly	No fixed cost	CLO's assignment
			Skill acquisition and enhancements to local indigenes and workforce							
	Project communities and Epe LGA		Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	Negligible	Only specialised professional workers will be recruited from outside the communities	The Community Investment Plan will outline monitoring requirements	Adherence to the IFC Performance Standards	Through out operation	Cost for service upgrades vary according to infrastru-cture type	Government Planning Department
	Construction workers, Host communit	Health	Increase of communicable diseases due to influx of people and poor living	Negligible	-Coordinate with medical posts and emergency services to prepare for water supply, waste management and incidents. -Install proper and independent	Ensure communication of health and safety risks to	**Observation Reports**	Periodic random screening Secondary	Part of project budget	NEPZA HSE Supervisor

	y		conditions around pre-construction sites		facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited. -Areal fumigation and use of Insecticide Treated Net should be promoted in the Workers camp	villagers near to settlements in batches and explain the various H & S measures being undertaken.		data from health institutions		
	Project Host communities	Socio-economic	Increase in social vices (like theft, prostitution) resulting from increased number of people	Negligible	Make security plan and emergency response and contacts with security forces. Coordinate with NEPZA security measures for their site. Professional security outfit be engaged in protecting lives and properties within the park. This must be registered with the Nigerian Police/NSCDC etc. A Local Content Plan should be prepared to facilitate involvement of locals in the security network.	Aerial surveillance using cameras	Security report	Proper monitoring and reporting	Budget of Security unit	NEPZA HSE Supervisor
	Project Host communities		Conflicts/community agitations over employment issues (quotas and methods)	Negligible	Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan The cooperation of the community leaders and Epe LGA should be sought so as to avoid any complications.	-Continuous stakeholders engagement sessions • NEPZA to develop mechanism to advertise, identify and recruit suitable workers from	•Evidence of stakeholders engagement sessions •Report on stakeholders feedback/concerns . Audit of local labour engagement plan	**Quarterly**	Part of CLO's Job description	NEPZA HR, HSE Supervisor and CLO

						the local community. • NEPZA to develop mechanism to communicate the skill requirement to eliminate unwanted expectations.				
	Streams around the project site	Surface water	Contamination of surface water as a result of siltation caused by increased erosion, during site preparation.	Minor	Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas.	Monitor run-off and river bed condition	Desilting programme/ sediment trapping	Prior to construct ion	**250,000**	HSE supervisor
	Host communit ies close to the project site (Idiroko, Oke-Egan etc.) flora and fauna, habitat	**Flora and Fauna**	Disturbance of the vegetation cover/ loss of forest products (fuel wood, timber, medicinal plants, crops) due to site clearing and preparation. Loss/disturbance of wildlife due to habitat loss/fragmentatio n from vegetation	**Minor**	-Site clearance activities to be restricted to the minimum required area. -Avoid the use of heavy equipment that could cause siltation of the aquatic habitats -Restrict removal of vegetation and trees to the boundary of project site only; Retain all native vegetation; -Protect all vegetation not required to be removed against damage; -Undertake quick re-vegetation of exposed soils with indigenous plant species; and	.Vegetation/ha bitat clearing • monitoring Species richness and diversity •Fauna observation	- Biodiversity Action Plan (BAP) including a record of the abundance and distribution of threatened floral and faunal species	Prior to construct ion	**350,000**	HSE supervisor

			clearing at site and access roads							
			Opening up of wildlife habitats/ increase in poaching due to an easier access for the local population and some workers.							
	Streams around the project site	**Geology**	Soil compaction leading to erosion, destabilization from excavation and surface runoff resulting in sedimentation problems.		-Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers. -Protect excavated soil materials from erosion. -Ensure that the land is physically restored (include revegetation where possible) during the rainy season subsequent to the construction activities. -Use of existing track for transport of man and material to the extent possible. -Construction of foundations to be undertaken in the dry season	Regeneration of vegetation regrowth	Monitoring of vegetal regrowth	Prior to construct ion	**100,000**	HSE supervisor
	Project site and host communi ties close to project site		Waste from wood, sand, paper; wastefrom laydown area and camp site (material and wood)		-Engage waste disposal managers (PSP) that are accredited by LAWMA -Proper sorting and collection of metals for recycling and monetary gain should be encourage -Develop and implement a site-specific Waste Management Plan	Monitoring of site for waste dump .	Physical observation	Monthly	Cost associated with LAWMA removal of waste	NEPZA HSE supervisor LASEPA/ FMEv

					(WMP) to prevent unregulated dumping of waste;					
CONSTRUCTION PHASE										
Foundation/ Earth Works •On-site geotechnical testings •Building foundations •Gutter/Drainage channels cuttings •Pilings and trenching, etc	Site workers, Host communities and Epe LGA	**Air Quality**	Generation of dust and automobile / heavy duty equipment emissions from construction earth works	Low	-Preference for usage of clean fuel like LPG, low sulphur diesel should be explored; -Energy conservation should be adopted by opting the alternate energy options like solar power; -Power Generators and equipment should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission	Air quality indicators such as SPM, SOx, NOx, CO, VOC, would be measured according to approved Nigerian regulatory guidelines, IFC PerformanceStandard.	Monitor air quality in and around the project activity area	Weekly throughout project construction activity	Cost associated with monthly noise monitoring	NEPZA HSE supervisor FMEv
	Host communities (Idiroko, Oke-Egan etc.) flora and fauna, habitat	**Flora and Fauna**	Flora/habitat loss and disturbance through vegetation clearing and earthworks on building site and access roads	Negligible	Maintain the industrial park in orderly condition and do not distribute material or vehicles over open spaces. Procure and distribute seedlings of local plant species for community members to grow in replacement of cleared plants	Vegetation / habitat clearing monitoring •Species richness and diversity •Fauna observation	Vegetation / habitat clearing monitoring •Species richness and diversity •Fauna observation	Quarterly during construction	**350,000**	NEPZA HSE supervisor and FMEnv
			Fauna disturbance and displacement as a result of migration away from	**Negligible**	-Protect all vegetation not required to be removed against damage; -Undertake quick re-vegetation of exposed soils with indigenous plant species	Vegetation / habitat clearing monitoring •Species richness	Flora abundance, species richness, habitat structure,	Quarterly during construction		NEPZA HSE supervisorand FMEnv

			construction activity area (e.g. impact on bird life). Reduction in wildlife population as a result of poaching due to easier access created access roads			and diversity •Fauna observation	fauna sightings, Presence or extinct of rare or native			
	Site Workers	**Safety**	Potential building collapse as a result of unsuitable geotechnical conditions	**Negligible**	Construction of foundations to be undertaken in the dry season.	Result of geotechnical survey should determine construction technique	Escavation to reach stable earth materials before casting	At Foundation design stage	Part of Construction cost	NEPZA contractor
	Surface water	**Hydrology**	Alteration of rivers/stream course and regime due to construction	**Negligible**	Development to align with the topography of the project site	Check direction of available treams	Rechannel without disorientation	Plan of the project site	Part of site development plan cost	NEPZA contractor
	Fauna/wildlife	**Noise**	Noise nuisance from construction activities resulting to temporary migration of sensitive mammals and human discomfort	**Negligible**	Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings Select 'low noise' equipment or methods of work Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources).	Activity to be undertaken only during daytime	Routine Activities	Periodic and surprise checks Periodic and surprise checks	50,000 monthly over construction period	NEPZA HSE supervisor, FMEnv, Lagos State Min of ENv,

	Site workers/ Nearby residents		Noise and attendant vibration effects from fabrication and associated welding equipment	**Minor**						
Fabrication/Installation	**Electrical installation workers**	**Health and Safety**	Risk of electrocution and burns (to onsite workers) during electrical installation processes	**Negligible**	Develop an emergency response plan following NEPZA and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of Lagos State and Epe LGA Use personal protection equipment Adhere to safe work procedure Use personal protection equipment	Emergency Response Plan, Occupational Health and Safety Management Plan, Employment and Workforce Policy and Spill Response Plan will set out monitoring requirements	Nigerian H&S law (Nigerian Institute of Safety Professionals, Factories Act 1990), the adherence to the IFC Occupational Health and Safety Guideline and incidents record	Through out Construction	As part of normal construction	NEPZA HSE Dept
	Construction workers	**Health and Safety**	Inhalation by onsite workers of toxic fumes during welding of steel components	**Negligible**						
	Project site, Neighbourhood	**Waste**	Generation of metal scraps from steel elements associated with fabrication of building roof	**Negligible**	Develop and implement a site-specific Waste Management Plan (WMP) to prevent unregulated dumping of waste; Engage waste disposal managers (PSP) that are accredited by LAWMA Proper sorting and collection of	Waste management plan	LASEPA/LAWMA waste handling procedure and guideline	Weekly	20,000	NEPZA HSE Dept /LASEPA

					metals for recycling and monetary gain should be encourage					
Economy/ Employment	Epe LGA, and Lagos and Ogun State and Nigeria	**Socio-economic**	Employment of local labour and skills acquisition for workers taking advantage of new opportunities	**Beneficial**	A Local Content Plan should be prepared and strictly adhered to in order to facilitate involvement of local labour. No hiring of short-term labour to be made at the site gate and be transparent to community leaders Only specialised professional workers will be recruited from outside the communities	The Community Investment Plan will outline monitoring requirements	Adherence to the IFC Performance Standards	Through out condtruction phase	**No cost**	NEPZA HR/ CLO
			Increased business and economic activities as well as diversification of income sources due to supply contracting and sub-contracting							
			Increased jobs and job opportunities from local labour hire and sub-contracting to indigenous suppliers.							
			Induced secondary development within the neighbouring host communities							

			from increased economic activities.							
Community/ Workers' Health and Safety and Security	**Socio-economics**	**Safety**	Traffic congestion along Lekki – Epe road during haulage of plant components to site for installation	**Minor**	-Coordinate with relevant agencies such as the Nigeria Police, LASTMA, NSCDC, etc. for traffic control -Schedule the movement of heavy-duty vehicles to off rush-hours in the area. - Materials and manpower that could be conveyed through the Lagoon should be explored to reduce road traffic congestion.	Accident record of all movement of personel and materials	Check compliance plan and record for traffic incidents	During Installation	**150,000**	NEPZA HSE and Security Unit
	Construction workers	**Health and Safety**	Workplace accidents/incidents (trip/falls etc) from heights during building installations, wiring and bolt/nuts tightening activities.	**Low**	NEPZA should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height during maintenance and repair works, emergency prevention and management. Use personal protection equipment. Have medical emergency equipment at hand.	HSE key Performance indicators	Hazards observations, near misses, unsafe acts, zero PPE, incidence reports	Implemented in the construction phase.	Part of safety officer and HSE Manager's job description	HSE Manager •Safety Officer •FMEnv
		Health and Safety	Risks of injury/death and loss of assets resulting from accidents associated with road transportation to and from construction sites							

		Safety	Risks of fire/explosions resulting from accidental ignition of onsite diesel storage tanks							
DEMOBILISATION AFTER CONSTRUCTION PHASE										
Relocation of machinery/Equipment	Project area and Neighbouring communities	**Safety**	Illegal access to project site leading to accident, asset damage, and loss	**Minor**	Adequate security should be engaged to protect properties against vandalization					
		Health and Safety	Workplace accidents from burns, bruises, trips and falls, object at height leading to injury of fatalities.	**Negligible**	NEPZA should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height during maintenance and repair works, emergency prevention and management.		HSE key Performance indicators	Hazards observations, near misses, unsafe acts, zero PPE, incidence reports	Part of safety officer and HSE Manager's job description	HSE Manager •Safety Officer •FMEnv
	Project Area/Epe LGA	**Safety**	Traffic congestion during transportation of demobilized equipment and personnel	**Negligible**	-Coordinate with relevant agencies such as the Nigeria Police, LASTMA, NSCDC, etc. for traffic control -Schedule the movement of heavy-duty vehicles to off rush-hours in the area.	Accident record of all movement of personel and materials	Check compliance plan and record for traffic incidents			
		Air Quality	Generation of dust and gaseous	**Minor**	-Preference for usage of clean fuel like LPG, low sulphur diesel should	Air quality indicators	Monitor air quality in	Weekly during	Cost associated	NEPZA

			emissions		be explored; -Energy conservation should be adopted by opting the alternate energy options like solar power; -Power Generators and equipment should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission	such as SPM, SOx, NOx, CO, VOC, would be measured according to approved Nigerian regulatory guidelines, IFC Performance Standard.	and around the project activity area	project decomissioning activity	with monthly noise monitoring	HSE supervisor FMEv
	Project area	**Flora**	Reclamation of marshaling yards and laydown areas	**beneficial**	Use native plants not alien plant species	Landscaping using professional standard	Physical observation	Close of the decomissioning stage	**100,000**	NEPZA HSE supervisor, Landscape contractor
	Epe LGA, Ogun and Lagos states	**Socio-economic**	Loss of employment and business opportunities due to completion of construction phase	**Minor**	-Engagement and consultation with concerned workers -Good severance programme and package	IFC Performance Standard.	Engagement and Feedback	Before th close of the decomissioning stage	**No extra cost**	NEPZA Management, CLO
OPERATION PHASE										
Recruitment of workforce	Factory Workers	**Safety**	Risk of injury from fall from height/trip or being hit by an object	**Low**	- A comprehensive HSE Policy of NEPZA must be displayed openly, and enforced through monitoring within the Park; -All workers must be trained and retrained on regular basis for HSE compliance;	Emergency Response Plan, Occupational Health and Safety Management	Nigerian H&S law (Nigerian Institute of Safety Professionals, Factories	Through out Operations	As part of normal operations	NEPZA HSE Department
		Safety	Limited knowledge on	**Low**						

			safety measures and behaviour associated with industrial operation that can lead to accidents		-Develop a training program including a code of conduct for all workers; -Well-equipped Clinic should be put up for emergence attention, while referral system should be arranged with Secondary Hospital	Plan, Employment and Workforce Policy and Spill Response Plan will set out monitoring requirements	Act 1990), the adherence to the IFC Occupational Health and Safety Guideline and incidents record			
Plant operation, Servicing and Power generation		**Air Quality**	Air pollution by gaseous emission (CO, SO_2, NO_2) and particulates from vehicles that supply raw materials and take away finished textile products	**Negligible**	-Preference for usage of clean fuel like LPG, low sulphur diesel should be explored; -Energy conservation should be adopted by opting the alternate energy options like solar power; -Odour should be managed at the site using odour suppressant and planting flowering trees with fragrance; -Power Generators and equipment should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission; Air pollution monitoring should be carried out quarterly by the industries to check the air pollution level; Enclosure of dust producing equipment, Use of local exhaust ventilation; Use of dust extraction and recycling systems to remove dust from work	Emissions monitoring. Details to be agreed with FMEnv prior to operation.	The IFC Performance Standards The WHO and EU Emission Standards Nigerian Emission	Monthly	Cost associated with ambient air monitoring programme	NEPZA HSE supervisor
	Factory workers	**Air Quality**	Emission from processes in Textile production							
	Factory workers/ Nearby residents	**Air Quality**	Generation of dust and gaseous pollutants from automobile emissions and textile production processes							

					areas; · Installation of fabric filters to prevent outdoor emissions.					
		Noise	Increase in noise level nuisance from vehicles supplying raw materials and carrying away finished textile products and noise from textile processing equipment eg spinning machine.	**Negligible**	Machineries to be used should comply with the noise standards prescribed by FMEnv. Workers shall be given PPE (ear plugs) and enforce compliance; Temporary noise barriers should be provided near the high noise generating areas; Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings; Select 'low noise' equipment or methods of work; Regular maintenance/servicing of machines and generator	Noise monitoring at sensitive receptors	Noise at sensitive receptors to not exceed Nigerian and WHO limits	Monthly	Cost associated with monthly noise monitoring	NEPZA HSE Supervisor
	Project area	**Soil contamination**	Metallic materials generation from plant parts, retrofitting/upgrade of parts during processing units servicing that may contaminate the soil on disposal	**Negligible**	Recyclable materials should be sorted and sold to scrap metal converters Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques.	Visual inspection	Visual inspection and photographic record	Daily	Part of HSE Supervisor's duties	NEPZA HSE supervisor
	Soil in the project area	**Soil contamination**	Potential for land contamination from solid waste	Neglligible	Put in place a dedicated waste management system to account for generated waste**.**	Regular checking and maintenance	Regular monitoring and analysis	Daily/ weekly	**400,000**	NEPZA HSE supervisor

			disposal			of all plant and equipment to minimize the risk of fuel or lubricant leakages.	Using samplers			
	Surface water around the project area and Lekki Lagoon	Surface water	Pollution of surface water bodies by wastewater discharges	Negligible	Ensure that wastewater is treated by (ETP) before discharging to nearby water bodies. Ensure that treated waste water is reused to minimize its discharge volume.	Water quality monitoring before effluent leaves the site. Visual Inspection.	Effluent quality meeting FMEnv requirements	Monthly		NEPZA HSE Supervisor
		Surface water	Reduction of water tables and source of water for production processes	Low	Reuse of dye baths; Adoption of continuous horizontal washers and vertical spray washers or vertical, double-laced washers; · Adoption of countercurrent washing (e.g. reuse the least contaminated water from the final wash for the next-to-last wash); Use of water flow–control devices to ensure that water only flows to a process when needed; Reuse of preparation and finishing water.	Visual inspection	Visual inspection and photographic record	Daily	Part of HSE Supervisor's duties	NEPZA HSE Supervisor
Recruitment of workforce	Project communities, Epe	**Socio-economic**	Community/individuals' dissatisfaction	**Minor**	-Engage communities in the recruitment of non-technical workforce so as to enhance	Continuous stakeholders engagement	•Evidence of stakeholders engagement	Quarterly	Part of CLO job	NEPZA HR, HSE

	LGA, Ogun and Lagos states		with the conduct of the proponent regarding recruitment of labour		transparency and involvement. -Enhance ongoing consultations with local communities (with good representation) by NEPZA to create continuous dialogue, trust and planning of community development activities -There should be no use of child labour (workers under age 18) and forced labour is not allowed; -Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required; -Provide proper work place facilities for water/sanitation/rest rooms; -In the event of retrenchment needs, first viable alternatives are analyzed and then adverse impacts of retrenchment on workers are reduced as much as possible. A transparent retrenchment plan will be prepared; -Develop worker's grievance redress mechanism, so that potential conflicts can be dealt with in an early and proper way	sessions • NEPZA to develop mechanism to advertise, identify and recruit suitable worker from the local community. • NEPZA to develop mechanism to communicate the skill requirement to eliminate unwanted expectations.	sessions •Report on stakeholders feedback/concerns Audit of local labour engagement plan		descriptions	supervisor and •CLO
Plant operation	Project area	**Vegetation/ ecosystem**	Change in Land Use of nearby areas	**Minor**	-Maintain the industrial park in orderly condition and do not distribute material or vehicles over open spaces. -Procure and distribute seedlings of local plant species for community members to grow in replacement of	NEPZA to develop a standard landscaping programm	Visual inspection	Continuous monitoring and maintenance	**150,000**	HSE supervisor

					cleared plants					
			Recreational facility from lawns/parks/green areas	**Beneficial**	Use native plant species to establish the lawns/parks -Maintain the industrial park in orderly condition and do not distribute material or vehicles over open spaces. -Procure and distribute seedlings of local plant species for community members to grow in replacement of cleared plants					
		Visual	Improved Ecology and Aesthetics with proper landscape and beautification							
Economy	Project communities, Epe LGA, Ogun and Lagos states	**Socio-economics**	Acquisition of skills by individuals to be employed as operators. Emergence of small businesses	**Beneficial**	A Local Content Plan should be prepared and strictly adhered to in order to facilitate involvement of local labour. No hiring of short-term labour to be made at the site gate and be transparent to community leaders Only specialised professional workers will be recruited from outside the communities	The Community Investment Plan will outline monitoring requirements	Adherence to the IFC Performance Standards	Through out operation on phase	**No cost**	NEPZA HR/ CLO
DECOMMISSIONING/ABANDONMENT										
Workforce/community welfare/ neihgbouring environment	Project Site workers	**Health and Safety**	Risk of accident and injury to workers during demolition of structures	**Low**	NEPZA should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height during maintenance and repair works, emergency prevention and management.	HSE key Performance indicators	Hazards observations, near misses, unsafe acts, zero PPE, incidence reports	Part of safety officer and HSE Manager's job description	No extra cost	HSE Manager •Safety Officer •FMEnv
	Project communit	**Air Quality**	Increased dust and vehicular	**Low**	-Energy conservation should be adopted by opting the alternate	Emissions monitoring.	The IFC Performance	Through out the	Cost associated	NEPZA HSE

	ies, Epe LGA		emissions during haulage of components from site by heavy-duty vehicles		energy options like solar power; -Suppress fugitive dust by sprinkling water; -Power Generators and equipment should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission; -Air pollution monitoring should be carried out quarterly by the industries to check the air pollution level;	Details to be agreed with FMEnv prior to operation.	Standards The WHO and EU Emission Standards Nigerian Emission	demolisi on phase	with ambient air monitoring programme	supervisor
	Stream around the site and Lekki Lagoon	**Surface water and ground water**	Risk of soil and adjoining surface water contamination from accidental oil and hazardous substance leakages	**Low**	-Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains. -Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. -Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. -Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. -Install oil/water separators and silt traps before effluent, leaves the site.	Check limits of specific parameters in soil and water	-Visual inspection and photographi c record -Soil quality monitoring form	Through out the demolisi on phase	100,000	HSE Manager •Safety Officer •FMEnv

	Lekki-Epe and Epe-Ijebu-Ode Road	**Safety**	Traffic obstruction from transportation of decommissioned structures and equipment	**Low**	-Coordinate with relevant agencies such as the Nigeria Police, LASTMA, NSCDC, etc. for traffic control -Schedule the movement of heavy-duty vehicles to off rush-hours in the area.	Accident record of all movement of personel and materials	Check compliance plan and record for traffic incidents	Through out the demolisi on phase	50,000	NEPZA HSE supervisor
	Host Communit ies	**Socio-economi c**	Availability of land for alternative uses	**-**	Return land to principal owner/Lagos State Government	**No monitoring required**	**No monitoring required**	**-**	**-**	**NEPZA manageme nt**
	Workers		Loss of employment	**Minor**	-Engagement and consultation with concerned workers -Good severance programme and package	IFC Performance Standard.	Engagement and Feedback	Before th close of the decomiss ioning stage		NEPZA Manageme nt, CLO

CHAPTER EIGHT
DECOMMISSIONING PLAN

8.1 INTRODUCTION

The project proponent (NEPZA) does not expect to close and terminate the operation of the Textile and Garment industrial Park for at least 50 years. On the other hand, in case closing and termination of the industrial will occur in the future the decommissioning will be done in accordance with a plan and standard procedures that meet local regulatory requirements and international standards. This section describes the activities that will be completed to restore the project location to an acceptable condition for its intended use. The incorporation of remediation plans into the overall project planning is essential because it allows proponents to understand the need for restoring the environment into its original, or near its original status when abandonment plans are being conceptualized.

8.2 STAKEHOLDERS CONSULTATION FOR DECOMMISSIONING.

Prior to decommissioning, NEPZA will consult with various stakeholders (e.g. Regulatory Bodies, Local Government and Host communities) regarding the details of decommissioning and would prepare an updated and comprehensive decommissioning plan as required to meet regulatory requirements in effect at that time.

8.3 PRE-DECOMMISSIONING ACTIVITIES

Prior to engaging in decommissioning works, the Proponent will develop a decommissioning plan in accordance with regulatory requirements at the time of decommissioning. Decommissioning and restoration activities will be performed in accordance with all relevant statutes in place at the time of decommissioning.

8.4 DECOMMISSIONING ACTIVITIES

At the end of the facilities utility, all equipment and structures will be decommissioned. In general, the activities to be carried out during the decommissioning phase shall include the following:

- Dismantling of towers including excavation
- Dismantling of all surface equipment and structures eg buildings
- Removal of foundations
- Environment and waste removal etc.

Managing Excess Materials and Waste

Most of the materials resulting from the decommissioning can be recycled or have residual value for reuse. conductors, and similar materials that cannot be re-used or recycled should be disposed of in the appropriate manner consistent with the requirements in place at the time.

8.5 IMPACTS AND MITIGATION MEASURES

Impacts

Typical activities during the decommissioning include removal of above ground components and gravel from access roads and other ancillary facility sites, breaking up of concrete foundations, recontouring the ground surface, and revegetation. Potential impacts from these activities are presented below, by the type of affected resource.

The potential impacts that might result from the decommissioning phase of the proposed project include:

- physical disturbance of the environment arising from the demolition of civil structures and ancillary equipment,
- potential hazards/accidents associated with decommissioning activities, and
- waste management problems

Acoustics (Noise): Sources of noise during decommissioning would be similar to those during construction and would be caused primarily by construction equipment and vehicular traffic

Air Quality: Emissions generated by activities during the decommissioning include vehicle emissions; diesel emissions from large construction equipment and generators; and fugitive dust from many sources such as structure removal, backfilling, dumping, reclamation of disturbed areas (grading, seeding, planting), and truck and equipment traffic.

Ecological Resources: Removal of aboveground structures would eliminate the impacts to wildlife that occur during operation (e.g. habitat fragmentation).

Environmental Justice: Issues that could be of concern during decommissioning and site reclamation are noise, dust, and visual impacts, as well as possible restoration of fish and wildlife populations for subsistence users.

Hazardous Materials and Waste Management: Impacts could result if these wastes were not properly handled and were released to the environment.

Human Health and Safety: Potential impacts to worker and public health and safety during decommissioning and site reclamation would be similar to those during construction; and relate to earthmoving, use of large equipment, dismantling of industrial components, and transportation of overweight and oversized materials.

Socioeconomics: Direct impacts would include the creation of new jobs for workers during decommissioning.

Soils and Geologic Resources*:* Activities during decommissioning that would result in impacts to soils include removal of access roads, transmission concrete foundation and other ancillary structures. Surface disturbance, heavy equipment traffic, and changes to surface runoff patterns could cause soil erosion. Soil erosion impacts include soil nutrient loss and reduced water quality in nearby surface water bodies.

Transportation: Short-term increases in the use of local roadways would occur during decommissioning and site reclamation. Overweight and oversized loads could cause temporary disruptions to local traffic.

Water Resources: Water would be used for dust control for road traffic, dismantling of towers, pipelines, substations, and other buildings, and for consumptive use by the construction crew. It might be trucked in from off-site or obtained from local groundwater wells or nearby surface water bodies, depending on availability**.**

Mitigation Measures

The strategy to be adopted for site remediation shall depend on the prevailing biophysical and social environmental attributes and the attendant impacts that may result from such an action as discussed in Chapter 6. The following measures need to be planned for implementation after decommissioning:-

- Facilities and ancillary equipment shall be dismantled completely
- All equipment and debris shall be removed from the environment
- Good waste management plan shall be implemented.

For abandonment, strict adherence to facilities abandonment policy, which includes restoring the project environment to its original status as much as possible, shall be encouraged. The procedure shall be in accordance with approved Environmental and Management Plan (EMP) and international industry standards. It is expected that if these measures are implemented, an environmentally friendly site restoration after decommissioning will be achieved.

Decommissioning of the Industrial Park and the ancillary installations will result in potential for work-related injuries and fatality from the dismantling process but increase land available for agriculture and other land use from the restoration of land to its original situation as much as possible and hand over of the reclaimed land to the original community and landowners

All facility components that can be used or recycled will be identified and quantified see Table 8.1. Vehicles for the operation and other facilities will be scrapped and / or moved to other locations. Topsoil will be added to the cleared site and seeded with a mix of fast growing native plant species.

8.6 Monitoring and Surveillance

After decommissioning and the clean-up process, the NEPZA will ensure to carry out environmental monitoring and surveillance. The essence is to:

i. to detect if an impact has occurred and to estimate its magnitude

ii. to ensure that legal standards for wastes are not exceeded;

iii. to check that mitigation measures are implemented in a manner prescribed in the report or other related documents.

8.7 IMPACT MONITORING

After decommissioning, the proponent will carry out impact monitoring. Variable to consider includes but are not limited to:

- Soil Status **-** Top and subsurface soil samples shall be collected from designated points within and around the project area.
- Water Quality Status (Groundwater & Surface water): Water samples from bore-holes and water body (rivers, streams, ponds, drainage) shall be collected monthly and analysed.

8.8 REPORTING

As required by regulations, a post-decommissioning report will be prepared and submitted to the Nigerian Regulators. The report will provide the following details:-

- Overview of decommissioning facilities
- Details of methods used for decommissioning
- Nature of decommissioning (partial or whole)
- Record of consultation meetings
- Details of recyclable/reusable materials/facility components
- Decontaminated facilities
- Decommissioning schedule
- State of the surrounding environment
- Waste management plan
- Plans for restoration/remediation.

Table 8.1: Typical Materials Decommissioned and their Typical Mode of Disposal

Component	Typical Mode of Disposal
Concrete Foundation	Crush and recycle as granular material
Solar Panel, turbine, dome for storage	Reuse or recycle
Steel and aluminium racks and mount	Salvage for reuse or recycle for scrap
Cablings and transmission lines	Recycle
Inverters step-up transformers, inverters and circuit breakers	Salvage for reuse or recycle for scrap
Granular materials	Reuse or dispose in landfill
Oil/lubricants/fuel containers	Can be Recycled
Hazardous materials	Shall be disposed through a licensed hauler
Geotextile materials	Shall be disposed in a landfill
Miscellaneous non-recyclable materials	Shall be disposed in a designated landfill

CHAPTER NINE

9.0 CONCLUSION

The conduct of this EIA for the proposed Textile and Garment Industrial Park project in the North East Quadrant of Lekki Free Trade Zone, Epe Local Government Area Lagoa State was executed in strict compliance with acceptable National and International regulatory requirements. The EIA process involved an extensive literature review, and wide-ranging consultation with all the identified communities and stakeholders, sampling and determination of the conditions of biophysical, social and health environmental components of the project area. The study sought the views and concerns of the host communities on essential aspects of the proposed project through special interaction and incorporated in the impact assessment process.

This EIA has identified and assessed both positive and negative impacts of the proposed project and accordingly evaluated the associated and potential negative effects on the environment (biophysical), socio-economic and health characteristics of the project area in detail and mitigation measures have also been prescribed for significant negative impacts. For effective implementation of the recommended mitigation measures, an Environmental Management Plan (EMP) has been developed to ensure environmental sustainability during the construction and operation phases of the proposed Garment and Industrial Park project.

The Environmental Impact Assessment also revealed that the project will have significant transformative impacts on the socio-economic life of the host communities and Lagos State in particular as well as the national economy in general.
The proposed Garment and Industrial Park would pose limited environmental and social risks, taken into account the proposed mitigation measures.
It is recommended that environmental performance should be regularly monitored to ensure compliance and that corrective measures be taken if necessary. In addition, it is very necessary that this information should be made available to the host communities on a regular basis.

The Environmental Management Plan (EMP) should be used as an on-site reference document during all phases (Planning, Construction and Operation) of the proposed Textile and Garment Industrial Park project.
Environmental auditing should be regularly undertaken, in order to determine compliance with the proposed EMP, and parties responsible for the implementation of the EMP should be held responsible for any inadequacy during the implementation process.

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