

ESIA

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

for the proposed

ATC

AGRICULTURAL TRANSFORMATION CENTRE

AT OKUKU, YALA LGA, CROSS RIVER STATE

by



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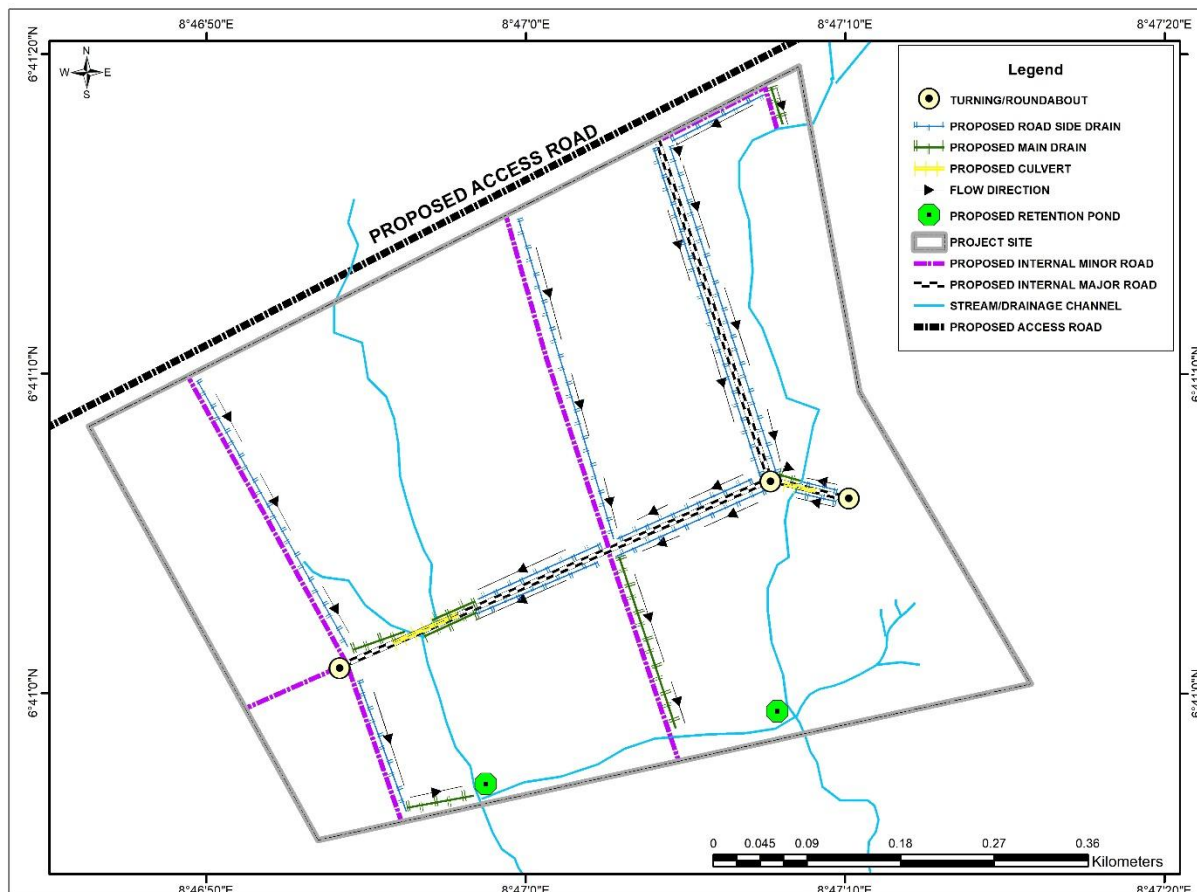


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Abbreviations & Acronyms

Acronym	Full Meaning
%	Percent
<	Less than
>	Greater than
≤	Lesser than or equal to
≥	Greater than or equal to
≥	Greater than or equal to
°C	Degree Celsius
°F	Fahrenheit
AfDB	African Development Bank
ATC	Agricultural Transformation Centre
AKSU	Akwa Ibom State University
AQ	Air Quality
CE	Critically Endangered
Cl ₂	Chlorine gas
CO	Carbon monoxide
CBO	Community-Based Organization
CRS	Cross River State
CRSMEnv	Cross River State Ministry of Environment
CRS-SAPZ	Cross River -Special Agricultural Processing Zone Program
CSO	Civil Society Organization
D	Dominant
Rmt	Running Meter
RCC	RCC – Reinforced Cement Concrete
MVA	MVA – Mega Volt Ampere
KVA	KVA – Kilo Volt Ampere
KLD	KLD – Kilolitre per Day
MBBR	MBBR – Moving Bed Biofilm Reactor
STP	STP – Sewage Treatment Plant
HDPE	HDPE – High-Density Polyethylene
GI	GI – Galvanized Iron
DD	Data Deficient
dB(A)	Decibel
E	East
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FBO	Farmer-Based Organization

Acronym	Full Meaning
FGD	Focus Group Discussion
FMAFS	Federal Ministry of Agriculture and Food Security
FMEEnv	Federal Ministry of Environment
FMoHSW	Federal Ministry of Health and Social Welfare
GBV	Gender-Based Violence
GI	Galvanized Iron
GPS	Geographic positioning unit
GRM	Grievance Redress Mechanism
H ₂ S	Hydrogen sulphide
HCN	Hydrogen Cyanide
HDPE	High-Density Polyethylene
IFAD	International Fund for Agricultural Development
IPP	Indigenous Peoples Plan
IsDB	Islamic Development Bank
IUCN	International Union for Conservation of Nature
KII	Key Informant Interview
KLD	Kilolitre per Day
LC	Least concern
LGA	Local Government Area
LGBTQ	Lesbian, Gay, Bisexual, Transgender, and Queer
LREP	Livelihood Restoration and Enhancement Plan
M	Meter
m/s	meters per second
m ³	Meter Cube
mg/m ³	Milligram per cubic meter
Max	Maximum
M&E	Monitoring and Evaluation
MBBR	Moving Bed Biofilm Reactor
Min	Minimum
MVA	Mega Volt Ampere
N	North
NE	North East
NGO	Non-Governmental Organization
NH ₃	Ammonia
NIOSH	National Institute of Occupational Safety and Health
NIMET	Nigerian Meteorological Agency
NO ₂	Nitrogen dioxide
NPC	National Population Commission
NT	Near Threatened
NW	North-West
PAPs	Project-Affected Persons

Acronym	Full Meaning
PEL	Permissible Exposure Limit
PM	Particulate matter
ppm	Part per million
PPP	Public-Private Partnership
RAP	Resettlement Action Plan
REA	Rural Electrification Agency
RCC	Reinforced Cement Concrete
Rmt	Running Meter
S	South
SE	South East
SAPZ	Special Agro-Industrial Processing Zones
SEA	Sexual Exploitation and Abuse
SGBV	Sexual and Gender-Based Violence
SIA	Social Impact Assessment
SMEs	Small and Medium Enterprises
SO ₂	Sulphur dioxide
STEL	Short-term Exposure Limit
STP	Sewage Treatment Plant
SW	South West
Th	Threatened
ToR	Terms of Reference
TVOCs	Total Volatile Organic Compounds
TWA	Time Weighted Average
VCD	Value Chain Development
VGP	Vulnerable Groups Plan
Vu	Vulnerable
W	West
WHO	World Health Organization
Zn	Zinc

EXECUTIVE SUMMARY

ES 1: Introduction

The Cross River State Agro-Processing Zone (CR-SAPZ) is part of the Federal Government of Nigeria's Special Agro-Industrial Processing Zones (SAPZ) programme, designed to enhance agricultural productivity and promote value addition in key agro-commodity chains. The proposed Agricultural Transformation Centre (ATC) in Okuku is a subproject of the CR-SAPZ located on a 37.8-hectare site in Okuku Community, Yala LGA, Cross River State. the CR-SAPZ aims to catalyze rural industrialization through modern infrastructure, reduce post-harvest losses, and create jobs. The project is sponsored by the Federal Ministry of Agriculture and food Security (FMAFS) and supported by the African Development Bank (AfDB), with implementation led by the Cross River State Government under a Public-Private Partnership (PPP) model.

The proposed ATC site in Okuku, Yala LGA is located at latitude 6°41'5.05"N; longitude 8°47'0.45"E along Ogoja-Yala highway in Okuku, Yala LGA of Cross River State and it covers 37.837 hectares of land owned by the Government of Cross River State but is used by the local farmers for cultivation of rice, yam, maize, groundnut and other crops, etc. The project site is located 350m north of the existing Ogoja Rice Mill which is an associated facility to the proposed ATC.

The project area, located in Yala LGA, Cross River State, lies within a tropical wet-and-dry climatic zone, characterized by high rainfall, moderate temperatures, and seasonal wind patterns. Soils are moderately fertile but erosion-prone, while air and groundwater quality are generally good. Surface water showed signs of seasonal turbidity and microbial contamination, highlighting the need for protective measures during construction.

Local biodiversity reflects a human-modified landscape dominated by farmland and secondary vegetation, with no endangered species recorded. Communities in the area are predominantly agrarian, with limited infrastructure and healthcare access. Public health challenges include malaria and waterborne diseases, underscoring the importance of targeted health interventions.

The ESIA was commissioned to comply with the Environmental Impact Assessment Act (Cap E12 LFN 2004) and the AfDB's Integrated Safeguards System (ISS). Its core objectives are to identify potential

environmental and social impacts of the CR-SAPZ, evaluate their significance, and propose mitigation and enhancement measures to ensure environmental sustainability, social inclusion, and compliance with national and international standards. The scope of the study includes an assessment of biophysical and socio-economic conditions, stakeholder engagement, and the development of a comprehensive Environmental and Social Management Plan (ESMP). Methodologies used include desk research, field sampling, socio-economic surveys, stakeholder consultations, GIS mapping, and impact analysis using standardized risk ranking matrices.

Chapter 3 outlines the comprehensive framework of environmental and social governance under which the CR-SAPZ program is being executed. It brings together the national, state, and international legal instruments, institutional arrangements, and policy frameworks that guide the planning, implementation, and monitoring of the Environmental and Social Impact Assessment (ESIA).

At the national level, emphasis is on the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, which mandates environmental evaluations for projects with significant environmental implications. The Federal Ministry of Environment (FMEnv) and the National Environmental Standards and Regulations Enforcement Agency (NESREA) are identified as the primary regulatory authorities. Other referenced legislation includes the Land Use Act of 1978, which governs land tenure and acquisition, and various sectoral environmental regulations.

In addition to Nigerian regulations, the project complies with international best practices and development partner guidelines, particularly those of the African Development Bank (AfDB). The AfDB's Integrated Safeguards System (ISS) outlines operational safeguards related to environmental sustainability, pollution prevention, resettlement, labor, and stakeholder engagement. The project's ESIA process aligns with these requirements through risk screening, stakeholder consultations, and the development of an Environmental and Social Management Plan (ESMP).

On the institutional front, the framework defines the roles and responsibilities of federal, state, and local government bodies, with provisions for oversight, enforcement, and collaboration. The Cross River State Ministry of Environment, the State Environmental Protection Agency, and relevant MDAs are key actors in this structure. Their engagement ensures that implementation aligns with environmental sustainability, community welfare, and statutory compliance.

The structure of the report is laid out in nine chapters, beginning with this introduction and followed by chapters covering project justification, legal frameworks, project description, environmental baseline, potential impacts, and mitigation planning, environmental and social management plans and a conclusion.

ES 2: Project Justification

The initiative is a response to persistent constraints in crop value chains within Cross River State—challenges spanning low yields, poor market access, inadequate processing technologies, unreliable infrastructure, and limited access to credit and extension services. These constraints have hindered agricultural productivity, especially among smallholder farmers who dominate the rural landscape.

The CR-SAPZ program aims to revitalize the agricultural sector by addressing these systemic issues through targeted investments in infrastructure, value addition, and market systems. Expected benefits include enhanced food security, poverty reduction, employment creation, improved livelihoods, and stimulation of both rural and national economies. Socioeconomic benefits are far-reaching: training in Good Agricultural Practices, creation of out-grower schemes, post-harvest loss reduction, and expanded access to domestic and international markets.

The benefits of the proposed project are detailed across three key stakeholder categories:

- **Government:** improved business environment, stronger investor confidence, and enhanced revenue generation;
- **Communities:** employment, market access, improved road networks, capacity building, and CSR-driven development;
- **Investors:** reduced operational costs, tax incentives, access to shared infrastructure, and compliance-ready facilities meeting international food safety standards.

Revenue streams for the ATC include land and facility leasing, energy and water supply fees, infrastructure maintenance, auxiliary services, and commercial ventures such as food courts, advertisements, and weighbridge operations. The project also demonstrates strong potential for

profitable cassava and rice value chains, highlighting job creation opportunities across logistics, processing, and export sectors, with high gender inclusiveness.

Sustainability was evaluated through environmental, social, economic, and technical lenses. The ESIA has embedded conservation strategies, climate-sensitive infrastructure designs, and stakeholder engagement mechanisms. Social sustainability is supported through inclusion of vulnerable groups, community hiring preferences, and livelihood restoration efforts. Economically, the ATC promises improved return on investment, labor absorption, and expanded markets. Technically, the project is deemed feasible due to its use of Best Available Technologies (BAT) and support from an experienced international contractor.

Three development options were considered: no-project (rejected due to food insecurity risks), delayed implementation (rejected due to inflation and opportunity loss), and immediate implementation (preferred for immediate and long-term benefits). For site selection, a GIS-based Multi-Criteria Analysis (MCA) was conducted comparing four potential sites. **Okuku** emerged as the most suitable based on topography, access to markets, drainage, and land use, outperforming alternatives like Bumbe in Obudu, Mbube in Ogoja and Abuagbor in Bekwarra LGA.

ES 3: Project Description

The ATC will operate under a Design, Build, and Operate (DBO) model, offering common-use infrastructure for agro-industrial tenants. Project Overview – Agro-Transformation Centre (ATC)

The proposed ATC development spans 37.8 hectares, integrating processing zones, vocational and training centres, residential and commercial areas, and supporting infrastructure. It complements the existing Ogoja Rice Mill and aims to catalyze agro-industrial growth in the region.

- **On-site Infrastructure** includes flexible road networks, stormwater drainage, power substations (13 MVA), borehole water supply, sewage treatment (500 KLD), and solar-powered street lighting.
- **Off-site Enhancements** involve rehabilitation of the Ogoja–Okuku Road to improve regional connectivity.
- **Utilities:** Water demand is estimated at 2,400 m³/day; power load at 10.98 MW, with solar hybrid backup systems.

- **Stormwater Management:** Dedicated discharge channels, roadside and main drains, culverts, and gravity-fed sewer systems.
- **Wastewater Treatment:** Packaged plants for domestic and industrial effluents.
- **Solid Waste Management:** Segregation of construction debris, sludge, and recyclables; residual waste handled by the Cross River Waste Management Agency.
 - Extensive use of cement, aggregates, steel, and heavy machinery.
 - Facility Management Plan embedded in the DBO contractor's scope to ensure long-term maintenance and sustainability.

Approximately 250 personnel of different cadre and origin would be required for the project implementation – 100 during the pre-construction phase, 250 during construction phase and 50 during operations. Some of these will feature in all the phases while others will participate in only one or two phases of the project.

ES 4: The Existing Environment

The ESIA for the Agricultural Transformation Centre (ATC) at Okuku was conducted using a structured, one-season field methodology, supported by stakeholder engagement and validated secondary data. Fieldwork was carried out during the wet season (June 2025), complemented by desktop reviews of prior EIAs and regional datasets to ensure contextual accuracy.

Baseline studies were conducted within a 500 m radius of the project site to understand the existing environmental and socio-economic conditions. Field sampling and laboratory analysis were carried out (at the Ministry of Science and Technology Laboratories in Uyo, Akwa Ibom State) in line with APHA (2017) standards and NESREA guidelines.

Physical Environment

- **Climate:** The area experiences a tropical humid climate with an annual rainfall of approximately 3,000 mm and an average temperature of 27°C.
- **Topography and Soil:** The terrain is gently undulating with loamy and sandy soil suitable for agriculture.
- **Hydrology and Hydrogeology:** Groundwater occurs at shallow depths; surface drainage is via natural creeks and man-made channels.
- **Air Quality and Noise:** Baseline air quality and noise levels were within FMEnv permissible limits, indicating minimal industrial activity.

- Water Quality: Groundwater and surface water samples met NESREA standards for pH, conductivity, total dissolved solids, and key ions.
- Geology: The area lies within the sedimentary basin with lateritic overburden and underlying shale/sandstone formations.

Biological Environment

- Flora: Vegetation consists of secondary regrowth and agricultural crops (cassava, maize, oil palm).
- Fauna: Common species include small mammals, birds, reptiles, and domestic animals; no endangered species were recorded.

Socio-Economic Environment

- Demographics: The Okuku community has a mixed population primarily engaged in farming and petty trading.
- Livelihoods: Agriculture is the dominant occupation; key crops include cassava, maize, and rice.
- Infrastructure: The community has basic amenities—schools, a health post, markets, and road access.
- Cultural Heritage: No sacred groves or archaeological sites were identified within the project footprint.
- Stakeholder Perception: The community expressed strong support for the project, emphasizing employment and market access benefits.

Stakeholder Engagement

The stakeholder engagement has been guided by philosophy of transparency, inclusiveness, free prior and informed consultation, cultural appropriateness, two-way dialogue, conflict sensitivity, and continuous engagement, with the objectives of identifying all relevant stakeholders, enabling active participation in decision-making, facilitating timely information sharing, ensuring grievances are addressed effectively, and building trust to minimise resistance while maximizing benefits.

Stakeholder mapping identified three categories: primary stakeholders – directly affected communities (Ipuole-Okuku), secondary stakeholders – regulatory agencies (FMEnv, NESREA, etc)

and other relevant MDAs, development partners, Yala local government council, and private sector actors, and tertiary stakeholders – NGOs, civil society, academic institutions, and media organisations.

Preliminary consultations during the ESIA preparation stage (May–July 2025) included stakeholder engagement / scoping workshop for all the categories of stakeholders on 17 June 2025 at Hogis Hotel, Calabar. Also, town hall meetings, focus group discussions, key informant interviews, and socio-economic surveys were conducted subsequently in Ipuole-Okuku community within the 3 km area of influence. Stakeholders, especially the PAPs and the Adiabo communities welcomed the proposed ATC but raised fears of project abandonment like a few other projects in the area that were not completed and operational. They expressed their expectations for project completion, and for local employment and inclusivity, fair compensation, market access, skills training, improved road and water infrastructure, and environmental protection measures.

The engagement strategy is designed for each phase of the project. A mix of engagement tools like community meetings, focus groups, local media, printed materials, social media, and liaison offices will ensure inclusivity and reach.

The FMEnv shall disclose the ESIA for 21 official days and place paid announcements in two national dailies and local radio station while AfDB shall disclose the cleared ESIA and other ancillary instruments on its website. Communication channels will be adapted for different audiences, including local languages and accessible formats for vulnerable groups. Monitoring disclosure effectiveness will involve surveys, meeting attendance records, and third-party reviews.

Grievance Redress Mechanism

A structured Grievance Redress Mechanism has been designed to provide multiple accessible channels for lodging complaints, establish a structured process for receiving, recording, and addressing grievances, ensure PAPs and vulnerable groups have equal access to resolution mechanisms, promote timely and transparent resolution of issues, and strengthen accountability of the CR-SAPZ, DBOC, and relevant public institutions.

The GRM will operate at multiple levels - starting with the Community Liaison Officer (CLO) as the first point of contact, escalation to the Grievance Redress Committee (GRC) at the project level, and further referral to state or national authorities, when necessary.

ES 5: Associated and Potential Impacts

The ESIA identifies a range of environmental, health, and socioeconomic impacts across the lifecycle of the Agricultural Transformation Centre (ATC) project in Okuku. The assessment covers pre-construction, construction, operation, and decommissioning phases, applying national regulations and international standards (e.g., ISO 14001 EMS). Impacts were rated by significance—low, medium, or high—based on legal compliance, risk severity, frequency, and stakeholder concerns.

Pre-Construction Phase

- **Land Use and Displacement:** Acquisition of 37.8 hectares of farmland will result in economic displacement and potential land-use conflicts if compensation is inadequate.
- **Community Pressure:** Early mobilization may lead to population influx, overstressing local infrastructure and services, with risks of sanitation issues, disease outbreaks, and noise pollution.
- **Cultural Sensitivity:** Disruption of informal communal land-use practices may occur, requiring culturally appropriate engagement.

Site Preparation Phase

- **Vegetation and Biodiversity Loss:** Clearing of 31 hectares will reduce carbon sequestration and disturb local flora and fauna.
- **Soil and Water Risks:** Topsoil removal and compaction increase erosion and sedimentation risks in nearby water bodies, potentially affecting aquatic habitats.
- **Air Quality Degradation:** Dust and emissions from biomass handling and earthworks may temporarily reduce air quality.

Construction Phase

- **Positive Impacts:** Employment generation, income growth, and stimulation of local commerce are expected.
- **Environmental Risks:** Large volumes of soil waste (~97,983.6m³), potential contamination of surface and groundwater, and increased dust and noise emissions.
- **Public Health and Safety:** Exposure to construction pollutants and occupational hazards; increased traffic and road safety concerns due to heavy machinery movement.

Operational Phase

- Positive Outcomes: Sustained job creation, business development, and regional economic uplift.
- Environmental Concerns: Air and noise pollution from processing facilities, soil contamination from maintenance waste, and improper agricultural waste handling.

ES 6: Mitigation Measures

A comprehensive set of mitigation measures have been developed in response to the potential environmental and social impacts identified in the project's impact assessment. The goal is to reduce medium- and high-significance adverse impacts to acceptable levels and enhance beneficial outcomes throughout the lifecycle of the proposed ATC in Okuku.

The mitigation approach is aligned with Nigerian environmental regulations, AfDB guidelines, and international best practices, while also incorporating stakeholder concerns and feasibility of implementation in the local context. Measures are categorized across the pre-construction, construction, operational, and decommissioning phases, addressing both biophysical and social receptors.

During the pre-construction phase, major issues such as land take, economic displacement, and potential community conflict are mitigated through the development of a Livelihood Restoration Program (LRP), transparent compensation mechanisms, and strong community liaison structures. Measures also address potential disease outbreaks and infrastructural strain from population influx, with sanitation, sensitization, and health support plans in place.

In the construction phase, mitigation targets employment conflict, noise, waste management, water contamination, and occupational safety. Strategies include prioritizing local hiring, fair recruitment practices, effective grievance redress systems, sound-proofing of machinery, dust suppression, proper batching plant siting, and water runoff control through silt fences and sediment basins.

Operational phase measures focus on pollution control, sustainable waste management, climate resilience, and community inclusion. These include air and noise emission controls, routine environmental monitoring, re-vegetation and erosion control, and provision of hazardous waste management systems. The plan also promotes economic participation of locals, addresses potential rise in social vices, and integrates skill-building programs for long-term community benefit.

During decommissioning, the plan ensures responsible dismantling of infrastructure, with measures to reduce dust and emissions, manage hazardous and non-hazardous waste, rehabilitate cleared land,

and protect community health. Personnel are to be trained and equipped with PPE, while site audits and environmental clean-up will ensure full compliance and restoration.

Across all phases, the mitigation measures aim to transition all high and medium-risk impacts to low significance, ensuring that project development proceeds in a sustainable, inclusive, and environmentally responsible manner.

ES 7: Environmental and Social Management Plan (ESMP)

The **ESMP** for the ATC provides a comprehensive strategy to mitigate environmental and social risks while enhancing the project's sustainability. The ESMP ensures compliance with Nigerian regulations and AfDB safeguards by translating the findings of the ESIA into actionable mitigation, monitoring, and capacity-building measures.

Capacity building and training are essential components for the successful implementation of environmental and social mitigation and monitoring plans throughout the lifecycle of the project. A well-structured capacity development strategy ensures that both project personnel and relevant stakeholders including contractors, host communities, and regulatory institutions possess the knowledge, skills, and tools necessary to comply with environmental standards, occupational health and safety protocols, and social engagement obligations.

Training needs were identified through a gap analysis of expected job functions, existing staff capacities, and stakeholder roles. The SPIU has two E&S safeguards officers (1 environmental, 1 social) and an M&E officer who need capacity strengthening in the areas of stakeholders' engagement, GRM implementation, monitoring, evaluation, and reporting of E&S safeguards instruments. The E&S safeguards officers of the DBOC and the Project Advisors will need the same capacity building. **Institutional Framework for ESMP Implementation**

Implementation of the ESMP is structured across multiple layers of responsibility:

- **CR-SAPZ SPIU:** Leads and oversees all ESMP activities including coordination, budgeting, and compliance reporting.
- **Design-Build-Operate (DBO) Contractors:** Handle day-to-day implementation of mitigation measures and incident reporting.

- Federal and State Ministry of Agriculture and Irrigation: Support the SPIU to ensure availability of improved crop seed varieties; offer extension services and design and disseminate IPM strategies adapted to local agronomic conditions
- National Programme Coordination Unit (NPCU): Inter-institutional and multi-stakeholder coordination.
- **Federal Ministry of Environment (FMEEnv) and Cross River State Ministry of Environment:** Provide regulatory oversight, environmental audits, and enforcement of national and state laws.
- **AfDB** – due diligence for compliance with all E&S safeguards requirements
- **Independent Environmental Consultants:** Monitor and report environmental performance, conduct lab analyses, and advise on improvements.
- **Community Liaison Officers (CLOs):** Engage with host communities, manage grievances, and support participatory monitoring.
- **Third-Party Auditors** (if engaged): Conduct compliance audits and independent assessments.

This collaborative structure ensures accountability, stakeholder inclusion, and proper execution across all project phases.

Monitoring Plan

The Environmental and Social Monitoring Plan (ESMoP) is central to the ESMP and ensures real-time evaluation of environmental and social performance. It includes:

- **Monitoring Parameters:** Air quality, noise, water quality, biodiversity, waste generation, employment ratios, community health, occupational safety, and grievance trends.
- **Frequency:**
 - Air/Noise/Community Health: Monthly
 - Water/Soil: Quarterly
 - Biodiversity: Bi-annually
 - Grievances and Safety: Monthly

- **Methodology:** Combines lab sampling, site inspections, social surveys, audits, and automated tools (e.g., noise meters, GPS trackers, rain gauges).
- **Reporting Structure:**
 - Daily logs by HSE officers
 - Weekly and monthly summaries to CR-SAPZ
 - Quarterly reports to FMEnv and annual audits by external reviewers
- **Key Performance Indicators (KPIs):**
 - ≥95% compliance with mitigation actions
 - <5% deviation from environmental baseline
 - ≥80% of grievances resolved within 14 days
 - ≥50% of workforce sourced locally
 - Zero fatalities and <1 LTIFR

This framework creates a feedback loop for continual improvement and ensures that emerging risks are identified early and managed effectively.

ES 8: Decommissioning and Abandonment

The decommissioning plan provides for environmentally responsible closure of the project. Activities include dismantling of equipment, removal of temporary structures, safe disposal of waste, soil remediation, and re-vegetation. Health and safety protocols will be observed, and local communities will be engaged to ensure smooth transition and possible reuse of the site for compatible purposes.

ES 9: Conclusion and Recommendations

The ATC will provide a significant opportunity to the farmers through improved agricultural productivity, in the entire value chain of the major crops of cassava, cocoa and rice. The construction and operation of the project will bring a large number of direct and induced employment opportunities to the local, regional and national economies. The project will significantly reduce poverty while protecting the environment. The adverse impacts generated by the project will be avoided or reduced to insignificant levels through appropriate mitigation and

compensation measures. Some adverse impacts, while mitigated to acceptable levels, will still be noticeable. These include a permanent net loss of agricultural land, two to five years' time required to completely replace the lost yields of tree crops. To ensure the protection of the environment from anticipated adverse impacts and to decide whether to take further actions for impact mitigation where needed, noise, air quality, and water quality will be monitored during construction and operation. The monitoring stations will be located in sensitive areas such as villages, schools, hospitals, and rivers.

The proposed ATC project is therefore recommended for ESIA Approval because the mitigation and enhancement measures that have been proffered will adequately address the identified impacts from the project; and the CR-SAPZ is committed to ensuring strict implementation of the project's ESMP.

ACKNOWLEDGEMENT

The Proponent, Cross River Special Agro-Industrial Processing Zone Program (CR-SAPZ), on behalf of the Government of Cross River State, wishes to express her appreciation and acknowledge the invaluable contributions, cooperation and support of the Federal Ministry of Environment, the Cross River State Ministry of Environment, African Development Bank (AfDB), the National Program Coordination Office for the Special Agro-Industrial Processing Zone Program (SAPZ), the Project Implementation Unit (PIU) team of the CR-SAPZ, Community Based Organizations, leaders and members of host communities, the environmental consultants, PGM Nigeria Limited, and other interested and affected parties for the successful preparation of this ESIA document.

1 CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The proposed Agricultural Transformation Centre located in Okuku, Yala Local Government Area of Cross River state is part of the Special Agricultural Processing Zones (SAPZs), a Federal Government of Nigeria's initiative driven by the Federal Ministry of Agriculture and Food Security (FMAFS) in collaboration with state governments, development partners, relevant federal ministries, departments and agencies (MDAs), and private investors and funded by the African Development Bank (AfDB), Islamic Development Bank (IsDB), International Fund for Agricultural Development (IFAD), and contributions from the Federal and State Governments.

This program aims to achieve greater economic diversification and promote long-term sustainable development. The Special Agro-Industrial Processing Zones program is a five-year program that is designed to develop multiple clusters of Agricultural Transformation Centers (ATCs) and Agro Industrial Hubs (AIHs) within major clusters of high agricultural production, where functional infrastructures like roads, power, water, communication are provided to attract private investment into modern Agro-industrial processing and value addition to locally produced crops, livestock and related agribusiness activities.

The establishment of SAPZs in Nigeria will boost the structural transformation of the economy by providing opportunities for public and private sector investment in agriculture, and when fully operational, the SAPZs will enhance national food and nutritional security, optimize the export of value-added agricultural commodities and improve the quality of livelihoods through wealth creation for rural farming communities.

The first phase of the SAPZ Program will be implemented in seven (7) states — Cross River, Imo, Kaduna, Kano, Kwara, Ogun, and Oyo, and the Federal Capital Territory (FCT). The Program is valued at USD 538.05 million (net taxes).

The SAPZ will consist of two key components: Agricultural Transformation Centres (ATCs) and Agro Industrial Hubs (AIHs) across the participating states and the FCT. Each facility, depending on the land area, may require Environmental and Social Impact Assessments (ESIAs) and Resettlement Action Plans (RAPs), or Livelihood Restoration Plans and other relevant environmental and social safeguards instruments, depending on the requirements of the funding partner.

Cross River State Government has therefore appointed PGM Nigeria Limited as Environmental & Social Safeguards Consultants to carry out the Environmental and Social Impact Assessment (ESIA) for the proposed Special Agro-Industrial Processing Zone Program in Cross River State. This is in compliance with the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, the AfDB's Integrated Safeguards System (2023), as well as other national and international regulations. The ESIA will apply the AfDB ISS 2023 across the ATC and any associated facilities like the nearby rice mill (functionally linked), and all associated facilities will be screened for E&S risks consistent with ISS and national law.

1.2 Proposed Project Location

The proposed Cross River State Special Agro-Industrial Processing Zone (SAPZ) project site in Okuku, Yala LGA is located at latitude 6°41'5.05"N; longitude 8°47'0.45"E along Ogoja-Yala highway in Okuku, Yala local government area of Cross River State (Figure 1.1 to 1.3) and it covers 37.837 hectares of land owned by the Government of Cross River State but is used by the indigenes for cultivation of rice, yam, maize, groundnut and other crops, etc.

As part of compliance with the Environmental Impact Assessment Act (Cap E12 LFN 2004) and AfDB Operational Safeguard 2 (Involuntary Resettlement), a comprehensive Resettlement Action Plan (RAP) accompanied by a Livelihood Restoration Plan (LRP) has been prepared for project-affected households who will experience loss of farmland or livelihood. These plans provide for fair compensation at full replacement cost, provision of alternative livelihood opportunities, and priority employment during construction and operations.

No physical displacement or relocation of residential structures is anticipated since the project site comprises farmlands rather than settlement areas. Economic displacement impacts have been assessed and mitigation will be implemented before commencement of construction. The RAP/LRP implementation will be monitored by the CR-SAPZ State Project Implementation Unit (SPIU) in

collaboration with the Federal Ministry of Environment (FMEnv), Cross River State Ministry of Environment (CRSMEnv), and the African Development Bank (AfDB) to ensure that all affected persons are adequately supported and their livelihoods fully restored.

The project site is located 350m north of Ogoja Rice Mill. Eastward, the proposed project site is located opposite Godwin Ali Cantonment and Army Barracks which are 700m and 1061m away from the site respectively. Other major landmarks around the proposed project site include Bakor Polytechnic Ogoja which is 1600m southward, University of Cross River State, Okuku Campus which is 2748m northward, Pollygals Hotel, which is located 2466m northward, among others. The drainage map of the study area shows that two first order streams under Ogoja watershed traverses the proposed project site at latitude 6°40'59.65"N; longitude 8°47'9.08"E (eastward) and latitude 6°40'58.67"N; longitude 8°46'58.16"E (westward) before joining at a confluence outside the project site at latitude 6°40'48.45"N; longitude 8°47'10.07"E which is 250m west of Ogoja Rice Mill (Figure 1.4).

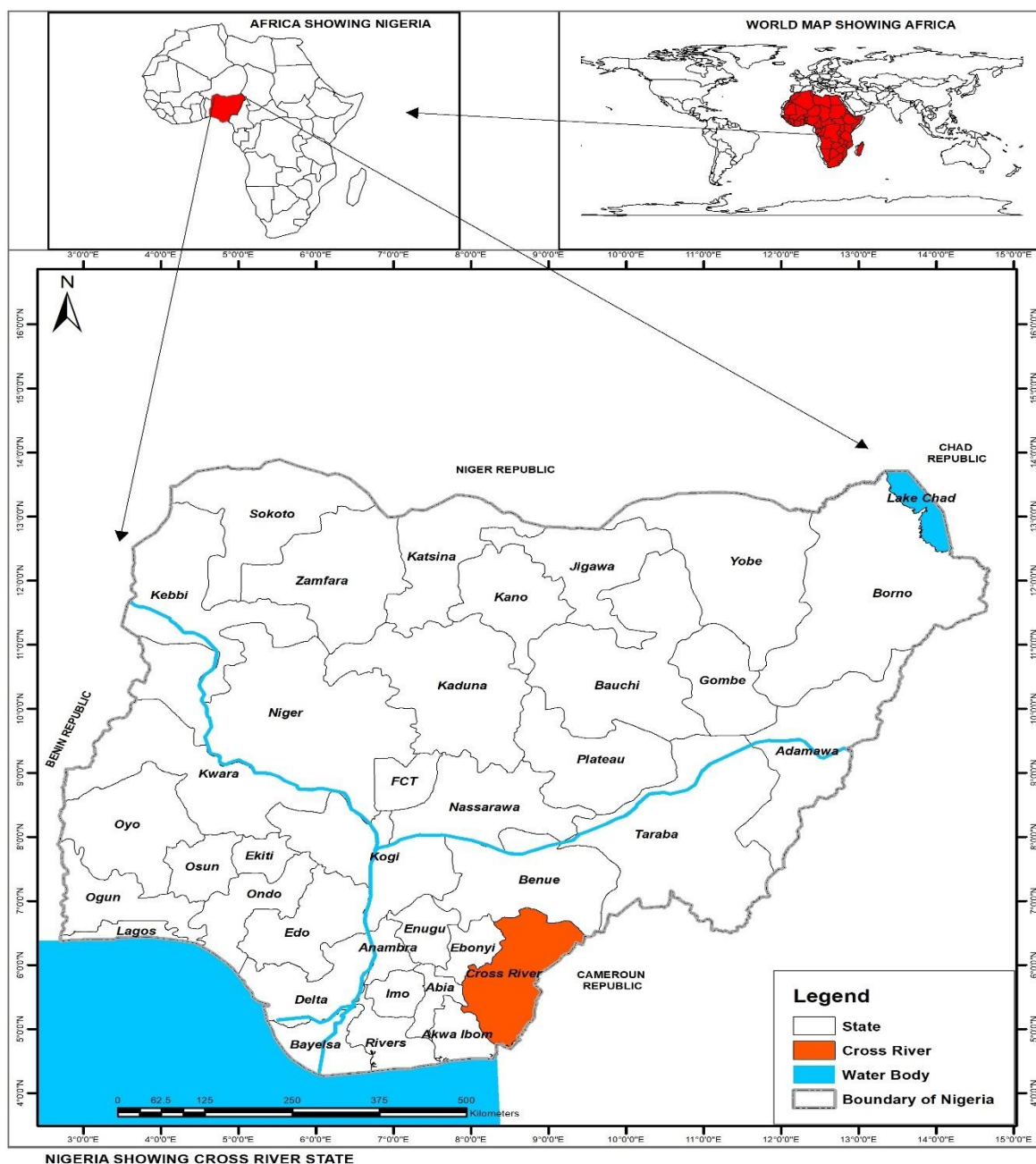


Figure 1.1: Map of Nigeria showing Cross River State

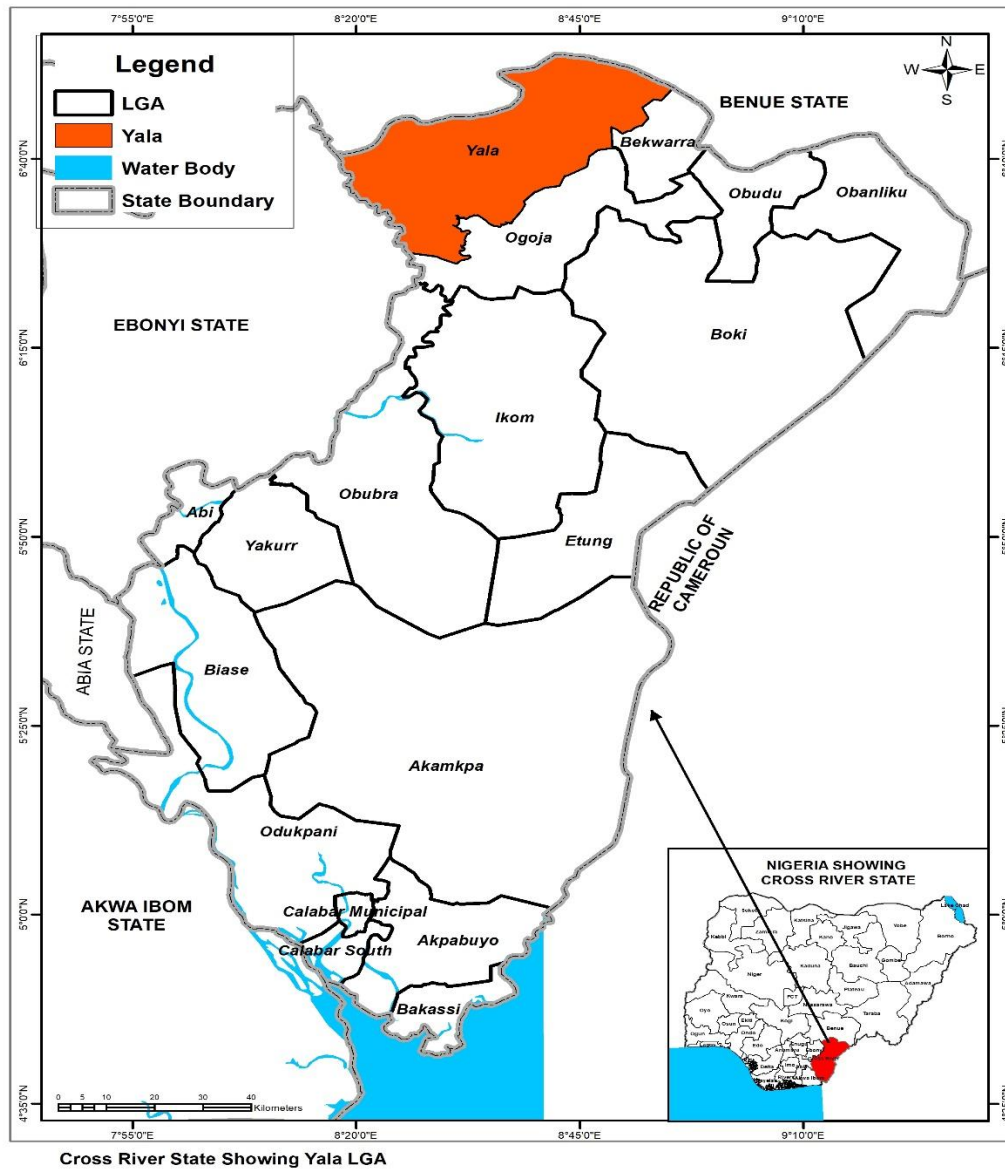


Figure 1.2: Map of Cross River State showing Yala LGA (The project LGA)

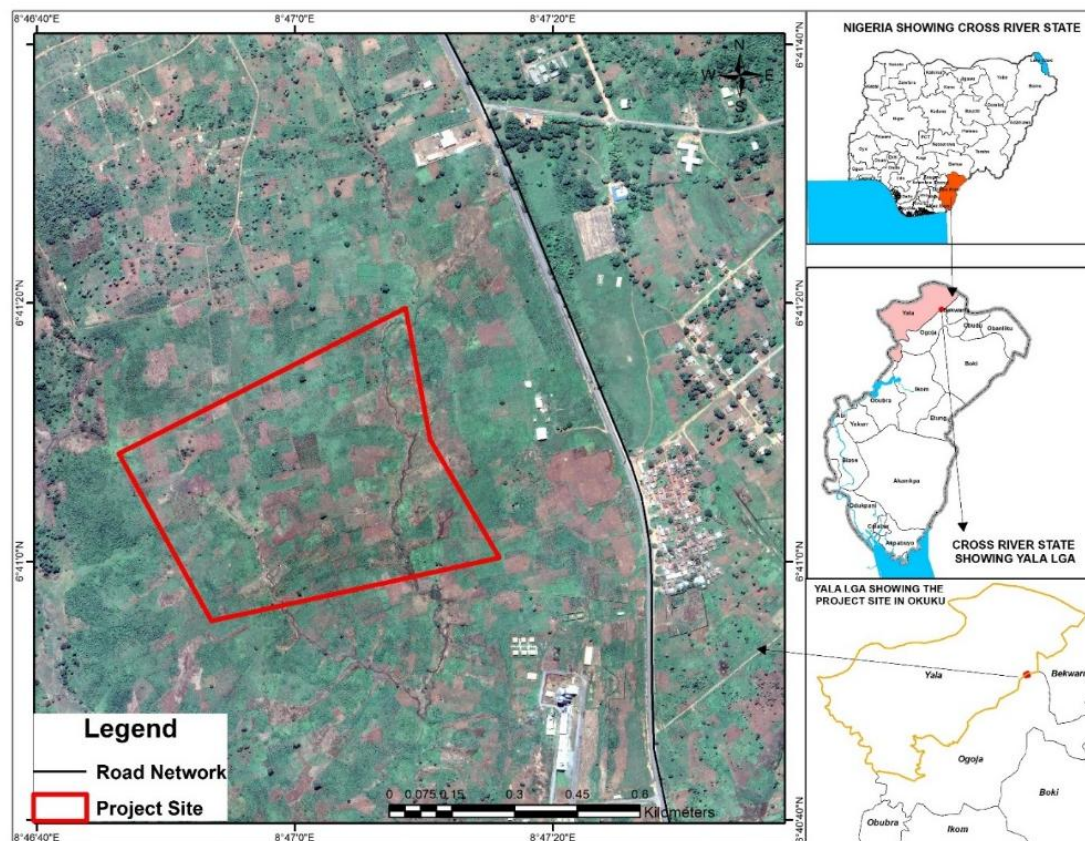


Figure 1.3: Location Map of the Cross River State Special Agro-Industrial Processing Zone (SAPZ) in Okuku, Yala LGA.

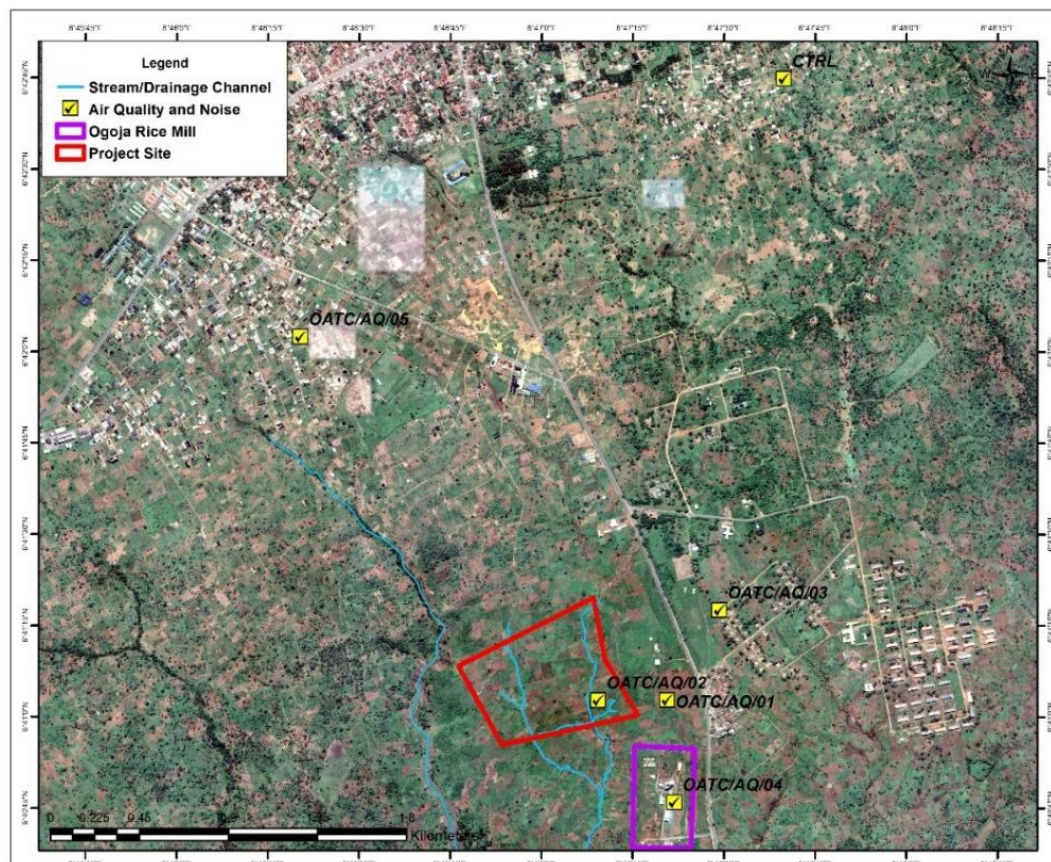


Figure 1.4: Satellite Imagery Showing Landmarks Around the Project Site in Okuku, Yala LGA.

1.3 Proponent's Intent & ESIA Objective

The proposed project is expected to have both negative and positive impacts on the environment and people of the area and it is recognized that comprehensive planning and management of environmental and socioeconomic issues are essential to the execution of any successful project. As such, the ESIA process seeks to fully integrate environmental and socioeconomic considerations into the life cycle of the proposed project.

CR-SAPZ, the proponent, therefore, has undertaken this environmental and social impact assessment, in parallel with the conceptual design of the project, to ensure that any identified adverse impacts are addressed in the detailed design and mitigated during the development stages which involves site preparation, construction, commissioning, operation, decommissioning and abandonment.

The purpose of this ESIA is to assess the potential and associated impacts of the project and project-related activities on the environment (including biophysical, and socioeconomic resources), and where applicable to proffer measures to enhance positive impacts and to avoid, reduce or mitigate (compensate) negative impacts to the environment; and develop cost-effective environmental and social management plans to make the proposed project sustainable.

Figure 1.3 depicts the Nigeria's country (FMEnv) ESIA process that has been adopted for the preparation and implementation of the ESIA of the proposed ATC project. This ESIA is prepared in accordance with FMEnv EIA Act Cap E12 LFN 2004 and AfDB ISS (2023), covering OS1, OS2, OS3, OS4, OS6, OS7, OS8, OS10, and OS5 were applicable.

1.4 Terms of Reference of the ESIA

The Terms of Reference (ToR) for the ESIA was prepared and submitted to the Federal Ministry of Environment (FMEnv) after the scoping exercise for approval in line with the requirements of the National EIA Procedural Guidelines. The ToR defined the objectives, and outlined the scope, approach, methodology and reporting format for the ESIA. The FMEnv's letter conveying approval for ESIA ToR for the project is attached as Appendix 1.1 to this report.

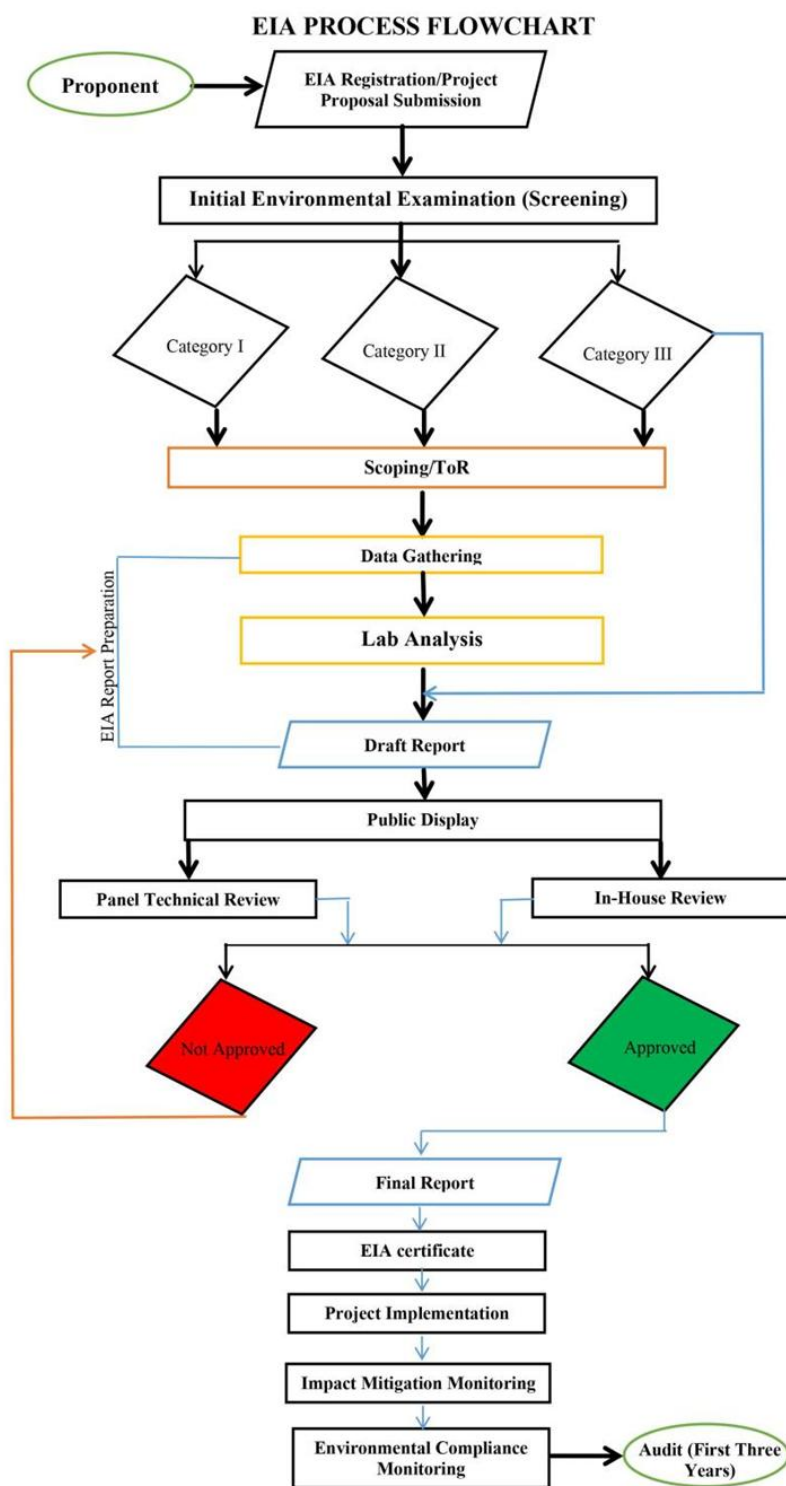


Figure 1.1: The ESIA Process

1.5 Statutory (Legal and Administrative) Framework

The legal, regulatory and policy framework for carrying out the ESIA of the proposed project is contained in the applicable acts and regulations of the Federal and State Government, statutes and international conventions to which the Nigerian Government is a signatory. Various environmental studies and related strategic initiatives would meet or surpass the relevant Nigerian and international environmental legislative requirements and guidelines. These include but not limited to:

1.5.1 Federal Ministry Environment

Act 58 of 1988 established the Federal Environmental Protection Agency (FEPA) as the chief regulatory body for environmental protection in Nigeria. The Act establishing FEPA placed on it the responsibility of ensuring that all industries meet the limits prescribed in the national guidelines and standards and the associated various regulations of environmental pollution management in Nigeria (e.g. effluent limitation, management of solid hazardous waste, etc.). FMEnv may update the National Guidelines and Standards from time to time.

Relevant specific standards, discharge limits, and other environmental requirements of the FEPA guidelines (1991) and subsequent relevant directives were reviewed. The Federal Government released the Environmental Impact assessment (EIA) Act CAP E12 LFN 2004. The Act makes the ESIA process mandatory for any major development project and prescribes the procedures for conducting and reporting EIAs.

1.5.2 FMEnv's Guidelines on ESIA

Federal Ministry of the Environment developed National ESIA procedures following the enablement of the EIA Act CAP E12 LFN 2004. The procedure indicates the steps to be followed from project conception to commissioning to ensure that the project is implemented with maximum consideration for the environment.

1.5.3 ESIA Sectoral Guidelines of the Federal Ministry of Environment

Federal Environmental Protection Agency (FEPA) was established by Act 58 of 1988 to monitor and prevent the pollution of the environment following the Koko toxic waste dump incident. This

status empowered the then FEPA to prepare Environmental Guidelines and Standards as instruments for prevention of environmental pollution. This Act also gives specific powers to FMEnv to facilitate environmental assessment of projects. In addition, FMEnv regulations S.I.8, S.I.9 and S.I.15 of 1991 provides guidelines and standards for the following:

- Solid and Hazardous waste management
- Effluent limitations
- Pollution abatement in industries generating waste.

In September 1995, EIA Sectoral Guidelines for proposed projects in Nigeria were published. The guidelines are intended to assist the proponent to conduct proper and detailed ESIA in compliance with the EIA Act of 1992. The procedure for EIA involves the project proposal stage where the project proponent officially notifies FMEnv of the proposed project. This proposal is to contain concise information of the project including a land use map. The legal and regulatory framework for carrying out ESIA of the proposed project are contained in relevant national statutes and international environmental conventions to which Nigeria is a signatory.

This stage is followed by the screening phase, whereby an Initial Environmental Examination (IEE) is executed by the FMEnv then the projects are assigned into categories based on the following criteria:

Magnitude

- Extent or Scope
- Duration and Frequency
- Risks
- Potential Environmental Impacts

Another stage of FMEnv's ESIA procedure is the scoping stage, the main feature of which the proponent is required to submit the Terms of Reference (TOR) for the proposed ESIA. In some cases, the FMEnv may demand a Preliminary Assessment Report from the proponent to assist in vetting the scope and the TOR of the proposed ESIA.

This stage is followed by:

- Actual Implementation of the ESIA
- Preparation of Draft Report
- Final ESIA Report
- Review Process and Approval/Certification.

Apart from the general EIA Guidelines, the Ministry has issued sectoral guidelines for ESIA in different infrastructural sectors.

1.6 Institutional Framework

A summary of other authorities with the mandate to implement aspects of Nigerian legislation over aspects relating to the Project are provided in this Section.

1.6.1 Federal Ministry of Environment (FMEnv)

FMEnv is the principal authority for the regulation and enforcement of environmental laws in Nigeria. The EIA Act, established by the Ministry, which ensures that all development and industrial activities, operations and emissions are within the limits prescribed in the national guidelines and standards and comply with relevant regulations for environmental pollution management in Nigeria as and when these are released by the Ministry. Further to the Mandate, FMEnv developed laws/ guidelines on various sectors of the national economy including the Environmental Impact Assessment (EIA Act CAP E12, LFN 2004) Act and procedures for evaluating EIA reports. Furthermore, in September 2021, through Official Gazette No. 105, Vol 108, the Federal Republic of Nigeria published S.I. No. 109, Environment Impact Assessment Procedures and Charges Regulations. This ESIA will consider these regulations, which outlines the EIA procedure from project conception to commissioning and describes the requisite follow up activities. FMEnv consults with State Ministries of Environment and their Environmental Protection Agencies during the EIA permitting process.

In addition, other regulatory agencies/authorities with oversight over specific industries have also issued guidelines to regulate the impact of such industries on the environment.

1.6.2 National Environmental Standards and Regulation Enforcement Agency (NESREA)

The National Environmental Standards and Regulations Enforcement Agency (NESREA) was established in 2007 by the Federal Government of Nigeria as an Agency of FMEnv. The Agency is charged with the responsibility of enforcing the environmental laws, guidelines, standards, and regulations in Nigeria, specifically during the operational phase of development projects.

1.6.3 National Regulatory Framework

The national policies and regulations included in Table 1.1 have E&S implications that pertain to the Project and associated ESIA.

Table 1.1: National Policies and Regulations and the Applicability thereof.

Governing Documents	Description	Applicability
National Policies		
National Policy on the Environment, 1989	The National Policy on the Environment, 1989 (revised 1999 and 2017), provides a national mechanism for routine coordination and consultation among various tiers of local, state, and federal government to improve the development and implementation of environmental policy as well as establish effective relationships. In doing so, this Policy aims to achieve sustainable development through conserving the environment and natural resources, raising public awareness between environmental resources development, maintaining, and enhancing ecosystem processes, and co-operating with other countries, organisations, and agencies to reduce transboundary environmental degradation.	In line with the aims of the policy, this ESIA includes an assessment of impacts to the physical, biological and Socioeconomical environments related with the different phases of the Project. Moreover, this ESIA includes mitigation measures and an associated Environmental and Social Management and Monitoring Plan (ESMMP) that aim to avoid /minimise/manage the severity of identified impacts. Once the ESIA is approved by the FMEnv, CR-SAPZ will need to implement the commitments included and conduct periodic audits to ensure continuous improvement.
National Policy on Climate Change, 2013	The mission of the National Policy on Climate Change, 2013 is to strengthen national initiatives to adapt to and mitigate climate change and involve all sectors of society, including the poor and other vulnerable groups (e.g., women, elderly, youth etc.) within the overall context of advancing sustainable	In line with the National Policy on Climate Change, 2013 and the Climate Change Act, 2021, the proposed ESIA will consider the climate change adaptation requirements for the Project and management relating to GHG emissions during all Project phases.

Governing Documents	Description	Applicability
	Socioeconomic development. Its main objectives are to: Implement mitigation measures that will promote low carbon as well as sustainable and high economic growth; Strengthen national capacity to adapt to climate change; Raise climate change-related science, technology, and research and development to a new level that will enable the country to better participate in international scientific and technological co-operation on climate change; Significantly increase public awareness and involve the private sector in addressing the challenges associated with climate change; and Strengthen national institutions and mechanisms (policy, legislative and economic) to establish a suitable and functional framework for climate change governance.	
Climate Change Act, 2021	The Climate Act 2021 provides a framework for achieving low greenhouse gas emission (GHG), inclusive green growth and sustainable economic development. The Act applies to the Ministries, Departments and Agencies (MDAs) of the Federal Government of Nigeria, and to public and private entities within boundaries of Nigeria for the development and implementation of mechanism geared towards fostering low carbon emission, environmentally sustainable and climate resilient society. Its main objectives are to: Ensure that Nigeria formulates programmes for achieving its long-term goals on climate change mitigation and adaptation; Facilitate the coordination of climate change action needed to achieve long-term climate objectives; Mainstream climate change actions in line with national development priorities;	

Governing Documents	Description	Applicability
	Facilitate the mobilization of finance, and other resources necessary to ensure effective action on climate change; Ensure that climate change policies and actions are integrated with other related policies for promoting Socioeconomic development and environmental integrity; Setting a target for year 2050-2070 for the attainment of a net zero GHG emission, in line with Nigeria's international climate change obligations; Identify risks and vulnerabilities, building resilience and strengthening existing adaptive capacities to the impacts of climate change; Implement mitigation measures that promote low carbon economy and sustainable livelihood; and Ensure that private and public entities comply with stated climate strategies, targets, and National Climate Change Action Plan.	
The National Gender Policy, 2021	The National Gender Policy, 2021 presents a set of minimum standards to meet the mandate for gender equality, good governance, accountability, and being socially responsive to the needs of vulnerable groups. The policy builds on the revision of the NGP, 2007 to respond to emerging issues across the sectors since 2006 and to incorporate current gender gaps to fulfil Nigeria's commitment to such global agenda as the SDGs. The strategic policy objectives are to bridge gender/social inclusion gaps, achieve parity in all spheres, to protect women's human rights, and mitigate sexual and gender-based violence through appropriate buffers and related services.	This ESIA process has (and continues) to be undertaken to ensure effective, transparent, and timely stakeholder engagement. Moreover, it will be structured such that all stakeholder engagement activities will take into consideration in gender sensitivities, particularly when engaging with local communities. Moreover, the ESIA considers gender equality in recruitment and that no employee or job applicant discriminated against on the basis of his or her gender, marital status, nationality, ethnicity, age, religion or sexual orientation.
National Policy on Occupational	The Occupational Safety and Health policy strengthens the National Labour Policy and extant labour legislations, provisions Cap 126, the workmen's	The safety, health and welfare of all the workers associated with the Project will need to be addressed in line with all the provisions of this Policy throughout

Governing Documents	Description	Applicability
Safety and Health, 2021	Compensation Act Cap 470, Trade Union Act Cap 126, Trade Dispute Act Cap 432, wages Board and Industrial Councils Act 466 and the Labour Act Cap 198, and other relevant Laws of the Federation of Nigeria. The goal of the policy is to facilitate improvement of occupational safety and health performance by providing the framework for participative occupational safety and health protection of workers including the most vulnerable groups in all sectors of economic activities.	the Project lifecycle (construction, operational and decommissioning phases).
National Policy on Solid Waste Management, 2022	The National Policy on Waste Management 2022 provides a guidance for efficient and sustainable solid waste management in Nigeria. The policy objective is to provide a national direction on solid waste management for the Federal, States, Local governments, private sector, and all stakeholders. In doing so, the policy aims to promote a healthy and aesthetically satisfactory environment by ensuring effective, sustainable, safe, and sanitary solid waste management.	The Project, during the construction, operational and decommissioning phases, will generate wastes, which will need to be disposed of as per the guidelines in this Policy. The ESMMP will consider these regulations and includes a section on solid waste management.
National Environmental Sanitation Policy, 2005 (revised 2018)	This Policy serves as the instrument for securing sustainable quality environment for good health and social wellbeing of present and future generations.	This ESIA process will be undertaken to cover events that could impinge on sanitation, hygiene, and health.
The Agriculture Promotion Policy, 2016	The Agriculture Promotion policy builds on achievement of Agriculture Transformation Agenda (ATA), 2011-2015 and was readjusted to solve challenges faced by implementation of ATA and highlight Federal government (in partnership with State Government) priorities in the agricultural sector.	In line with this policy, CR-SAPZ is required to abide to climate change and environmental sustainability in its operation and participation in agricultural promotion.
General Environmental		
Environmental Impact Assessment Act 86 of 1992 (amended by	This is the primary governing Act for EIA in Nigeria. The Act establishes a procedure and methodology to be followed to undertake an EIA. Section 2 (2) of the Act requires that an EIA must be	As the proposed Project will entail an EIA in line with the provisions of the EIA Act is therefore required prior to the project commencing. Accordingly, an ESIA is proposed to be carried out in

Governing Documents	Description	Applicability
EIA Act CAP E12 LFN 2004) and regulation 2021	undertaken in accordance with the Act when the extent, nature, or location of the proposed project or activities is likely to affect the environment significantly.	line with the requirements of this Act and has further considered the Environment Impact Assessment Procedures and Charges Regulation, 2021, CR-SAPZ shall be required to commit to implementing the commitments included in the ESMMP which will be laid out in the proposed ESIA Report and any other conditions as laid out by FMEnv, should an ESIA licence be issued for the Project.
National Environmental Impact Assessment Procedural and Sectoral Guidelines, 1994	FMEnv developed the National EIA Procedural Guidelines in response to the establishment of the EIA Act. The Procedural Guidelines assists proponents in conducting detailed E&S assessments by providing an overview of the baseline information, key issues, impacts, mitigation, and management plans to be considered as part of the EIA.	This ESIA will be undertaken to comply with the requirements of these Guidelines. CR-SAPZ shall be required to commit to implementing the resultant ESMMP and any other conditions stipulated by FMEnv.
The National Environmental (permitting & Licensing System) Regulation, 2009	The purpose of these regulation is to enable consistent application of Environmental Laws, Regulations and Standards in all sectors of the economy and geographical regions.	In line with these regulations, the ESIA will consider the Environmental Laws, guidelines, standards, and regulations in Nigeria during all Project phases.
Waste and Pollution		
National Environmental (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991, S.I.9	These Regulations impose restrictions on the release of toxic substances into the environment and stipulate requirements for pollution monitoring units, machinery for combating pollution, and contingency plans to be implemented by industries.	The Project, during the construction, operational and decommissioning phases, will generate wastes, which will need to be disposed of as per the guidelines in these Regulations. The ESMMP will consider these regulations and includes a section on the management of both non-hazardous and hazardous wastes.
National Environmental Protection (Effluent Limitation) Regulation 1991, S.I.8	The National Effluent Limitation Regulation, S.I.8 of 1991 (No. 42, Vol. 78, August 1991) makes it mandatory for industries such as waste generating facilities (including research institutes, clinics, hotels etc.) to install pollution prevention and pollution abatement	The Project, during the construction, operational and decommissioning phases, will generate waste effluent, which will need to be managed per the guidelines in these Regulations. This regulation requires the Project to install anti-pollution equipment for the

Governing Documents	Description	Applicability
	equipment on site. The regulation is specific for each category of a waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the ecosystem. Appropriate penalties for contraventions are also specified in the regulation.	detoxification of effluent and chemical discharges emanating from its activities and specify selected wastewater parameters for the industries in the First Schedule to the Regulations.
National Environmental (Management of Solid and Hazardous Wastes) Regulations, 1991, S.I.15	This instrument regulates the collection, treatment, and disposal of solid and hazardous waste streams from municipal and industrial sources. It gives a comprehensive list of chemicals and chemical waste by toxicity categories. The regulation requires the project proponent to practice waste segregation (at source) and engage the services of a government-approved waste management agents for appropriate waste disposal throughout the project's life cycle.	The Project, during the construction, operational and decommissioning phases, will generate wastes, which will need to be managed and disposed of as per the guidelines in these Regulations. The ESMMP will consider these regulations and includes a section on the management of both non-hazardous and hazardous wastes.
National Environmental (Sanitation and Wastes Control) Regulations, 2009, S.I.28	This Regulation aims to adopt sustainable and environment-friendly practices in environmental sanitation and waste management to minimize pollution.	The provisions included in this Regulation have been considered as part of the Project ESMMP.
Soils and Water		
National Environmental (Soil Erosion and Flood Control) Regulations, 2011, S.I.12	The overall objective of this Regulation is to ensure that projects developed on sites that are vulnerable to flooding, including facilities that serve such projects, are protected against flooding by appropriate design at the time of initial construction.	The provisions included in these Regulations will need to be considered by CR-SAPZ as part of Project Engineering designs.
National Environmental (Surface and Groundwater Quality Control) Regulations, 2011, S.I.22	The purpose of these Regulations is to enhance and preserve the physical, chemical and biological integrity and to maintain existing use of groundwater and surface water resources. The standards contained herein provide for the protection of surface and ground water from pollutants so that the waters shall be protected, used, developed, conserved, managed, and controlled in ways that take into account:	The Project will be associated with waste generation, more specifically solid and effluent wastes, which should be managed and disposed of in an environmentally friendly manner to avoid any form of pollution, including water pollution. This ESIA and associated ESMMP will consider these regulations.

Governing Documents	Description	Applicability
	■ Citizens right of access to clean water and sanitation; ■ Protection of aquatic ecosystems and long-term sustainability of water resources; and ■ Reduction and prevention of pollution and degradation of surface water resources and recognition of preventive, precautionary, and polluter-pays-principles.	
Water Resources Act, CAP W2 LFN, 2004	This Act is aimed at promoting the optimum planning, development, and use of Nigeria's water resources; ensuring the coordination of activities that are likely to influence the quality, quantity; distribution, use, and management of water; providing the application of appropriate standards and techniques for the investigation, use, control, protection, and management of water resources; and facilitating technical assistance and rehabilitation for water supplies.	In line with the requirements of this Act, CR-SAPZ will need to safeguard the integrity water systems within and surrounding the Project area throughout the implementation of the Project. This includes implementing proper waste management to prevent water pollution during the construction, operational and decommissioning phases.
Climate Change		
Climate Change Act, 2021	The Climate Change Act provides a legal and institutional framework for reducing GHG emissions in Nigeria. The objective of the law is to establish a framework for reducing GHG emissions and to embed climate change actions into national plans and programmes. The Act establishes the National Council on Climate Change (NCCC), which will be delegated the authority to make policies and decisions on all matters relating to climate change in Nigeria. The NCCC is directed to collaborate with the Federal Inland Revenue Service (FIRS) to develop a carbon tax in Nigeria. The proceeds from the carbon tax will go to the Climate Change Fund established under the Act. The Fund is to be used for the administration and general operation of the NCCC, the funding of innovative climate change mitigation and adaptation projects, conducting assessments of	In line with the requirements of this Act, this ESIA will consider the climate change adaptation requirements for the Project and management relating to GHG emissions during all Project phases.

Governing Documents	Description	Applicability
	climate change impacts on vulnerable communities, and incentivizing the transition to clean energy. The law is the first stand-alone comprehensive climate change legislation in West Africa. The Climate Change Act seeks to achieve net-zero GHG emissions in Nigeria between 2050 and 2070. It further provides a framework to help achieve Nigeria's NDCs and mandates the Ministry of Environment, in consultation with the Federal Ministry for Budget and National Planning, to set a carbon budget to keep the average increase in global temperature to within 2°C, and to help keep to 1.5°C rise above pre-industrial levels. The Act also requires the NCCC to collaborate with the FIRS to develop and implement a mechanism for carbon emission trading and empowers the Ministries to periodically revise the carbon budget, in line with Nigeria's NDCs with a view to complying with Nigeria's international obligations. The Climate Change Act also requires the preparation of a National Climate Change Action Plan (every five-years) to ensure that the carbon budgets are being met, and that climate change mitigation actions are identified and are being actively applied.	
Air Quality		
National Environmental (Air Quality and Control) Regulations, 2021, S.I.88	The objective of the Regulations is for the prevention, control, and reduction of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g. vessels, motor vehicles) and stationary sources (e.g. industries). Emission limits for different areas and facilities have been set. The regulations make provision for designating controlled areas and the setting of	The Project, during the construction, operational and decommissioning phases, will generate air emissions. As part of this ESIA process, an air quality study will be undertaken. The primary objective of the air quality study is to consider and assess the potential impacts which the Project may have upon existing air quality, during both construction and operational phases. The assessment of construction impacts focuses on the potential effect

Governing Documents	Description	Applicability
	objectives of air quality management plans for these areas.	of construction dust and construction-related combustion emissions (including vehicles) at existing sensitive receptor locations immediately adjacent to the Project. The assessment of operational impacts focuses on the potential negative effects of pollutants from a variety of sources. Impacts of emissions on air quality have been quantified by comparison of the predicted maximum concentrations with the Project applicable air quality standards (which have considered these Regulations). Moreover, the ESMMP includes specific controls to mitigate air quality emissions.
Noise		
National Environmental (Noise Standards and Control) Regulations, 2009, S.I.35	The Regulation highlights the permissible noise levels to which a person may be exposed, control and mitigate noise, permits for noise emissions above acceptable levels and enforcement maximum permissible noise levels a facility or activity to which a person may be exposed to.	The Project, during the construction, operational and decommissioning phases, will generate noise. As part of this ESIA process, a noise study will be undertaken. The study will consider noise emissions at the potentially most affected noise sensitive receiver (NSR) locations in proximity to the Project. The Project will be required to comply with these Regulations to promote a healthy and safe working environment throughout all Project phases. Noise impacts have been quantified by comparison of the predicted maximum concentrations with the Project applicable noise standards (which have considered these Regulations). Moreover, the ESMMP includes specific controls to mitigate noise emissions.
Biodiversity		
National Environmental (Control of Alien and Invasive Species) Regulations, 2013, S.I.32	This regulation seeks to prevent the decline and minimise the modification and destruction of the ecosystem and human health caused by alien and invasive species.	This ESIA and associated ESMMP will consider a range of potential ecological impacts associated with the Project, including the control of invasive alien plants in the immediate Project area and surrounds.

Governing Documents	Description	Applicability
Endangered Species Act CAP E9 LFN, 2004 as amended 2016	This Act prohibits, except under a valid license, the hunting, capture, or trade-in animal species, either presently or likely being in danger of extinction, and defines the liability of any offender under this Act. It also provides for regulations to be made necessary for environmental prevention and control regarding the purposes of this Act.	These regulations have been considered in the biodiversity study for the ESIA and associated ESMMP.
Health and Safety and Labour		
Employment Laws and Regulations Nigeria 2023	The Employment Laws and Regulation 2023 strengthens employment laws as stated in the constitution of the Federal Republic 1999, the Labour Act 2004, Federal and State laws that relate to labour and employment, and international conventions, treaties and protocols relating to labour and employment, industrial relations or matters connected therewith that have been ratified by Nigeria.	CR-SAPZ will be bound to abide to Nigeria labour and employment laws and regulation during its Project lifecycle.
Factories Act, CAP F1 LFN 2004	The Factories Act 1990 (amended in 2004) is the primary law regulating the health, safety and welfare of workers in the country's factories. The Law holds management and staff personally responsible for violations of the provisions in the Act.	The safety, health, and welfare of all the workers associated with the Project will need to be addressed in line with all the provisions of this Act throughout the Project lifecycle.
Labour Act, CAP L1 LFN 2004	Nigeria has ratified all core International Labour Organisation Conventions. The Labour Act 1990 (amended in 2004) is the primary law protecting the employment rights of individual workers. The Act covers protection of wages, contracts, employment terms and conditions, and recruitment; and classifies types of workers and special workers.	CR-SAPZ will be bound by this Act to abide to its stipulation on employee management and remuneration during its construction and operational phases.
Trade Unions Act, 2005	This Act contains provisions with respect to the formation, registration, and organization of trade unions. It includes stipulation of 'equal pay for equal workers without discrimination on account of sex, or any other ground whatsoever'.	The Proponent will respect workers' rights to join (or not join) unions of their choice and to engage with those unions which workers are members of in relation to collective bargaining, disciplinary proceedings, and retrenchment of workers.

Governing Documents	Description	Applicability
National Minimum Wage Act, 2019 (Amended 2024)	The Act prescribes the national minimum wage and provides for a legal framework for a seamless review of the stated national wage.	CR-SAPZ will abide to the stipulation of this Act on employee remuneration during the Project lifecycle.
Employee Compensation Act, 2010	This Act repeals the Workmen's Compensation Act W6 LFN 2004 and makes comprehensive provisions for payment of compensation to employees that suffer from occupational diseases or suffer injuries from accident at workplace or in the course of the employment.	The safety, health, and welfare of all the workers associated with the Project will need to be addressed in line with all the provisions of this Act throughout the Project lifecycle.
Pension Reform Act, 2014	This Act makes provision for the contributory pension scheme for public and private sectors in Nigeria.	CR-SAPZ will be bound by this Act to abide to its stipulation on employee remuneration during all Project phases.
Violence against Persons (Prohibition) Act, 2005	The Violence against Persons (Prohibition) Act (VAPP) was passed into law in May 2015. The Act was necessitated as a result of agitations for the protection of persons against different forms of violence. The Act has strengthened advocacy against rape, female genital mutilation, partner battery, stalking, harmful widowhood practices while prohibiting all forms of violence, including physical, sexual, psychological, domestic, harmful traditional practices and discrimination against persons. It also provides maximum protection and effective remedies for victims and punishment of offenders.	The safety, health, and welfare of all the workers and communities associate with the Project will need to be addressed in line with all the provisions of this Act throughout the Project lifecycle.
Land		
Land Use Act CAP L5 LFN, 2004	Land Use Act No. 6 was enacted in 1978 (revised in 1990 and 2004). The Act vests all land in the territory of each State (except land vested in the Federal Government or its agencies) solely in the Governor of the State, who holds such land in trust for the people and is solely responsible for the allocation of land in all areas, to individual resident in the State and to organizations for residential, agricultural, and commercial purposes.	CR-SAPZ will have to legally secure rights to the land associated with development of the Project.
Other		

Governing Documents	Description	Applicability
National Environmental (Ozone Layer Protection) Regulations, 2009, S.I.32	This regulation prohibits the use, emission, storage, and disposal of stratospheric ozone-depleting substances (ODS) and articles which contain those substances.	CR-SAPZ will need to ensure that equipment containing ODS's will either not be used on site or, if currently being used, will need to be phased out.
National Environmental (Construction Sector) Regulations (S.I No. 19), 2011	The purpose of these Regulations is to prevent and minimize pollution from construction, decommissioning and demolition activities applicable to Nigerian projects. It stipulates that new projects in the construction sector shall apply cost-effective, up-to-date, efficient, use best available technology, to minimize pollution to the barest degree practicable.	This ESIA considers a variety of potential impacts that may result in pollution to the environment during the construction and decommissioning phases of the Project. CR-SAPZ shall be required to commit to implementing the ESMMP laid out in this ESIA and any other conditions stipulated by FMEnv.
Harmful Waste (Special Criminal Provisions) Act CAP H1 LFN, 2004	The Harmful Waste (Special Criminal Provisions) Act CAP H1 LFN, 2004 prohibits and declares unlawful activities relating to the purchase, sale, importation, transit, transportation, deposit, and storage of harmful wastes. Appropriate penalties for infringement are prescribed.	The Project is not anticipated to generate any harmful waste, ESMMP will consider these regulations and includes a section on the management of both non-hazardous and hazardous wastes.
The Standards Organization of Nigeria (SON) ACT NO. 14, 2015	The Standards Organisation of Nigeria was established by Act. No.56 of 1971 which vested it with the authority for: Standards elaboration, Specifications, Quality assurance system of commodities, manufactured industrial and imported products and services generally. The Act No. 14 of 2015 amended the previous SON Act, 2004, and was enacted for the purpose of providing additional functions for the Standards Organisation of Nigeria, increasing penalty for violations; and for related matters.	CR-SAPZ shall be required to commit the quality standards as certified by SON throughout its operation.
Criminal Code of 1990 (now CAP 38 LFN, 2004)	The Act contains the primary criminal law offences related to environmental damage, public health, and natural resources. Some environmental crimes include causing a public nuisance, fouling the water of any spring, stream, well, or reservoir of a place, and violating the	CR-SAPZ shall be required to commit to implementing the ESMMP laid out in this ESIA and any other conditions stipulated by FMEnv and Cross River State environmental legislations (CRMEnv, town planning, water resources permit) relevant

Governing Documents	Description	Applicability
	atmosphere in any position to make it harmful to the health of persons.	

Other applicable national laws and regulations include:

Conventions, Protocols and Agreements

Nigeria is a signatory to several international conventions and agreements targeted toward the conservation and protection of the environment to ensure sustainable development. The relevant international conventions and regulations most applicable to the project are highlighted below in Table 1.2.

Table 1.2: List of Relevant International Conventions and Regulations

Conventions	Year Adopted	Overview
The Paris Accord	2015	The Paris Accord is a legally binding international treaty on climate change. It was adopted by 196 Parties at the United Nations Climate Change Conference, COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. The Paris Accord's long-term temperature goal is to keep the rise in mean global temperature to well below 2 °C (3.6 °F) above pre-industrial levels, and preferably limit the increase to 1.5 °C (2.7 °F), recognizing that this would substantially reduce the impacts of climate change. Emissions should be reduced as soon as possible and reach net-zero in the second half of the 21st century. It aims to increase the ability of parties to adapt to climate change impacts and mobilize sufficient finance. Under the Agreement, each country must determine, plan, and regularly report on its contributions.
International Health Regulations (IHR)	2005	The IHR is an international legal instrument that is binding on 196 countries across the globe, including all the Member States of World Health Organisation (WHO). This binding instrument of international law was first adopted in 1969,

Conventions	Year Adopted	Overview
		revised in 2005 and entered into force on 15 June 2007. The purpose and scope are “to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks and which avoid unnecessary interference with international traffic and trade”.
International Labour Organization (ILO): ILO-OSH, 2001 - Guidelines on Occupational Safety and Health (OSH) Management	2001	These guidelines call for coherent policies to protect workers from occupational hazards and risks while improving productivity. The guidelines present practical approaches and tools for assisting organisations, competent national institutions, employers, workers, and other social partners in establishing, implementing and improving occupational safety and health management systems, with the aim of reducing work-related injuries, ill health, diseases, incidents and deaths. At the organisational level, the guidelines encourage the integration of OSH management system elements as an important component of overall policy and management arrangements. Organizations, employers, owners, managerial staff, workers, and their representatives are motivated in applying appropriate OSH management principles and methods to improve OSH performance. Nigeria ratified the guidelines in 2001.
The United Nations Convention on Biological Diversity	1994	The Convention was adopted in 1994. The objectives of the Convention include the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.
The Rio Declaration on Environment and Development	1992	The Declaration was made in 1992 in Rio de Janeiro, reaffirming the declaration of the United Nations Conference on Human Environment

Conventions	Year Adopted	Overview
		adopted at Stockholm in 1972. The principle works towards international agreement which respects the interest of all and protects the integrity of the global environment and development. The principles of the declaration relevant to the proposed project include: <u>Principle 4:</u> In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it. <u>Principle 17:</u> EIA as a national instrument shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.
The United Nations Framework Convention on Climate Change	1992	The Convention on Climate Change was adopted in 1992 during the Rio Earth Summit in Rio De Janeiro, Brazil and entered into force in 1994 to limit Greenhouse Gas (GHG) emissions which cause global warming.
International Convention on Oil Pollution Preparedness, Response, and Co-operation (OPRC)	1990	Parties to the International Convention on OPRC are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries. Parties to the convention are required to provide assistance to others in the event of a pollution emergency and provision is made for the reimbursement of any assistance provided. Ships and operators are required to carry a shipboard oil pollution emergency plan, oil pollution emergency plans or similar arrangements which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents.
The Montreal Protocol on Substances that	1987	The Protocol was adopted on 16 September 1987 as an international treaty to eliminate ozone

Conventions	Year Adopted	Overview
deplete the Ozone Layer. Adopted on September 16, 1987.		depleting chemicals production and consumption.
Vienna Convention for the Protection of the Ozone Layer.	1985	The Vienna Convention was adopted in 1985 and entered into force on 22 September 1988. It places general obligations on countries to make appropriate measures to protect the environment against adverse effects resulting from human activities which tend to modify the ozone layer.
Protocol Concerning Cooperation in Combating Pollution in Cases of Emergency in the West and Central African Region	1981	The objective of the protocol is to protect the marine environment, the coastal zones and the related internal waters falling within the jurisdiction of the States of the West and Central African region against pollution in cases of emergency. The Parties undertake to cooperate in all matters relating to the protection of their respective coastline and related interests from the threat and effects of pollution resulting from marine emergencies, especially by exchanging relevant information (arts. 4, 5, 6, 7, 8 and 10). They agree to assist each other, on demand, in cases of marine emergencies (art. 8). Finally, they are to endeavor to maintain and promote marine emergency contingency plans (art. 9) and take appropriate measures to prevent, reduce, combat and control the effects of pollution (art. 10).
Convention on the Conservation of Migratory Species of Wild Animals, 1979	1979	This Convention, also known as the Bonn Convention, was adopted in 1979 and entered into force in 1983. It stipulates actions for the conservation and management of migratory species including habitat conservation. <u>West African Aquatic Mammals Memorandum of Understanding (MoU), 2008</u> This MoU concerns the conservation of the manatee and small cetaceans of Western Africa and Macaronesia. It is a Multilateral Environmental MoU and entered into effect on 3

Conventions	Year Adopted	Overview
		October 2008 under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals. The MoU aims to protect these species at a national, regional, and global level. <u>MoU concerning Conservation Measures for Marine Turtles of the Atlantic Coast</u> This MoU requires signatories to endeavour to put in place measures for the conservation and, where necessary and appropriate, strict protection of marine turtles at all stages of their life cycle (including eggs, hatchlings, juveniles, sub-adults and adults. It came into effect in 1999 and is an agreement under Article IV, paragraph 4, of the Convention on the Conservation of Migratory Species of Wild Animals.
African Convention on the Conservation of Nature and Natural Resources	1968	The African Convention on the Conservation of Nature and Natural Resources was adopted in Algiers, Algeria, on 15 September 1968, and entered into force on 16 June 1969. The Convention stipulates that the contracting States shall undertake to adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interests of the people.

1.7 International Best Practice Standards and Guidelines

African Development Bank's Integrated Safeguards System

The AfDB provides a set of 10 Operational Safeguards standards that present a credit risk management framework for determining, assessing and managing social and environmental risk in project financing

The AfDB's ISS establishes a unified framework of operational safeguards (OS) designed to promote environmental sustainability, social inclusion, and resilience in all Bank-financed projects. Based on the project's characteristics, scale, and identified environmental and social risks, the CR-SAPZ Adiabo project has been classified as a Category 1 project — requiring a full ESIA, Environmental and Social Management Plan (ESMP), and Resettlement Action Plan (RAP). The AfDB Operational Safeguards (OS) applicable to the CR-SAPZ Okuku project is presented in Table 1.3.

Table 1.3: AfDB Operational Safeguards (OS) applicable to the ATC Okuku

Operational Safeguard	Objective / Key Requirements	Relevance to the Project
Environmental and Social Operational Safeguard 1: Assessment and Management of Environmental and Social Risk and Impact	This OS, together with OS10 (<i>Stakeholder Engagement and Information Disclosure</i>), provide the overall process framework for the ESA and management of Bank-financed operations at the level of the project, activities or other undertakings supported through Bank financing. The objectives of OS1 include: Identify and assess the E&S risks and impacts including those related to gender inequalities, climate change, and vulnerability of Bank lending, investment, and grant-supported operations, in their areas of influence in a manner consistent with the OSs; provide opportunity for stakeholder engagement and consultation in assessing and managing the E&S risks and impacts; and utilize national E&S institutions, systems, laws, regulations, and procedures in the assessment.	Fully applicable. The Agro-Industrial Hub is a Category 1 project with potential biophysical and socio-economic impacts. A comprehensive ESIA and ESMP have been prepared to identify, assess, and manage these impacts in compliance with AfDB's ISS.
Environmental and Social Operational Safeguard 2: Labour and Working Conditions	creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions.	Fully applicable. A Labour Management Plan (LMP) and Occupational Health and Safety Plan (OHS) are embedded in the ESMP. These address local employment, PPE provision, safe work conditions, grievance redress, and emergency preparedness.
Environmental and Social Operational	This Operational Safeguard (OS) recognizes that economic activities often cause air, water, and land pollution, and consume finite resources that may threaten people, ecosystem services, and the	Applicable. The project includes processing and construction activities with potential emissions and

Operational Safeguard	Objective / Key Requirements	Relevance to the Project
Safeguard 3: Resources Efficiency and Pollution Prevention and Management	environment at the local, regional, and global levels. The current and projected atmospheric concentration of greenhouse gases (GHGs) threatens the welfare of current and future generations.	effluents. The ESMP incorporates air quality management, waste segregation, stormwater control, and energy-efficient systems (including 1.098 MW solar hybrid installation)..
Environmental and Social Operational Safeguard 4: Community Health, Safety and Security	This Operational Safeguard (OS) recognizes that projects, activities, equipment, and infrastructure can increase community exposure to risks and impacts. OS4 addresses the health, safety, and security risks to and impacts on project-affected communities and the corresponding responsibility of the Borrower to avoid or minimize them, with particular attention to people who, due to their particular circumstances, may be vulnerable.	Implementation of the Project will need to ensure that the health, safety and security of all Project affected communities are not compromised.
Environmental and Social Operational Safeguard 5: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement	Environmental and Social Operational Safeguard (OS) 5 recognizes that project-related land acquisition, restrictions on land access or land use, and loss of property/assets can have adverse impacts on communities and persons. Project-related land acquisition and restrictions on land use may cause physical displacement (relocation, loss of residential land or loss of shelter), economic displacement (loss of land, assets or access to assets, leading to loss of income sources or other means of livelihood), or both.	Fully applicable. Approximately 94.6 ha of farmland cultivated by 145 households will be affected. A Resettlement Action Plan (RAP) with a Livelihood Restoration Plan (LRP) has been prepared to ensure equitable compensation and livelihood improvement
Environmental and Social Operational Safeguard 6: Habitat and Biodiversity Conservation, and Sustainable Management of Living Natural Resources	This Environmental and Social Operational Safeguard (OS 6) outlines the requirements for the Borrower to (i) identify and implement opportunities to conserve and sustainably use biodiversity and natural habitats; and (ii) observe, implement, and respond to requirements for the conservation and sustainable management of priority ecosystem services.	Applicable. The site includes 14 ha of fallow vegetation and 36 ha of riparian forest. The ESMP provides mitigation through vegetation conservation, buffer zones, erosion control, and reforestation to maintain ecosystem integrity.
Environmental and Social Operational Safeguard 7: Vulnerable Groups	Some individuals and/or groups may be less resilient to risks and adverse impacts than others. Within the context of the Bank's operations, individuals and/or groups who are at a higher risk of being unable to anticipate, cope with, resist, and recover from project-	Vulnerable persons and/or groups have been identified and considered in the project

Operational Safeguard	Objective / Key Requirements	Relevance to the Project
	related risks and/or adverse impacts are considered vulnerable.	
Environmental and Social Operational Safeguard 8: Cultural Heritage	he Bank recognizes that cultural heritage is an inherent and essential part of self-identification, and that it provides continuity in tangible and intangible forms between the past, present, and future. People identify with cultural heritage as a reflection and expression of their constantly evolving values, beliefs, knowledge, and traditions.	As part of this ESIA process a cultural heritage impact assessment (considering both tangible and intangible forms of cultural heritage) has been undertaken.
Environmental and Social Operational Safeguard 9: Financial Intermediaries	Environmental and Social Operational Safeguard 9 (OS9) recognizes that strong domestic capital and financial markets, and access to finance are important for economic development, growth, and poverty reduction. The Bank is committed to supporting sustainable financial sector development and enhancing the role of domestic capital and financial markets.	The OS 9 is not triggered by the proposed project
Environmental and Social Operational Safeguard 10: Stakeholder Engagement and Information Disclosure	The objectives of OS10 are as follows: • To establish a systematic approach to stakeholder engagement that will help Borrowers identify stakeholders, and build and maintain a constructive relationship and channels of communication with them, in particular project-affected parties. • To assess the level of stakeholder interest and support for the project and to enable stakeholders' views to be taken into account in project design and E&S performance, among others.	

Harmonization of Nigeria ESIA Guidelines and African Development Bank Integrated Safeguards System

The Nigeria's ESIA requirements and African Development Bank Integrated Safeguards System have been harmonized as far as possible in order to make the ESIA responsive to the objectives of good practice (Table 1.4).

It should be noted that the principles inherent in the environmental and social standards of the AfDB are in tandem with the FMEnv ESIA procedures and processes.

However, in the event of divergence between the two, FMEnv, on one hand, and AfDB ISS on the other hand, the most beneficial, environmentally and socially speaking, shall take precedence in the execution of the project and utilization of the ESIA instrument for project implementation

Before commencement of an ESIA, the **FMEnv** issues a letter of intent on notification by the proponent, calls for public participation, review and mediation. The proposed study shall take into consideration this process and/or procedure produces a report that is acceptable to both FMEnv. The report shall also ensure compliance with State Legislations and International conventions ratified by the Federal Government of Nigeria on environmental conservation and protection.

Table 1.4: AfDB's Operational Safeguards

Safeguard / Thematic Area	Relevant Nigerian Legal / Regulatory Framework	AfDB ISS Operational Safeguard / Requirement	Identified Gaps / Discrepancies	Proposed Mitigation Measures / Harmonization Actions	Preferred Framework in Case of Conflict
Environmental & Social Assessment	Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004; FMEnv Procedural Guidelines (1995); NESREA (Act 2007).	OS 1: Environmental and Social Assessment — requires early, integrated, participatory ESIA including ESMP, disclosure, and monitoring.	National framework largely aligned but less emphasis on social inclusion, gender, and participatory monitoring.	Apply AfDB's ISS provisions on inclusive stakeholder engagement and continuous monitoring to strengthen local EIA practice.	AfDB ISS (OS1) — broader and more comprehensive in social coverage.
Labour Conditions, Health & Safety	Labour Act (2004); Factories Act (1990); Employee Compensation Act (2010); National Policy on Occupational Safety & Health (2016).	OS 2: Labour Conditions, Health and Safety — enforces fair labour practices, safe workplaces, and prohibition of child/forced labour.	Nigerian framework ensures worker safety but lacks structured grievance redress and contractor monitoring protocols.	Implement project-level Labour Management Plan (LMP) and OHS Plan per AfDB OS5 to ensure compliance across contractors.	AfDB ISS (OS5) — ensures consistent standards with international labour norms.
Pollution Prevention & Resource Efficiency	NESREA Environmental (Noise Control, Effluent, Air Quality, Waste Management) Regulations; FMEnv	OS 3: Pollution Prevention and Control, GHGs, Hazardous Materials, Resource Efficiency — requires efficient use of energy, water,	National regulations specify pollutant limits but lack provisions on GHG quantification and energy efficiency.	Integrate GHG monitoring, energy efficiency, and resource optimization measures as per AfDB OS4.	AfDB ISS (OS4) — broader environmental scope.

Safeguard / Thematic Area	Relevant Nigerian Legal / Regulatory Framework	AfDB ISS Operational Safeguard / Requirement	Identified Gaps / Discrepancies	Proposed Mitigation Measures / Harmonization Actions	Preferred Framework in Case of Conflict
	Guidelines (2011).	and safe waste management.			
Involuntary Resettlement & Livelihood Restoration	Land Use Act (1978); FMEnv RAP Guidelines (2018); Constitution of Nigeria (Section 44).	OS 5: Involuntary Resettlement, Land Acquisition, and Compensation — requires full replacement cost compensation, livelihood restoration, and pre-displacement consultation.	Nigerian laws emphasize compensation for land but lack explicit livelihood restoration and vulnerability consideration.	Implement RAP and LRP consistent with AfDB OS2; adopt AfDB's replacement-cost principle and livelihood improvement measures.	AfDB ISS (OS2) — offers higher social protection standards.
Community Health, Safety & Security	National Health Act 2014, Public Health Emergency Bill 2022	OS 4: Community Health, Safety and Security- Assess community health & safety risks (traffic, disease, influx, emergency preparedness) and implement prevention/mitigation	National public health and security laws do not fully cover project-induced influx dynamics, GBV/SEA risks or contractor security management standards.	Adopt AfDB OS 4 to manage the health, safety and security risks to communities and people	AfDB OS 4 offers comprehensive community health & safety measures beyond national provisions
Biodiversity Conservation & Ecosystem Services	National Environmental (Regulations on Biodiversity Conservation) 2011; Endangered Species Act Cap E9 LFN 2016.	OS 6: Biodiversity, Renewable Natural Resources, and Ecosystem Services — mandates mitigation hierarchy and conservation offsets.	Nigeria's law lacks explicit ecosystem services valuation and offset mechanisms.	Adopt AfDB OS3 hierarchy: avoid–minimize–restore–offset; integrate biodiversity monitoring indicators in ESMP.	AfDB ISS (OS3) — internationally recognized conservation approach.
Vulnerable groups	National Gender Policy; Ministry of Women Affairs guidelines	OS 7: Vulnerable Groups- ensure the protection of vulnerable groups and individuals during project implementation	National policy exists but implementation is uneven	Prepare Gender Action Plan (GAP) per OS7: targets for women/youth employment, gender-sensitive consultations, GBV risk mitigation, and gender-disaggregated M&E. Integrate into SEP and LMP.	AfDB ISS (OS7) — offers implementation towards the protection of the vulnerable groups.
Protection of cultural heritage	National Commission for Museums & Monuments Act; FMEnv cultural heritage guidance	OS 8: Cultural Heritage- addresses the protection of cultural heritage in project activities and processes	National law strongly protects physical sites but has limited scope for intangible/community heritage and participatory documentation.	Develop Cultural Heritage Management Plan (CHMP) for the documentation of tangible and intangible heritage, community protocols, and	AfDB OS8 provide a broader intangible/cultural protocols where national law is narrower)

Safeguard / Thematic Area	Relevant Nigerian Legal / Regulatory Framework	AfDB ISS Operational Safeguard / Requirement	Identified Gaps / Discrepancies	Proposed Mitigation Measures / Harmonization Actions	Preferred Framework in Case of Conflict
				mitigation measures	
Stakeholder Engagement & Grievance Redress	FMEnv EIA Procedural Guidelines (1995); Public Hearing Guidelines (2009).	Embedded across OS1–OS10 and explicitly guided under AfDB's Stakeholder Engagement Framework (2024).	National framework limited to one-time consultations during EIA scoping; no requirement for ongoing engagement or structured GRM.	Apply AfDB SEP and GRM procedures; establish continuous engagement through CLOs and quarterly disclosure.	AfDB ISS — provides ongoing engagement and accountability requirements.
Climate Change & Green Growth	National Climate Change Act (2021); National Renewable Energy Policy (2015).	AfDB Supplementary Guidance: Climate Change and Green Growth — emphasizes resilience, low-carbon design, and GHG tracking.	Nigeria's framework lacks operational GHG accounting standards for projects.	Integrate AfDB climate resilience tools; monitor GHG emissions and implement adaptation strategies (solar hybrid, drainage, green buffers).	AfDB ISS — more operationalized for climate risk management.

1.8 Structure of EIA Report

An outline of the proposed contents of the main volume of the ESIA report is provided in Table 1.8.

The proposed structure follows the guidance provided by FMEnv.

The content may be altered during the evolution of the project or based on the outcomes of on-going consultations. However, it is anticipated that the contents of the ESIA report will accord broadly within the suggested framework.

Table 1.5: Structure of the ESIA Report.

Chapter Number	Contents Reading	Explanatory Note
Front Piece		Title page, acknowledgments, authors and contributors, table of contents (including lists of figures, tables and maps)
0	Non-technical summary	Summary of the entire ESIA report.
1	Introduction	This Chapter will outline the development and structure of the ESIA report including the background, terms of reference and declaration. The policy, legal and institutional framework within which the ESIA will be conducted will be discussed. National regulations will be summarized along with relevant international agreements and

		conventions to which Nigeria is party as well as applicable international best practice guidelines and project standards.
2	Project Justification	This chapter will include discussion of the project background, objectives, need for the project, value of the project, envisioned sustainability, alternatives considered (including no project alternative), developed options considered and site selection.
3	Project Description	This Chapter will provide a concise description of the project and its geographical and temporal context. It will include a site description and overview of the facility project design and details of project inputs and outputs.
4	Description of the environment	This chapter will summarize the available baseline data on the environmental and social resources and receptors within the project AoI. It will be based on both primary and secondary data resources and will consider changes in the baseline condition without the development in place.
	Stakeholders Engagement	This Chapter will present the results of consultation undertaken as part of the ESIA, plus plans for future consultation. It will identify key project stakeholders and present their feedback on the project
5	Potential and Associated Impacts	This Chapter will summarize the predicted positive and negative impacts of the project. Cumulative impacts of the project. Cumulative impacts will be assessed as appropriate.
6	Impact Mitigation Measures	This Chapter outlines general and specific mitigation measures to avoid, reduce, or mitigate (compensate) negative impacts to environmental and social receptors. Enhancement measures for all positive impacts are also presented here.
7	Environmental and Social Management Plan (ESMP)	The ESMP will draw together the possible mitigation measures; group them logically into components with common themes; define the specific actions required and timetable for implementation; identify training needs, institutional roles and responsibilities for implementation and estimate the costs of the measures.
8	Conclusion	This Chapter will summarize conclusions that are made based on the assessment as well as outline any further recommendations.
References		All references made in the report and documents drawn upon during the course of the assessment.
Annexes		These will include technical annexes with details of specific technical surveys.

2 PROJECT JUSTIFICATION

This Chapter discusses the need and rationale for the proposed ATC project and enumerates the benefits to be derived from project implementation. It also discusses the envisaged sustainability of the project as well as the project alternatives and development options considered.

2.1 The Need for the Project

The need for the proposed ATC stems from the existence of constraints on crop value chains, especially for cocoa, cassava and rice, in Cross River State as summarized in Table 2.1.

Table 2.1: Crop value chain constraints in Cross River State

Production Constraints	Marketing Constraints	Processing Constraints
Low yield	Inadequate access to appropriate packaging material	Inappropriate processing technologies particularly among small-scale millers
Pest and diseases which limit optimum yield in most of the production areas of state;	Price fluctuation	Poor equipment maintenance support by dealers, shortages and high cost of equipment and spares
Limited access to information from extension service.	Inadequate sources of finance	Erratic power supply and increased cost of fuel
Inadequate certified inputs such as seeds, fertilizer and herbicides etc	Small traders have limited storage capacity and thus are committed to a continuous cycle of buying and selling.	Unreliable supply of produce

A large percentage of households in rural areas of Nigeria are dependent on subsistent farming for survival, with majority of them being smallholder farmers. While they have the landmass as compared to the cities, such factors as youth migration, limited access to funding, infrastructure and technology among others are causing an increasing decline in food security. A solution to these food security challenges will increase agricultural output, create jobs and improve livelihoods for its citizens. Another benefit of this strategy is the creation of job opportunities, reduced cost of living, diversification of the Nation's economy and generally enhancing sustainable development.

The agricultural sector of Nigeria remains largely untapped and poses bright prospects for the her to tap into for the country's general development. The establishment of SAPZs in Nigeria (Cross River State) will boost the structural transformation of the economy by providing opportunities for public and private sector investment in agriculture, and when fully operational, the SAPZs will enhance national food and nutritional security, optimize the export of value-added agricultural commodities and improve the quality of livelihoods through wealth creation for rural farming communities.

2.2 Benefits of the Project

The Special Agro-Processing Zone (SAPZ) is designed to diversify Nigeria's economy by positioning agriculture as a major and sustainable source of revenue. It will enhance food security, strengthen inter-state and international trade, reduce rural-urban migration, and create mass employment across the agricultural value chain. By promoting agro-industrial processing, market access, and modern farming practices, the project will reduce post-harvest losses, raise productivity, and improve livelihoods, while also aligning with federal efforts to grow non-oil exports and achieve broader development goals.

The project brings multiple layers of benefits. For government, it improves the business environment, boosts investor confidence, and generates new revenue streams. For communities, it enhances security, infrastructure, financial inclusion, and market accessibility while offering training for youth and women and driving local economic growth through CSR. For investors, it lowers costs through affordable leases, tax incentives, and shared facilities, while world-class infrastructure ensures compliance with global food safety and quality standards. Finally, the ATC will generate diverse revenue from land and space leases, facility management, agricultural services, energy and water supply, auxiliary services, advertising, truck parking, and weighbridge operations ensuring long-term financial sustainability

2.3 Value of the Project

The monetary value of the proposed ATC is expected to be capital intensive considering that the project cost covers components such as including site preparation, infrastructure development, utility systems (power, water, and wastewater), internal and access roads, administrative and

processing buildings, equipment procurement, environmental mitigation measures, and initial operational support under the Design–Build–Operate (DBO) model.

The investment is jointly funded by the African Development Bank (AfDB) and the Federal Ministry of Agriculture and Food Security (FMAFS), with counterpart contributions from the Cross River State Government under the Cross River Special Agro-Industrial Processing Zone (CR-SAPZ) Program. The financial structure follows the Public–Private Partnership (PPP) model, combining concessional loans, grants, and private equity. Beyond its financial worth, the project’s value lies in its capacity to stimulate the regional economy, create over 650 direct and indirect jobs, expand market access for agricultural producers, and strengthen Cross River State’s position as a hub for agro-industrial transformation. The anticipated multiplier effect through agricultural value chains, logistics, housing, and the project’s overall economic rate of return (ERR) is projected at 18–22% over a 25-year operational lifespan, indicating strong economic viability. Tables 2.3 and 2.4 summarize the potential value chains for two of the three major crops for the CR-SAPZ, cassava and rice, respectively.

Table 2.2: Potential Cassava Value Chain

Potential value	Details
Potentials for value addition	✓ Increase yields from 9 ton to 30mt / ha ✓ Availability of improved varieties ✓ Production/processing of industrial products such as ethanol, starch, etc. ✓ Import substitution potentials ✓ Availability of improved processing techniques
Market potentials	✓ There is an opportunity for grouped sales by organized smallholder producers or cooperatives upon meeting the off-taker requirement, ✓ Stable price ✓ High industrial demand ✓ Export potential of cassava by products
Potential for pro-poor growth Gender relevance	✓ Women farmers are actively involved in cassava production ✓ Marketing of cassava related products are dominated by women ✓ Retail selling is mainly female business ✓ Small scale processing is dominated by women ✓ Industrial processing is dominated by men

Potential value	Details
Job creation in downstream sectors	✓ High potential in small-scale processing ✓ Export ✓ High potential to attract FDI ✓ Transportation/logistics ✓ Artisanal and industrial processing will generate significant number of jobs

Table 2.3: Potential Cocoa & Rice Value Chains

Potential value	Details
Potentials for value addition	✓ Improved quality of processed cocoa beans & milled rice, especially reduction of impurities and stones by better harvesting and processing techniques ✓ Innovations for farm machinery/extension services ✓ Soil testing for optimum fertilizer application ✓ Training on GAP (including fertilizers, herbicides, etc.) ✓ Promotion of agro machinery service providers ✓ Capacity building for machinery and equipment operators (power tiller, mills, etc.) ✓ Linkages to effective financial services/literacy trainings/management ✓ Improved quality of certified seeds ✓ Strengthened linkages among the value chain actors ✓ Availability of credible market information
Market potentials	✓ Huge deficit demand and supply of rice in Nigeria ✓ Availability of off-takers all over the country ✓ Import substitution potentials
Potential for pro-poor growth Gender relevance	✓ Women are actively involved in processing and production ✓ Marketing of rice paddy and cocoa beans is predominantly carried out by men and youth ✓ Retail selling is mainly female business ✓ Small scale processing is dominated by women
Job creation in downstream sectors	✓ High potential to attract FDI ✓ Transportation/logistics ✓ Seed breeders and multipliers ✓ Small and large-scale production, marketing and processing will generate significant number of jobs
Natural endowments	✓ Favorable climatic condition such as low temperature and optimum relative humidity during large part of the year
Profitability	✓ Highly profitable upon meeting the requirement of the buyers and off-takers

2.4 Envisaged Sustainability

Sustainability is the ability of a development project to maintain or expand a flow of benefits at a specified level for a long period after project inputs have ceased. The concept of sustainability means different things to different activities, organizations and developments. Specifically, for the project, sustainability means, ensuring the project continues to maintain its operations, provide its services and deliver its long-term benefits during implementation and projected life span. The sustainability of the proposed project is evaluated and described below using the following dimensions/ factors, namely: environmental, social, economic and technical considerations.

2.4.1 Environmental friendliness

An environmentally sustainable project is one that will meet the needs of the present without compromising the ability of future generations to meet their own environmental needs. Based on the above definition, the proposed Agricultural Transformation Centre (ATC) will be constructed to reduce environmental impacts and designed to consider such factors as climate change, judicious use of resources, protection of natural ecosystems among others. Potential impacts that are likely to arise as a result of the project in the different phases have been identified and their mitigation measures proffered, starting from the design-level, and documented for reference throughout the project lifespan to ensure that the environment quality is not compromised for future generations.

The proposed project is considered to be environmentally friendly, as environmental protection initiatives have been embedded in the project implementation process. And as such, the potential environmental risks and impacts of the project have been assessed as part of this ESIA and discussed in detail in Chapter Five (5). Environmental conservation and management measures have also been proffered not only to reduce ecological footprints of the project, measures have also been proffered to ensure that the proposed ATC is constructed and maintained using energy and resource efficient materials and methodologies to the extent possible. These measures address the potential environmental risks impacts identified during the different phases of the project and are well articulated in the ESMP developed as part of the ESIA Report. The ESMP is presented in Chapter Seven (7).

2.4.2 Social Desirability

The ATC project prioritizes her stakeholders' perception, especially the acceptance of the hosts communities. Stakeholders' Engagement and Grievance Redress Mechanisms have been established throughout the project life cycle to address the needs of stakeholders. The engagement process already commenced from the scoping stage all through the field data gathering exercise to the public consultation held with stakeholders on the outcome of the ESIA. It is envisaged that the effective implementation of the E&S safeguards instruments, including the Livelihood Restoration Plan, will ensure social desirability of the project. Additional measures to ensure social sustainability of the project, will include the following:

- Inclusion of vulnerable groups such as elderly people, female heads of household, children and youth, racial and ethnic minorities, displaced persons, women and girls etc.
- Implementation of Corporate Social Responsibility (CSR) programmes targeted at improving Socioeconomic and health status in project affected communities will be embarked upon.
- Employment of as many local inhabitants of the host communities as possible during all phases of the project. Contractor's employment policy shall give preference to indigenes of these communities in a bid to ensure that they benefit directly from the project.
- promote training, mentorship and development opportunities to prepare talented employees for successful succession

2.4.3 Economic Viability

The economic viability of the proposed ATC project is based on the fact that it will eliminate agricultural and agro-industrial constraints, improve productivity, and therefore Return on Investment (ROI), improving exports to other states and outside the country as well. Additionally, the expansion of local markets is imminent with the inception of the project. The ATC project is designed to create both direct and indirect labour, skilled and unskilled workers for both indigenes and non-indigenes, which will in turn improve livelihood of the people and bring economic development to the state and the country at large.

2.4.4 Technical Feasibility

The construction and implementation of the proposed ATC project design is will be based on Best Available Technologies (BAT). The project team includes Arise Network, the DBO Contractor, a world-class firm with experience and expertise in the building and operations similar complex projects in and outside Africa.

2.5 Development Options

2.5.1 No Project Option

This is a do-nothing option. This option implies that the ATC project will not be implemented and the status quo will be maintained with the attendant challenges of food shortages and insecurity in the state and the country at large. This option if adopted will represent a major setback for the initiatives and efforts of the Federal Government of Nigeria strategy to alleviate poverty by improving the agricultural sector. In addition, the inherent Socioeconomic benefits of the project including stimulation of economic activities, job creation, improved livelihood, poverty reduction among others This option was neither socially desirable nor economically viable and was therefore rejected.

2.5.2 Delayed Project Option

The delayed project option implies that the project will be suspended and implemented in the future. This option may prolong the realization of the Federal Government of Nigeria strategy to alleviate poverty by improving the agricultural sector. In addition, the agricultural shortfalls of the state and the Nation will remain the same with grave implication for the economic development of the State and the nation in general. Furthermore, this option is not economically sustainable as huge amount of money will continue to be spent on importation of food products which provides only temporary solutions to the inherent problems. The project cost may also increase significantly given the unstable currency and exchange rate around the world. This option is therefore rejected because it is socially and economically unsustainable.

2.5.3 Immediate Project Implementation

This option implies that the project will go ahead as planned. Adoption of this option will ensure the realization of the numerous benefits of the project, especially the enormous associated

socioeconomic benefits to the state, region and nation as a whole, e.g., increased agricultural productivity and employment, leading to reduced hunger, improved standard of living for the PAPs and other persons who will be directly or indirectly involved in the project. This will also avoid the continued deterioration of the existing rice mill which will be resuscitated as an associated facility to the ATC. This option is therefore the preferred option.

2.6 Project Site Alternatives

Site suitability assessment is a critical process in determining the best use of land resources, particularly for agriculture. Geographic Information Systems (GIS) combined with Multi-Criteria Analysis (MCA) techniques provide a powerful framework for integrating various biophysical, environmental, and Socioeconomic factors to assess the optimal locations for agricultural development. In this research, the GIS and MCA technique was adopted in selecting suitable site for the Special Agro-Industrial Processing Zone (SAPZ) in Cross River State. Four different locations were assessed and they include: Bumbe in Obudu, Okuku in Yala, Mbube in Ogoja and Abuagbor in Bekwarra LGA.

The major relevant factors that influence crop growth and agricultural productivity considered in the analysis include biophysical factors (land-use and elevation/relief, drainage, etc.), Socioeconomic factors (proximity to roads/markets), environmental factor (drainage and flood risk). The parameters were assessed and reclassified based on their suitability status. For instance, in the land-use map, built-up areas were reclassified as 'not suitable' while fallowed/cultivated farmlands were reclassified as 'highly suitable areas. Similarly, site that are closer to access road and market were classified as highly suitable and vice versa.

In assigning weight to the identified parameters, Analytical Hierarchical Process (AHP) and expert knowledge was used to assign importance to each factor. The AHP involves pairwise comparisons between criteria and consistency ratio (CR) to check judgment reliability. The reclassified parameters were integrated to form a suitability map using the formula in the raster calculator (ArcGIS 10.8). the result was classified into four suitability classes: highly suitable, moderately suitable, marginally suitable and not suitable.

Consequently, GIS-based MCA offers a systematic, reproducible, and spatially explicit approach to agricultural land suitability assessment. When well-executed, it provides robust decision-support for

policymakers, planners, and farmers aiming for sustainable agricultural development. From the result in this analysis, among all the sites selected, the proposed site at Okuku was observed to be highly suitable for the project as it meets all the criteria. While other locations (Bumbe in obudu) recorded difficult terrain, Abuagbor in Bekwarra recorded poor access to main road, market and high level of insecurity.

On the other hand, Okuku was observed to be highly connected to the major roads and market, with moderate topography to support the intention of the project as well as agricultural land-use type. These attributes qualify Okuku as a suitable site for the project (Figure 2.1 and Table 2.5).

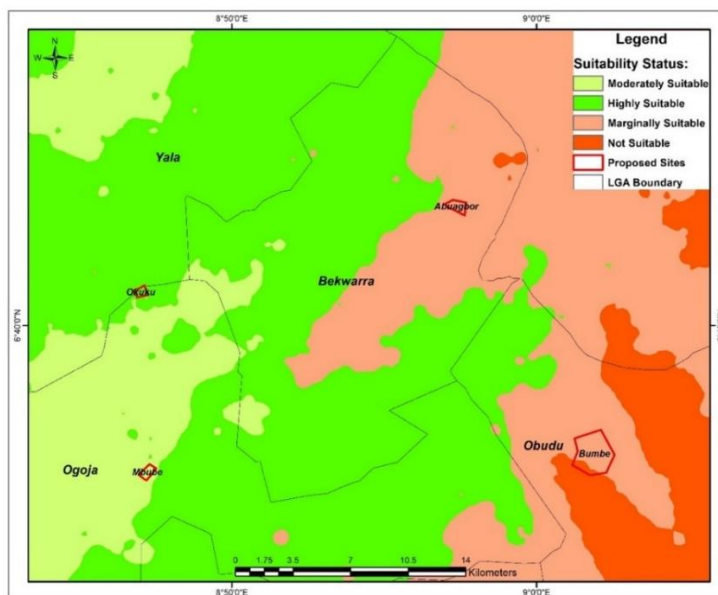


Figure 2.1: Site Suitability Map for the proposed ATC Using GIS and MCA Techniques

Table 2.4: MCA for site selection

S N	Site Location	Criteria							D
		Land Availability	Relief	Inter-modal Accessibility	Security	Proximity to farmers	Proximity to markets	Score (%)	
1	Bumbe in Obudu LGA	6	4	3	3	6	4	43.33	R
3	Mbube in Ogoja LGA	7	6	5	6	7	5	60	R
4	Abuagbor in Bekwarra LGA	6	5	6	4	5	6	53.33	R
2	Okuku in Yala LGA	7	9	7	8	9	9	81.67	S

Weights: 0 = Not suitable; 1-3 = Marginally suitable; 4-6 = Moderately suitable; 7-10 = Highly suitable.

D = Decision; R = Rejected; S = Selected.

3 PROJECT DESCRIPTION

3.1 Introduction

The proposed Agricultural Transformation Centre (ATC) is being developed through a Design, Build and Operate (DBO) / site and services model. It is planned to sit on a 37.8 ha of land (Figure 3.1). Ancillary to the proposed ATC is an existing, moribund rice mill established and owned by the Government of Cross River State. The ATC is planned to provide common infrastructure and facilities to the expected 11 agro-industries of various scales, ranging from small to medium and large which will be established, owned and operated by prospective investors. This ESIA covers only the common infrastructure and facilities of the project as detailed in subsequent sections of this chapter. The prospective agro-industries will take advantage of this ESIA when approved, to carry out their individual E&S assessments as will be required of them prior to establishment.

3.2 ATC Layout

Based on the value chain needs of the ATC, the site layout is developed. The required facilities are as shown in Table 3.2. The site layout is shown in Figure 3.1

3.3 Components of the Agricultural Transformation Centre (ATC) at Okuku

The proposed ATC Agricultural Transformation Centre (ATC) infrastructure will include office buildings, training centres, general services fencing, internal access roads/parking, drainage, power supply, water, and sewerage, effluent management, health, and safety specialized services will include quarantine, quality control, lab. and certification centres. breeding centres, business support services (administrative) knowledge/ ICT/procurement /employment centres, and activities to implement the ESMP.

The proposed ATC will have common on-site and off-site infrastructures and facilities for the use of all tenants and operators. These will include access and internal roads and drainage, power and water supplies, solid and liquid waste management facilities, warehousing, market, etc. The industries will be built.

3.4 On-Site Infrastructure and Facilities Planning

On the basis of function and facilities required for the ATC, on-site infrastructure is planned as described in Table 3.1, Table 3.2, Table 3.3 & Table 3.4 while Table 3.5 shows the Bank + ATM,

small, medium and large-scale industries are not part of this ESIA as their details are not available now and therefore their full impacts cannot be identified and assessed presently.

Table 3.1: ATC Site provisions

SN	Description	Remarks
1	Land Development	Site grading works will only be for the road and general infrastructure area, to enhance economy and environmental considerations. The vegetation along the water courses, accounting for about 6.5 ha of the proposed site (Figure 3.2) shall be conserved green to retain the carbon sequestration capacity of the site. The entire site has crops that would be harvested before construction. There are 62 trees in the land which will be left, as much as possible, standing. 49 (79%) will be left in place while 13 (11%) will be removed due to their heights and age which make them potentially risky to be left near the buildings to be constructed within the ATC.
2	Boundary wall and fencing	A wall fence to surround the zone is planned. This will enhance the security of the project. The total approximated length of the fence is 2.6 km. Trees shall be planted at 10 m interval along the internal fence line to enhance the carbon sequestration capacity of the facility and compensate for the 32,220 m³ of biomass that will be removed during site clearing. Approximately, 57,200 pieces of sancrete blocks will be used to erect the perimeter fence.

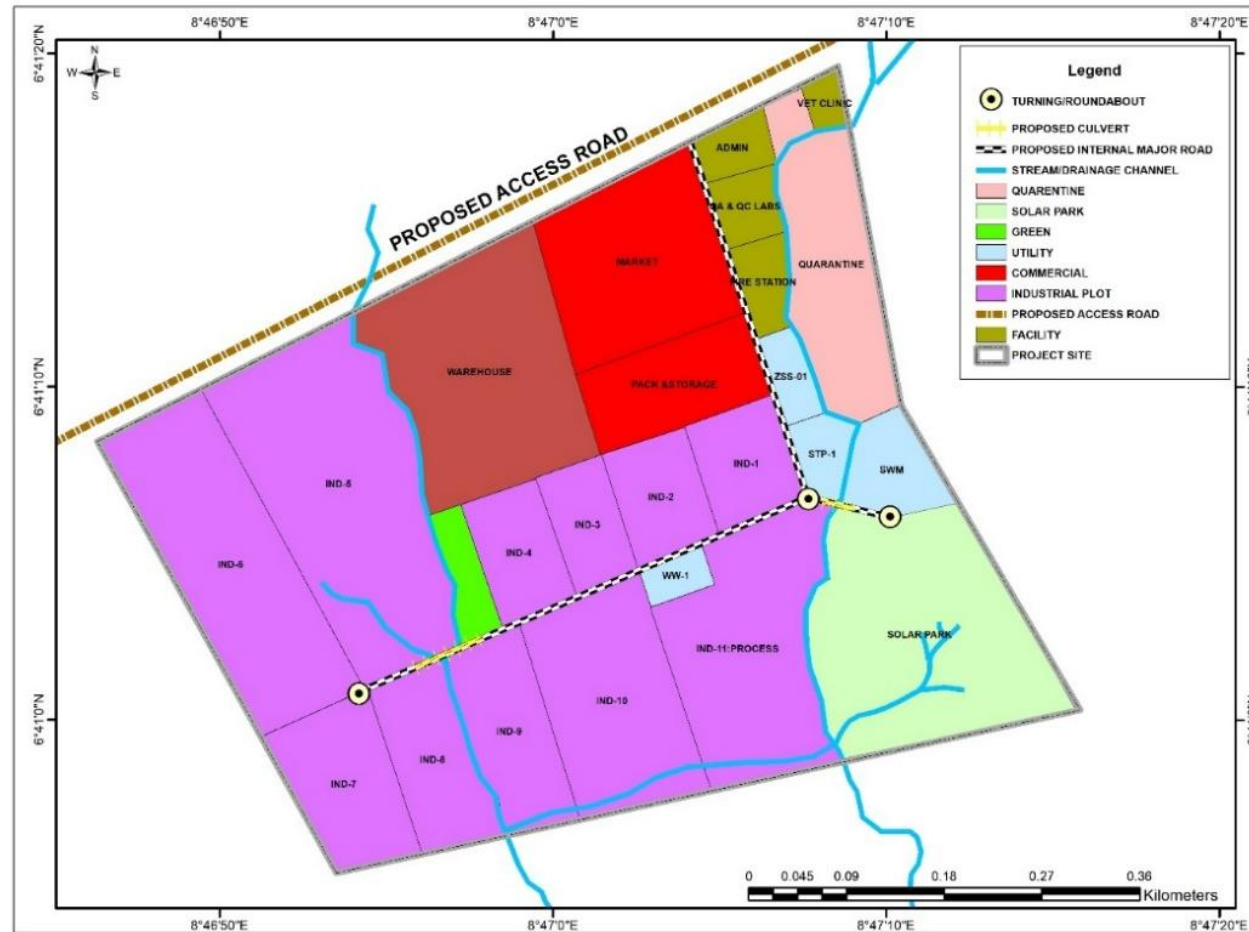


Figure 3.1: Proposed ATC Layout

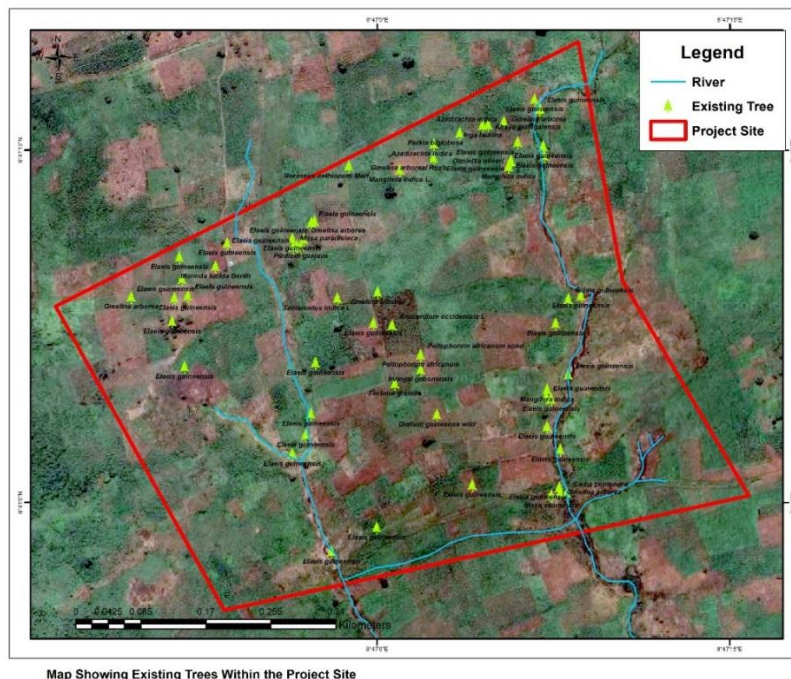


Figure 3.2: The ATC site showing the existing trees to be conserved

Table 3.2: Facilities and components in the proposed ATC

Description	Area (SqM)
Perimeter Fence	650
Gate /gate house	250
Security outpost	250
Commodity service Centre	3,000
Commodity processing Centre	5,692
Industrial / Employment zone	28,462
Truck Park	20,000
Community vocational Centre	5,000
Residential area	15,000
Water facility (boreholes, overhead tanks/steel towers & reticulation)	1,000
Water treatment plant	1,000
Power facility	1,000
Storage warehouses	5,000
Cold storages (meat etc.)	3,000
Fuel station	1,500
Solid waste management plant	1,000
Sewage and effluent treatment plant	1,000

Description	Area (SqM)
Fire station	1,000
Admin. Block	1,000
Commodity loading and uploading bays	5,000
Veterinary clinics and Health centre	350
Health centre	350
Market	10,000
Recreational	2,000
QA&QC lab	350
Knowledge centre	800
Procurement centre	500
Agric equipment centre	3,000
Bank + ATM services	600
Small scale industrial zone	55,000
Medium scale industrial zone	55,000
Large scale industrial zone	55,000
Future development area	30,000
Green area	65,246
	378,000

Table 3.3: ATC component capacity and lifespan details

ATC Project Components		
Component	Capacity / Specification	Design Life (Years)
Internal Roads	2902 Rmt, Flexible pavement, 18m ROW with solar street lights	20
Drains	5804 Rmt, RCC rectangular, 600 mm wide	30
Power Demand	Peak Load 13 MVA (Installed capacity 500 KVA)	N/A
Substation	1 Compact substation (500 KVA)	20
Electrical Distribution	3.8 km	20
Borewells	2 Nos, Depth 200 m, Yield 65 m ³ /hr	20
Storage Tanks	500 KLD, Ground-level RCC tanks	35
HDPE Distribution Pipes	3.8 km, PN 10, 225–280 mm diameter	25–50
Wastewater Generation	750 KLD, Domestic + Industrial mix	N/A
STP Type	MBBR technology	
STP Capacity	500 KLD	
STP Lifespan (Civil)		35
STP Lifespan (Mechanical)		15
Sewer Network	3.8 km, HDPE 225–280 mm diameter	25–50
Admin / R&D / Other Buildings	RCC framed, GI roofing	50–60
Public Toilets	60 sqm, 16 WCs	30–40
Fire Station	75 sqm, RCC, 24x7 manned	40–50
Gate & Gatehouse	RCC structure	40–50

ATC Project Components		
Chain Link Fencing	2600 Rmt, 2m height, steel posts with concrete foundation	15-20

Table 3.4: Facility Design Details

Design Details of ATC		
A	Area in Ha	37.8 ha (green area – 6.5 ha)
B	Time period (ATC+ATC)	
	Design	4 Months
	Construction	18 Months
	O&M (Including DLP)	60 Months
C	Internal Road	Length: 1902 Rmt ROW: 18m wide, with solar street lights and channel kerbs.
D	Drain	Length: 3804 Rmt - ranging from 500mm x 500mm to 1000mm x 1000mm
E	Electrical	
	Power Source	0.2 Km to the substation, 33 kV line along the plot Boundary
	Power Demand	13MVA
	Distribution length	3.8 km
	Sub-station	Compact substation of 500 kVA
F	Water	
	Source	Ground Water (Unless state brings surface water to the site)
	Demand	1500 KLD
	borewell	2 Nos
	Storage	500 KLD Capacity
	Distribution	3.8 Km of HDPE pipe ranging from 225 mm to 280 mm
G	Wastewater	
	Generation	750 KLD
	STP	500 KLD
	Conveyance	3.8 Km of HDPE pipe ranging from 225 mm to 280 mm
H	Buildings	1. Administrative Block + Research and Development + Disaster Management - 400 Sqm
	Fire station	75 Sqm - with Shed for fire tender (Does not include cost of fire tender)
	Public Toilet	60 Sqm - 8 WCs x 2
I	Gate & Gatehouse	1 Nos
J	Boundary wall	2600 Rmt - Chain Link Fencing
K	Access Roads	1.2 km

The facilities presented in Table 3.5 will be developed, owned and operated by private investors. The would be subjected to both FMEnv's and AfDB's E&S requirements, to prepare and implement specific ESMPs for their individual operations, leveraging on this ESIA, when it has approved and implemented.

Table 3.5: Facilities to be developed by Investors in the ATC

SN	Description
1	Fuel station
2	Small scale industrial zone
3	Medium scale industrial zone
4	Large scale industrial zone
5	Bank + ATM Services

3.5 Internal Roads

To attain smooth daily traffic flow inside the ATC, internal road network was designed according to the classification of major and minor roads. Major roads will enhance mobility while minor roads will maximize accessibility to each factory. Access road to the ATC is directly connected to the Ogoja-Okuku Road.

The major road will have two lanes for vehicular traffic with drainage and sidewalks on both sides while the minor roads are single lane with side drainage on both sides. In anticipation of high level of activities in the ATC, the surfacing will be asphalt over a lateritic base and sub-base courses. These surfacing will reduce cost of maintenance and rehabilitation. Based on the ATC layout, the internal road details are presented in the Table 3.6.

Table 3.6: Internal roads specifications

SN	Description	Length (m)	Number of Lane	Width of Lane	Materials
1	Major Road	869.05	2	10m + 10m	Asphalt
3	Access Road	1374.5	1		

The layout and cross sections of the proposed major and minor internal roads are presented in Figure 3.3, Figure 3.5 and Figure 3.6.

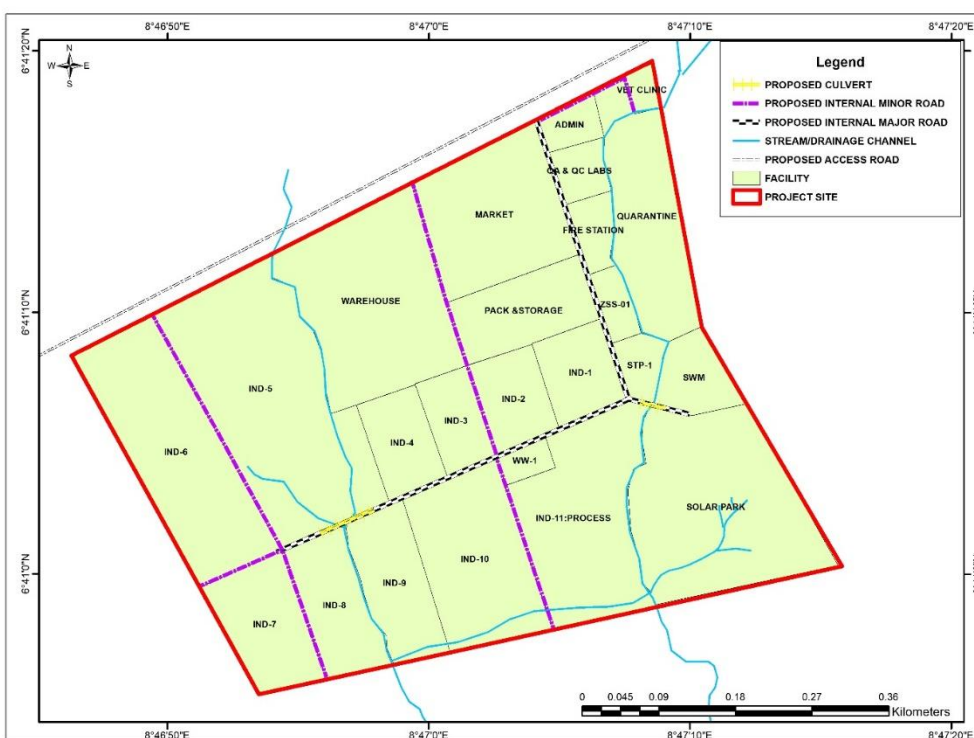


Figure 3.3: layout and cross sections of the proposed major and minor internal roads

3.6 Off-Site Road Requirement

There is a need to upgrade the Okuku-Ogoja Road to 30-ton axle load capacity to withstand the expected traffic pressure without sudden collapse or deterioration e. These interventions will facilitate transportation of inbound and outbound raw materials and products, access to the site and commuting of employees from the community. The provision for the roads is shown in Table 3.7.

Table 3.7: Off-site roads details

SN	Description	Length (km)	Cross-section	Material
1	Upgrade of Okuku-Ogoja Road leading to the ATC, to 30 tons axle capacity		Recommended	Asphalt

3.7 Construction Materials

Construction materials for the project will be sourced predominantly from local suppliers within Cross River State to enhance cost efficiency and stimulate local economic activity.

- Lateritic soil and sharp sand will be obtained from licensed borrow pits located within Yala and Ogoja LGAs, approximately 15–25 km from the project site.
- Crushed aggregates and gravel will be sourced from approved quarries near Ikom or Obubra, depending on quality availability.
- Cement, reinforcement steel, and fittings will be procured from registered distributors in Calabar or Ogoja, ensuring adherence to national standards (SON).
- Water for construction will be supplied from boreholes established on-site or through certified local vendors.
- Bitumen and asphalt materials (for access roads and pavement) will be procured from recognized suppliers within the state or neighbouring Ebonyi State.

All borrow pits and quarries to be used shall have valid Environmental Compliance Certificates and be rehabilitated after extraction, in line with FMEnv and NESREA environmental requirements.

Table 3.8 and Table 3.9 present the basic construction materials and product output.

Table 3.8: Schedule of Construction Materials

Material	Approximate Quantity
Steel Reinforcement Rods (Rebars)	~ 500 MT
Cement	~ 12000 bags
River Sand (Concrete Grade)	~ 25000 m ³
Sand (Masonry / Plastering)	~ 1000 m ³
Stone Aggregates (Crushed)	~ 40000 m ³
Gravel / Fine Aggregates	~ 8000 m ³
HDPE Pipes (PN 10, 225-280mm)	~5.5 km
PVC Pipes and Fittings	~1 km (various diameters)
Bitumen	~2,500 tonnes
Concrete Blocks / Bricks	~1.5 million units
Steel Sections (Beams, Channels, Angles)	~100 tonnes
Formwork Materials (Plywood, Props)	~25,000 m ² plywood + props
Reinforcement Accessories (Ties, Chairs, Wire)	Various quantities (e.g., 3-5% of rebar weight)
Electrical Cables and Accessories	Lump sum based on design (~10 km cables)
Solar Street Lights and Fixtures	~80 sets (estimate based on 18m ROW length)
Waterproofing Materials	~1,000 m ²
Paints and Coatings	~5,000 liters
Chain Link Fencing	6,000 Rmt

Table 3.9: Product Output

Product Output	
Product	Quantity
Concrete for drainage, median, manholes etc.	33290 m ³
Fill material	223223 m ³
Asphalt wearing course	5061 m ³
Asphalt binder course	7592 m ³
Base course	145400 m ³

3.7.1 Major Project Equipment

The major equipment to be deployed for the construction are listed in Table 3.9.

During decommissioning, plies and deck concrete will be dismantled and removed from site.

Table 3.10: Schedule of Equipment

Construction Equipment			
Equipment/Plant	Quantity	Capacity / Size	Duration of Use
Excavators	2	20-ton class	12–18 months
Dump Trucks / Tippers	4	15-20 ton payload	12–18 months
Concrete Mixer Trucks	2	6–8 cubic meters per batch	10–12 months
Vibratory Rollers	2	10-ton	6–9 months
Water Tanker Trucks	2	10,000 liters	12–18 months
Mobile Crane	1	20-ton lifting capacity	6 months
Welding Machines	3	Standard portable units	12–18 months
Generators	1	250 kVA	12–18 months
Concrete Pumps	1	30 m ³ /hr	6–9 months
Transit Mixture	2	7 m ³	12–18 months
Operation Equipment			
Equipment/Plant	Quantity	Capacity / Size	Duration of Use
Maintenance Vehicles	2	Medium duty trucks	5 years (ongoing)
Fire Tender (fire truck)	1	4,000 liters water tank	5 years (ongoing)
Water Pumps	3	10–15 HP pumps	5 years
Generators	1	100 kVA	Backup power for critical systems
Landscaping Equipment	1 set	Standard lawn mowers, trimmers	Seasonal/periodic use

3.7.2 Construction Material Transportation

The transportation of construction materials for the proposed project will be managed efficiently to minimize environmental impact and ensure timely delivery. Materials such as crushed stone, sand, and aggregate will be sourced from quarries and suppliers located within a 50-kilometer radius of the project site, thereby reducing transportation costs and emissions. These materials (as highlighted in Table 3.8) will be transported using 10-ton dump trucks, adhering to safety and load regulations.

Asphalt and cement will be procured from regional production facilities with the capacity to meet the project's quality and quantity requirements. Delivery will be scheduled to align with construction phases to optimize storage and usage. Excavated soil and other spoil materials will be promptly removed from the site to avoid clutter and potential environmental hazards. These materials will be transported to designated and approved dump sites, ensuring compliance with environmental regulations and minimizing disruption to Okuku and surrounding communities.

Additionally, the excavated soil spoil will be efficiently removed from the site and transported to designated dump sites, ensuring a streamlined and organized construction process while maintaining the integrity of the surrounding environment.

3.7.3 Project Personnel

Approximately 250 staff members will be engaged for the pre- construction and construction phase of the project, and expert subcontractors will be enlisted as required by the DBOC. The subcontractors will be selected from firms and individuals residing in the communities surrounding the construction site. To facilitate the transportation of employees to and from the work location, shuttle buses will be furnished at designated spots within the town and its surroundings. These buses will depart prior to 7 am and return at the conclusion of the workday. Of the entire workforce, 70% will be sourced locally, comprising 40% unskilled labor, 20% semi-skilled labor, and 10% skilled workers, while the remaining 30% will be recruited from areas outside of the local vicinity. Of the 250 expected staff members, 100 will be engaged during the preconstruction phase, additional 150 will be added for construction while the number will drop to 50 during the operations. These figures are for the DBOC and their subcontractors. When the investors come on board, these figures will change accordingly.

The drains material will be reinforced concrete to reduce cost of maintenance and rehabilitation. The design of drainage system is based on established design criteria. The expected storm water runoff from rainfall is estimated using the Rational Method as recommended in the Federal Highway Manual Part 1 Design, and of the form.

$$Q = 0.278 CIA$$

Where:

Q = Quantity of run-off in cubic metre per second (m³/sec)

C = Coefficient of run-off expressed as a percentage of imperviousness of the water shed surface.

I = Rainfall intensity in millimeter per hour (mm/hr.)

A = Catchment area in square kilometer.

The above formula is true for catchment areas of 12 square kilometres maximum. An area reduction factor is then applied for areas above 12 square kilometres. This factor is derived from the work done by Balasha-Jalon Consultants (1977) on the Benin City Master Plan for Drainage Scheme and can be applied for catchment areas in the sub-Saharan region of Africa.

$$Factor = \frac{1}{e^{(1\frac{12}{A})}}$$

Where, A=area of catchment in square kilometres

The sizing of the drains using Manning's formula for uniform flow calculations:

$$Q = \frac{AR^{\frac{2}{3}}S^{\frac{1}{2}}}{n}$$

Q = Flow Rate (Discharge) m³/sec

A = Area of Section in m²

R = Hydraulic radius in meter

n = Manning's roughness coefficient

S = Slope of channel in m/m

The designed channel is such that the minimum velocity is 0.6m/s for self-cleansing and the maximum should be such that scouring will be prevented.

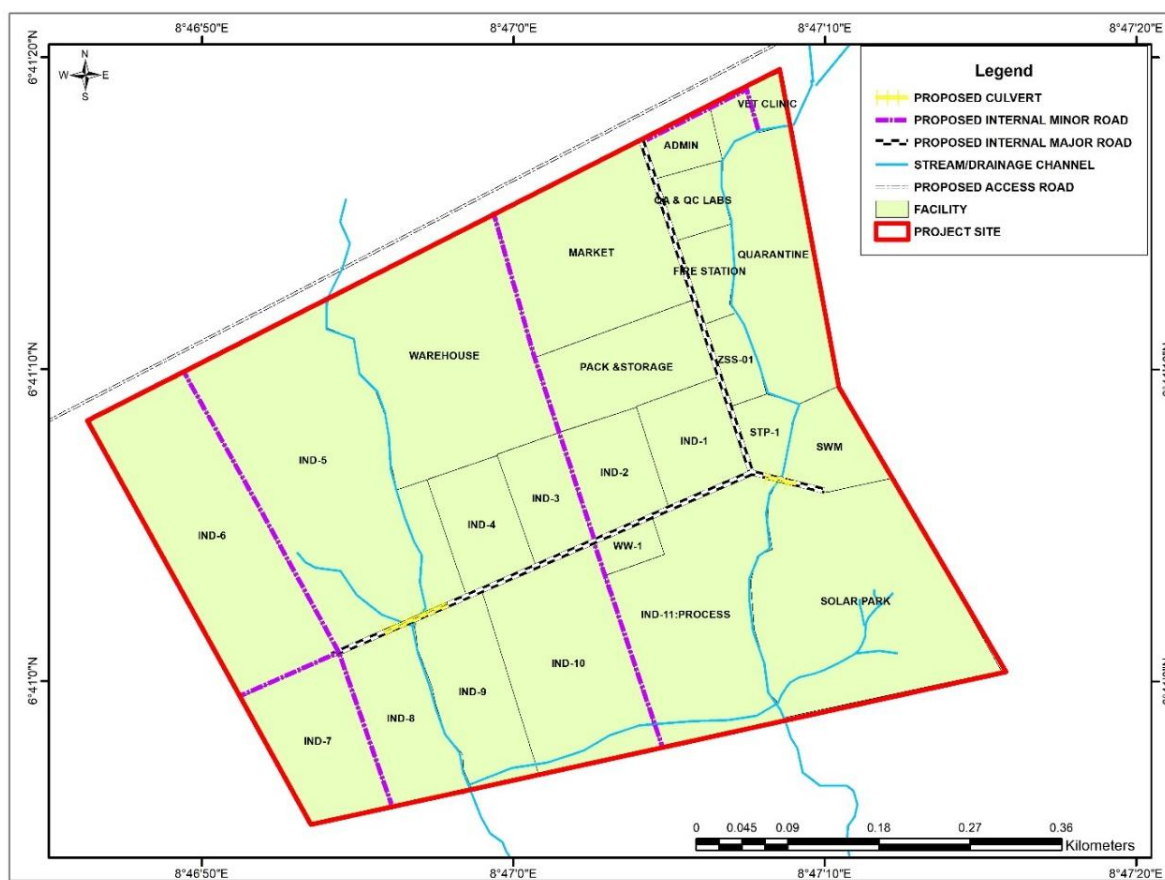


Figure 3.4: Layout of the proposed internal roads in the ATC

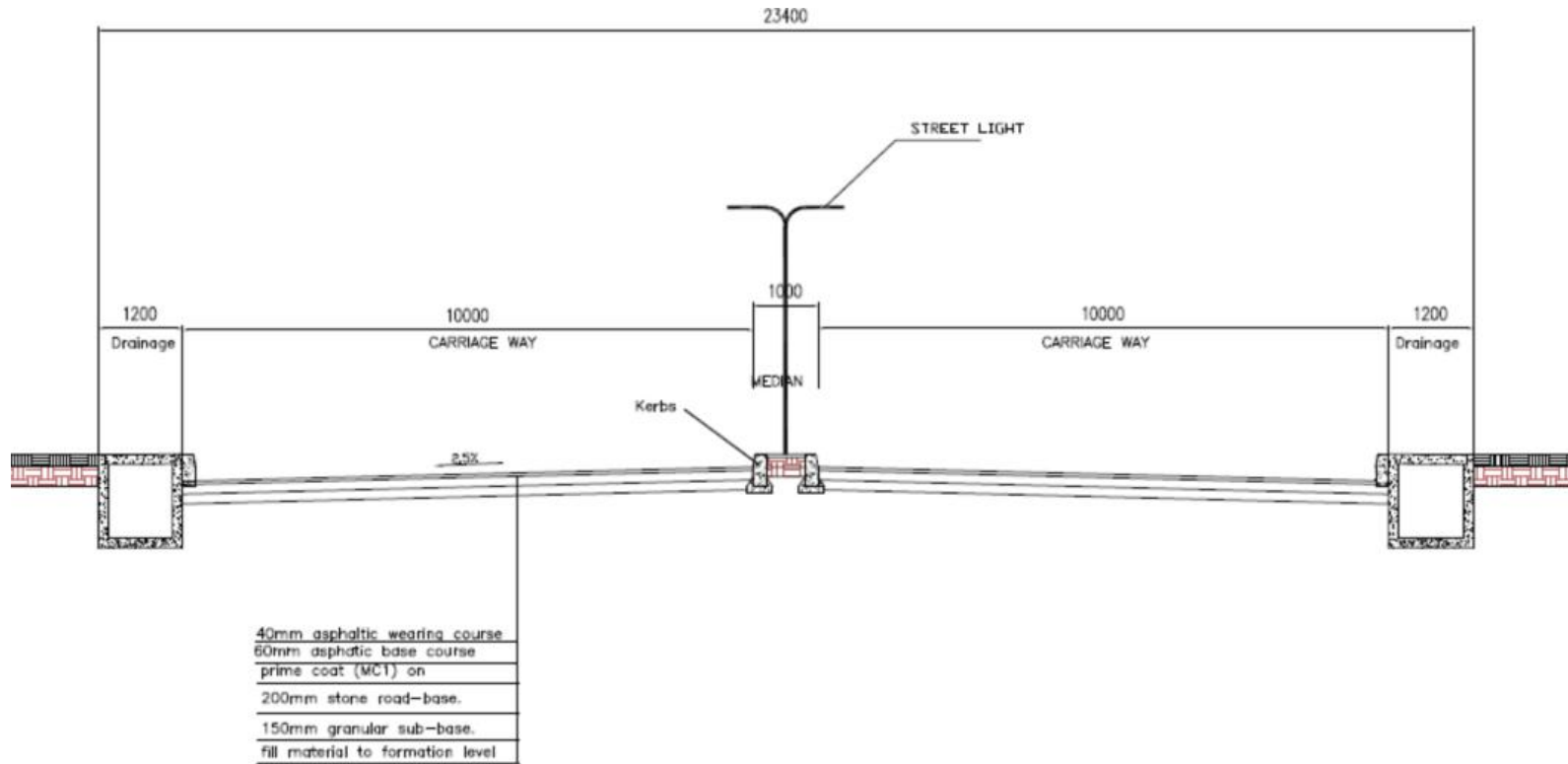


Figure 3.5: ATC's Typical Major Road Cross Section

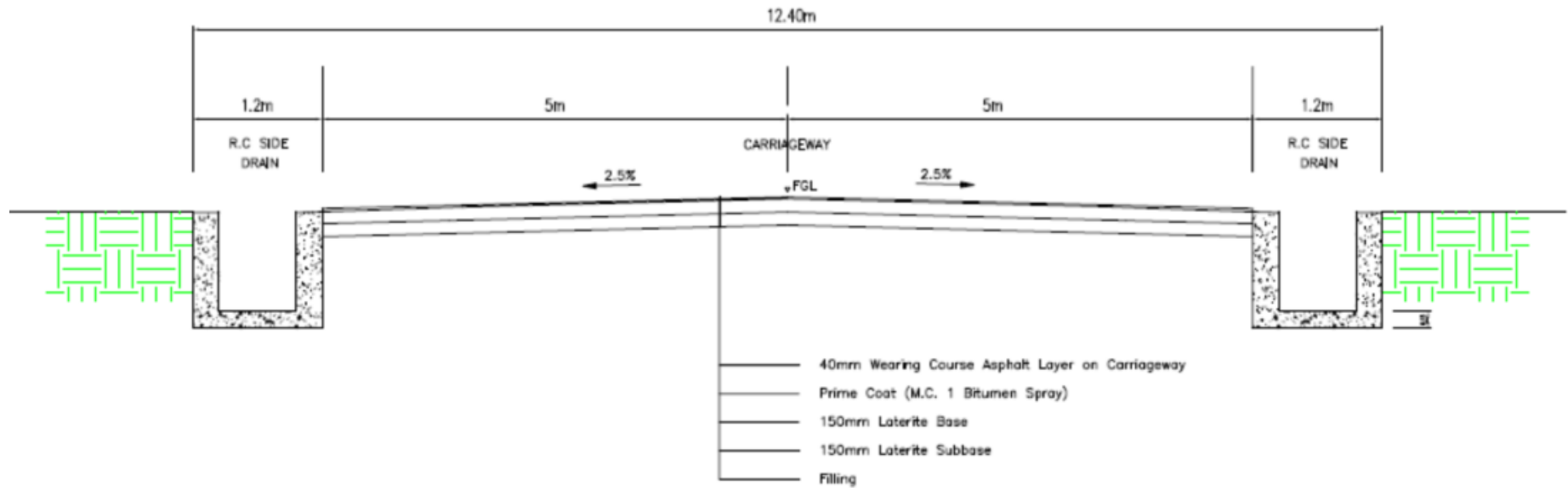


Figure 3.6: ATC's Typical Minor Road Cross Section

3.7.4 Storm Water Drainage Channel

Storm water drainage channel is planned to discharge stormwater from the ATC site down the drainage corridor. Storm water inside the ATC is planned to be collected into roadside drains along the internal road and then released into the retention pond before letting out into the existing drain/ stream. Cross culverts are located at appropriate locations. Based on the ATC layout the storm water drainage details are presented in Table 3.11 and

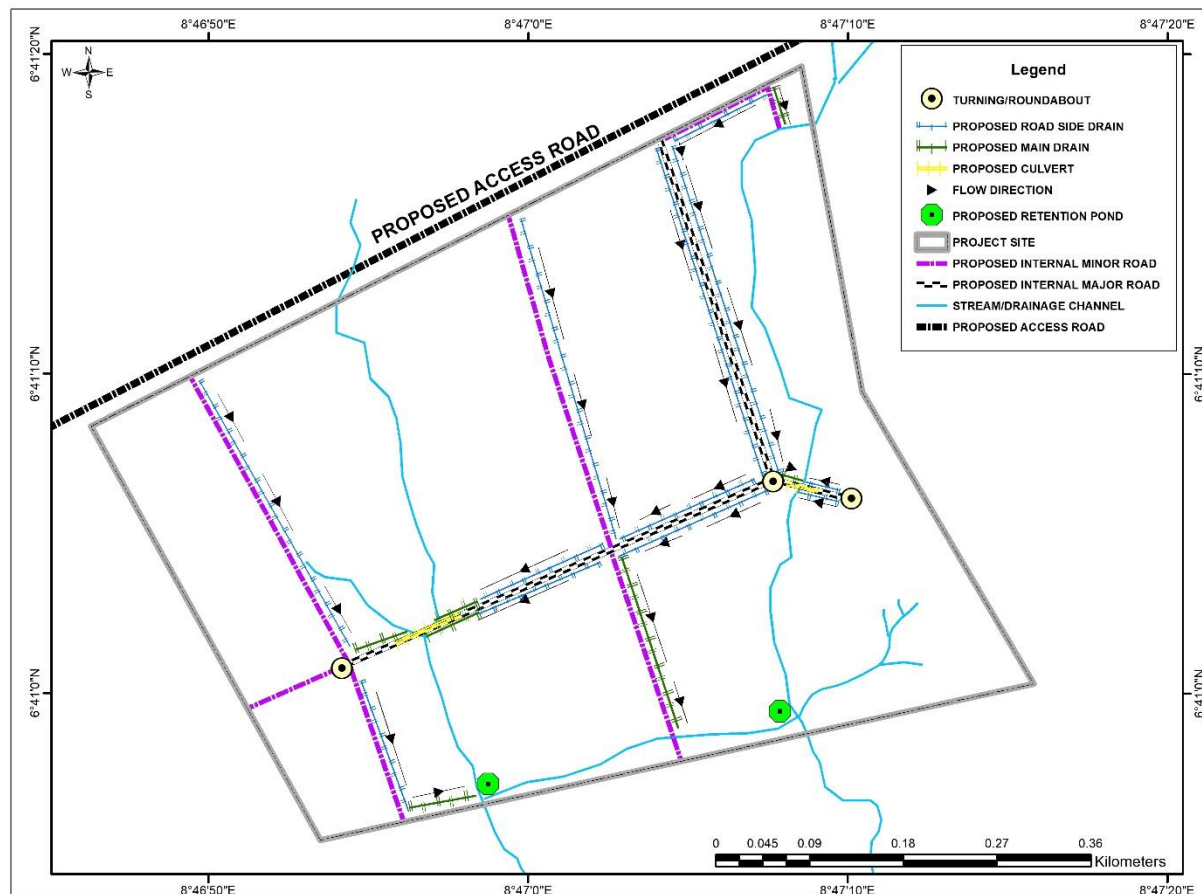


Figure 3.8.

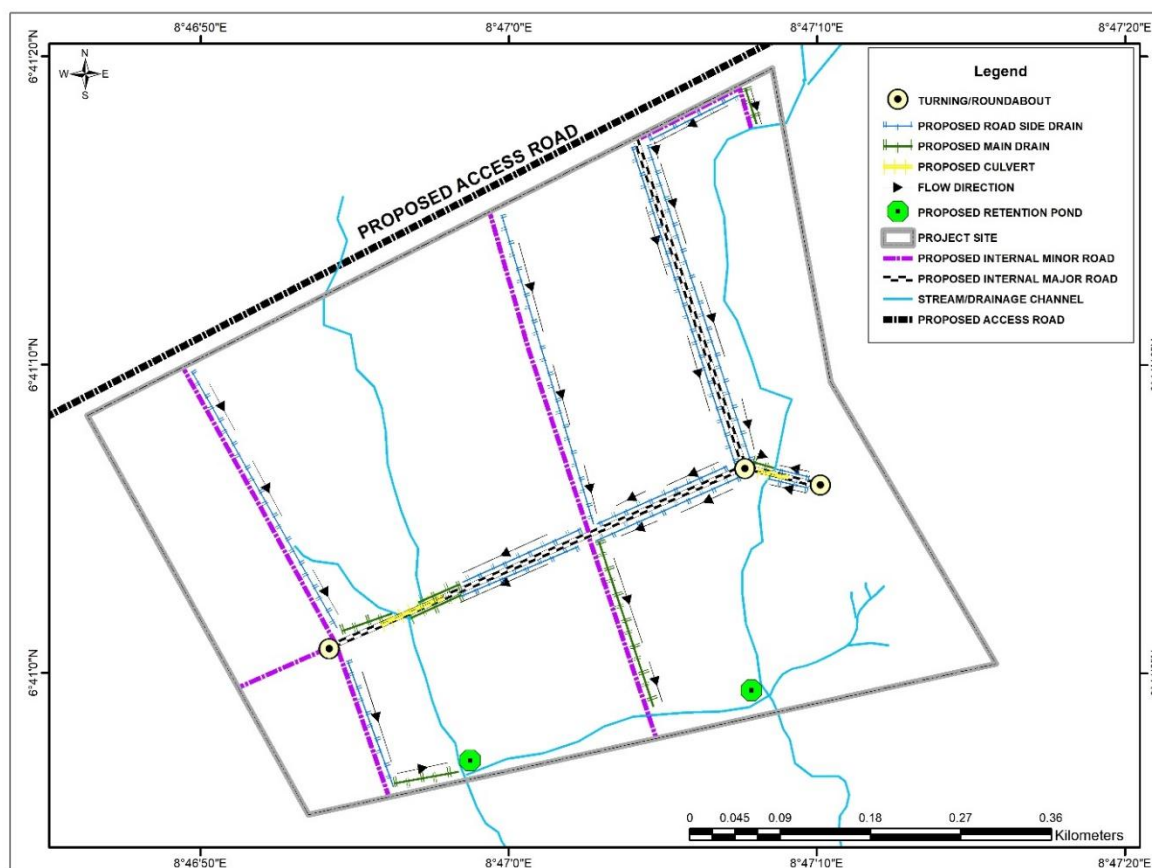


Figure 3.7: Water Drainage details

Table 3.11: Storm water drainage specifications

SN	Description	Length (m)	Number	Dimension
1	Road Side drains	2144.7	2	1.2m x 1.2m
2	Main drain for discharge to outfall	453.4	1	2.0m x 1.5m
3	Cross culverts	100	25	1.2m x 1.2m

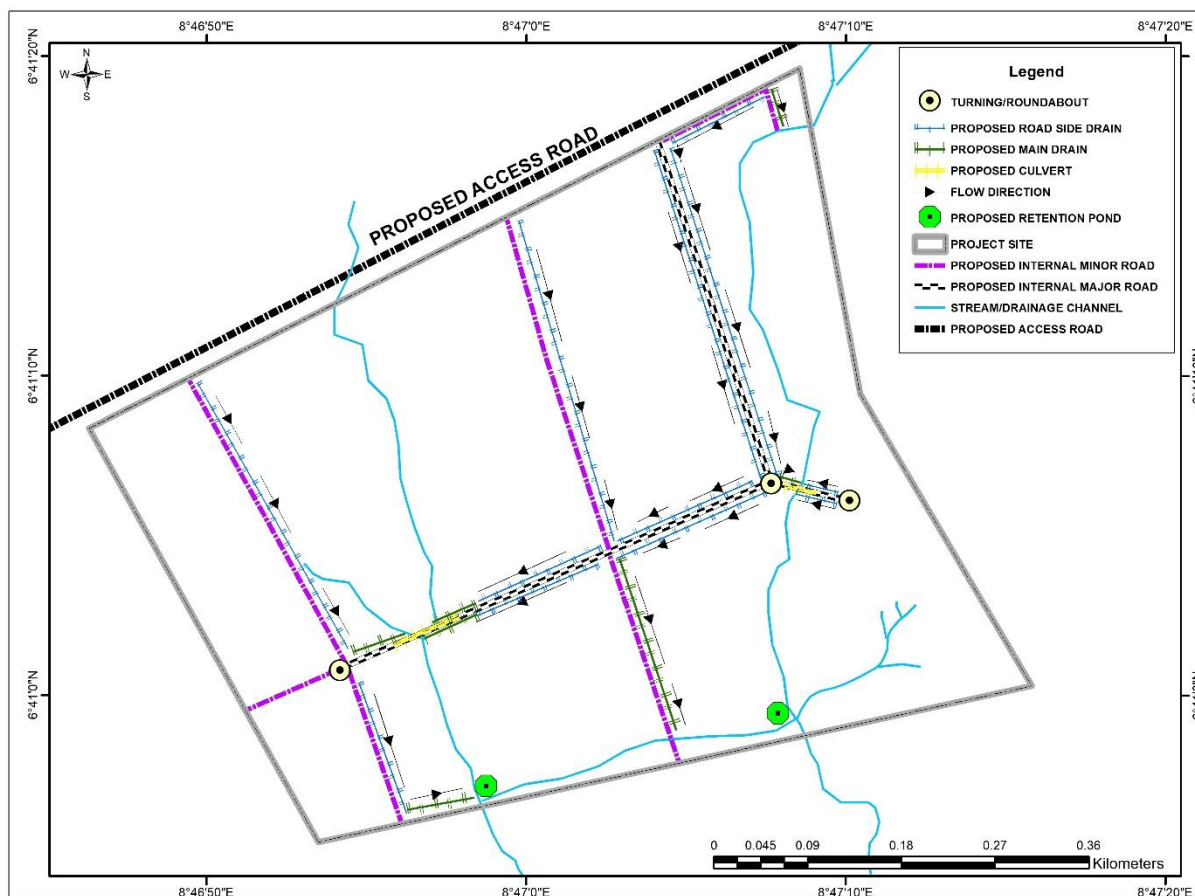


Figure 3.8: Storm water drainage at the ATC site

3.7.5 Water Sources and Demand

The main water sources will be boreholes, a network of industrial boreholes will be utilized. The ATC shall have constant water supply to cater for the following:

- For use by the industries in the ATC;
- For people in the facility for drinking, bathing, cooking, etc.; and
- Other uses such as gardening, cleaning, toilet flushing etc.

The basis used in estimation of the water demand are shown in Table 3.12: Average day unit demand figures, losses of up to 10% will be taken into account.

Table 3.12: Average day unit demand figures

Consumer Type	Average Day Unit Water Demand
Domestic	
Standpipe	20 litres/person/day
Yard tap	40 litres/person/day
House connection	200 litres/person/day; High Income Consumers (with multiple fixtures and a garden tap; includes car washing and garden watering)

Consumer Type	Average Day Unit Water Demand
	100 litres/person/day; Medium Income Consumers (with a kitchen sink, one or two WCs, showers and bathtubs and hand wash basins). 50 litres/person/day; Low Income Consumers (with limited fixtures, a WC and one or two taps).
Institutional Schools – Day (students and staff) – Boarders (students and staff) Hospitals – Outpatients and non-resident staff – In-patients and resident staff Mosques Churches	5 litres/person/day 50 litres/person/day 10 litres/person/day 100 litres/person/day 15 litres/person/day 5 litres/person/day
Commercial Hotels Lodges Shops Bars/Restaurants Offices Petrol stations/washing bays Abattoirs/butcheries	100 litres/bed/day 50 litres/bed/day 25 litres/shop/day 200 litres/day 5 litres/person/day 200 litres/day 50 litres/day
Industrial Milk cooling Dry processing mills Unspecified industrial areas	200 litres/day 30 litres/day 10,000 litres/hectare/day
Livestock Livestock Unit	50 litres/head/day

3.7.5.1 Fluctuations in Rate of Demand for Water

Average Daily Per Capita Demand

= Quantity Required in 12 Months/ (365 x Population)

If this average demand is supplied at all the times, it will not be sufficient to meet the fluctuations.

- **Seasonal variation:** The demand peaks during the dry season. Fire breakouts are generally more in dry season, increasing demand. So, there is seasonal variation.
- **Daily variation** depends on the activity. People draw out more water on weekends and festival days, thus increasing demand on these days.
- **Hourly variations** are very important as they have a wide range. During active household working hours i.e., from six to ten in the morning and four to eight in the evening, the bulk of the daily requirement is taken. During other hours the requirement is negligible. Moreover, if a fire breaks out, a huge quantity of water is required to be supplied during short duration, necessitating the need for a maximum rate of hourly supply.

So, an adequate quantity of water is available to meet the peak demand. To meet all the fluctuations, the supply pipes, service reservoirs and distribution pipes properly proportioned. The water is supplied by pumping directly and the pumps and distribution are system is

designed to meet the peak demand. The effect of monthly variation influences the design of storage reservoirs and the hourly variations influences the design of pumps and service reservoirs. As the population decreases, the fluctuation rate increases.

$$\text{Maximum daily demand} = 1.8 \times \text{average daily demand}$$

Maximum hourly demand of maximum day, i.e., Peak demand

$$\begin{aligned} &= 1.5 \times \text{average hourly demand} \\ &= 1.5 \times \text{Maximum daily demand}/24 \\ &= 1.5 \times (1.8 \times \text{average daily demand})/24 \\ &= 2.7 \times \text{average daily demand}/24 \\ &= 2.7 \times \text{annual average hourly demand} \end{aligned}$$

3.7.5.2 Water Demand

Table 3.13 shows the water demand for the ATC, which is estimated based on the basics presented in Table 3.13.

Table 3.13: ATC Projected water demand

SN	Land Use Description	Estimated Water Demand (m ³ /Day)	10% Loss	Total Demand (m ³ /Day)
1	Offices	101.25	10.125	111.375
2	Residential	27	2.7	29.7
3	Commercial	405.71748	40.571748	446.2892
4	Small scale Industries	509.625	50.9625	560.5875
5	Medium scale Industries	496.125	49.6125	545.7375
6	Large scale Industries	321.3504	32.13504	353.4854
				2,047.17

The Average Daily Per Capita Demand of the ATC is estimated to be 2047 m³/day.

While, the maximum daily demand = 4,200 m³/day.

Peak demand = 350 m³/hour.

It is expected this demand will be sourced from boreholes which require little treatment.

3.7.5.3 Fire Fighting Demands:

Provision for firefighting demand to be met through hydrants (Figure 3.10) is governed by the mathematical formula $100\sqrt{P}$ where P is population in thousands and quantity is in kilolitres subject to minimum provision of 5% of total water demand.

3.7.5.4 Water Storage Tank

Storage tanks serve to store the water needs of the population. They are sized so as to meet one of two values:

- (1) 25% of daily peak demand, and
- (2) 50% of average daily demand.

Selection of volume followed the following criteria: a surface storage tank sized close to 25% of daily peak demand and overhead water tank for 50% of daily average, by considering extension problems and marginal price difference on execution. Another factor is due to pumping by generator that requires ensuring a more comfortable storage for compensating more extended pump stopping. Reservoir capacity required specifically for firefighting is 1% of daily demand.

3.7.5.5 Water Distribution Lines

Water distribution facilities consist of a water supply tank and distribution pipelines. (Figure 3.9 and Figure 3.10) Storage capacity of the water tank was designed, taking into account the hourly water demand fluctuation, the necessary water amount for firefighting and emergency (cut-off of water supply) situations. The diameter of water distribution pipes is to accommodate the required hourly maximum water consumption.

The pipeline networks are classified into three categories:

- Conveyance pipes: this type of pipeline links up supply points, treatment plant and pumping stations
- Transmission pipes link up pumping stations with water storage tanks, and
- Distribution pipes: starting from water storage tanks or connection points in case of a gravitational network up to distribution points.

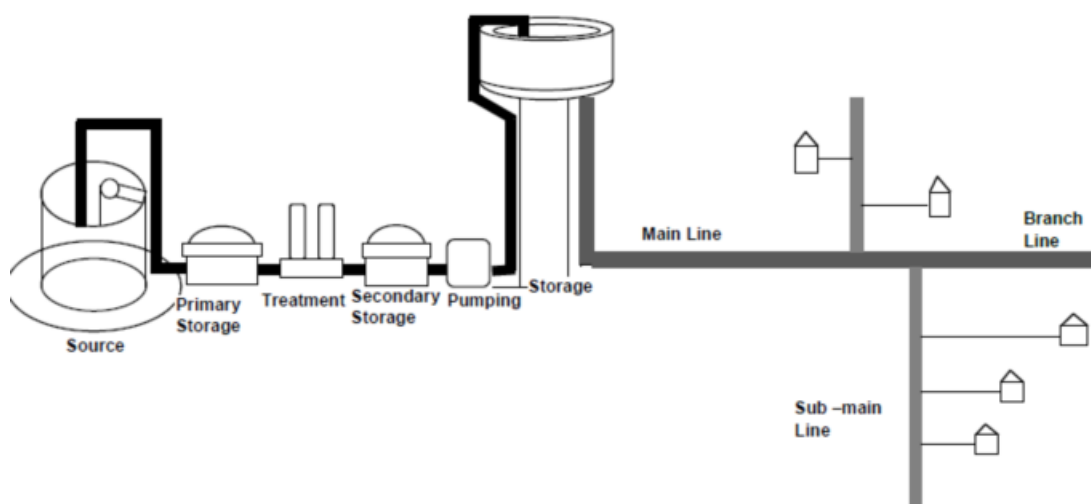


Figure 3.9: Water supply schematic diagram

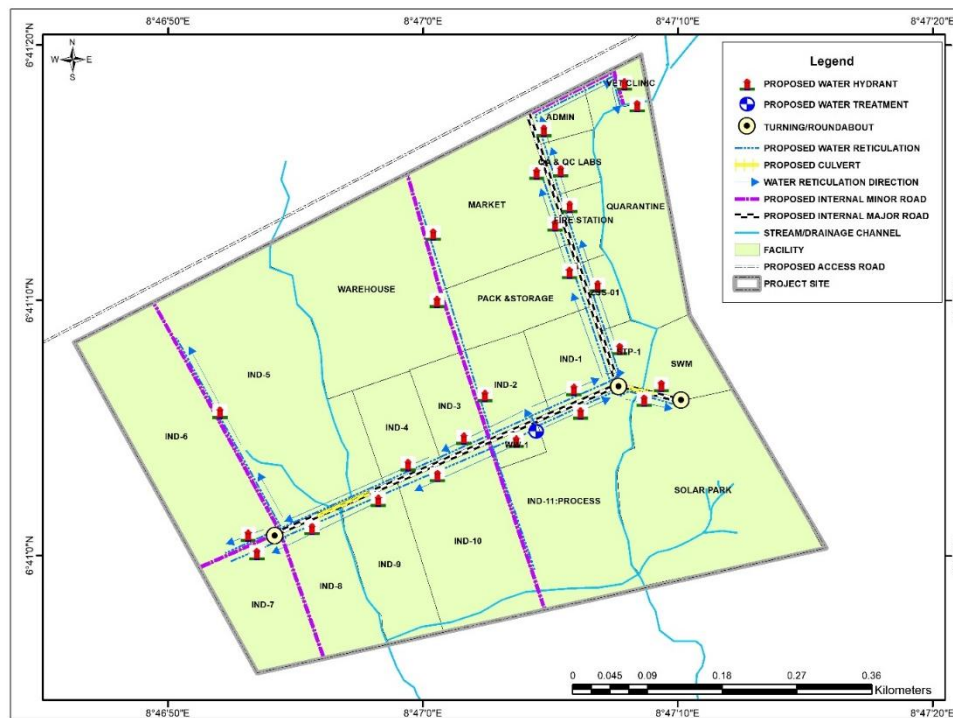


Figure 3.10: ATC site plan showing proposed water reticulation and hydrant points layout

3.7.5.6 Power Demands

Overhead power distribution lines (33 kV) from the national grid would be extended to each tenant enterprise inside the ATC. Installation of step-down transformers is planned for small and medium power consumers, while the 33 kV line will be directly extended to big power consumers.

Provisions for the use of renewable energy to complement the power needs will be made. Table 3.14: Energy load estimation indicates a load estimation.

Table 3.14: Energy load estimation

SN	Description	Remarks	Estimated Power Load (kW)	Cumulative Estimated Power Load (kW)
1	Commodity Service Centre 1-90 W, 2-150 W	- lighting load - small power load for meat storage	9 +15	24
2	Residential Areas 1-90 W; 2-150 W	- lighting load - small power load for ventilation and cooling.	30.06+50.1	80.16
3	Market and Banking areas 1-90 W, 2-150 W	- lighting load small power load for ventilation and cooling	18+30	48

SN	Description	Remarks	Estimated Power Load (kW)	Cumulative Estimated Power Load (kW)
4	Health center 1-90 W; 2-150 W	- lighting load small power load for ventilation and cooling	7.83+13.050	20.88
5	Processing Centre 1-90 W, 2-150 W	- lighting load small power load for ventilation and cooling	47.6+79.35	126
6	Community Vocational Centre 1-90 W, 2-150 W	- lighting load small power load for ventilation and cooling	79.35+47.61	126.96
7	Fire station 1-90 W	- lighting load	74.520	75
8	Vet clinic 1-90 W	- lighting load	7.65	7.65
9	Admin block 1-90w 2-150w	- lighting load small power load for ventilation and cooling	53.82+89.7	143
10	Agric Equipment Centre 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	39.33+65.55	104
11	Recreational Centre 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	315,09+525.150	840.24
12	Cold storage 1-90 W 2-150 W	- lighting load small power load for ventilation and cooling	13.5+22.5	36
13	Trucks parking 1-90w	- lighting load	13.5	13.5
14	Medium-scale industrial zone 1-90 W 2-150 W 3-180 W	- lighting load - small power load consumption machines. - medium power consumption machines.	330.75+551.25+661.5	1543
15	Large-scale Industrial Zone (D) 1-90 W 2-150 W 3-180 W 4-200 W	- lighting load - small power load consumption - medium power consumption machines -high consumption machines	206.28kw+343.8kw+412.56+458.4	1421
16	Small-scale Industrial Zone 1-90 W 2-150 W 3-180 W	- lighting load - small power load consumption machines	45+75+90	210
17	QA & QC LAB 1-90 W	- lighting load	9+15	24

SN	Description	Remarks	Estimated Power Load (kW)	Cumulative Estimated Power Load (kW)
	2-150 W	, small power load for testing machines and test sample cold storage.		
18	Commodity Processing Centre 1-90 W 2-150 W	- lighting load small power load for water & fuel pumping machines	6.93+11.55	18.48
19	Solid waste management.	- lighting load small power load for sewage pumps	3.6+6	9.6
20	Power facilities 1-90 W 2-150 W	- lighting load small power load for water & fuel pumping machines	6.93+11.55	18.48
21	Sewage effluent treatment plant. 1-90 W 2-150 W	- lighting load small power load for sewage pumps	4.5+7.5	12
22	Security street lighting 1-90 W	Lighting load	270	270
23	Total estimated load for the whole district			5,171.95

3.7.5.7 Load Mapping / Distribution for the ATC

Since the total load requirement/estimated based on the above-named estimating method, the proposed arrangement and load survey for the whole district are proposed in Table 3.15, with the underground distribution network layout presented in Figure 3.11.

Table 3.15: Load Mapping

SN	Location	Estimated Load (MW)	Distribution Transformer Sizing/Selection	Remarks
1	The whole district under study/observation	5,171.95	2-Number 15mVA 33/11 kV, with all necessary connecting accessories	Power other power transformers using 11 kV overhead or underground ring supply or radial
2	Large-scale industrial zone (A)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
3	Large-scale industrial zone (B)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground

SN	Location	Estimated Load (MW)	Distribution Transformer Sizing/Selection	Remarks
4	Large-scale industrial zone (C)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
5	Large-scale industrial zone (D)	1.421	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
6	Medium-scale industrial zone (A)	1543	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
7	Medium-scale industrial zone (A)	1543	2 Number 1mVA power transformer 11 kV/0.415 kV	Tap via 11 kV lines overhead or underground
	SUM TOTAL	9MW		
		10.989 MW=1.089 MW		

NOTE: all other loads to be on the balance load of 1.089



Figure 3.11: Proposed underground power distribution network in the ATC

Proposed solar power estimation of the ATC

The total power load of the proposed ATC is estimated at 10.98 megawatts, based on the thumb power estimation rule. To enable the utilisation of green energy for the proposed project, 10% of this estimated load is set aside for the solar energy provision.

10% of 10.98MW=1.098MW.

So, 1.098MW was set aside for solar installation for the proposed project, and the proposal to consist of the following: -

- Solar power hybrid
- With a capacity of 1.098MW.
- With 3137 solar PV panels
- With PV combiners
- Connecting control breakers
- Ring main unit
- Step up transformer – (1mVa) 415V / 11kV.
- Earthing
- Armoured cabling
- Aluminium conductors
- Hybrid sensors power source

Street Lighting

All roads will be provided with solar street lights.

3.7.6 Wastewater Treatment System

The wastewater collection facilities are planned to collect pre-treated effluent from each factory, and sewage from other facilities, in accordance with the following basic concepts:

- Separate system: which is a system for transporting wastewater and storm water separately, while stormwater drainage is planned to utilize drain ditch beside the internal road network,
- Industrial wastewater and sewage from toilet are collected into the same pipe to avoid duplication of facilities, and
- Wastewater is transported as free flowing basically by gravity (
- Figure 3.13) to avoid the possibility of choking in pipes as well as to reduce the cost of construction and maintenance of the pumping system.

The domestic sewage to be generated has been assumed to be 80% of the domestic water consumption.

Based on the domestic sewage demand of 80% of the water demand, which is 1640m³/day, a packaged wastewater treatment plant (Figure 3.14) is designed to provide this volume.

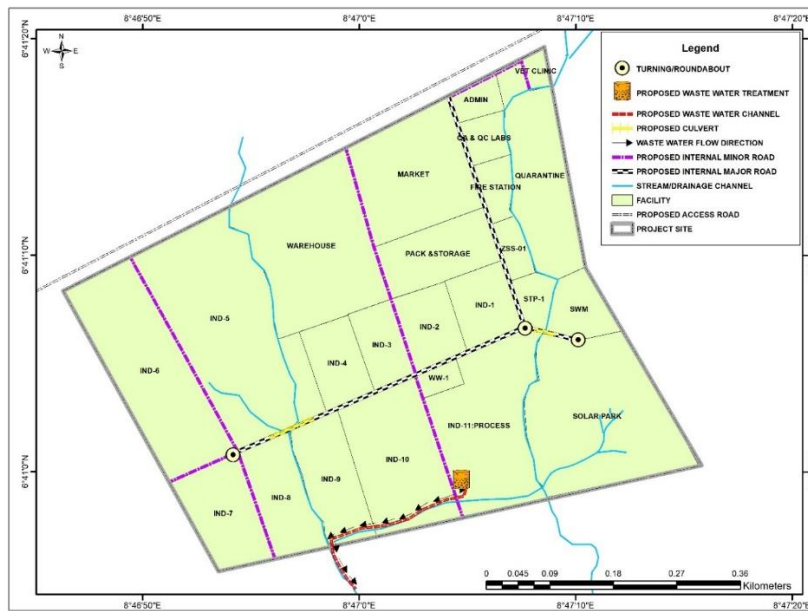


Figure 3.12: Proposed Waste Water Drainage Network

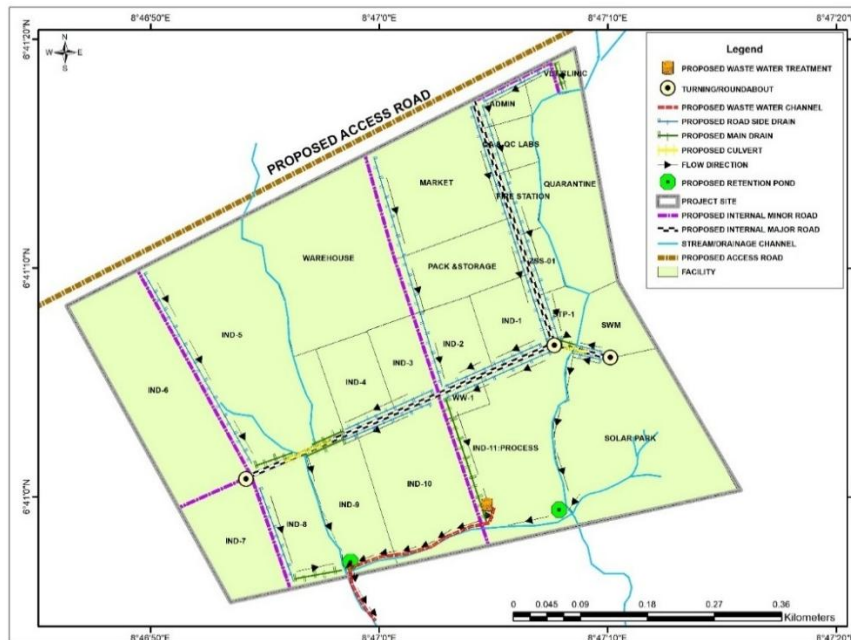


Figure 3.13: Interaction between the waste water drainage, storm water layout and the retention pond

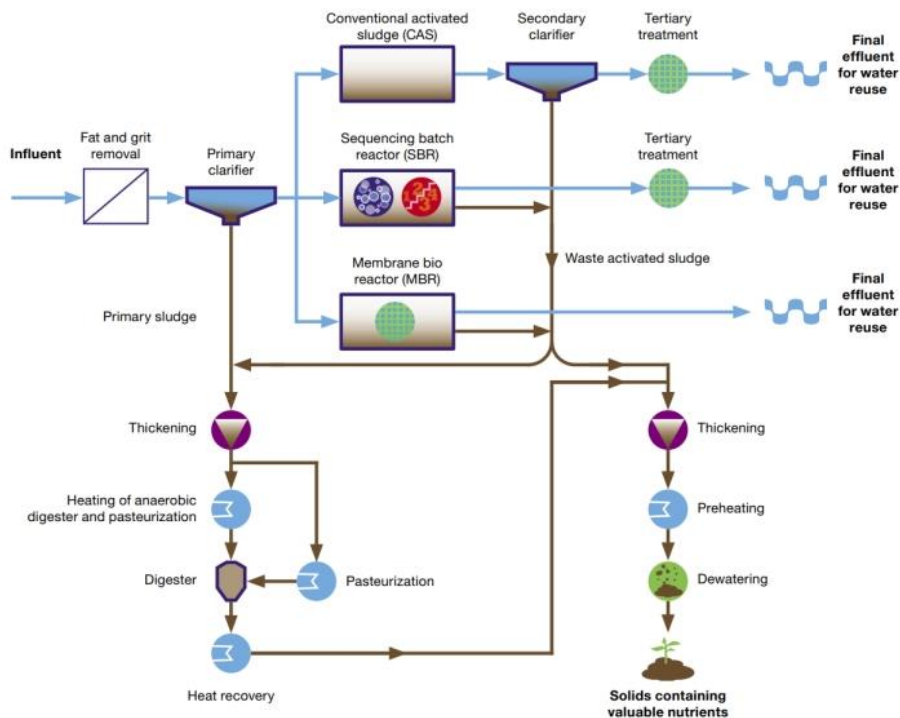


Figure 3.14: Flow diagram of the proposed waste water treatment plant

3.8 Solid Waste Handling Facilities

The Design, Build & Operate (DBO) contractor and prospective investors will adapt the WMP prepared for this project (Figure 3.15). The waste management plan for the proposed project has been carefully prepared based on a thorough understanding of potential waste characteristics. The project waste considered here include:

- **Construction waste:** vegetative (32,220 m³).
- **Excavated soil:** the expected 97,983.6 m³ of soil from excavation will be stocked and reused as back filling material for road and building foundations, and for landscaping. The cut-and-fill portion is not regarded here.
- **Oil:** oil and grease from malfunctioning vehicles and equipment on-site.
- **Recyclables** such as paper, glass, metal and plastics.
- Industrial process waste.
 - Rice husk stream and valorisation (briquetting/biomass energy)
 - Ash management is used as fuel.
- Wood from pallets for transporting products,
- Concrete from the batching plant
- Dewatered sludge is generated in the wastewater treatment facility.

Scrap metals, paper, glass, and plastics will undergo sorting and be sold for recycling or reuse. At the source, solid waste will be segregated (Figure 3.15). The Cross River State Waste Management Agency will be engaged to collect and dispose of waste not recovered by the DBO contractor for

reuse. The waste will be carefully tracked and dumped at approved sites. The approved dumpsites for the project area are located at:

- i. Ogoja Main Dumpsite: Approximately 28 km from the project site, serving Yala and Ogoja LGAs; designated by CRSWMA for municipal and non-hazardous waste disposal.

Calabar State Waste Disposal Facility (for hazardous or special waste): For any hazardous, oily, or chemical wastes that cannot be treated locally, materials will be transferred under manifest to the Calabar Integrated Waste Disposal Facility for controlled treatment and disposal.

Each type of waste shall be segregated and put in respective colour-coded containers (Figure 3.15). each colour is distinct for a particular purpose. Yellow for plastics and paper, red (or black) for general waste, green for organic waste (food and garden waste) and blue for glass and cardboard. (Qureshi, 2023)

Especially, food processing waste is diverted to compost through several processes. Outside the ATC, recyclables will be sold, while sludge and other wastes will be transported to a designated landfill site. Dedicated refuse collection bins will be provided in the ATC at the appropriate locations. (Figure 3.14).



Figure 3.15: Sample of colour-coded containers for waste collection

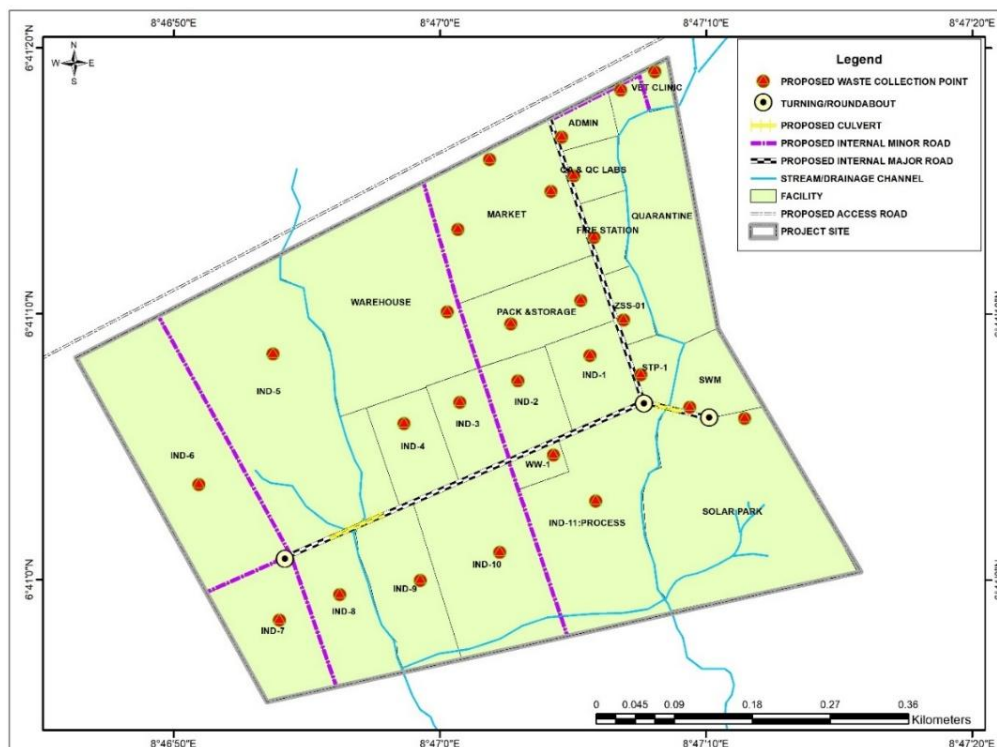


Figure 3.16: Location Map of Solid Waste Collection Points within the ATC

Upon completion of construction, the DBO contractor will decommission the construction site and clear all debris, including remnants of temporary structures erected by food and other vendors for site workers, preparatory to ATC's commissioning for operations. The DBO contractor's waste disposal subcontractor will handle the collection and disposal of these materials. This meticulous waste management strategy ensures a responsible and environmentally conscious approach throughout construction. Figure 3.16 presents a simplified flowchart for the proposed waste management strategy for the proposed ATC project.

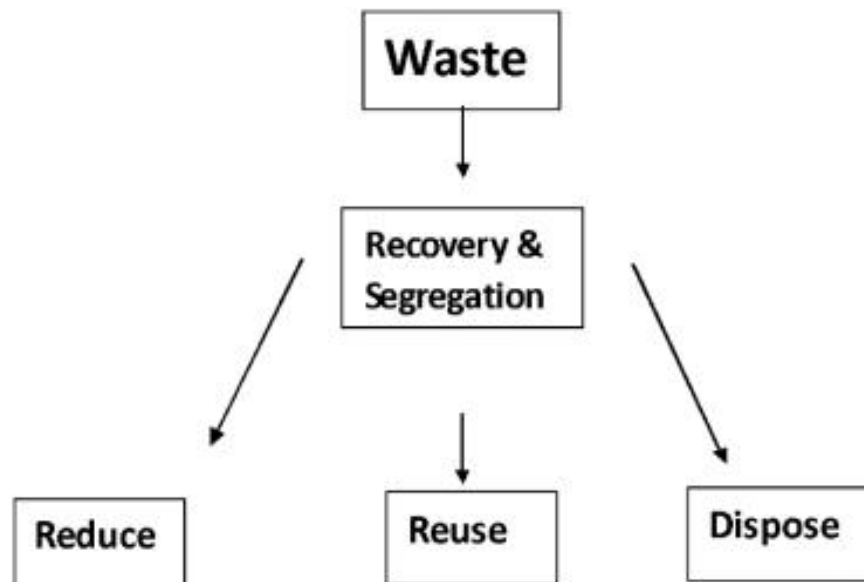


Figure 3.17: Waste Management flowchart for the proposed project.

3.9 Telecommunication

Although there may be telecommunication masts in the area, provision will be made for an additional base station. This will take care of both the telephone and internet requirements of the site.

3.10 Operational Phase of the Project

During the operational phase, the ATC will host multiple agro-processing and service enterprises. Operations will include raw material intake, processing of crops such as cassava, rice, and cocoa, packaging, storage, and logistics. The ATC will also support administrative offices, training and research centres, and small business incubators. Operations will be powered by a hybrid energy system combining solar and grid power, with a wastewater treatment facility ensuring compliance with FMEnv discharge standards.

Routine maintenance will include road cleaning, drainage desilting, landscaping, and equipment servicing. The operational workforce will consist of approximately 150 permanent and 100 temporary staff, with a strong emphasis on local employment and gender inclusion.

3.11 Project Lifespan and Decommissioning

The ATC has an anticipated lifespan of 40 years, depending on maintenance and economic viability. Decommissioning may involve the removal of structures, dismantling of industrial equipment, and restoration of affected areas. A Decommissioning and Site Restoration Plan (DSRP) will be implemented at that stage, ensuring environmental protection, waste recycling, and re-vegetation of the area where appropriate. The plan will comply with FMEnv and AfDB standards for closure and transition.

3.12 General Construction Work scope

Figure 3.14 presents a flow chart of the work scope and the principal sequence of the construction works process for the infrastructure. These activities, from pre-construction through construction

and operational and decommissioning phases of the proposed project are the sources of impacts, as presented in chapter five with proffered mitigation / enhancement measures in chapter six, and generic and specific plans developed to manage the environmental and social impacts identified as presented in chapter seven and annexes.

Maintenance Plan

CRSAPZ, through the DBO Contractor, is unwavering in its commitment to guaranteeing the safety and efficiency of the ATC for all operators. The maintenance strategy is provided in the DBO Contractor's Facility Management Plan (Appendix 3.1).

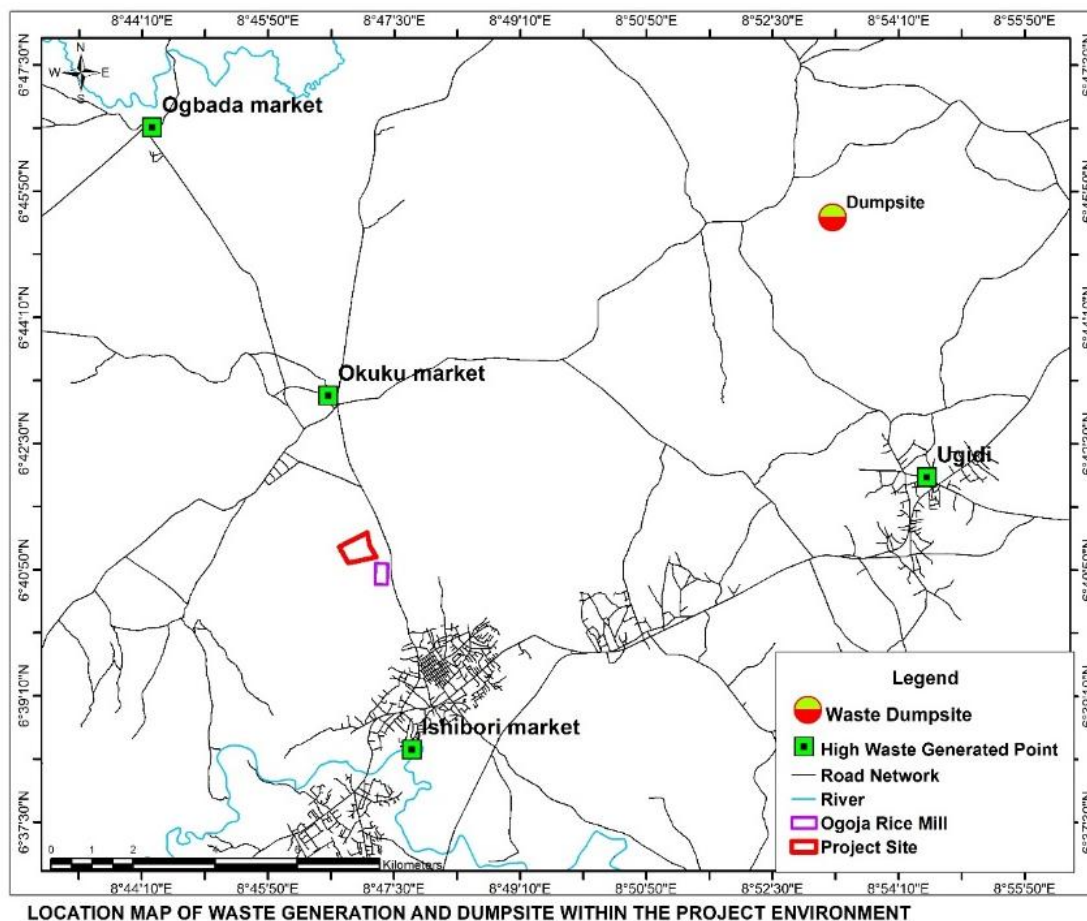


Figure 3.18: Major waste generation and dumpsite locations in the Okuku area

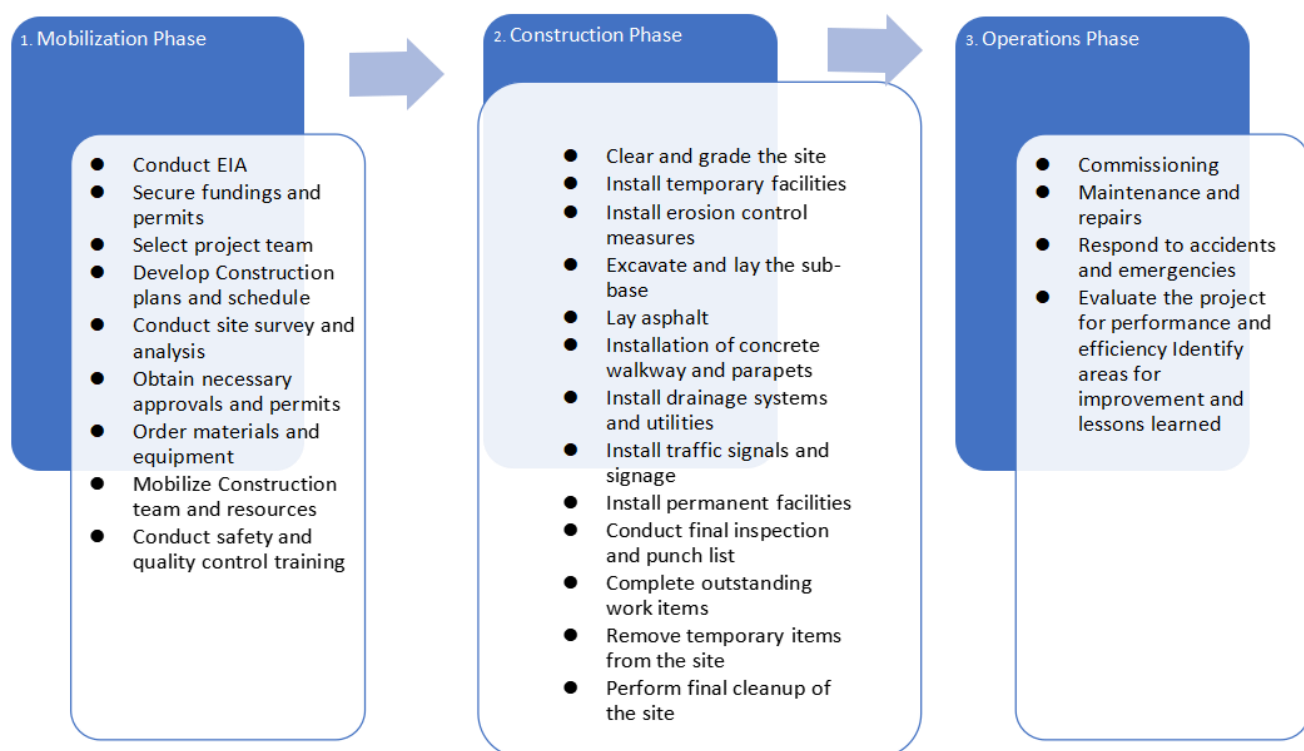
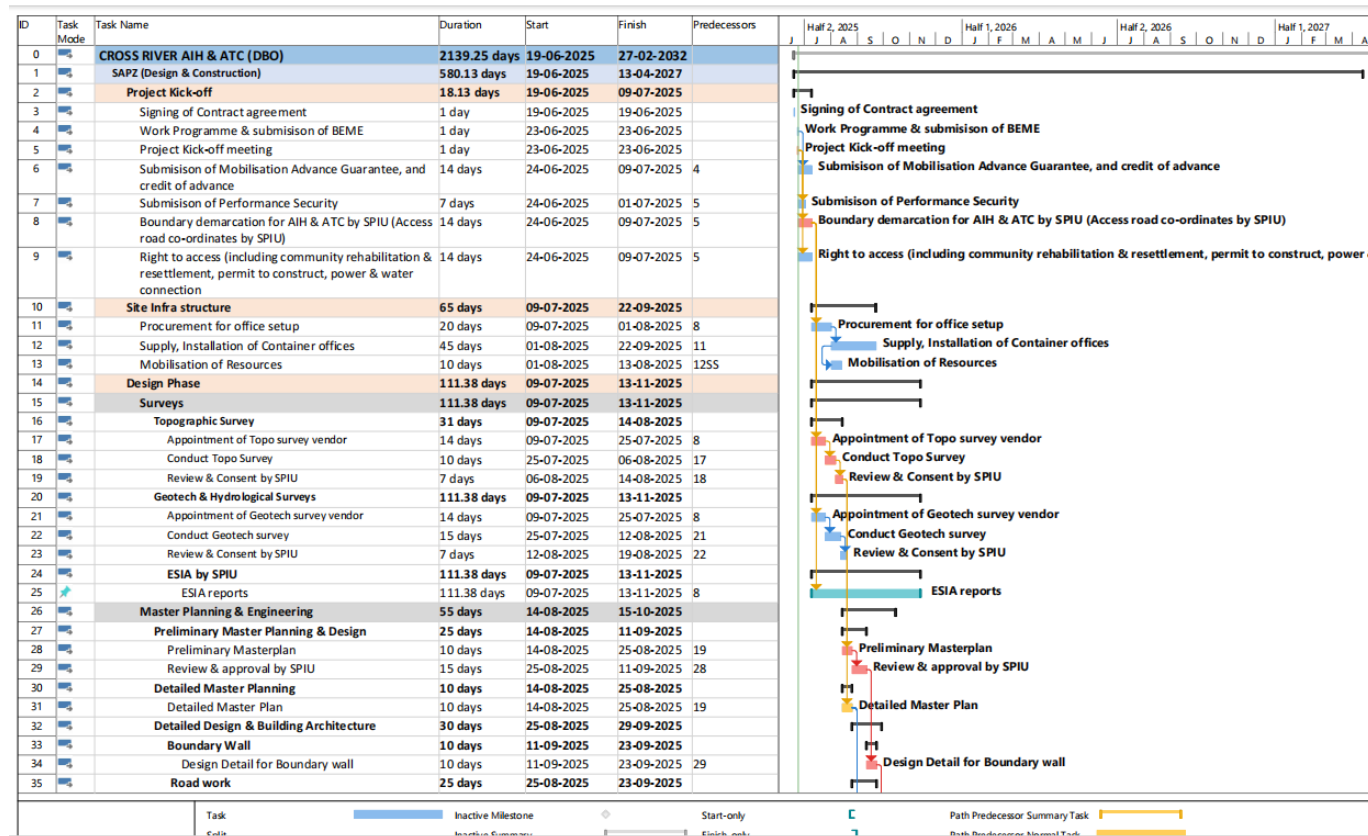
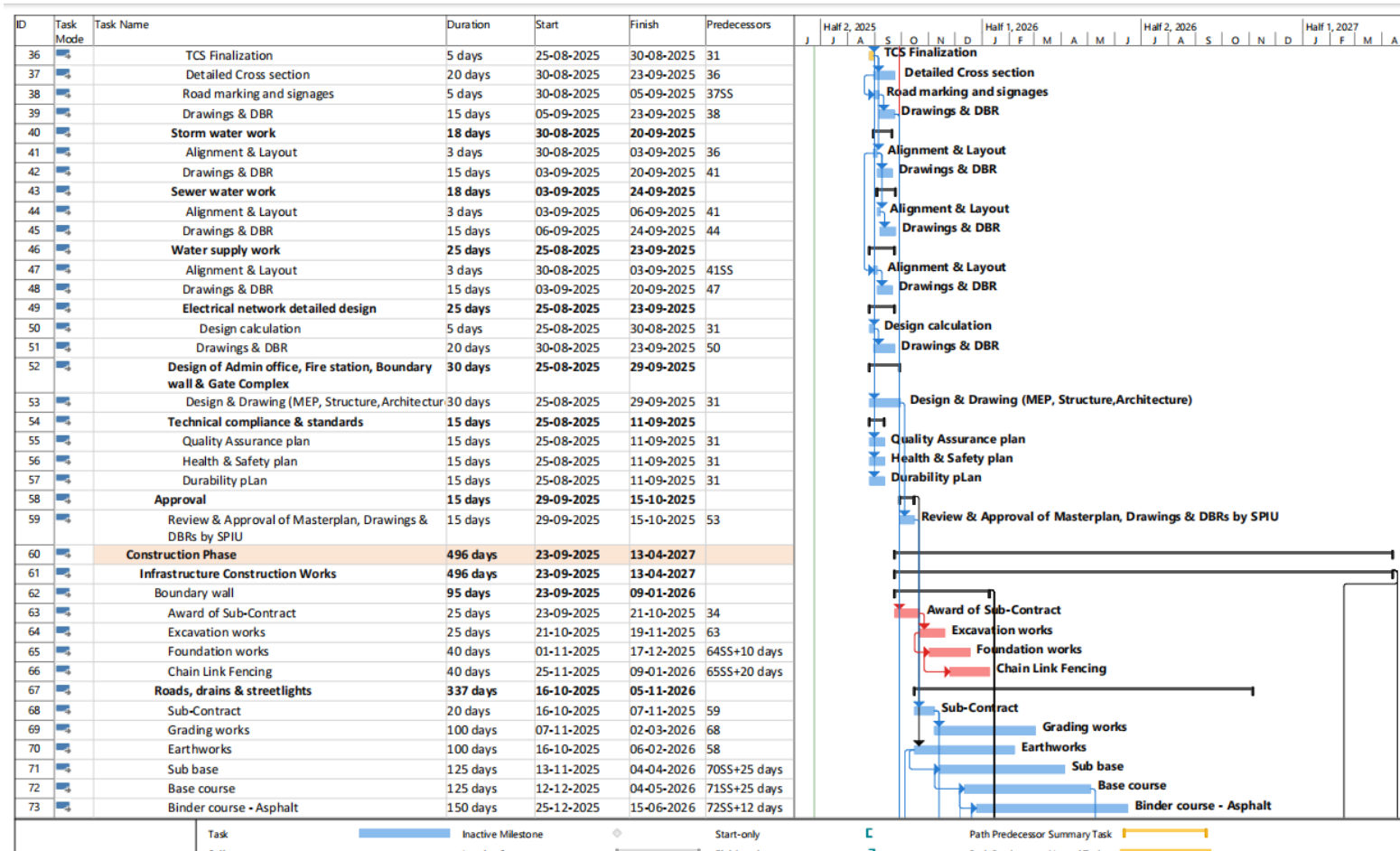
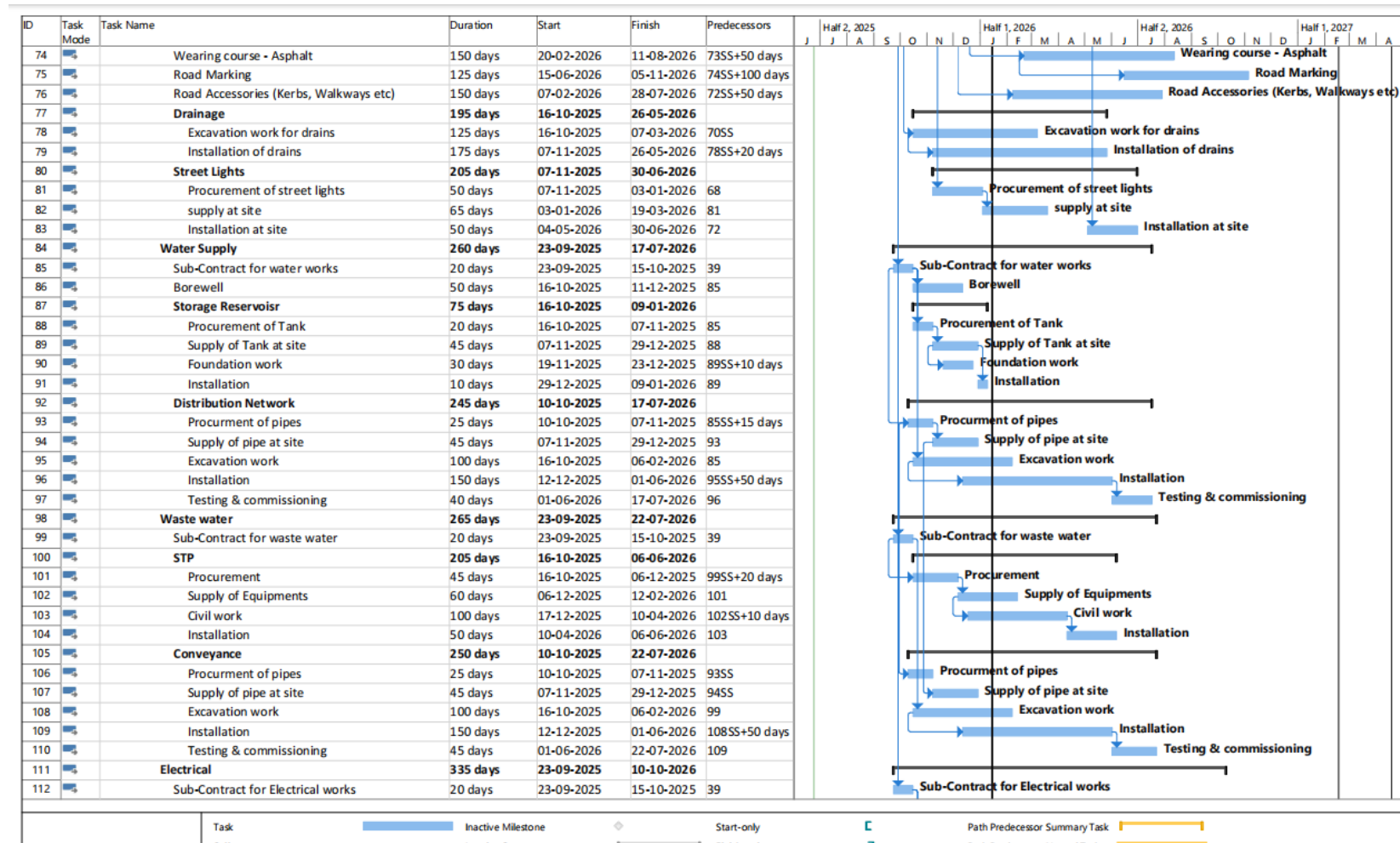


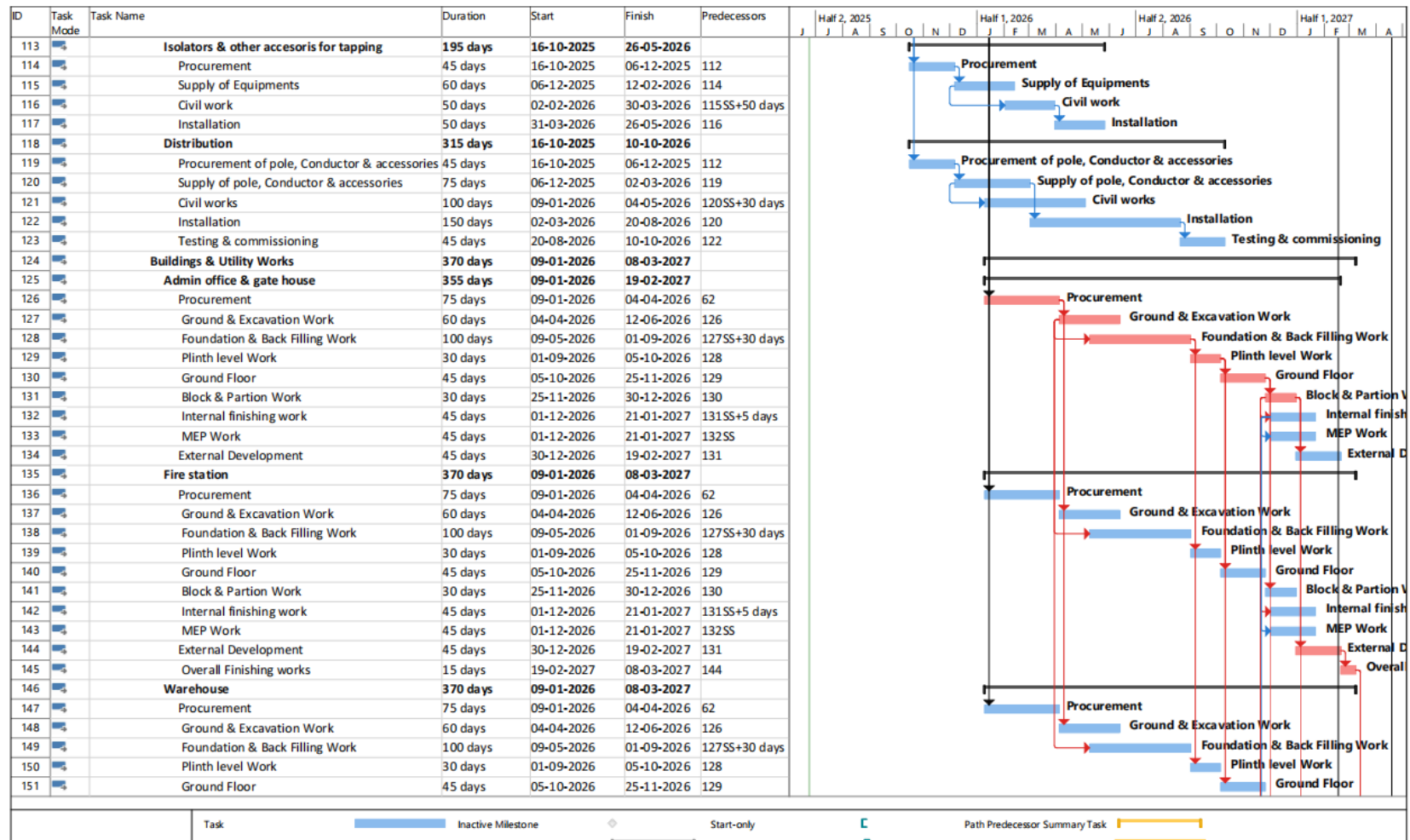
Figure 3.19: Flowchart of general construction work

Table 3.16: Proposed Project Execution Schedule









ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Half 2, 2025							Half 1, 2026							Half 2, 2026							Half 1, 2027						
152		Block & Partion Work	30 days	25-11-2026	30-12-2026	130	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A					
153		Internal finishing work	45 days	01-12-2026	21-01-2027	131SS+5 days																												
154		MEP Work	45 days	01-12-2026	21-01-2027	132SS																												
155		External Development	45 days	30-12-2026	19-02-2027	131																												
156		Overall Finishing works	15 days	19-02-2027	08-03-2027	155																												
157		Handing Over	31 days	08-03-2027	13-04-2027																													
158		Quality Check by SPIU	30 days	08-03-2027	12-04-2027	145,156																												
159		As built drawings	30 days	08-03-2027	12-04-2027	145,156																												
160		Start of DLP	1 day	12-04-2027	13-04-2027	159																												
161		Operation & Maintenance	1598 days	27-02-2027	27-02-2032																													
162		O&M manuals	7 days	13-04-2027	21-04-2027	61																												
163		Emergency resonse plan	15 days	13-04-2027	29-04-2027	61																												
164		Waste management plan	15 days	13-04-2027	29-04-2027	61																												
165		Health & safety Management plan	15 days	13-04-2027	29-04-2027	61																												
166		Quality Assurance management plan	15 days	13-04-2027	29-04-2027	61																												
167		Operation & maintenace	1598 days	27-02-2027	27-02-2032	61																												

4 DESCRIPTION OF THE EXISTING ENVIRONMENT

DESCRIPTION OF THE EXISTING ENVIRONMENT

This chapter captures all the baseline information of the study area of the proposed Agricultural Transformation Centre (ATC). This includes 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 Socioeconomic and health conditions of the project affected communities.

4.1 Study Approach

The baseline environmental and social conditions were established based on data obtained over two (2) climatic seasons (wet seasons) sampling carried out in the study area. Primary data was obtained from wet season field sampling exercise which commenced on Thursday 26th through Saturday 28th June, 2025. Figure 4.1 shows the generalized sampling points for all environmental samples.

The baseline status of the project area was obtained through consultations with the relevant stakeholders as well as from field studies covering the following:

- Reconnaissance survey;
- Field studies including air, surface water, sediment, soil and vegetation sampling;
- Geophysical investigation and groundwater sampling;
- Field analysis and sample preservation;
- Laboratory analysis of samples;
- Socioeconomic and health studies;
- Data processing, analysis and interpretation; and
- Reporting

4.1.1 Baseline Data Acquisition Methods

Basically, measurements, field data collection and sample collection of representative populations were utilized in the data acquisition process to determine the environmental parameters of the study area. This exercise involved a multi-disciplinary approach and was executed within the framework of a quality, health, safety and environment (QHSE) management system approach. Using the best available equipment, resources, and personnel, this method guarantees that the necessary data and samples were collected in accordance with established (scientific and regulatory) requirements. 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 methodology/procedures for collecting field data are described in the succeeding sub-sections. Also, baseline environmental conditions of the proposed ATC project area as recorded during field study are described in succeeding sections below. 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.

4.1.2 Consultation with Regulators and Stakeholders

Prior to field sampling, meetings were held with the relevant stakeholders to intimate them of the project and seek their consent to carry out the field data gathering. Consultation is an important element of Socioeconomic assessment and an integral component of the entire ESIA process. This is because appropriate and adequate consultations will ensure smooth project implementation and guarantee economic and commercial sustainability of the proposed project. It involves information dissemination and interaction/dialogues with the host communities and other stakeholders on the EIA of the proposed project.

The key objectives of consultation on the ESIA for the proposed ATC project are to:

- Ensure that the communities and all stakeholders are given early and adequate information on the ESIA and the proposed ATC project activities;
- Provide a framework for improving the understanding of the potential impacts of the proposed project on the Socioeconomics and biophysical environment;
- Include stakeholders' views and concerns as part of the ESIA execution especially as it concerns the potential impacts;
- Identify contentious issues in the proposed project execution;
- Establish transparent procedures for carrying out the proposed projects; and
- Create accountability and a sense of local ownership during project implementation, thus minimizing communities' conflicts and project delays that may result thereof.

4.1.3 Desktop Studies

Desktop studies involved the acquisition of relevant background information on the environment of the study area. Approved reports from earlier environmental studies conducted in the region, as well as books, articles, maps, and other materials about the proposed ATC project area and environs similar to it, were among the materials studied.

4.2 Objectives of Field Sampling/Measurement

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 ground and surface 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 Socioeconomic and health status of the project affected communities.
- Geology and hydrogeology conditions of the project area



Plate 4.1: Air Quality and Noise Sensors, Soil Auger and Sampling bags

4.3 Analytical Methods

Samples collected from the field were analysed using various methods in the laboratories of the Akwa Ibom State Ministry of Science and Technology, Uyo.

This study employed analysis techniques approved by the Federal Ministry of Environment. Some international analytical procedures were also adopted for this study. Those of APHA, EPA, and ASTM analytical procedures for soil, sediment, and water quality were among analytical procedures adopted and used in the course of this study. To ensure the reliability and integrity of some unstable physico-chemical parameters, in-situ measurement of pH, conductivity, Total Dissolved Solids (TDS), and temperature were carried out in the field. All field instruments were regularly cleaned and recalibrated after each use, some of which are shown in Plate 4.1.

The Quality Assurance and Quality Control (QA & QC) for laboratory analyses is in accordance with FMEv. recommended method, and include blank analyses to establish analyte level, duplicate analyses to establish analytical precision, spiked and blank sample analyses to determine analytical accuracy.

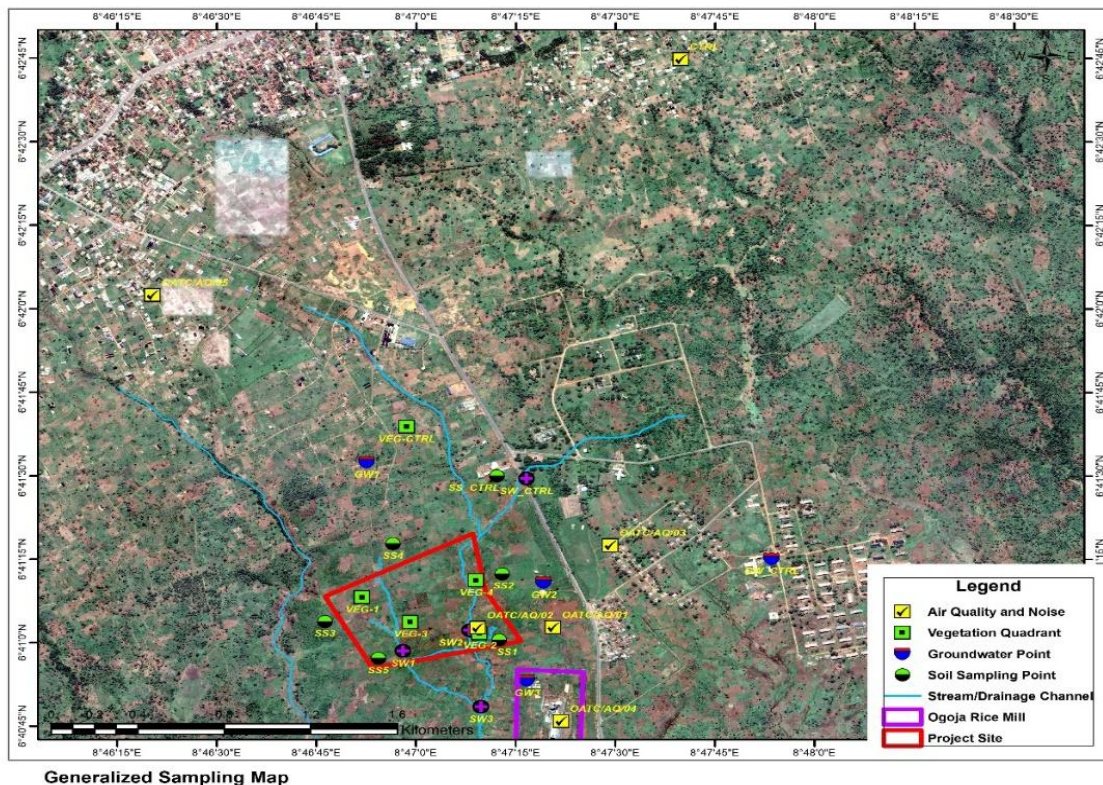


Figure 4.1: Generalised sampling map for all Environmental Components Studied at the Proposed ATC Project Area

Source: Field work 2025

4.4 Air Quality, Noise and Meteorological Studies

4.4.1 Study Sites

Situated within equatorial coordinates of 06°40'58.62"N to 06°42'03.36"N latitude and 08°45'50.62"E to 08°47'52.92"E longitude, Okuku is a rural agricultural community in Yala Local Government Area of Cross River State, Nigeria. This strategically located settlement lies within Nigeria's ecological transition zone, characterized by its fertile arable lands, dense forest reserves rich in biodiversity, and a network of water bodies that support both irrigation and livestock husbandry activities.

In Okuku community, several existing human activities and natural factors currently impact air quality and noise levels even before the implementation of the proposed Agricultural Transformation Centre (ATC). Regarding air quality, the predominant agricultural activities including bush burning for land clearing and crop residue management release particulate matter (PM_{2.5} and PM₁₀), meat processing facilities and greenhouse gases. The widespread use of firewood and kerosene for domestic cooking in households generates smoke containing carbon monoxide, nitrogen oxides, and volatile organic compounds. Transportation activities along the community's unpaved roads produce dust emissions, particularly during dry seasons, while occasional generator use for electricity contributes diesel exhaust emissions. Natural factors like Harmattan winds between December and February introduce dust particles from the Sahara Desert, significantly reducing air visibility and quality.

Noise pollution in the community primarily stems from agricultural machinery such as small tractors and harvesters used in farming operations. Transportation noise occurs from motorcycles and vehicles moving along the rural roads, often exacerbated by the unpaved road surfaces. Social and religious gatherings, including outdoor ceremonies and festivals, generate intermittent but significant noise levels. Domestic activities like grinding machines and power generators, though limited to fewer households, contribute to the noise profile. The natural environment adds ambient noise from forest wildlife and flowing water bodies, though these typically fall within acceptable levels. These existing conditions establish an important baseline for monitoring potential changes that may result from the proposed ATC development.

4.4.2 Air Sampling

A comprehensive air quality assessment was conducted across five monitoring stations using highly sensitive digital portable analyzers. The monitoring equipment measured concentrations of multiple pollutants, including nitrogen dioxide (NO₂), sulfur dioxide (SO₂), hydrogen sulfide (H₂S), hydrogen cyanide (HCN), ammonia (NH₃), chlorine (Cl₂), carbon dioxide (CO₂), carbon monoxide (CO), methane (CH₄), and particulate matter (PM_{2.5} and PM₁₀).

The specific models and technical specifications of all portable gas detectors employed in the study are detailed in Table 4.1 while Table 4.2 highlights the methods employed in sampling. This standardized monitoring approach ensured accurate quantification of baseline air pollutant levels throughout the study area prior to project implementation.

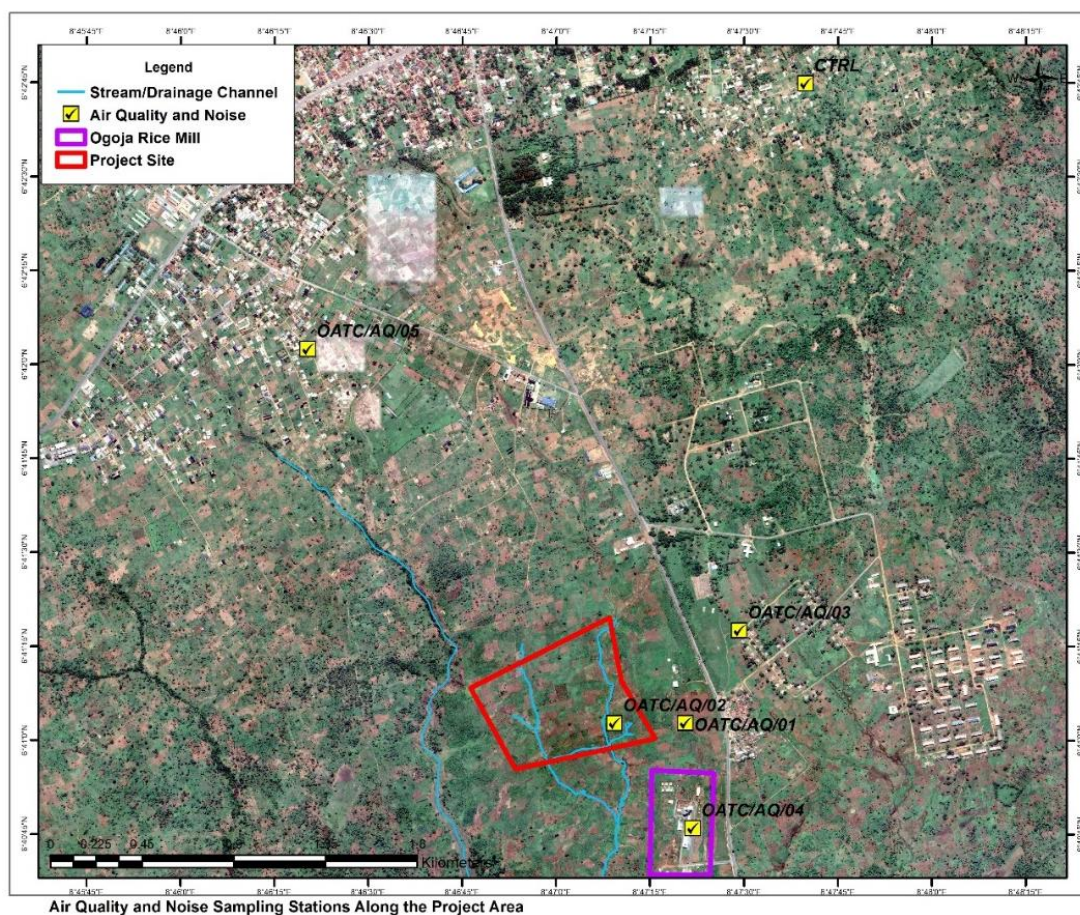


Figure 4.2: Air Quality and Noise Sampling Points in the Project Area and its Environs

Table 4.1: Gaseous Emissions and Noise Measuring Instruments

Parameter	Equipment	Range	Alarm levels
Sulphur dioxide (SO ₂)	SO ₂ Crowcon Gasman S/N: 19648H	0-10ppm	2.0ppm
Nitrogen dioxide (NO ₂)	NO ₂ Crowcon Gasman S/N: 19831N	0-10ppm	3.0ppm
Hydrogen sulphide (H ₂ S)	H ₂ S Crowcon Gasman S/N: 19502H	0-50ppm	10ppm
Carbon monoxide (CO)	CO Crowcon Gasman S/N: 19252H	0-500ppm	50ppm
Carbon dioxide (CO ₂)	KANGWF Air Quality Detector JSM - 131SC	0-5000ppm	2001-5000ppm
Ammonia (NH ₃)	NH ₃ Crowcon Gasman S/N: 19730H	0-50ppm	25ppm
Chlorine (Cl ₂)	Cl ₂ Crowcon Gasman S/N: 19812H	0-5ppm	0.5ppm
Hydrogen Cyanide (HCN)	HCN Crowcon Gasman S/N: 19773H	0-25ppm	5ppm
Methane (CH ₄)	XP-3160	0-5,000 ppm	250 or 500 ppm
Suspended particulate monitor (SPM)	Haz-Dust TM 10µg/m ³ particulate monitor	0.1-200 10µg/m ³	+1-0.0210µg/m ³
Noise Level Meter	NM 102	Auto Ranging (30-130dB)	-

Table 4.2: Methods for sampling of air pollutants

Method No.	Parameter measured	Method
TM-4	Sulfur dioxide (SO ₂)	USEPA (2000) Method 6 or 6A or 6B or USEPA (1996) Method 6C or ISO (1989) Method 7934 or ISO (1992) Method 7935 or ISO (1993) Method 10396 or ISO (1998) Method 11632 (as appropriate)
TM-5	Hydrogen sulfide (H ₂ S)	USEPA (2000) Method 11 or USEPA (2000) Method 15 or USEPA (2000) Method 16 or Environment Canada (1992) Reference Method EPS1/RM/6 (as appropriate)
TM-7	Chlorine (Cl ₂)	USEPA (2000) 26A
TM-11	Nitrogen dioxide (NO ₂)	USEPA (2000) Method 7 or 7A or 7B or 7C or 7D or USEPA (1990) Method 7E or USEPA (1996) Method 20 or ISO (1993) Method 10396 (as appropriate). NO _x analyzers may be substituted in Method 7E provided the performance specifications of the method are met.
TM-32	Carbon monoxide (CO)	USEPA (1996) Method 10
TM-34	Volatile organic compounds (VOC)	USEPA (2000) Method 18 or USEPA (2000) Method 25 or 25A or 25B or 25C or 25D or 25E (as appropriate)
OM-5	'Fine' particulates (PM _{2.5})	USEPA (1997) Method 201 or 201A (as appropriate)
AM-22	Particulate matter – PM ₁₀ – TEOM	AS 3580.9.8-2001
OTM-29	Hydrogen cyanide (HCN)	US EPA, Method OTM-29
Method 323	Formaldehyde	US EPA, 40 CFR Part 63, Method 323

4.4.3 Meteorological Data Acquisition

The existing meteorological and climatic data from Nigeria meteorological stations was used for the write-up. However, additional field data will be collected for atmospheric pressure, relative humidity, temperature, and wind speed and wind direction. The measurements were taken at 5 stations AATC/AQ/01-AATC/AQ/05 with a control point. The measurements of the meteorological parameters were carried out using *in situ* portable pieces of equipment as given in Table 4.3. and Plate 4.1.

Table 4.3: Meteorological Instruments

Parameter	Equipment
Relative humidity, Temperature	MAX-MIN THERMOMETER, HYGROMETER MODEL: KTJ TA318
Wind speed	MASTECH MS6252A Digital Anemometer
Wind direction, Atmospheric Pressure	Sun Road Digital compass (Altimeter) Model: CR2032
PM _{2.5} , PM ₁₀ , TVOC and CH ₂ O	Air Ae Steward Air Quality Monitor

4.4.4 Precaution/Quality Assurance/Quality Control (QA/QC)

In marking sampling location, special preference was given to the following:

- Accessibility

- Availability of open space with good configuration free from shed
- Meteorological consideration of upward and downward directions
- Areas with minimal local influence from vehicular moment.
- In sampling, consideration was given to:
 - Sensitivity and stability of equipment used
 - Re-calibration of equipment
 - Reproducibility of results.

4.4.5 Data Analysis

The Dispersion Modeling of Air Quality using ARC-GIS Version 10.8 was described by Gulliver and Briggs (2011).

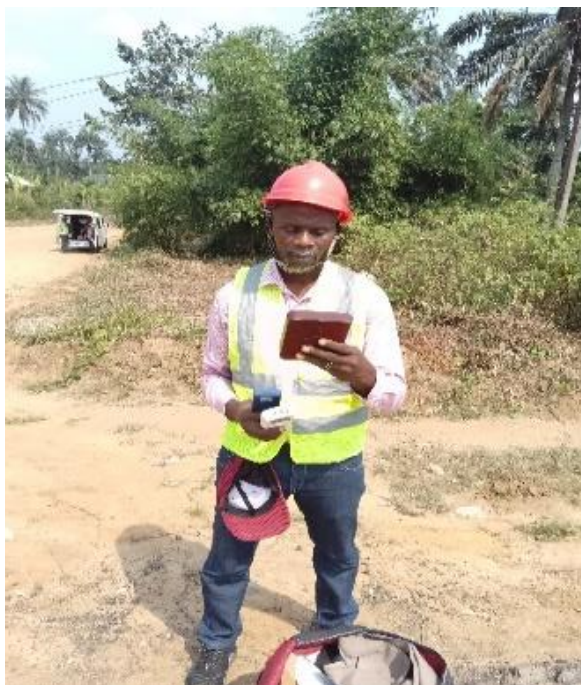


Plate 4.2: Air quality, noise levels and field meteorological measurements

Baseline Findings for Air Quality, Noise Level and Meteorological Conditions

The baseline results demonstrate that the ambient air quality within the project area is generally good, with most parameters falling below national and international guideline limits. However, localized elevations of particulate matter (PM_{10}) and noise were recorded in specific areas influenced by existing community activities.

Particulate Matter ($PM_{2.5}$ and PM_{10})

- i. $PM_{2.5}$: Ranged between $58.6 \mu\text{g}/\text{m}^3$, below the FME_{env} limit of $75 \mu\text{g}/\text{m}^3$ and WHO limit of $60 \mu\text{g}/\text{m}^3$, indicating clean fine-particulate air with minimal combustion sources.

- ii. PM_{10} : Ranged between $125.8 \mu\text{g}/\text{m}^3$, with slight exceedances above the FMEnv permissible limit of $150 \mu\text{g}/\text{m}^3$ recorded near the Okuku-Ogoja access road and land-clearing areas.

The PM_{10} exceedances are attributed to re-suspended dust from unpaved access roads, material stockpiles, and dry-season soil exposure, rather than combustion sources. The low $PM_{2.5}$ levels confirm minimal fine-particle pollution, typical of rural settings with low traffic and no industrial discharge.

Gaseous Pollutants

The concentration of the air pollutant around the project area is presented in 4.3. The dispersion model of the pollutants is presented in Figure 4.4a and Figure 4.4b to reveal their spatial patterns and variations. Among the pollutants;

- i. SO_2 : Measured concentrations 0.16 ppm surpasses the 0.01 ppm FMEnv limit, showing some form of industrial combustion influence.
- ii. NO_2 : with concentration of 0.01 ppm is below the 0.04 ppm threshold, suggesting limited vehicular or biomass burning emissions.
- iii. CO : Concentrations 2.8 ppm, below both FMEnv (10 ppm) and WHO (9 ppm, 8-hour mean) limits, indicating good ventilation and absence of major traffic congestion.
- iv. H_2S and NH_3 : Both gases were below detection limits (<0.001 ppm) at all locations, reflecting the absence of waste decomposition, sewage release, or industrial discharge sources.
- v. VOCs: Detected in trace levels (<0.02 ppm) near residential areas, likely from domestic waste burning or cooking emissions, but well below concern thresholds.

Noise Levels

The noise level concentration across the 10 points and one controls sampled is presented in Figure 4.5. The spatial dispersion model for noise around the study area is presented in Figure 4.6.

- i. Ambient noise levels across the study area ranged between 59.7 to 70.4 dB(A) during the day and 53–56 dB(A) at night.
- ii. Quiet agricultural zones and undeveloped lands such as OATC/NL/04 recorded average values of 59.7 dB(A), well within the FMEnv limit of 75 dB(A) for mixed land-use areas.
- iii. Roadside settlements and market vicinities recorded higher levels 75.5 dB(A)), exceeding guideline values due to vehicular traffic, community trading, and occasional machinery operations.

Meteorological Condition

Meteorological data collected during field measurements (Figure 4.7) showed that the project area experiences tropical humid conditions, characterized by alternating wet and dry seasons. The recorded data at the time of monitoring are summarized below:

- i. Temperature: $29.2\text{--}31.6^\circ\text{C}$ (mean 30.4°C), typical of daytime dry-season conditions (presented in Figure 4.8).
- ii. Relative Humidity: 65–79%, indicating moderate atmospheric moisture conducive to natural pollutant dispersion (Figure 4.9).
- iii. Wind Speed: 1.2–2.4 m/s, with predominant southwesterly winds ($210^\circ\text{--}240^\circ$) reflecting coastal influence from the Atlantic Ocean (details presented in Table 4.4 and Figure 4.10).

- iv. Rainfall: The rainfall data (1994–2024) for Okuku, Cross River State, Nigeria, with annual totals ranging from 3000 mm (2004) to 3200 mm (2012) and an average of 3,100 mm, reveals a tropical monsoon climate critical to planning the proposed Okuku ATC.
- v. Atmospheric Pressure: Averaged 1008–1012 hPa, indicating stable atmospheric conditions with limited vertical mixing.

The combination of low rainfall, moderate humidity, and light winds supports short-distance pollutant transport and temporary accumulation of dust, explaining localised variations in PM₁₀ levels observed during the study.

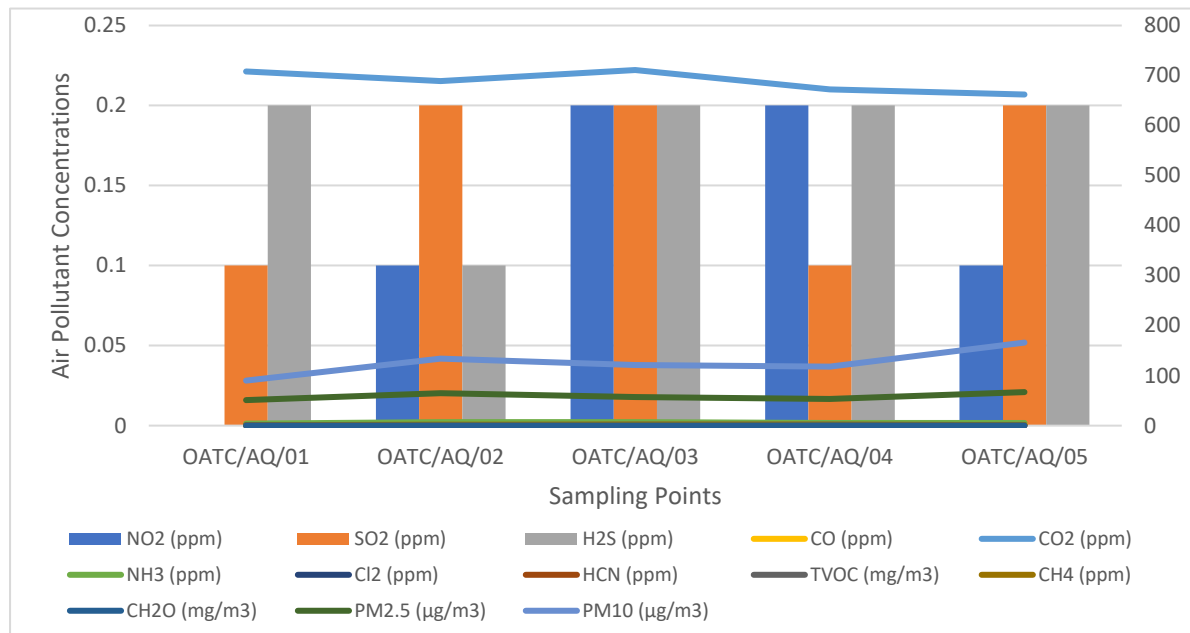


Figure 4.3: Air Pollutant Concentrations in the Study areas

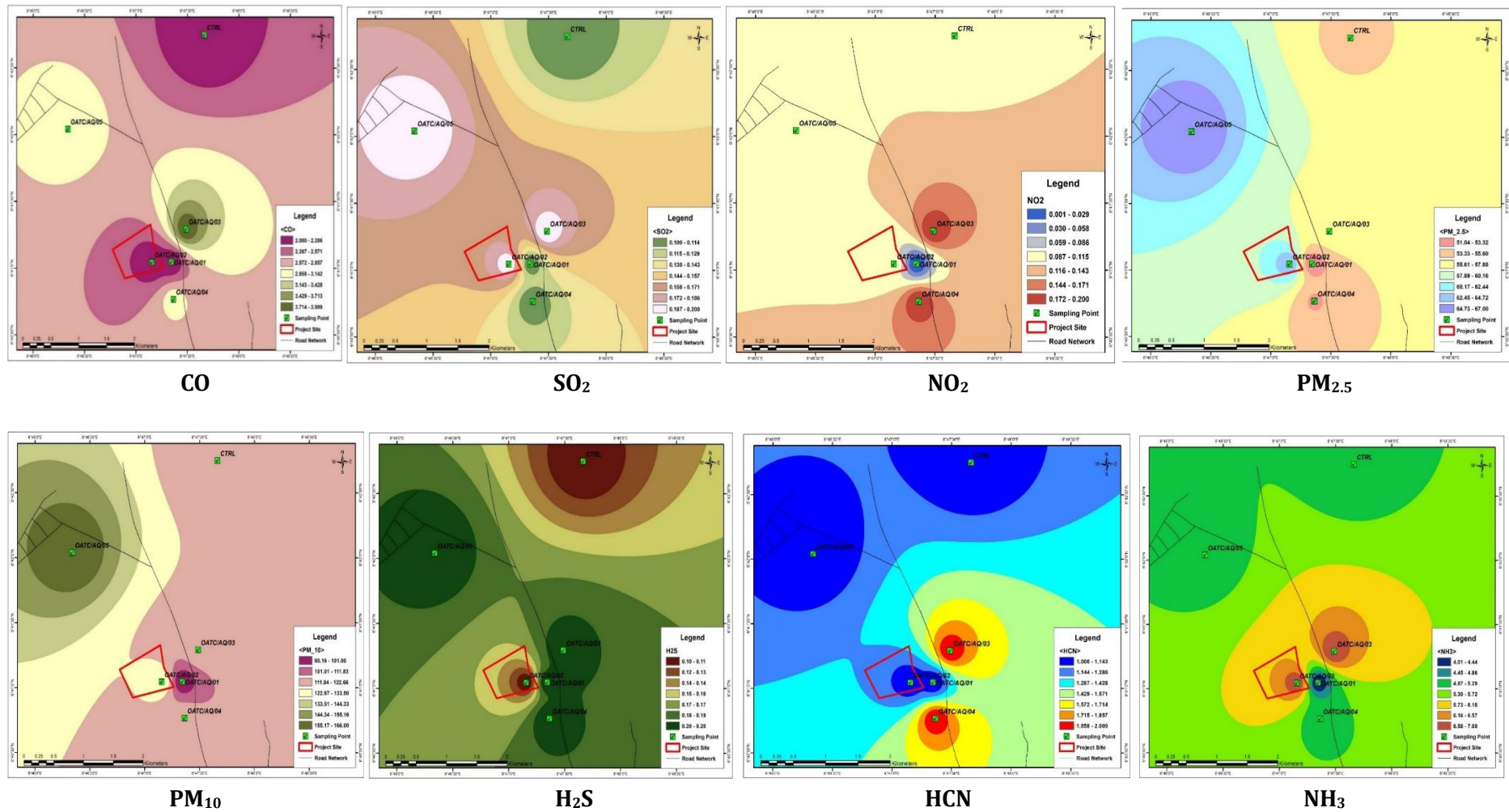


Figure 4.4a: Map Indicating Spatial Dispersion of Gaseous Pollutants

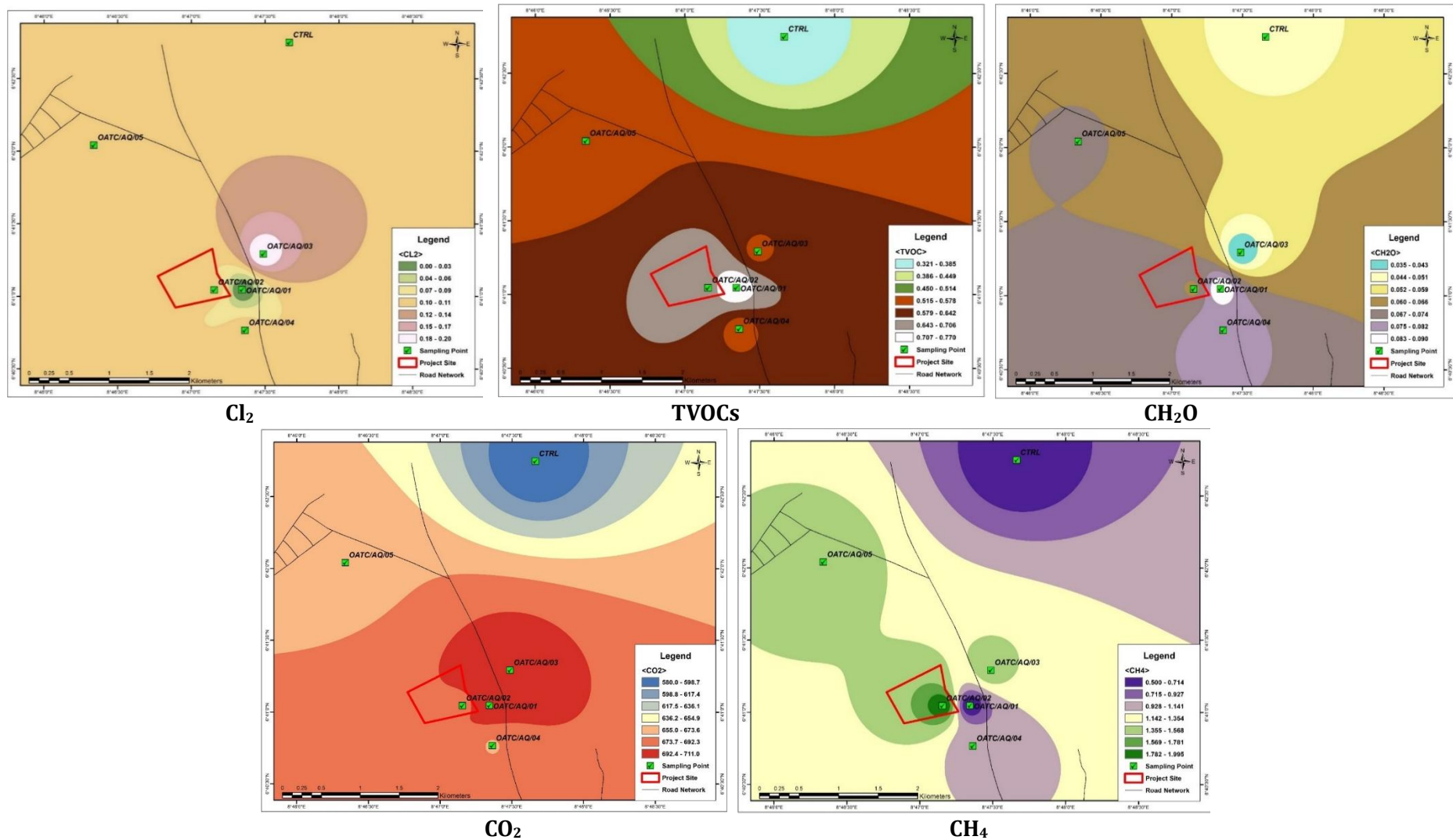


Figure 4.4b: Map Indicating Spatial Dispersion of Gaseous Pollutants

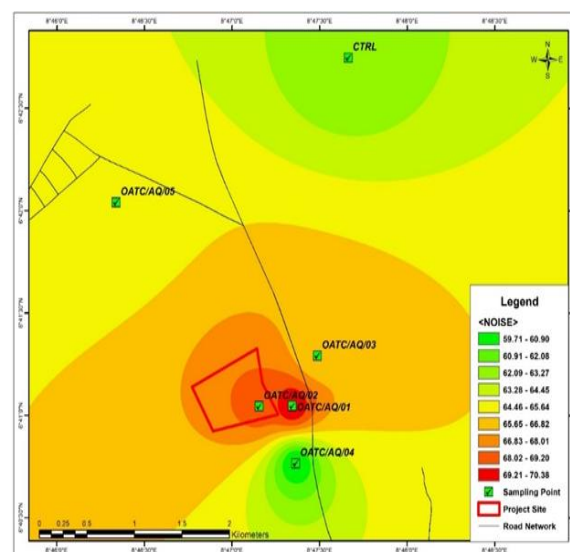
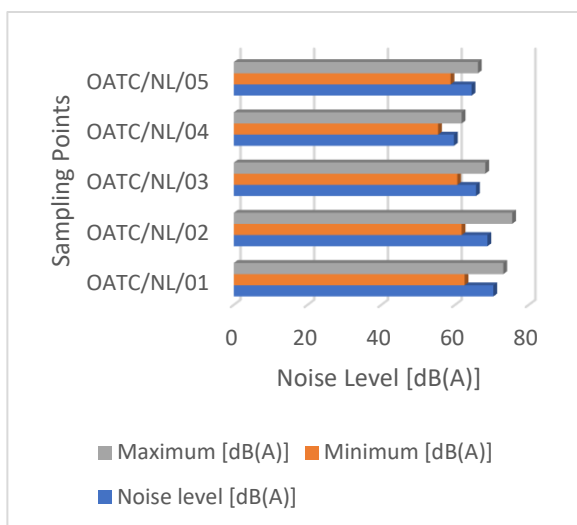


Figure 4.5: Noise Level of the Study area

Figure 4.6: Map Indicating Spatial Dispersion of Noise Level

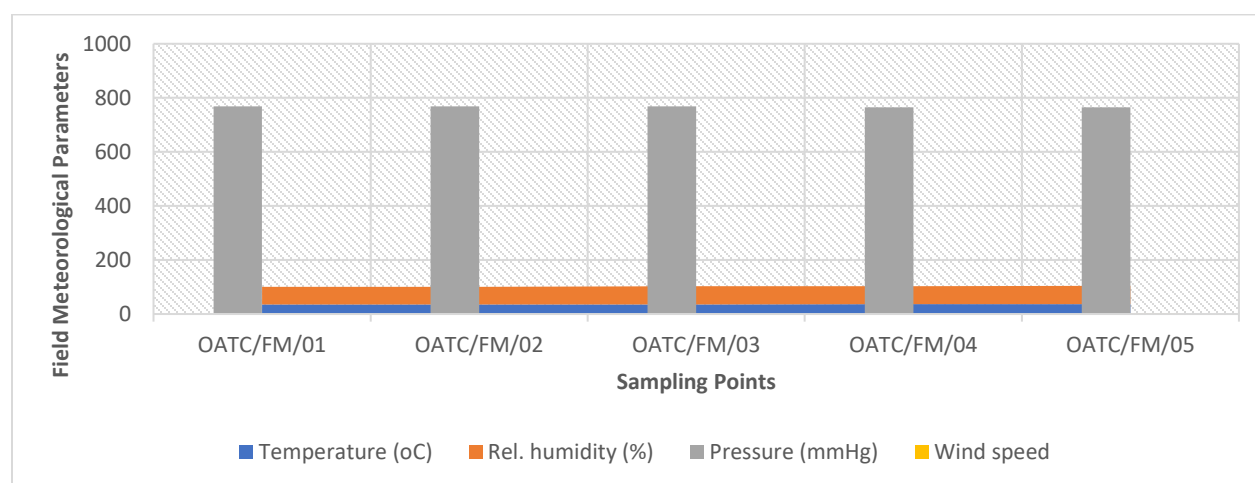


Figure 4.7: Field Meteorological Parameters

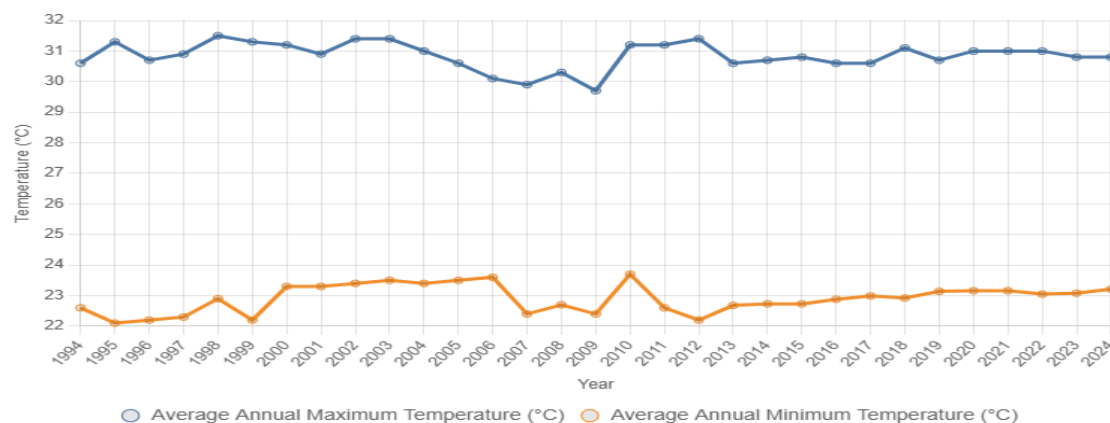


Figure 4.8: Average Annual Maximum and Minimum Temperature of the Study Area

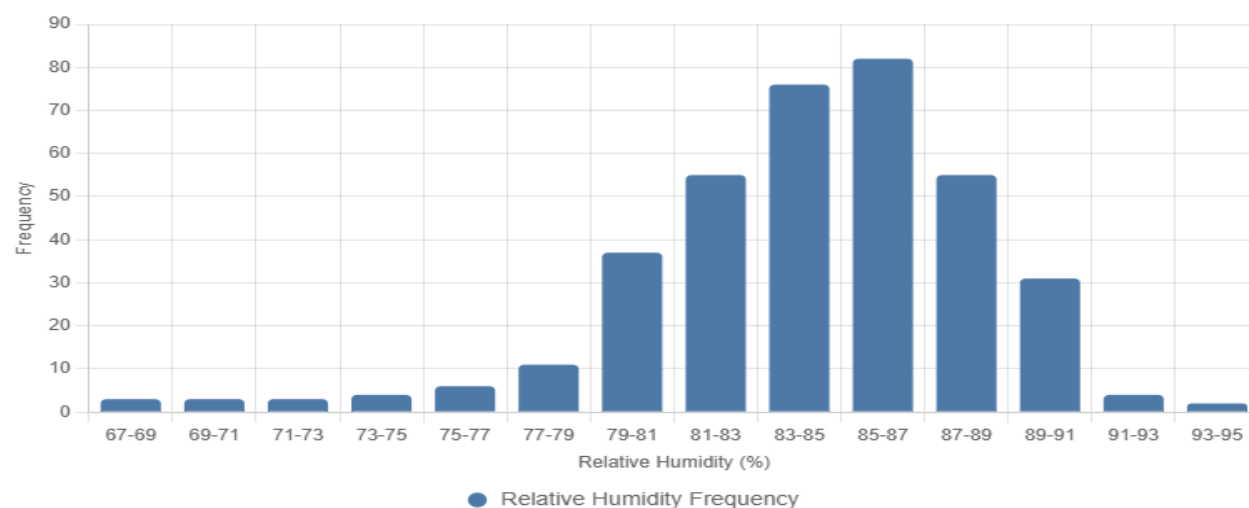
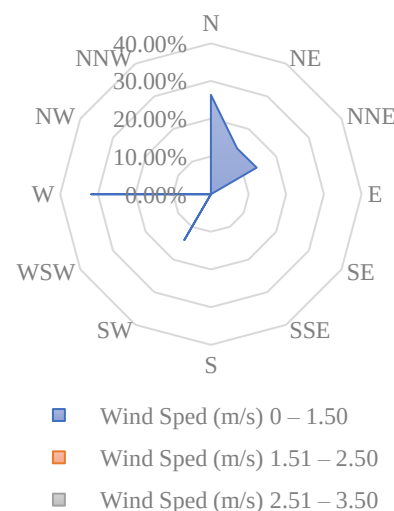


Figure 4.9: Relative Humidity Distribution (1994-2024) of the Study Area

Table 4.4: Wind Pattern

WD	Wind Sped (m/s)		
	0 - 1.50	1.51- 2.50	2.51 - 3.50
N	0.93 = 26.35%	0 = 0 %	0 = 0 %
NE	0.50 = 14.04%	0 = 0 %	0 = 0 %
NNE	0.50 = 14.04%	0 = 0 %	0 = 0 %
E	0 = 0%	0 = 0%	0 = 0 %
SE	0 = 0%	0 = 0 %	0 = 0 %
SSE	0 = 0%	0 = 0 %	0 = 0 %
S	0 = 0%	0 = 0%	0 = 0 %
SW	0.5 = 14.04%	0 = 0 %	0 = 0 %
WSW	0 = 0%	0 = 0 %	0 = 0 %



W	1.13 = 31.74%	0 = 0 %	0 = 0 %
NW	0 = 0%	0 = 0%	0 = 0 %
NNW	0 = 0%	0 = 0%	0 = 0 %

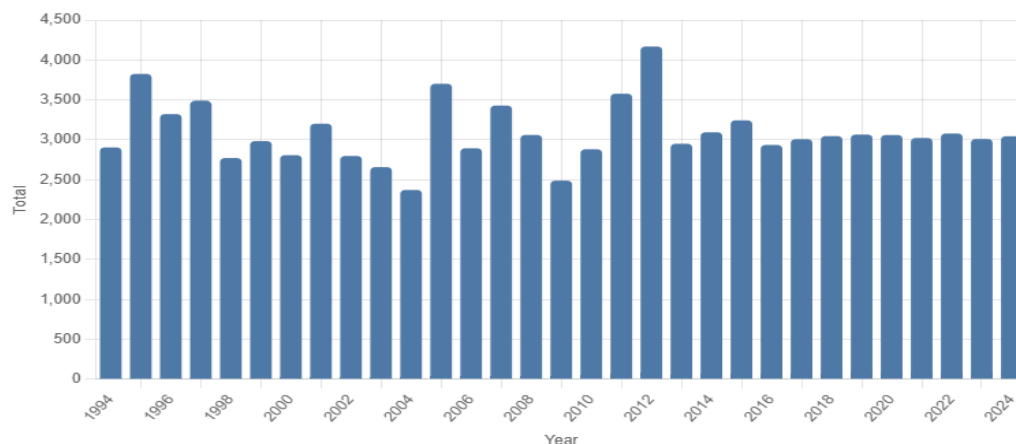


Figure 4.11: Average and Total Annual Rainfall Distribution in the Study Area

The results indicate that the ambient environment is generally clean, characterized by low concentrations of pollutants and minimal anthropogenic stressors.

However, PM₁₀ and noise represent localized exceedances that reflect typical semi-rural community activities rather than industrial emissions. The meteorological data show that low rainfall, warm temperatures, and light winds during the monitoring period contributed to the limited dispersion of coarse particles (PM₁₀) and the accumulation of dust in roadside locations. The dominant sources of airborne particulates are windblown dust, soil disturbance, and vehicular movement on untarred access roads.

Noise peaks are primarily due to transportation and market interactions, which are intermittent and not continuous exceedances.

Overall, the area presents a moderate baseline condition that can easily accommodate short-term construction emissions, provided effective mitigation and monitoring measures are implemented.

4.5 Regional and Local Geology

Generally, Cross River State is dominated by two major geological domains: (A) extensive areas of the Precambrian Nigerian Basement Complex (expressed as the Oban Massif, Obudu/Sankwala uplands and other crystalline outcrops), and (B) younger Meso–Cenozoic sedimentary cover that includes the Calabar Flank, Mamfe Embayment and coastal plain deposits (sands, clays and recent alluvium). Much of the interior highland (Oban Massif, parts of the Obudu/Oban-Obudu uplands) is underlain by high-grade metamorphic rocks (gneisses, migmatites, quartzites) with Pan-African (Neoproterozoic) reworking and intrusions of older and younger granitoids. These rocks form deeply dissected plateaus and ridges (heights up to 1,000 - 1,125 m in places) and are dominantly Precambrian in origin. The basement complex is found in major parts of Akamkpa, Obudu, Boki, Bekwarra, Obanliku,

among others. The Sedimentary cover are around the crystalline core and to the south and southeast, the Oban/Calabar flank grades into Cretaceous to Tertiary sedimentary sequences: Albian Asu River Group (clastics), Turonian–Coniacian shales and sandstones (e.g., Nkporo/Nkporo-equivalent units), and younger coastal plain formations including Benin Formation (thick Tertiary–Quaternary sands and gravels) and alluvium in river valleys and mangrove/swamp zones. These units host much of the state’s shallow aquifers and coastal soils and are found around South and south-western parts of Cross River State (Figure 4.4). (The Nigerian Geological Survey Agency).

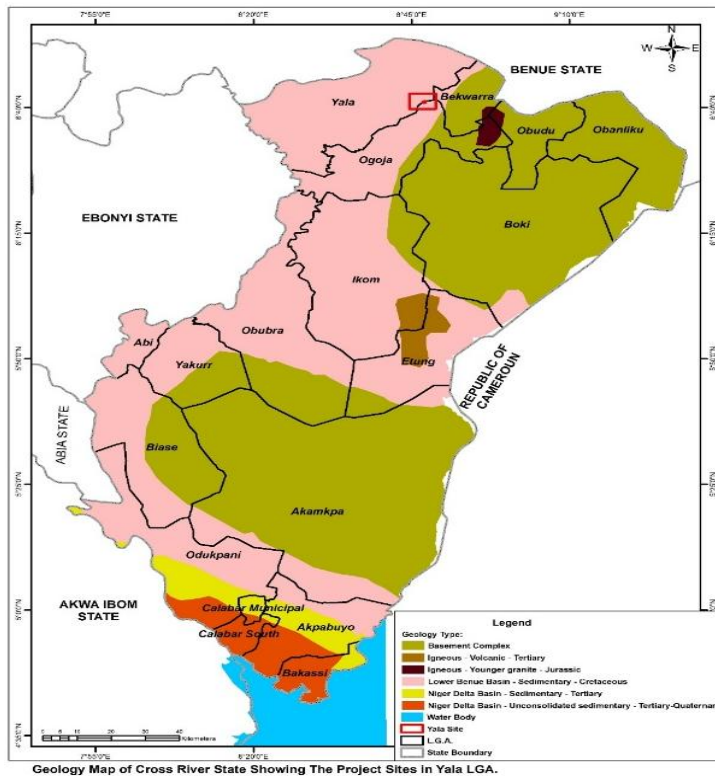


Figure 4.4: Geological Map of Cross River State showing the Study Area

Geologically, the study area in Okuku falls within the Lower Benue Trough; exhibiting varied sedimentary layering (shale, sandstone, limestone), magnetic anomalies, and structural features linked to basin formation; sandstone hosts freshwater aquifers, while shale layers may contain saline zones (Figure 4.4). However, given the regional context, we can infer that Okuku shares much of the sedimentary cover typical of the Lower Benue Trough, possibly with less structural complexity than Ogoja but containing similar materials such as Sandstones and Shales (Ekwok *et al.*, 2020).

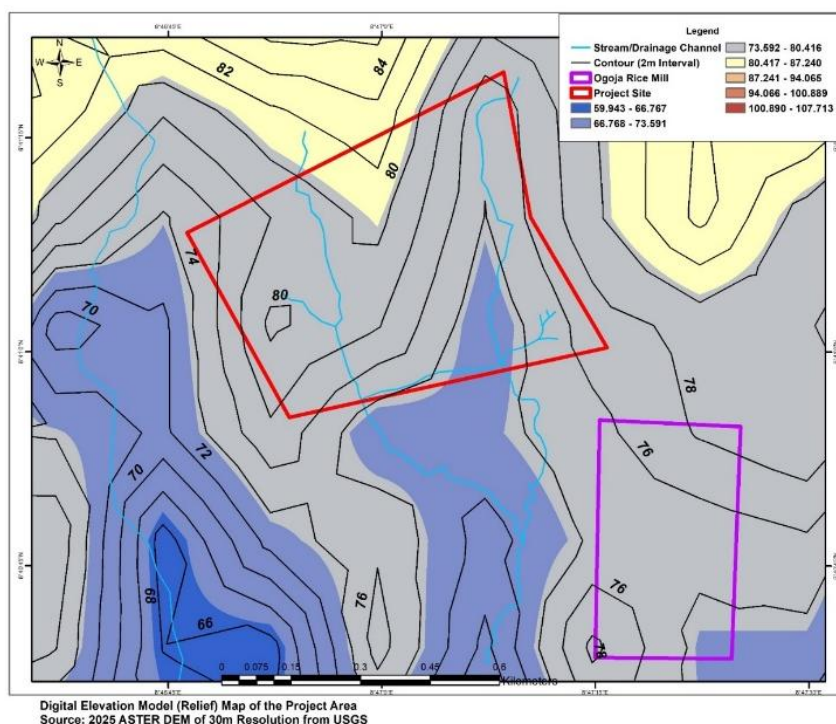


Figure 4.5: Elevation Model of the Project Area

4.6 Physico-chemical Studies

4.6.1 Groundwater and Surface Water

Summary of the results of the field and laboratory measurements/analyses of groundwater and surface water samples are presented in Table 4.5 and Table 4.6 respectively, while the full data is captured in Appendix 4.1, Tables A4.4 and A4.5. Plate 4.4 shows the sample collection. The Federal Ministry of Environment (FME) and World Health Organization (WHO) standards for water potability are also included for comparison. Figure 4.6 shows the sampling points for ground water around the project site while that for surface water is shown in Figure 4.9.

Groundwater in the CR-SAPZ Okuku area was found to be clear, mildly acidic, and of low mineral content, with most parameters within the FME and WHO permissible limits. The detailed parameter ranges from Table 4.5 are summarized below:

- pH: Ranged from 5.33 to 5.47, slightly below the WHO lower limit (6.5) at two locations, indicating mild acidity typical of lateritic tropical soils influenced by carbonic acid from organic matter decomposition.
- Temperature: 27.3–27.6 °C, reflecting stable tropical aquifer conditions.
- Turbidity: 0.77–0.84 NTU, well below the 5 NTU guideline, indicating excellent clarity.
- Electrical Conductivity: 79.5–80.3 $\mu\text{S}/\text{cm}$, and TDS: 39.75–40.15 mg/L — both signify very low mineralization, confirming freshwater origin with minimal saline intrusion.

- Total Hardness: 30.5–31.2 mg/L, far below the 250 mg/L limit, classifying the water as soft.
- Dissolved Oxygen (DO): 0.18–0.27 mg/L, indicating low oxygen levels due to the reducing nature of the aquifer.
- BOD₅ / COD: Averaged 0.66–0.83 mg/L and <0.01 mg/L, respectively — both extremely low, confirming negligible organic load.
- Chloride and Sulphate: 20.8–28.7 mg/L (Cl⁻) and 5.82–6.22 mg/L (SO₄²⁻), both well below the 250 mg/L permissible limit.
- Nitrate: 0.75–0.88 mg/L — far below the 10 mg/L threshold, indicating no leaching of agricultural fertilizers or sewage infiltration.
- Phosphate: 0.33–0.37 mg/L — trace concentration, environmentally insignificant.
- Iron (Fe): 1.05–1.23 mg/L, within the 0.36 mg/L limit.
- Copper (Cu): 0.48–0.77 mg/L — marginally above the FMEnv guideline (0.01 mg/L) but well below the WHO limit (1.0 mg/L).
The slight elevation likely reflects natural mineral dissolution from copper-bearing soils.
- Lead (Pb): 0.154–0.215 mg/L, well below the 0.05 mg/L limit.
- Zinc (Zn): 1.08–1.14 mg/L, below the 3.0 mg/L WHO limit.
- Total Hydrocarbon Content (THC): <0.01 mg/L — no detectable hydrocarbon contamination.
- Microbiological analysis results (Table 4.5) show:
 - Total Coliforms: 0 cfu/100 mL (Not Detected)
 - Faecal Streptococci: 0 cfu/100 mL (Not Detected)
 - Total Heterotrophic Bacteria (THB): 15–20 cfu/mL (mean = 17.67 ± 2.5)

These results confirm absence of faecal pollution and excellent bacteriological quality, implying that groundwater abstraction points are well protected from surface contamination.

The baseline results indicate a clean, fresh, and potable aquifer system. Given the proposed CR-SAPZ activities (construction, utilities, and limited process water abstraction), potential impacts are minimal but must be managed to avoid sediment infiltration, oil spillage, or seepage from waste disposal areas during construction.

Baseline data from Table 4.5 will serve as a benchmark for future monitoring and comparison during ESMP implementation.

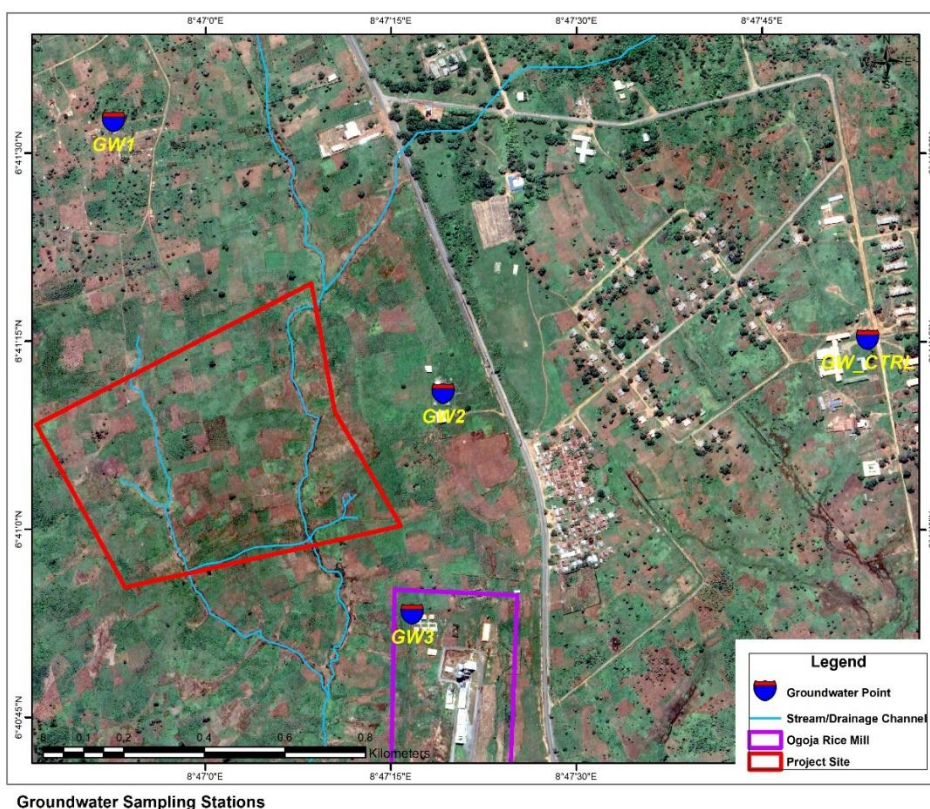


Figure 4.6: Ground Water Sampling Points around the Project Site

Table 4.5: Summary of the Physicochemical Characteristics of Groundwater

Parameter	Mean±SD	Range	WHO Limit	FMENV Limit
Color (Pt Co Units NCASI)	1.64±0.1	1.58-1.71	5.0-15	-
pH	5.36±0.1	5.33-5.47	6.5-8.5	6.5-9.0
Temperature (°C)	27.4±0.2	27.3-27.6	-	-
Turbidity (NTU)	0.81±0	0.77-0.84	5	5
Salinity as Cl ⁻ (mg/l)	22.09±0.1	22.00-22.22	-	-
Total Hardness (mg/l)	30.77±0.3	30.5-31.2	250	250
Conductivity (μS/cm)	79.83±0.4	79.5-80.3	1000	400
Dissolved Oxygen (mg/l)	0.23±0.04	0.18-0.27	5	>4.0
Biological Oxygen Demand (mg/l)	0.75±0.1	0.66-0.83	-	-
Chemical Oxygen Demand (mg/l)	<0.01	<0.01	-	150
Total Hydrocarbon Content (mg/l)	<0.01	<0.01	-	-
Phosphate (mg/l)	0.35±0.02	0.33-0.37	-	-
Sulphate (mg/l)	6.06±0.2	5.82-6.22	250	250
Nitrate (mg/l)	0.81±0.1	0.75-0.88	10	10
Total Dissolved Solids (mg/l)	39.92±0.2	39.75-40.15	1000	1000

Parameter	Mean±SD	Range	WHO Limit	FMENV Limit
Total Suspended Solids (mg/l)	0.34±0.01	0.32-0.35	-	-
Copper (mg/l)	0.67±0.2	0.48-0.77	1	0.01
Iron (mg/l)	1.15±0.1	1.05-1.23	0.36	0.36
Lead (mg/l)	0.178±0.03	0.154-0.215	0.05	<1.0
Zinc (mg/l)	1.11±0.2	1.08-1.14	3	<1.0
Cadmium (mg/l)	0.065±0	0.055-0.073	0.003	<1.0
Chromium (mg/l)	0.060±0	0.057-0.065	0.05	0.05
Potassium (mg/l)	0.72±0.1	0.66-0.77	-	-
Barium (mg/l)	0.21±0.03	0.17-0.23	-	-
Faecal Coliform (cfu/100ml)	0	0	0	0
Total Coliform (cfu/100ml)	0	0	0	0
Total Heterotrophic Bacteria (cfu/ml)	15.33±2	14-17	100	100

Source: Fieldwork/Laboratory Analysis (2025) GW = Groundwater

Surface Water Quality

Surface water quality monitoring was undertaken to establish the physico-chemical and biological characteristics of water bodies within and around the CR-SAPZ Okuku project area. Surface water samples were collected from a perennial stream known locally as the Okuku Stream, which represents the primary surface water body in proximity to the proposed project site. The stream serves as a water source for domestic and agricultural activities within the host community. The Okuku Stream is located at an approximate distance of 680 meters northeast of the proposed ATC site and flows in a north–south direction before draining into the Okpoku River system, a tributary of the Cross River Basin.

The primary aim was to assess the current condition of the Calabar River and associated drainage channels, identify any existing contamination sources, and establish a baseline against which future project-related impacts can be measured. Sampling locations were selected to represent both upstream and downstream sections of surface water bodies likely to be influenced by construction runoff or wastewater discharges during project implementation. All results were benchmarked against NESREA (2007) and FMEnv (2011) permissible limits for freshwater quality (Table 4.6). Overall, surface water quality in the Okuku project area is moderately good, reflecting a semi-rural environment with limited industrial influence. However, isolated exceedances in certain parameters were observed, primarily in areas influenced by local agricultural and domestic activities.

- pH and Temperature: Values ranged between 8.54-8.88 and 27.3–30.5°C, respectively—within acceptable limits for freshwater ecosystems and indicative of stable, near-neutral aquatic conditions.
- TDS and Conductivity: Measured between 49.4-63.9 mg/L and 69.9–83.7 µS/cm, both below the NESREA limit of 1000 mg/L (TDS) and 1000 µS/cm (EC), showing low mineralization and limited anthropogenic salinity input.

- iii. TSS: Slightly elevated levels (11.95–12.0 mg/L) were recorded at downstream locations, exceeding the FMEnv limit of 30 mg/L. These values suggest surface runoff from agricultural plots and unpaved roads, particularly following rainfall events during the sampling period.
- iv. BOD₅ and COD: Average BOD₅ ranged 1.38–1.52 mg/L, while COD averaged 0.61–0.83 mg/L, slightly above guideline values (BOD₅ ≤ 6 mg/L). These elevated organic loads likely originate from domestic effluents, decomposing vegetation, and small-scale washing activities observed along the stream.
- v. Heavy Metals (Fe, Pb, Zn, Cu): All measured concentrations were below regulatory thresholds, indicating no evidence of industrial metal pollution. Iron concentrations ranged 7.33–7.63 mg/L, well above the 1.0 mg/L limit.
- vi. Microbiological Quality: Total coliform counts were recorded at 14–20 CFU/100 mL, above the NESREA limit of 10 CFU/100 mL, suggesting domestic waste and runoff influence near residential sections of Ipuole residential area.

The slight deviations observed in TSS, BOD₅, COD, oil and grease, and coliform counts are not indicative of severe contamination but rather reflect localized human influence on natural water bodies. Given that the CR-SAPZ project involves land preparation, construction, and potential effluent discharge during operational phases, maintaining water quality integrity is critical. The current baseline indicates a slightly stressed but recoverable aquatic environment, and project activities, if unmanaged, could worsen suspended solids and organic load. However, with appropriate erosion control, drainage design, and wastewater management, impacts can be effectively mitigated.

Table 4.6: Summary of Physicochemical Characteristics of Ipuole Stream (Surface Water)

Parameter	Mean±SD	Range	WHO Limit	FMENV Limit
Color (Pt Co Units NCASI)	17.2±0.6	16.5-17.7	5.0-15.0	-
pH	8.72±0.2	8.54-8.88	6.5-8.5	6.5-9.0
Temperature (°C)	28.8±2	27.3-30.5	-	-
Turbidity (NTU)	28.72±0.1	28.64-28.81	5	5
Salinity as Cl-(mg/l)	41.6±0.6	41.1-42.3	-	-
Hardness (mg/l)	70.23±0.5	69.8-70.7	250	250
Conductivity (µS/cm)	75.1±7.5	69.9-83.7	1000	400
Dissolved Oxygen (mg/l)	6.75±0.1	6.68-6.81	5	>4.0
BOD (mg/l)	11.44±0.1	1.38-1.52	-	-
COD (mg /l)	0.73±0.1	0.61-0.83	-	150
THC (mg/l)	<0.01	<0.01	-	-
Phosphate (mg/l)	0.86±0.1	0.81-0.92	-	-
Sulphate (mg/l)	0.38±0.1	0.31-0.47	250	250
Nitrate (mg/l)	3.29±0.1	3.13-3.32	10	10
TDS (mg/l)	54.7±8	49.4-63.9	1000	1000
TSS (mg/l)	11.97±0.02	11.95-12.00	-	-
Copper (mg/l)	1.549±0.02	1.532-1.565	1	0.01
Iron (mg/l)	7.49±0.2	7.33-7.63	0.36	0.36
Lead (mg/l)	0.565±0.02	0.546-0.577	0.05	<1.0

Parameter	Mean±SD	Range	WHO Limit	FMENV Limit
Zinc (mg/l)	5.27±0.1	5.16-5.37	3	<1.0
Cadmium (mg/l)	0.044±0.01	0.038-0.051	0.003	<1.0
Chromium (mg/l)	0.022±0.01	0.016-0.029	0.05	0.05
Potassium (mg/l)	2.14±0.1	2.09-2.19	-	-
Barium (mg/l)	1.44±0.1	1.37-1.53	-	-
Faecal Coliform (cfu/100ml)	14.3±3	11.0-17.0	0	0
Total Coliform (cfu/100ml)	17.00±3	14.0-20.0	0	0
Total Heterotrophic Bacteria (cfu/ml)	$1.5 \times 10^5 \pm 0.4$	$1.1 \times 10^5 - 1.8 \times 10^5$	100	100

Source: Fieldwork/Laboratory Analysis (2025) US = Upstream MS = Midstream DS = Downstream

4.6.2 Soil Studies

4.6.2.1 Site Description and Soils

The soils of Cross River State are diverse due to its humid tropical climate, varied geology, and mixed landscapes, ranging from coastal plains to highlands. Generally, they are deep, well-drained sandy loams to loams in upland areas, with clay-rich, poorly drained soils in floodplains and inland valleys. Most soils are acidic (pH 4.5–6.0) with low to moderate natural fertility, particularly deficient in phosphorus, though basalt-derived and some alluvial soils have higher nutrient reserves. Textures vary from loamy sands along the coast to reddish sandy clay loams in basalt areas, while structure ranges from granular in topsoil to blocky or prismatic in subsoils. Heavy rainfall promotes leaching, making organic matter and base cation replenishment important, while seasonal waterlogging in lowlands and erosion risk on slopes influence agricultural use and management (Onyekwere, *et al.*, 2009; Essoka and Esu 2004). These soil characteristics are grouped by (FAO/UNESCO) into ferric acrisol, cambisol, gleysols, fluvisols, nitosols, among others based on their composition (Figure 4.7).

Locally, soils in the project area in Okuku mostly develop on lower Benue Basin and related clastic sediments in the Okuku study area plus colluvial/alluvial deposits in valley bottoms. Profile types reported include sandy clay to clay textured soils on upslope and valley positions, often with lateritic development in weathered zones. The soil texture ranges from sandy loam → loam → sandy clay loam → clay loam / heavy clay, with valley and floodplain soils tending to heavier (more clay) and upland ridge soils lighter (more sand). The soil structure and morphology indicate typical horizons show A (dark topsoil with some organic matter), B horizons with blocky to subangular blocky structure (clay accumulation in some profiles), and mottling/grey colours in seasonally waterlogged valley soils indicating transient saturation/poor drainage (Uquetan, *et al.*, 2016).

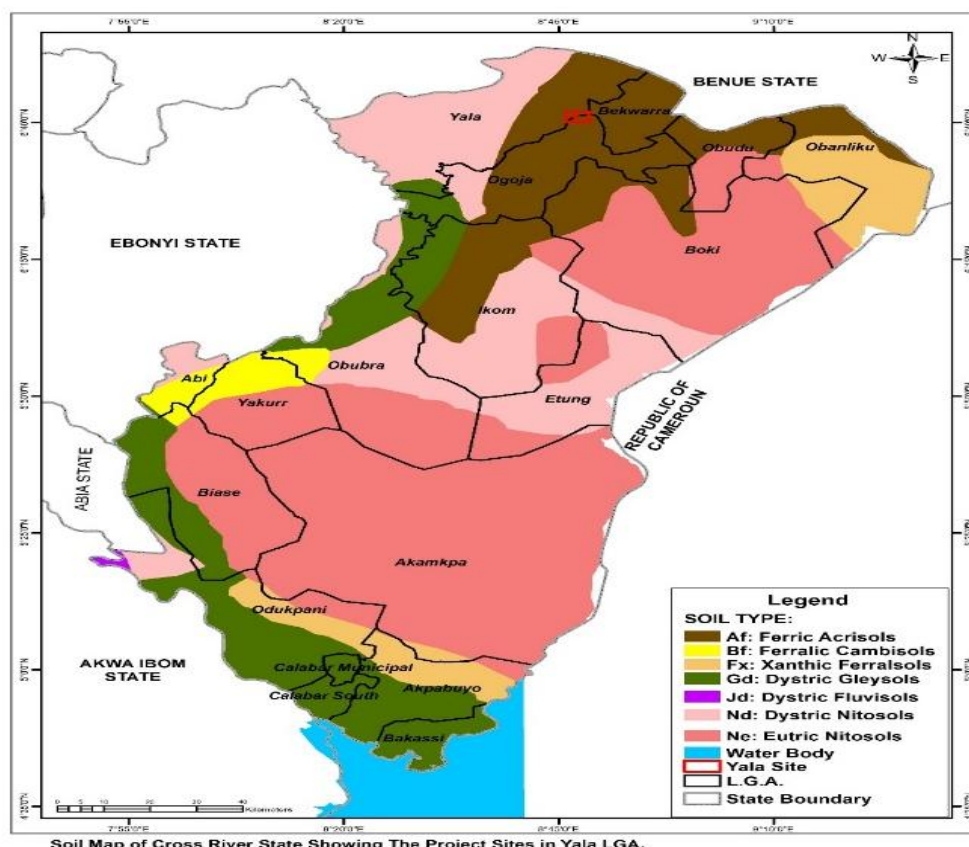


Figure 4.7: Soil Map of Cross River State Showing the Project Site

4.6.2.2 Field Soil Sampling

Composite soil samples were collected at the depth sequence of 0 - 15cm and 15 - 15cm representing surface and subsurface soils respectively (Plate 4.3). The sampling points are shown in Figure 4.8 while Table 4.8 highlights their GPS coordinates. The soil samples collected were air-dried (room temperature), ground with wooden roller and sieved via 2mm mesh. Samples for bulk density were also collected and placed in an oven at 105°C until constant weight was reached (Tel and Hagarty, 1984; Obi, 2000). A total of 12 soil samples (inclusive of the control) were collected representing 5 stations (exclusive of the control) within the proposed project site. The percent total pore space was computed from the bulk density assuming a particle density of 2.65g/cm³.

The samples collected were processed, sieved through a 2mm mesh prior to physico-chemical analyses. The parameters of interest for the soil section include:

- pH (H₂O)
- Available phosphorus (MgKg⁻¹)
- Organic Carbon (%)
- Total Nitrogen (%)

- Electrical conductivity (dSm^{-1})
- Exchangeable bases (Ca, Na, K, Mg) (Cmolkg^{-1}) (Nutrients) and their anions
- Exchange acidity (Cmolkg^{-1})
- Bulk density (mgm^{-3})
- Particle size distribution (sand, silt and clay) (%)
- Micronutrients (mgkg^{-1}): (Fe, Pb, Ni, V, Pb, Cu and Zn)
- Total Hydrocarbon (THC) (mgkg^{-1})
- Microbiological analyses (THB, THF, HUB, HUF).



Plate 4.3: Collection of soil samples using soil auger

Table 4.7: GPS Coordinates for soil sample locations

Code	Latitude	Longitude
SS1	6° 41' 0.506" N	6° 41' 0.506" N
SS2	6° 41' 12.381" N	6° 41' 12.381" N
SS3	6° 41' 3.819" N	6° 41' 3.819" N
SS4	6° 41' 17.785" N	6° 41' 17.785" N
SS5	6° 40' 57.192" N	6° 40' 57.192" N
SS_CTRL	6° 41' 29.967" N	6° 41' 29.967" N

Source: Field Work (2025)

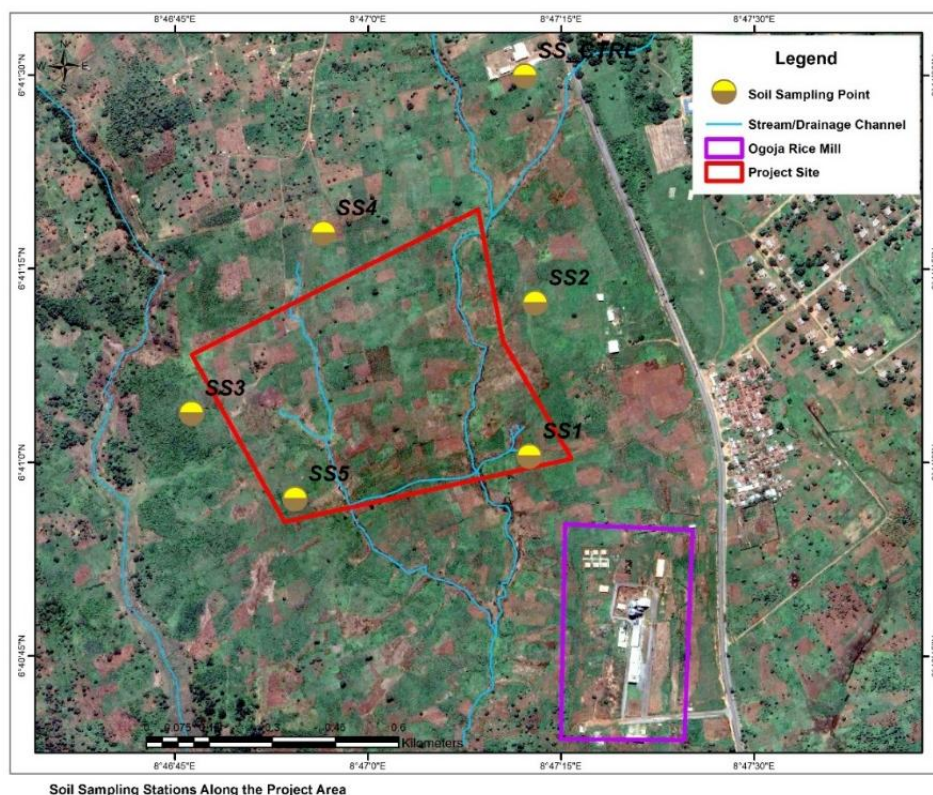


Figure 4.8: Showing Soil Sampling Points around the Study Area

4.6.2.3 Laboratory Analysis

The weight of the oven-dry samples was later taken and recorded accordingly. The bulk densities of the samples were evaluated using the equation (Eq. 1):

$$BD = \frac{\text{Wt. of oven dry sample (gm)}}{\text{Volume of sample (Cm}^3\text{)}} \dots\dots\dots (\text{Eq.1})$$

Particle size distribution was determined by Bouyoucos hydrometer method (Gee and Bauder, 1986) using sodium hexa-metaphosphate as a dispersant and the textural classes determined using the textural triangle chart.

Soil pH was determined using the routine method of IITA (1979). The method of Walkley and Black (1934) as outlined by Juo (1979) were used in the determination of organic carbon (Table 4.8). Available phosphorus was determined by Bray and Kurtz (1945) No. 1 method. Total nitrogen was determined by the micro-Kjeldahl digestion method (Jackson, 1962). Exchangeable bases (Ca, Mg K and Na) were extracted with neutral IM NH_4OAc , pH 7.0; the potassium and sodium in the extract was by flame photometry while calcium and magnesium were by Versenate EDTA titration method (Jackson, 1962; IITA, 1979). Cation exchange capacity (CEC) was obtained by the summation of exchangeable bases.

Heavy metals contents of the soils were extracted by digestion of the samples with a mixture of concentrated HNO_3 and HCl and their concentrations determined by Atomic Absorption Spectrophotometry (AAS) using “Buck Scientific 200A” by flame atomization (Barnhisel and Bertsch, 1982).

Table 4.8: Summary of analytical methods and equipment used in laboratory analysis of soil samples

S/N	Parameters Determined	Equipment/Technique
1.	pH	Jenco UC meter 6100
2.	Particle size distribution (PSD)(%)	Bouyoucos hydrometer method (Gee and Bauder, 1986)
3.	Hardness	EDTA Titration kit, AAS
4.	Permeability	Metal ring (15-30cm diameter) driven into the soil to form a test area
5.	Porosity	Core sampler or metal cylinder used to collect undisturbed soil sample
6.	THC mg/Kg	GC-FID, UV-Vis
7.	TN%	Graphite furnace and gravity
8.	Organic Carbon (%)	Walkley and Black (1934) as outlined by Juo (1979)
9.	Available Phosphorus (mg/Kg)	Bray-1 Method
10.	Heavy Metal mg/l or ppm	AAS, UNICAM 939, after digestion
11.	Soil Moisture Content %	Gravimetry after drying to constant weight
12.	Soil permeability	Falling head permeability test
13.	Exchangeable cations (cmol/kg)	AAS, after digestion

4.6.2.4 Soil Physical and Chemical Characteristics

The physical and chemical characteristics of the soil samples for the prescribed study are presented in the **Appendix 4.1** (Table A4.6) and summarized in Table 4.9. The sand, silt and clay fractions varied in texture within the sampling stations. The texture of the soils sampled within the site varied from sandy loam, clay loam, and loamy sand texture depending on the *pedogenesis* and edaphic features of the stations. Soil texture determines water absorption, storage capacity, ease of tillage and amount of aeration influencing its fertility status (FMANR, 1990).

The key baseline results for soil quality within the CR-SAPZ Okuku project area are summarized below:

- Soil Texture and Type: The soils are predominantly sandy and well-drained, characteristic of the Benin Formation. They are structurally friable, non-clayey, and suitable for both agricultural and construction purposes.
- pH (Acidity/Alkalinity): The soils exhibit a slightly acidic pH range of 4.52-6.03, typical of tropical rainforest soils. This mild acidity supports the growth of most crops and vegetation.
- Electrical Conductivity (EC): Recorded values ranged from 0.05-0.18 $\mu\text{S}/\text{cm}$, well below the FMEnv limit of 1000 $\mu\text{S}/\text{cm}$, confirming that the soils are non-saline and free from ionic contamination.

- iv. **Moisture Content and Organic Matter:** Moisture content values ranged between 27.7% and 32.8%, while organic matter content was 0.95–1.45%, indicating moderate fertility and adequate microbial activity for organic decomposition.
- v. **Macronutrients (Nitrogen and Phosphorus):** The nitrogen (28.7-35.8%) and phosphorus (11.6–15.3 mg/kg) indicate high nutrient content, a natural outcome of leaching and high rainfall in tropical environments.
- vi. **Exchangeable Bases:** Calcium, magnesium, potassium, and sodium concentrations were low to moderate, maintaining a balanced exchange complex and confirming the absence of soil sodicity.
- vii. **Heavy Metals:** All detected metal Iron (13.57–16.32 mg/kg), Manganese (1.03–1.46 mg/kg), Copper (Cu 0.05–0.09 mg/kg), Zinc (0.11–0.18 mg/kg) and Lead (0.03–0.06 mg/kg) concentrations were well below FMEnv and WHO permissible limits, confirming no contamination.
- viii. **Total Hydrocarbon Content (THC):** All samples recorded below detection limits (<0.01 mg/kg), confirming absence of hydrocarbon or petroleum-related contamination in the project area.

The baseline results indicate that the soils in the Okuku project area are chemically stable, slightly acidic, and free from contamination. Their physical and nutrient characteristics reflect natural tropical conditions rather than anthropogenic impacts. The low nutrient and organic carbon values are due to intense leaching and organic decomposition, while trace metal concentrations represent natural background levels. Overall, the soils provide a clean, geochemically stable foundation for project development, with no indications of salinity, hydrocarbon pollution, or heavy-metal accumulation.

Table 4.9: Summary Results Showing Physico-chemical status of soils

Parameter	Mean±SD	Range
Permeability (%)	21.65±2	19.4-25.3
Porosity (%)	39.16±2.0	35.2-42.5
Bulk density (mg/kg)	1.32±0.1	1.15-1.47
% Sand	56.47±1	53.6-58.4
% Silt	13.63±4	7.6-20.4
% Clay	29.9±3	26.0-34.0
pH	5.14±0.5	4.52-6.03
Conductivity (dS/m)	0.11±0	0.05-0.18
Moisture content (%)	30.01±2	27.7-32.8
Nitrate (mg/kg)	32.81±2	28.7-35.8
Phosphate (mg/kg)	13.42±1	11.6-15.3
Sulphate (mg/kg)	25.76±3	20.6-31.2
Calcium (cmol/kg)	4.54±0.3	4.19-5.01
Magnesium (cmol/kg)	1.30±0.1	1.03-1.46
Potassium (cmol/kg)	1.28±0.1	1.03-1.49
Sodium (cmol/kg)	0.2±0	0.15-0.25
THC (mg/kg)	<0.01	<0.01

Parameter	Mean±SD	Range
Vanadium (mg/kg)	0.66±0.1	0.492-0.887
Nickel (mg/kg)	0.633±0.1	0.499-0.726
Iron (mg/kg)	15.39±0.8	13.57-16.32
Lead (mg/kg)	2.338±0.1	2.165-2.432
Copper (mg/kg)	7.29±0.1	7.09-7.45
Zinc (mg/kg)	17.12±0.9	16.08-18.53

Source: Fieldwork, 2025

4.6.3 Sediment Physico-chemistry

The overall mean, range and standard deviation of physical and chemical parameters of the sediments for the study area given in Table 4.10 while the full details are captured in. The texture of the sediment samples was mostly silty-clay. The pH of the sediment shows slight alkalinity (8.68-8.86) with an average pH value of 8.77 ± 0.1 . All sediment sampling points are shown in Figure 4.9.

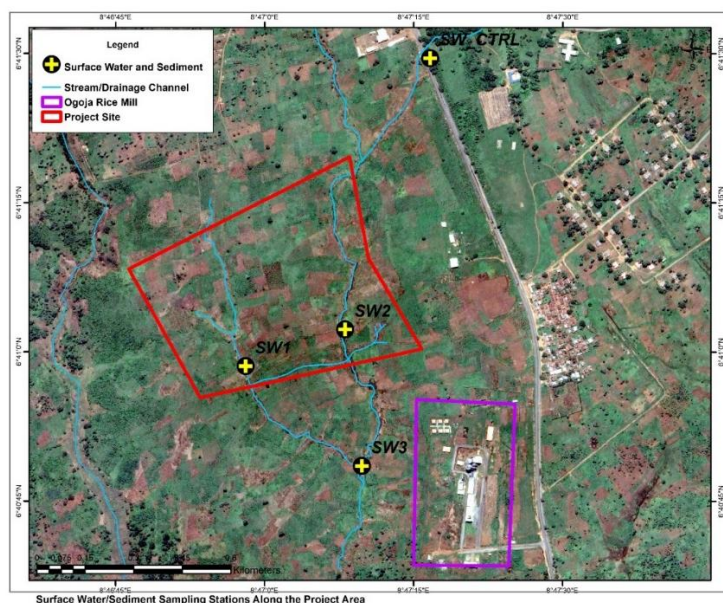


Figure 4.9: Showing Surface Water and Sediment Sampling Locations

Trace elements in sediments

The mean concentrations, ranges and standard deviations of heavy metals (cadmium, zinc, iron, copper, lead, chromium, vanadium, nickel, manganese, mercury and arsenic) and major elements are presented in Table 4.10. Most of the heavy metal values represent background levels. The mean concentration of cadmium (0.032 ± 0 mg/kg) ranged from a minimum value of 0.025 mg/kg to a maximum value of 0.037mg/kg. The concentrations of zinc ranged between 4.75 and 4.93 mg/kg (overall mean = 4.86 ± 0.1 mg/kg). Iron concentrations ranged between 12.27 and 12.37 mg/kg (overall mean = 12.33 ± 0.1 mg/kg). The concentrations of copper ranged between 0.095 and 0.112

mg/kg (overall mean = 0.104 ± 0.01 mg/kg). Lead concentrations ranged from 0.209 mg/kg to 0.223 mg/kg (mean = 0.216 ± 0 mg/kg) while values for chromium ranged between 0.025 and 0.041 mg/kg (overall mean = 0.032 ± 0 mg/kg). The concentrations of vanadium varied between 0.023 and 0.032 mg/kg (overall mean = 0.027 ± 0 mg/kg) while those of manganese showed fluctuation from 4.29 mg/kg to 4.45 mg/kg with a mean concentration of 4.36 ± 0.1 mg/kg.

Table 4.10: Physicochemical Characteristics of Sediment Samples

Parameter	Mean $\pm$ SD	Range
pH	8.77 $\pm$ 0.1	8.68-8.86
E C (μ S/cm)	89.2 $\pm$ 0.5	88.7-89.7
TOC (%)	6.23 $\pm$ 0.1	6.14-6.33
Av. P (mg/kg)	3.13 $\pm$ 0.04	3.09-3.17
NO ₃ ⁻ (mg/kg)	7.36 $\pm$ 0.1	7.27-7.47
SO ₄ ²⁻ (mg/kg)	1.13 $\pm$ 0.04	1.09-1.18
Na (meq/100g)	21.3 $\pm$ 0.02	21.27-21.31
K (meq/100g)	5.76 $\pm$ 0.1	5.68-5.83
Ca (meq/100g)	58.08 $\pm$ 0.1	58.00-58.17
Mg (meq/100g)	10.17 $\pm$ 0.1	10.11-10.27
Fe (mg/kg)	12.33 $\pm$ 0.1	12.27-12.37
Mn (mg/kg)	4.36 $\pm$ 0.1	4.29-4.45
Zn (mg/kg)	4.86 $\pm$ 0.1	4.75-4.93
Cu (mg/kg)	0.104 $\pm$ 0.01	0.095-0.112
Pb (mg/kg)	0.216 $\pm$ 0	0.209-0.223
Cd (mg/kg)	0.032 $\pm$ 0	0.025-0.037
V (mg/kg)	0.027 $\pm$ 0	0.023-0.032
Cr (mg/kg)	0.032 $\pm$ 0	0.025-0.041

Source: Field Work, 2025

4.7 Microbiological Studies

4.7.1 Methodology

The soil samples were collected using a sterilized auger and immediately placed in sterile polyethylene bags, where they were thoroughly mixed to ensure homogeneity prior to analysis. Groundwater specimens were obtained from borehole standpipes following standard pumping protocols, while surface water samples were collected from Okuku stream (Plate 4.4) using pre-sterilized containers. All water samples were promptly stored in ice-packed coolers at 4°C during transportation to the Research and Development Laboratory at the Ministry of Science and Technology in Uyo, Akwa Ibom, Nigeria.

For analytical processing, different preservation methods were applied depending on the required tests. For microbiological examination, samples were mixed with a 0.35% sodium chloride solution and subjected to 30 minutes of mechanical agitation to dislodge microorganisms, followed by serial

decimal dilution in sterile saline solution to prepare them for quantitative microbial analysis through culturing on appropriate media. This standardized approach ensured sample integrity throughout the collection, transportation, and preparation stages while maintaining the conditions necessary for accurate analytical results across different testing parameters. The methodology followed established protocols to minimize contamination and preserve the representative characteristics of each sample type.



Plate 4.4: Collection of water samples and Measurement of in situ Water Quality Parameter at Ipuole Stream

The quantification of heterotrophic bacteria was performed using the surface-spread method on nutrient agar, while fungal populations were enumerated on Sabouraud dextrose agar following established microbiological protocols (Harrigan & McCance, 1990). Microbial enumeration techniques included the use of MacConkey agar for total coliform counts and oil agar for assessing hydrocarbon-degrading microorganisms. Selective isolation procedures employed cycloheximide (100 µg/mL) and benomyl (50 mg/mL) to inhibit fungal growth during bacterial isolation, whereas streptomycin (0.5 µg/mL) was utilized to suppress bacterial growth when isolating fungal colonies.

The enumeration and identification of sulfate-reducing bacteria (SRB) was conducted using modified Bacto Sulfate API agar, supplemented with yeast extract, sodium lactate, and ferrous ammonium sulfate as growth substrates. Following serial dilution, SRB cultures were maintained under anaerobic conditions at 28°C for a 48-hour incubation period. Differential incubation protocols were implemented for various microbial groups: bacterial cultures at 37°C for 24 hours, fungal specimens at 28±2°C for 4 days, and hydrocarbon-degrading microorganisms at 28±2°C for 7 days. Quantitative analysis of microbial growth was performed using a Quebec colony counter, with subsequent taxonomic identification accomplished through standardized morphological characterization as described in established microbiological references (Cowan, 1985; Barnett & Hunter, 1987).

Quantification of Heterotrophic Bacteria

The enumeration of total heterotrophic bacteria was performed following standardized plating methodologies (Collins and Lyne, 1976). Samples underwent a 10-fold serial dilution series, with 1 mL aliquots from appropriate dilutions (10^{-7} for soil and 10^{-5} for water) aseptically transferred into sterile Petri dishes using calibrated pipettes. Molten nutrient agar (Biotec), maintained at 40–45°C, was poured over the inoculum, and each plate was carefully swirled to ensure even sample distribution.

Following solidification, plates were inverted and incubated under two temperature regimes: duplicate sets were maintained at 37°C for 24 hours and at 28±2°C (ambient laboratory conditions) for 48 hours. Post-incubation, visible colonies were enumerated using a colony counter, with final microbial densities calculated by applying the respective dilution factors. Results were reported as colony-forming units per milliliter (cfu/mL) for aqueous samples or colony-forming units per gram (cfu/g) for solid matrices.

This dual-temperature incubation protocol facilitated the recovery of both mesophilic and environmental bacterial strains, while the standardized dilution scheme ensured countable colony ranges for accurate quantification. The methodology provided reproducible quantification of culturable heterotrophic bacteria while maintaining aseptic conditions throughout the analytical process.

Fungal Quantification Methodology

The total fungal count (TFC) was determined through surface plating techniques using Potato Dextrose Agar (PDA, Oxoid). A 0.1 mL aliquot from the 10^{-3} dilution supernatant was aseptically transferred onto PDA plates and uniformly distributed across the agar surface using a sterile glass spreader. All samples were processed in duplicate to ensure methodological reliability. Plates were incubated at 28±2°C (ambient laboratory temperature) for a period of 3-5 days to allow for complete fungal development. Following incubation, discrete colonies were enumerated, with final concentrations calculated and reported as colony-forming units per milliliter (cfu/mL) for liquid samples or colony-forming units per gram (cfu/g) for solid matrices.

4.7.1.1 Enumeration of Coliform Bacteria

The quantification of coliform bacteria in water samples was performed using the membrane filtration method according to standard protocols (Harrigan and McCance, 1976). The procedure employed sterile Millipore filters with a 147 mm diameter and 0.45 µm pore size to concentrate bacterial cells from 100 mL water aliquots. Prior to filtration, the filtration apparatus was sterilized with 70% ethanol to prevent contamination. Each water sample was passed through the sterile membrane under vacuum pressure, after which the filter was carefully transferred to a Petri dish containing an absorbent pad saturated with membrane lauryl sulfate broth. For comprehensive analysis, duplicate filters were prepared for each sample. The plates were incubated under two temperature regimes to differentiate coliform types: one set at 37°C for total coliform enumeration and another at 44°C for 24 hours to selectively identify thermotolerant (fecal) coliforms. This dual-

temperature approach enabled the specific detection of potentially pathogenic strains while maintaining optimal growth conditions for accurate colony counting.

The membrane filtration technique provided an efficient and reliable means of concentrating bacteria from large water volumes, ensuring sensitive detection of coliform populations. The method's precision was further enhanced through duplicate sampling and controlled incubation parameters, yielding reproducible results for water quality assessment.

4.7.1.2 Confirmation of Coliform Identification

To validate the membrane filtration results, additional biochemical tests were performed on representative colonies. For total coliform verification, selected colonies were inoculated into lactose peptone water and incubated at 37°C for 48 hours. The formation of gas bubbles within the Durham tubes during this period served as definitive confirmation of total coliform presence.

For thermotolerant (fecal) coliforms and *Escherichia coli* confirmation, a dual-culture approach was employed. Selected colonies were simultaneously transferred to both lactose peptone water and tryptone water broths, followed by incubation at 44°C for 24 hours. Gas production in the lactose peptone water confirmed thermotolerant coliforms, while *E. coli* identification required additional testing with Kovac's reagent (0.2-0.3 mL) added to the tryptone water cultures. The development of a distinct red color layer indicated indole production from tryptophan metabolism, providing positive confirmation of *E. coli* presence.

4.7.1.3 Quantification of Hydrocarbon-Degrading Microorganisms

The enumeration of crude oil-degrading microbes in environmental samples was conducted following established protocols (Jackson et al., 1994). The surface plating technique, similar to that employed for fungal counts, was implemented using serial dilutions (10^{-3} and 10^{-4}) plated in duplicate on specialized crude oil agar medium. The selective medium was prepared by supplementing Zajic and Supplison's (1972) mineral salt base with 0.2% Qua Iboe light crude oil and 2% bacteriological agar. Following inoculation, plates were maintained at $28 \pm 2^\circ\text{C}$ for 5-7 days to allow colony development. After incubation, distinct colonies were enumerated and reported as colony-forming units per gram (cfu g^{-1}). For fungal hydrocarbon degraders, the same basal medium was modified by acidification with 10% lactic acid (v/v) to create selective conditions favoring fungal growth while inhibiting bacterial development. This adaptation allowed for the specific isolation and quantification of oil-utilizing fungal populations from mixed microbial communities.

4.7.1.4 Microbial Isolate Characterization and Identification

The isolated bacterial strains underwent comprehensive characterization through a polyphasic approach examining cultural, morphological, and biochemical properties. Taxonomic identification was achieved by comparing observed characteristics with standardized references, primarily Bergey's Manual of Determinative Bacteriology (Holt et al., 1994) and Cowan and Steel's Manual for the Identification of Medical Bacteria (Barrow & Feltham, 1993). This systematic evaluation included analysis of colony morphology, staining reactions, and metabolic profiles to establish precise taxonomic positions.

Fungal isolates were identified through detailed morphological assessment, examining both macroscopic colony features on growth media and microscopic characteristics. Special attention was given to reproductive structures, particularly asexual spore formation patterns. Identification was conducted using authoritative mycological references: *Illustrated Genera of Imperfect Fungi* (Barnett & Hunter, 1972) for general taxonomy and *Fungi in Agricultural Soils* (Domsch et al., 1980) for ecological context. The dual approach of macroscopic and microscopic evaluation ensured accurate classification within the fungal taxonomy.

4.7.1.5 Quantification and Verification of Fecal Streptococci

The analysis of fecal streptococci in aqueous samples was performed according to established microbiological protocols (Fawole & Oso, 1988). The enumeration process involved selective cultivation on sodium azide-supplemented medium, with incubation maintained at 37°C to promote specific microbial growth.

For confirmatory testing, positive isolates were subcultured in glucose azide broth and incubated at an elevated temperature of 44.5°C for 48 hours. Verification of fecal streptococci was based on two definitive biochemical indicators: (1) observable microbial growth and (2) characteristic acid production, as evidenced by pH-dependent color changes in the medium.

4.7.1.6 Quantification and Confirmation of *Clostridium perfringens*

The detection and enumeration of *C. perfringens* was performed using a combination of differential reinforced clostridium medium (DRCM) and litmus milk medium following established protocols (Itah et al., 1996). Water samples were inoculated in varying volumes (10 mL and 5 mL) into both double-strength and single-strength media contained in screw-capped bottles. These were then incubated at 37°C for 48 hours under anaerobic conditions using an anaerobic jar. Positive samples were identified by the characteristic blackening of the DRCM medium. The most probable number (MPN) of *Clostridium* species was determined through statistical analysis using MacCrady probability tables.

4.7.2 Results and Discussion

4.7.2.1 Microbiological Water Quality Assessment

The microbiological evaluation of surface water samples, as presented in Table 4.11 and Table 4.12, employed coliform bacteria as key biological indicators of fecal contamination. These organisms serve as reliable proxies for potential waterborne pathogens that are often challenging to isolate directly. The presence of coliforms signals possible fecal-oral disease transmission risks through contaminated water sources. Research by Wheather et al. (1980) established that the relative proportion of total coliforms to fecal streptococci can help differentiate contamination sources. A fecal coliform-to-streptococci ratio exceeding 4:1 strongly suggests human-derived pollution, while lower ratios typically indicate animal sources. Our findings revealed animal-related fecal contamination in river samples, while groundwater samples showed no detectable coliform presence.

4.7.2.2 Microbiological Assessment of Surface Water Quality

Water contamination, characterized by the introduction of hazardous substances into aquatic systems (Wanjala et al., 2018), poses significant risks to biodiversity and ecosystem integrity. Groundwater, accounting for a major portion of the world's freshwater reserves, is crucial for human consumption and economic activities but remains susceptible to pollution (De Giglio et al., 2016). Pathogens from fecal sources can infiltrate water supplies, particularly in regions with porous or fractured geological formations where natural filtration is limited (Berger, 2008; Beer et al., 2015). Aquatic microbial communities are shaped by chemical, physical, and biological conditions. Contaminants from sewage discharge and industrial effluents introduce harmful microorganisms, necessitating rigorous water quality assessments (Kolwzan et al., 2006). Sediment-associated bacteria are vital in nutrient processing but are often disrupted by anthropogenic pollution (Yang et al., 2013). Extreme weather events and excessive groundwater extraction further exacerbate contamination, threatening potable water safety (Wu et al., 2015; Pitkänen et al., 2011). Implementing effective water treatment protocols and safeguarding water sources are essential to minimizing microbial hazards and ensuring public health protection.

The microbiological analysis of surface water samples, detailed in Table 4.11 and Table 4.12, revealed the presence of total coliforms, fecal streptococci, and heterotrophic bacteria. The detection of *Escherichia coli* in these samples provides definitive evidence of recent fecal contamination. While heterotrophic bacteria themselves are not pathogenic, elevated counts indicate favorable conditions for bacterial proliferation, potentially facilitating the growth of harmful pathogens.

The study employed the total coliform to fecal streptococci (TC/FS) ratio as a diagnostic tool for contamination source identification, following the methodology established by Tchobanoglous and Burton (1991). Their research demonstrates that TC/FS ratios below 1.0 suggest animal-derived contamination, while ratios exceeding 4.0 indicate human waste sources. As shown in Table 4.12, the analytical results consistently demonstrated TC/FS ratios characteristic of animal fecal pollution throughout the study area. Surface water samples at the proposed ATC is contaminated, exceeding WHO/FME limits. Faecal streptococci (14.3 ± 3 cfu/100ml), total coliform (17.0 ± 3 cfu/100ml), and heterotrophic bacteria (1.5×10^5 cfu/ml) indicate faecal and organic pollution, likely from runoff. Downstream counts are the highest.

Table 4.11: Microbiological Profile of Surface Water Samples

Parameter	US	MS	DS	Mean	Range	WHO limit	FMEEnv limit	NSDWQ
Faecal Streptococci (cfu/100ml)	15	11	17	14.3±3	11.0-17.0	0	0	0
Total Coliform (cfu/100ml)	17	14	20	17.00±3	14.0-20.0	0	0	0
Total Heterotrophic Bacteria (cfu/ml × 10 ⁵)	1.1	1.0	1.4	1.5	1.1-1.8	-	-	100

Source: Laboratory Analysis (2025) US = Upstream, MS = Midstream, DS = Downstream
NSDWQ = Nigerian Standards for Drinking Water Quality

Table 4.12: Ratio of FC to FS

Sample	TC	FS	TC/FS
US	17	15	1.1
MS	14	11	1.27
DS	20	17	1.18

4.7.3 Sediment Microbiology

Sediments, while sharing some characteristics with soils, are distinct due to their unique environmental conditions, particularly their constant submersion under water bodies such as oceans, lakes, rivers, fjords, or reservoirs. This continuous wetness, along with varying water chemistry, primary productivity (autochthonous input), and external contributions from runoff or rivers (allochthonous input), shapes the microbial communities within sediments. These microbes are critical for transforming organic matter and driving biogeochemical cycles involving elements like nitrogen, sulfur, phosphorus, and iron (Zhang et al., 2014).

The microbial composition of sediment samples is detailed in Figure 4.10 and Figure 4.11, more details in Appendix 4.1 Table: A4.4. Total heterotrophic bacteria ranged from 2.9×10^5 to 3.7×10^5 cfu/g, total heterotrophic fungi from 2.1×10^5 to 2.7×10^5 cfu/g, hydrocarbon-utilizing bacteria from 1.1×10^5 to 1.8×10^5 cfu/g, and hydrocarbon-utilizing fungi from 1.0×10^5 to 1.2×10^5 cfu/g. A total of 33 microbial species were identified, comprising 19 bacterial species, including *Acinetobacter* sp., *Nocardia* sp., *Bacillus subtilis*, *Desulfobacterium* sp., *Desulfobulbus* sp., *Desulfovibrio* sp., *Methanococcus* sp., *Methanohalophilus* sp., *Methanosarcina* sp., *Clostridium* sp., *Fusobacterium* sp., *Desulfuromonas* sp., *Bacteroides* sp., *Achromobacter* sp., *Bacillus* sp., *Micrococcus* sp., *Pseudomonas* sp., and *Paracoccus* sp. (Figure 4.6.1), and 14 fungal species, including *Aspergillus fumigatus*, *Rhizopus* sp., *Chytridium* sp., *Fusarium* sp., *Aspergillus niger*, *Candida tropicalis*, *Alternaria* sp., *Candida* sp., *Rhizophydium* sp., *Pythium* sp., *Phytophthora* sp., *Mucor* sp., *Candida albicans*, and *Penicillium* sp (Figure 4.10).

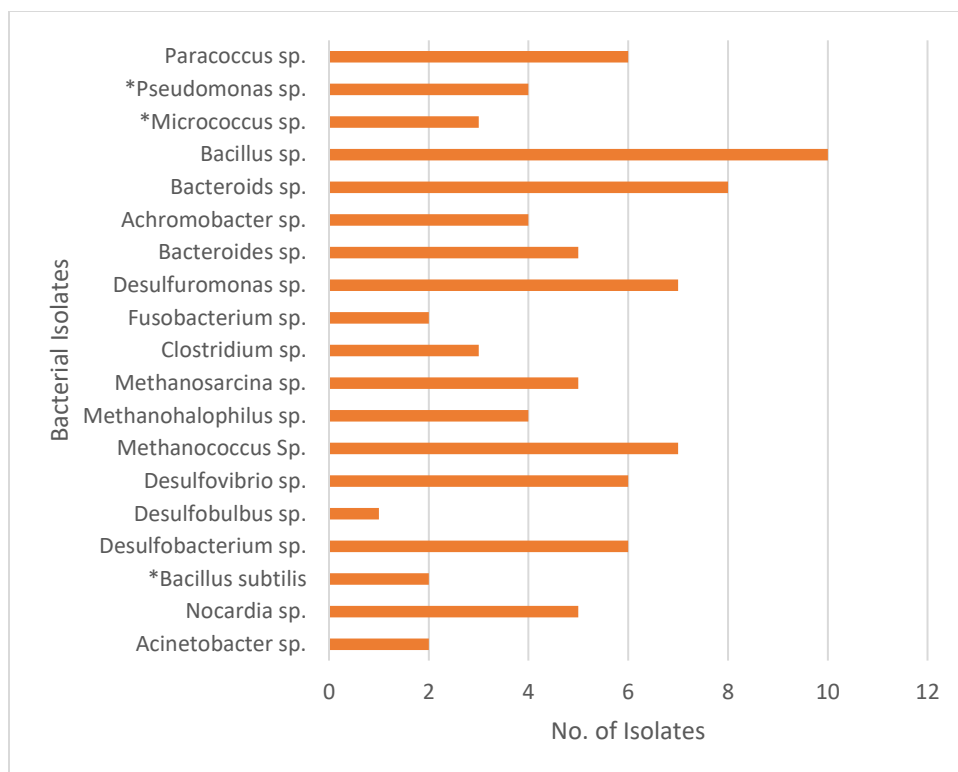


Figure 4.10: Bacterial Isolates Identified in Sediment Samples

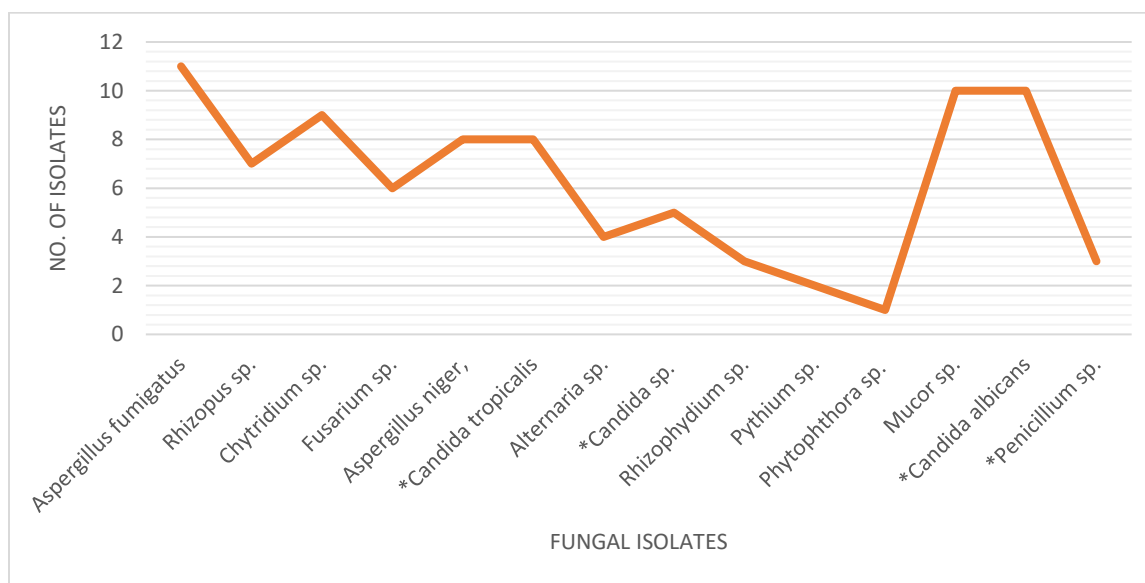


Figure 4.11: Fungal Isolates Identified in Sediment Samples

4.7.4 Groundwater Microbiology

Table 4.13 summarizes the groundwater analysis results. Total coliform and fecal streptococcal bacteria were absent in the samples. Although viable bacteria were detected and deemed harmless to humans, an elevated heterotrophic plate count suggests conditions favorable for pathogenic bacterial growth.

Table 4.13: Microbiological Profile of Groundwater Samples

Parameter	Groundwater			Control					
	GW 1	GW 2	GW3		Mean	Range	WHO limit	FME limit	
Faecal Coliform (cfu/100ml)	0	0	0	0	0	0	0	0	
Total Coliform (cfu/100ml)	0	0	0	0	0	0	0	0	
Total Heterotrophic Bacteria (cfu/ml $\times 10^2$)	1.5	1.7	1.4	1.0	1.5	1.4 - 1.7	-	-	

4.7.5 Soil Microbiology

The microbial abundance and distribution in soil within the project area are detailed in Figure 4.12, and Figure 4.13 (Appendix 4.I; tables A4.9 and A4.10). Bacterial and fungal densities varied across sampling sites, with heterotrophic bacteria ranging from 2.2×10^5 to 3.9×10^5 cfu/g and fungi from 2.7×10^5 to 3.8×10^5 cfu/g, indicating a fertile soil environment. Oil-degrading microbes were present, with low counts of oil-degrading bacteria (1.1×10^5 to 1.7×10^5 cfu/g) and fungi (1.1×10^5 to 1.7×10^5 cfu/g), suggesting a slightly elevated hydrocarbon load in the soil (Essien and Antai, 2005; Odu, 1972). These microbes indicate potential for natural remediation of hydrocarbon contamination during construction.

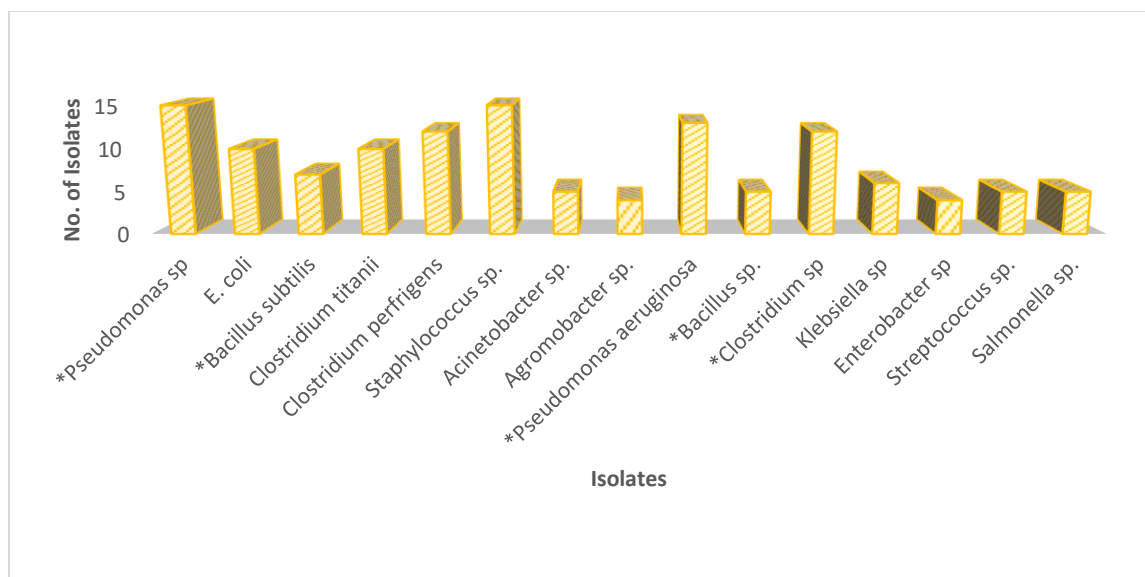


Figure 4.12: Bacterial Isolates Showing % Occurrence in Soil Samples

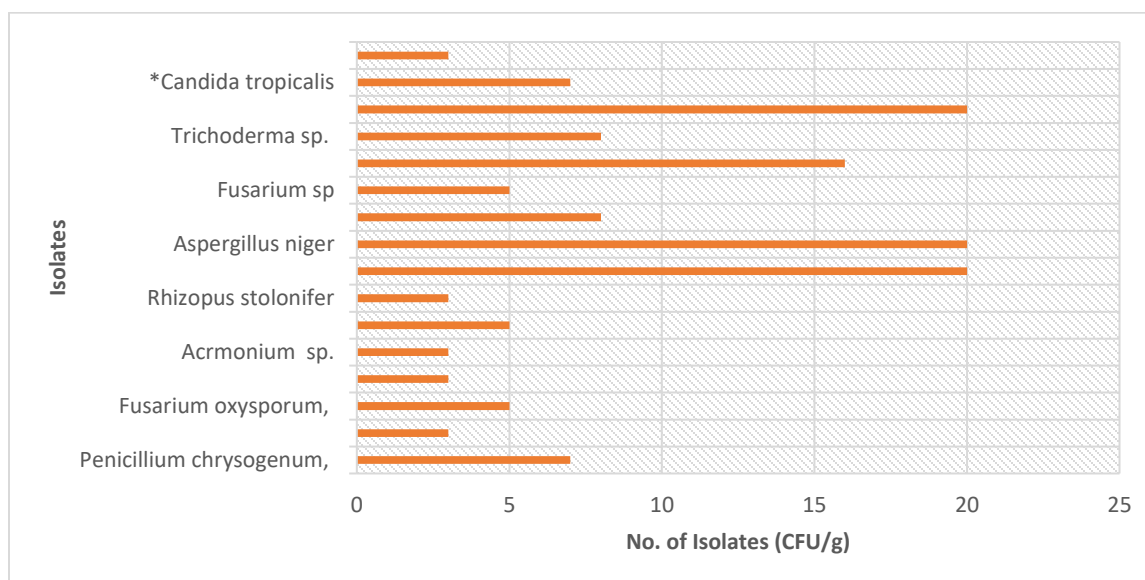


Figure 4.13: Fungal Isolates Showing % Occurrence in Soil Samples

4.7.6 Conclusion

The surface water's contamination requires attention and source control to protect health and agricultural activities. Sediments and soils, while microbially active and capable of natural remediation, indicate hydrocarbon presence that must be monitored during construction. Groundwater, though less contaminated, warrants vigilance due to potential pathogen growth. Comprehensive water treatment, pollution source mitigation, regular monitoring, and community education are critical to ensure the safety and sustainability of the proposed Okuku ATC project.

4.8 Ecology

4.8.1 Vegetation

4.8.1.1 Methodology

Vegetation studies were carried out to determine the baseline status of the study area vis-à-vis the species composition, diversity, and population of the plant species as well as their medicinal and economical uses. The density and percentage of the key tree species and the herbaceous layers were determined while rare and endangered plant species and all those of special significance to the ecosystem and the local economy were categorized. The species diversity of the plants was calculated as the ratio between the number of species and importance value which for the purpose of this study was taken as numbers of individual per quadrat. Both the generic and specific characteristics of the vegetation were assessed by determining their floristic composition, life form and biological spectra.

Four (4) stations point of the study area was established (120m x 240m). Each sampling station was further divided into sampling points. A sampling point was established as a five-line transect of 200m apart over a 300m length. Four (4) stations were within the proposed site while fifth station was located outside the project site at about 1.5km distance, serving as control. An average of 5000 m² was adopted as sampling size per sampling point. This resulted in a total sampled area of 4 hectares. Figure 4.14 shows the sampling points around the project area while the Diameter at Breast Height (DBH) of trees were measured.

4.8.1.2 Wildlife

The wildlife study cuts across the entire ecosystem. Methodologies of sample collection and identification include:

- Visual observations and documentation of droppings.
- Oral discussion with natives of the study area.
- Tree beating, shaking, purpose mark, feathers, shells, sounds, foot prints, information on the available species and relative abundance was obtained through oral interviews and discussions with artisanal hunters and indigenes.

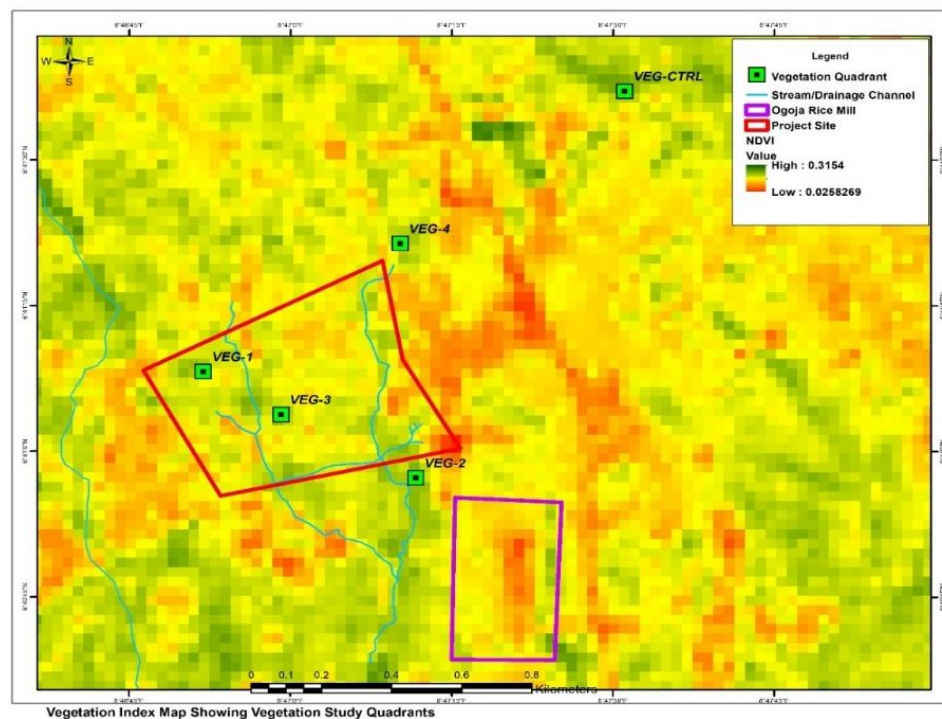
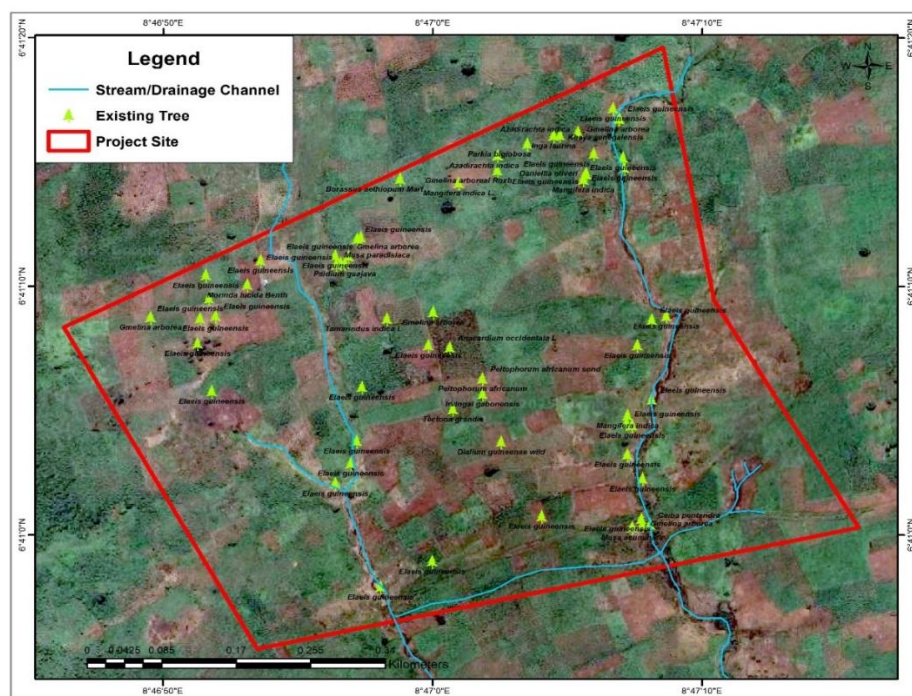


Figure 4.14: Vegetation sampling points

4.8.1.3 Description of study area

The existing vegetation comprises secondary vegetation typical of lowland rainforest transition zones, with scattered cultivated lands, tree species, shrubs, and grasses. Two first-order streams traverse the project site, flowing into a confluence west of the site; stream one (right side - 1195.7m) and stream two (left side - 1292.1m). Sparse riparian vegetation observed along stream courses. These areas are ecologically sensitive and serve as drainage and biodiversity corridors. The flora is mainly agroforestry types majorly dominated by *Elaeis guineensis* (oil palm), *Mangifera indica* (mango) and *Gmelina arborea* (Gmelina). The spatial distribution of these vegetation types in the study area is presented in Figure 4.15.

The natural vegetation is a mosaic of derived savanna interspersed with remnant lowland rainforest patches. Agricultural encroachment and urban development have modified much of the original vegetation. Scattered food crops such as cassava, maize, plantain (*Musa* spp.), and yam are cultivated within and around the project boundary. The common tree species include; *Elaeis guineensis* (oil palm), *Mangifera indica* (mango), *Gmelina arborea*, *Azadirachta indica* (neem), *Khaya senegalensis*, *Parkia biglobos*, *Tectona grandis* (teak), *Dialium guineense*, *Inga laurina*, *Borassus aethiopum*, *Ceiba pentandra*. A total of 62 individual trees were georeferenced and identified as important for in-situ conservation (Plate 4.5) while the geographical details and individual name of the trees is presented in Appendix A4.11. The density distribution of trees in this forest type shows that *Elaeis guineensis*, *Mangifera indica* and *Ceiba pentandra* are the most dominant tree species (Figure 4.16). Table 4.14 captures the frequency of censused trees in the proposed site.



Map Showing Existing Trees Within the Project Site

Figure 4.15: Spatial Distribution of the Existing Geo-referenced Trees (62) within the Project Area

4.7.1.4 Cultivated areas

The project area is predominately use for agricultural purpose while some trees and shrubs are still standing despite the agricultural activities. Plants occurring here are mainly foods crop such cassava (*Manihot esculenta*), maize (*zea mays*), plantain (*Musa Spp.*), and yam (*Discorea rotundata*).



*Ceiba
pentandra*
6.683442,
8.785581



*Gmelina
arborea*
6.683443,
8.785502



*Elaeis
guineensis*
6.684841
8.785599



*Mangifera
indica*
6.684666,
8.785347



*Dialium
guineense*
6.684370,
8.784046



*Tectona
grandis*
6.684734,
8.783548

					
<i>Daniellia oliveri</i> (African copaiba balsam tree)	<i>Khaya senegalensis</i> (mahogany)	<i>Inga laurina</i> Guama (guava)	<i>Azadirachta indica</i> (neem)	<i>Parkia biglobosa</i> African (locust-bean)	<i>Peltophorum africanum</i> sond
6.687361, 8.784910	6.687811, 8.784650;	6.687737, 8.784540	6.687830, - 8.784835	6.687636, 8.784245	6.685733, 8.782885;

					
<i>Borassus aethiopum</i> (African fan palm)	<i>Musa paradisiaca</i> (Banana)	<i>Morinda lucida</i> Benth (Brimstone tree)	<i>Irvingia gabonensis</i>	<i>Musa acumunata</i> (Plantain)	<i>Tamarindus indica</i> L
6.687379, 8.782978	6.686352, 8.782345	6.686121, 8.781426;	6.684904 8.783855	6.683413 8.785396	6.685745 8.782867

	
<i>Psidium guajava</i> (Guava)	<i>Anacardium occidentale</i> L. (Cashew)
6.687379, 8.782978	6.685425, 8.783514

Plate 4.5: Individual Georeferenced Exiting Tree and Shrubs in the Project Area
(fieldwork, 2025)

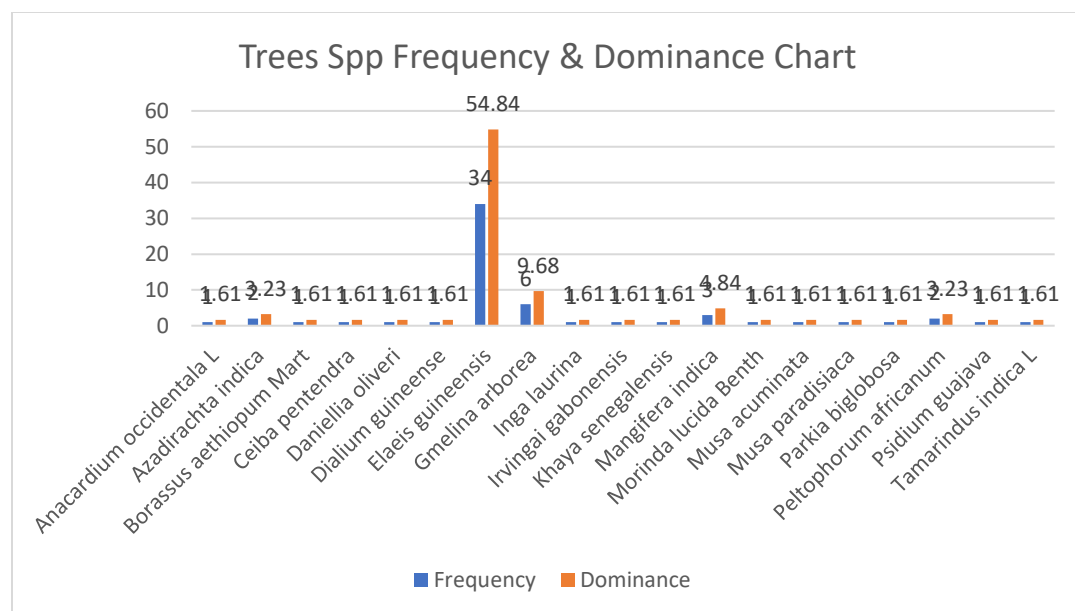


Figure 4.16: Tree Species Frequency and Dominance

Table 4.14: Frequency of censored` trees in the proposed site

SN	Name	English/ Common Name	Local Name	Frequency	Dominance
1.	<i>Anacardium occidentala L</i>	Cashew		1	1.61
2.	<i>Azadirachta indica</i>	Neem	Dogon yaro	2	3.23
3.	<i>Borassus aethiopum Mart</i>			1	1.61
4.	<i>Ceiba pentendra</i>	Kapok tree or Silk cotton		1	1.61
5.	<i>Daniellia oliveri</i>	African fan palm	Atet	1	1.61
6.	<i>Dialium guineense</i>	Velvet Tamarind	Icheku	1	1.61
7.	<i>Elaeis guineensis</i>	Oil Palm	Isip Eyop	34	54.84
8.	<i>Gmelina arborea</i>	Gmelina	Ayinke	6	9.68
9.	<i>Inga laurina</i>	Ice cream Bean		1	1.61
10.	<i>Irvingai gabonensis</i>	Bush Mango	Ogbono	1	1.61
11.	<i>Khaya senegalensis</i>	African Mahogany	Ono	1	1.61
12.	<i>Mangifera indica</i>	Mango	Mangolo	3	4.84
13.	<i>Morinda lucida Benth</i>	Brimstone tree	Eze ugu	1	1.61
14.	<i>Musa acuminata</i>	Dwarf Banana		1	1.61
15.	<i>Musa paradisiaca</i>	Plantain	Unene	1	1.61
16.	<i>Parkia biglobosa</i>	African locust bean	Dawa dawa	1	1.61
17.	<i>Peltophorum africanum</i>	African Wattle		2	3.23
18.	<i>Psidium guajava</i>	Guava	Ugwoba	1	1.61
19.	<i>Tamarindus indica L</i>	Tamarind	Tsamiyar kurm	1	1.61
20.	<i>Tectona grandis</i>	Teak		1	1.61
				62	100.00

4.8.2 Aquatic and Riparian Ecology

The aquatic and riparian ecosystems within the project site are defined primarily by the presence of two seasonal first-order streams, their tributaries, and associated riparian vegetation. These watercourses not only serve as natural drainage channels for the site but also support ecological functions essential for biodiversity conservation and microclimate regulation. The riparian zones act as transitional habitats between terrestrial and aquatic environments, harboring species that are dependent on periodic water availability, especially during the rainy season. Due to their linear

structure, these ecosystems also serve as biodiversity corridors for the movement of aquatic and semi-aquatic species. The integrity of these zones is therefore crucial to the ecological health and sustainability of the surrounding landscape.

Within the project area, the follow **aquatic and riparian** ecology was identified.

- i **Streams and drainage:** Two first-order streams traverse the project site, flowing into a confluence west of the site.
 - Stream One (right Side): 1195.7m
 - Stream Two (left Side): 1292.1m
 - One tributary and stream crossing identified.
- ii **Riparian Vegetation:** sparse riparian vegetation observed along stream courses. These areas are ecologically sensitive and serve as drainage and biodiversity corridors although the farmers have turned them into rice farms.
- iii **Aquatic Ecology:** The presence of two ephemeral/seasonal streams and associated riparian zones makes the site ecologically significant. These streams likely support:
 - **Amphibians:** frogs and toads, especially during the wet season.
 - **Aquatic invertebrates:** mayflies, dragonflies, and mosquito larvae.
 - **Flora:** semi-aquatic vegetation including *Cyperus spp.*, ferns, and aquatic grasses.

4.8.3 Flora Composition

The vegetation structure within the proposed project site is characteristic of a secondary ecosystem, shaped by both natural successional processes and human intervention. It consists of a mosaic of remnant native trees, agroforestry species, fallow lands, and cultivated crops. This mixed landscape supports both economic and ecological plant species, providing resources such as food, timber, shade, and erosion control. The presence of mature trees, some exceeding several decades in age, indicates residual ecological value and a potential for biodiversity conservation. The floristic survey aimed to identify and catalogue the existing tree species, document their geographic coordinates, and assess their importance for conservation, especially for planning mitigation measures such as in-situ preservation and afforestation.

4.8.3.1 IUCN Status of the Flora

The International Union for Conservation of Nature (IUCN) is a globally recognized authority on the status of the natural world and the measures needed to safeguard it. Each species is assessed and categorized based on criteria such as population trends, geographic range, and habitat condition—ranging from Least Concern (LC) to Extinct (EX) as presented in

Table 4.15.

Table 4.15: IUCN 2023 Status of the Censored Trees in the Proposed Site

SN	Name	IUCN 2023 Status
1.	<i>Anacardium occidentale L</i>	LC
2.	<i>Azadirachta indica</i>	LC
3.	<i>Borassus aethiopum Mart</i>	NE
4.	<i>Ceiba pentandra</i>	LC
5.	<i>Daniellia oliveri</i>	NE
6.	<i>Dialium guineense</i>	NE
7.	<i>Elaeis guineensis</i>	LC
8.	<i>Gmelina arborea</i>	NE
9.	<i>Inga laurina</i>	NE
10.	<i>Irvingia gabonensis</i>	NE
11.	<i>Khaya senegalensis</i>	VU
12.	<i>Mangifera indica</i>	NE
13.	<i>Morinda lucida Benth</i>	NE
14.	<i>Musa acuminata</i>	NE
15.	<i>Musa paradisiaca</i>	NE
16.	<i>Parkia biglobosa</i>	VU
17.	<i>Peltophorum africanum</i>	NE
18.	<i>Psidium guajava</i>	NE
19.	<i>Tamarindus indica L</i>	NE
20.	<i>Tectona grandis</i>	NE

Key: LC: Least Concern, NE: Not Evaluated, VU: Vulnerable

- Many of the widely cultivated or economically important species (*Borassus aethiopum*, *Dialium guineense*, *Elaeis guineensis*, *Gmelina arborea*, etc.) appear **not to have formal global assessments** on the IUCN Red List, meaning they are listed as **Not Evaluated (NE)**.
- *Khaya senegalensis* is consistently assessed as **Vulnerable (VU)** due to habitat loss and heavy exploitation for timber.
- *Parkia biglobosa* is globally assessed as **Least Concern (LC)** but recent local studies (e.g., in Nigeria's Sudan savanna) have categorized it as **Vulnerable regionally** due to population declines.
- *Irvingia gabonensis* (African bush mango) has no current global IUCN listing but continues to be widely documented in other conservation and ethnobotanical sources; it appears **not evaluated** by IUCN as of 2023.

4.8.3.2 Ecosystem Service

Understanding the ecosystem services provided by these censored tree species enhances our capacity to prioritize conservation strategies, support sustainable land management, and foster

nature-based solutions in policy and development planning. Details of the economic services of the tress species is presented in Table 4.16.

Table 4.16: Ecosystem Services of the Censored Trees in the Proposed Site

Scientific Name	Provisioning Services	Regulating/Supporting Services	Cultural Services
<i>Anacardium occidentale</i>	Fruit, nuts, medicine, wood	Soil fertility, microclimate regulation	Agroforestry, traditional medicine
<i>Azadirachta indica</i>	Oil (neem), biopesticide, timber	Pest control, nitrification inhibition	Medicinal, spiritual, urban greening
<i>Borassus aethiopum</i>	Edible palm products, thatch	Shade, windbreaks	Cultural, local construction
<i>Ceiba pentandra</i>	Kapok fiber, timber, medicine	Agroforestry, soil enhancement	Mythological significance, shade
<i>Daniellia oliveri</i>	Timber, medicinal bark	Nitrogen fixing, soil fertility	Cultural symbol, local construction
<i>Dialium guineense</i>	Edible fruit, medicinal use	Agroforestry component	Cultural and nutritional importance
<i>Elaeis guineensis</i>	Palm oil, palm kernel oil	Habitat provisioning, carbon sink	Sacred in some African traditions
<i>Gmelina arborea</i>	Fast-growing timber, fuelwood	Shade, reforestation	Agroforestry and erosion control
<i>Inga laurina</i>	Fodder, fuelwood	Nitrogen fixing, shade	Agroforestry and intercropping
<i>Irvingia gabonensis</i>	Fruit (bush mango), kernels	Soil enrichment, agroforestry	Local culinary and market value
<i>Khaya senegalensis</i>	High-quality timber	Shade, erosion control	Ornamental and symbolic use
<i>Mangifera indica</i>	Fruit, leaves, timber	Shade, pollinator support	Staple crop in home gardens
<i>Morinda lucida</i>	Medicinal bark and leaves	Forest understory species	Traditional healing practices
<i>Musa acuminata</i>	Bananas, fiber	Mulch, erosion control	Cultural food crop
<i>Musa paradisiaca</i>	Plantains, leaf wrapping	Agro-waste for composting	Traditional staple food
<i>Parkia biglobosa</i>	Fermented seeds, timber	Nitrogen fixing, shade	Cultural and food security role
<i>Peltophorum africanum</i>	Fuelwood, poles	Soil fertility, shade	Boundary planting
<i>Psidium guajava</i>	Edible fruit, medicine	Pollinator resource	Garden and cultural crop
<i>Tamarindus indica</i>	Fruit pulp, timber	Water retention, erosion control	Food preservation, rituals
<i>Tectona grandis</i>	High-value timber	Carbon sequestration	Commercial forestry

4.8.3.3 Ecological Sensitivity and Risk Zones

Identifying ecological sensitivity zones within the project site is essential for understanding areas of high environmental value, potential vulnerability, and ecological function. These zones serve as

indicators for prioritizing conservation efforts and guiding environmentally responsible project design and implementation. The ecological sensitivity assessment considers a range of biophysical features such as riparian corridors, mature vegetation clusters, seasonal wetlands, and agriculturally degraded lands. Each zone is evaluated based on its ecological role, degree of disturbance, biodiversity content, and susceptibility to adverse impacts such as erosion, flooding, and habitat fragmentation. Mapping these sensitive areas provides a foundation for developing spatially targeted mitigation and monitoring strategies throughout the project lifecycle. Table 4.17 presents the identified ecological sensitivity zones of the project area.

Table 4.17: Identified Ecological Sensitivity Zones of the Project Area

Feature	Description	Sensitivity Level
Riparian Buffer Zones	Critical drainage and biodiversity corridor	High
Existing Tree Groves	Mature native/economic trees	Medium-High
Wetland/Moist Depressions	Flood-prone, seasonal water collection	Medium
Farmland-Adjacent Area	Potential agrochemical runoff to streams	Medium

4.9 Socioeconomics

4.9.1 Objectives of the Socioeconomic Impact Assessment Study

The SIA serves the following overarching purposes:

- To assess how the ATC project is likely to affect the people, institutions, and social networks in Okuku and nearby communities.
- To provide evidence-based guidance for designing and implementing measures that will enhance the project's social sustainability and acceptability.
- To ensure that the voices of affected stakeholders—including women, youth, farmers, traditional leaders, and vulnerable groups—are incorporated into the planning and execution of the project.
- To develop a robust Social Management Plan (SMP) that aligns with national laws and international best practices.

4.9.2 Scope of the SIA

The scope of the SIA covers:

- A baseline study of the social and economic characteristics of the project area.
- Identification and assessment of potential social impacts throughout the project lifecycle (pre-construction, construction, operation, and decommissioning).
- Engagement and consultation with key stakeholders using participatory and inclusive tools.

- Development of practical mitigation, enhancement, and monitoring strategies to address identified impacts.

4.9.3 Methodology

The SIA employed a mixed-methods approach combining qualitative and quantitative tools to ensure a comprehensive and participatory analysis. Key steps included:

- **Desk Review:** Analysis of existing policy documents, project reports, and socio-economic data relevant to Okuku and Yala LGA.
- **Primary Data Collection:** Household surveys using structured household questionnaire developed using KoboToolbox, a mobile-based data entry software and pre-tested, Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and Participatory Rural Appraisal (PRA) and participatory mapping to gather detailed local-level information.

Target Population

The socio-economic baseline survey was conducted 28 June 2025, covering all communities within a 5 km radius of the proposed ATC site, which represents the project's spatial boundary of influence. The target population for the study were residents and stakeholders of the community directly affected by the project – Ipuole Okuku in Okuku Clan, Yala LGA, Cross River State.

4.9.3.1 Sampling Method

Stratified random sampling was used for household surveys, while purposive sampling methodology was employed for Focused Group Discussion (FGDs) and Key Informant Interviews (KIIs). Also, transect walks to capture qualitative insights on social conditions, cultural practices, and livelihood systems. This combined quantitative and qualitative approach ensured comprehensive representation of community perspectives and improved the reliability of socio-economic baseline information.

Sample Size:

A total of 120 structured questionnaires were administered to household heads, community leaders, women, and youth representatives across Ipuole Okuku communities. The 100 questionnaires (100%) were successfully retrieved and validated for analysis.

Initial consultation and sensitization meetings were held with the LGA chairman, Councilors, deputy village head, chiefs and traditional leaders of the community at the Sanctus Hotels, Ipuole Okuku

4.9.3.2 Household Surveys and Data Collection Tool

A structured questionnaire (Appendix 4.2) was administered to a representative sample of 100 Heads of Households (HH) across the target communities, using KoboToolbox. The respondents were heads of households or their representatives and adults above 18 years of age. Information gathered

included household composition, income sources, education, health, housing, food security, land use, access to services, concerns and expectations from the proposed project.

4.9.3.3 Focus Group Discussions (FGDs)

FGDs were held with elders, women, and youth leaders and fisherfolks in the communities. Discussions explored perceptions of the ATC, socio-cultural norms, impact history, conflict resolution mechanisms, concerns and expectations from the project.

4.9.3.4 Key Informant Interviews (KIIs)

KIIs were conducted with individuals including community leaders, women leaders, youth representatives, school heads, fisherfolks and farmers. Focus areas for the KII included community development priorities, historical grievances, land tenure systems, gender relations, impact history, concerns and expectations from the project etc.

4.9.3.5 Observational Assessments

Field teams carried out community walk with representatives of the communities to assess and record infrastructure conditions (roads, schools, health centres), water sources, waste disposal methods, and community layout. Photographs of these facilities were also taken and recorded.

4.9.3.6 Scoping and Stakeholder Engagement Workshop

A scoping and stakeholder workshop involving relevant stakeholders was convened to present the project to relevant stakeholders and to receive their inputs into the design and implementation of the project to ensure a win-win outcome for all

4.9.3.7 Data Collation and Analysis

Data obtained from all the sources above were analyzed and interpreted for the report writing.

4.9.3.8 Data Analytical Techniques and Data Presentation

Summary statistics including percentages, averages and ratios were used in the report and data presentation was done in tables and charts. Labour force population covers all persons aged 15-64years who are willing and able to work regardless of whether they have a job or not (Annual Abstract of Statistics, Vol. 1, 2016). Population sizes and relevant distributions were determined using the following formulae:

- I. Population projection using the exponential model

$P_n = P_o (1 + r)^n$; where P_o is population in the base year, r is estimated annual growth rate of population, and n is time lapse in years.

- II. Sex Ratio = $\frac{\text{Number of males}}{\text{Number of females}} \times 100$

Number of females

- III. Dependency Ratio = $\frac{\text{Population aged 0-14years} + \text{65years and above}}{\text{Population aged 15-64years}} \times 100$

Population aged 15-64years

- **Stakeholder Analysis and Mapping:** Identification of project-affected persons (PAPs) and institutions with varying levels of influence and interest.
- **Impact Assessment Framework:** Rating and categorizing impacts using significance, reversibility, and duration criteria.

4.9.4 Social Area of Influence (SAI)

A ‘social area of influence’ consists of the people potentially impacted by a project. Affected peoples include both ‘communities of place’ and ‘communities of interest’. The location of affected people frequently does not neatly align with the geographic boundaries or the area of influence determined by the environmental impact of a project. In fact, often the buffer zones determined by technical experts are inadequate. Furthermore, downstream water users are often not considered in assessment of impacted peoples. It is worth noting that social impacts do not necessarily decrease in intensity with distance from the project site. People are connected by a vast array of linkages and networks. Projects also can often have a wide logistics corridor and complex value chains (with backwards and forwards linkages). Defining a ‘social area of influence’ does not necessarily require the articulation of a geographic boundary. Instead, the social extent of the project can be determined through a combination of stakeholder analysis and social mapping, and through an iterative process of understanding the social, economic, political and environmental changes induced by the project and the livelihoods and networks of potentially impacted people (Vanclay et.al 2015)

Ipuole Okuku the direct host community to the project have been identified as being directly affected by the proposed project (Figure 4.17). The average distance of human settlements to perimeter fence of the proposed project site is, while the project site covers 37.8 hectares of land. Land use within 5 km² radius of the ATC project site is within Ipuole Okuku community. This community, together with the physical footprint of the project will hereafter be referred to as the “**Area of Influence**” or “**Host Community**” for the ATC project. However, the social area of influence for the project extends beyond the above boundary.

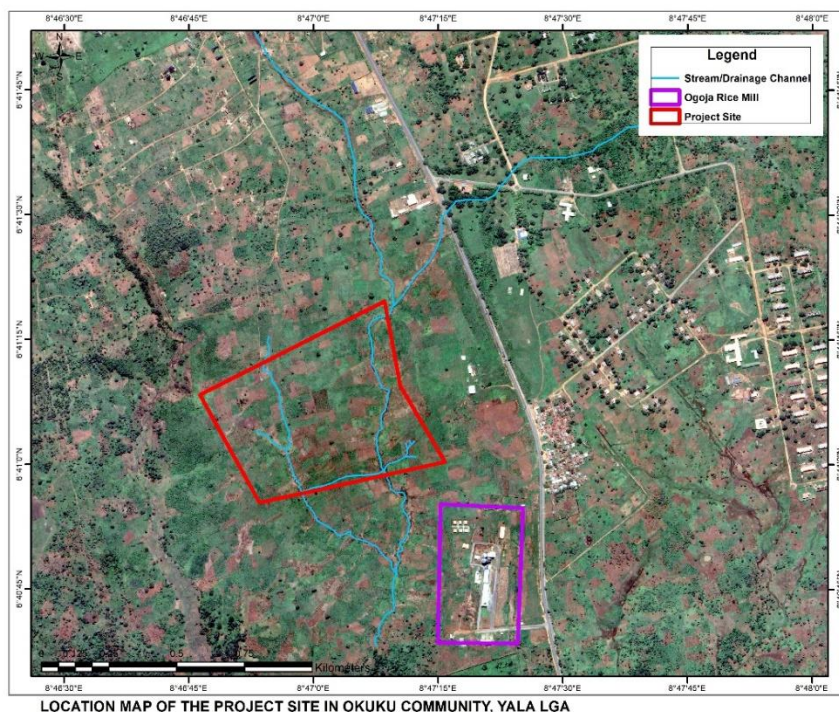


Figure 4.17: Map showing the project community and the project site

4.9.5 Scope of the Study

The proposed project will directly involve one community – Ipuole Okuku in Yala LGA of Cross River State. The socio-economic impact studies were focused on this community.

4.9.6 Stakeholder Consultations and Integration in the Study

Major development projects proposals have the potential to impact the socio-economic environment in several ways within and outside the project's immediate environment. Impacts could arise from perceptions of benefits, loss of assets, changes in income levels, among others. The proposed ATC project would potentially impact individuals, families and communities in the project area. Impacts would vary with different phases of the project from mobilization through construction, commissioning, operations and decommissioning. The impacts could be beneficial, adverse, negligible, significant, short term or permanent. In consideration of these impacts, it was necessary to ensure participation and integration of various stakeholders including the local populace (community residents), non-governmental organizations, public agencies, security agencies, professional bodies, government regulators and the academia in the environmental and social studies. The integration and participation were aimed at public consultation and disclosure, data gathering and involvement of stakeholders in identifying associated and potential impacts and developing acceptable mitigation and enhancement measures. This process helped to secure a **Social License to Operate** in the communities and ensure sustainability in the proposed ATC project.

The stakeholder engagement and consultation exercises involved:

- i. Consultation with the Yala LGA chairman, Councilors, and Ipuole community leaders at Sanctus Hotels, Okuku, Yala LGA on the 26th of June, 2025.
- ii. A consultation, FGD, KII etc. meetings were held with the Ipuole community leaders, youth and women leaders on the 27th of June, 2025 at Sanctus Hotels, Okuku, Yala LGA.
- iii. Participatory data gathering using household Questionnaire administration, FGDs, and KIIs were also conducted simultaneously with Project Affected Persons (PAPs) and assets enumeration for Resettlement Action Plan (RAP) and Livelihood Restoration and Enhancement Plan (LREP) development for the project on the 27th and 28th June, 2025. The consultation meetings were useful in eliciting stakeholders' perceptions, concerns and expectations from the proposed project, Plate 4.7 and Plate 4.8. Consultation and engagement activities are continuous to provide useful feedback to ensure community integration and sustainable development during all phases of the project. Minutes of the different engagements are provided below, while attendance lists for the meetings are attached in Appendix 4.3.
- iv. Field consultations and engagements were also carried out with community groups, owners of assets on and around the proposed project site. The engagements provided information about stakeholders' perceptions, concerns and expectations, and preferred mitigation measures to the identified potential impacts.
- v. A Scoping and Stakeholders' Engagement Workshop was held on the 17th of June, 2025 at HOGIS Hotel, State Housing Estate, Calabar, Cross River State. The workshop was attended by the communities' leaders, residents, members of the public, the project proponent (CR-SAPZ), security agencies (including the Nigerian Navy, Department of State Security (DSS), Nigeria Security and Civil Defence Corps (NSCDC), Nigeria Police (NP), Nigeria Customs Service (NCS), regulators (Federal Ministry of Environment, NESREA), etc and the academia (Plate 4.8).

At the workshop an overview of the proposed project and its potential impacts was presented, and stakeholders' perceptions, concerns and suggested mitigation measures were discussed.

Table 4.18: Participants and Discussions at the Stakeholders' Engagements

Date	Participants	Type of Engagement	Issues Discussed and Comments
26/06/25	Yala LGA chairman, Councilors, and Ipuole community leaders at Sanctus Hotels, Okuku, Yala LGA on the 26 th of June, 2025.	Consultation/Briefing meeting on the proposed ATC project and the ESIA of the project.	Consultation and briefing of Yala LGA chairman, Councilors, and Ipuole community leaders at Sanctus Hotel, Okuku, Yala LGA on the ATC project/ESIA by the E&S Team Lead, Dr. Bassey Uzodinma. After the opening prayers for the meeting and the introduction of the leaders of the communities and the ESIA team, Dr. Bassey Uzodinma informed the community leaders that the ESIA team was commissioned and sent by the CRS government through the CR-SAPZ programme to carry out an

Date	Participants	Type of Engagement	Issues Discussed and Comments
			ESIA of the proposed ATC project to ensure the environmental and social sustainability of the project. He informed them that the coming of the ESIA team was a preliminary and consultation meeting with the LGA Chairman, Councilors and elders of the community to inform them about the project and the ESIA in the communities to obtain their permission and obtain their social licence to operate, before starting the ESIA activities in the communities. In his response, the Chairman, Yala LGA Dr. Fred Okem welcomed the team to Yala LG and appreciated the President Bola Tinubu, The Ministers of Agriculture and Environment, the Governor of Cross River State for siting the ATC in Yala LGA. He expressed his full support and that of his administration for the project. He informed the team that Yala people were a very friendly and hospitable people and apologized for the incident that took place when the team came the first time. He introduced Chief Ogbuole, an Ipuole Okuku community leader as the community team lead to work with ESIA. In his response Chief Ogbuole welcomed the ESIA team and apologized for the harassment and attack the team experienced the first time they came to the community. He informed the team that their action was prompted by the large number of hectares of land in different locations in the community that have been taken by various governments in the past in the name of projects development. Some these large parcels of land were fenced and later abandoned and the land cannot be used by the people for their farming activities, while some of the projects which were started remain uncompleted till today bringing no benefits to the people. He expressed the hope that the proposed ATC project will not suffer same fate. He said that they accepted and whole heartedly supported the project as it is going to bring benefits to the community. He promised to work with and assist the team to its work successfully.

Date	Participants	Type of Engagement	Issues Discussed and Comments
27/06/25	Community leaders, youth, women leaders, fisherfolks and community members	Focused Group Discussions FGD), Key Informant Interviews (KII), Questionnaire surveys, Community Walk and Participatory Rural Appraisal (PRA) for ground truthing by the SIA team	Focused Group Discussions FGD), Key Informant Interviews (KII), Questionnaire surveys, Community Walk and Participatory Rural Appraisal (PRA) for ground truthing by the SIA team. FGD and KII were held with leaders of Ipuole Okuku village at the Sanctus hotel where the people were briefed about the ATC project and the ESIA. The people welcomed the project and indicated their support for the project as they expected the project to bring many benefits to the communities. However, they voiced their concerns about possible marginalization of their people in employment, inadequacy of the quantum of compensation, delay in payment of compensation and the fear of abandonment of the project as experienced with many projects in the past in the communities etc. The team lead for the Social Impact Assessment (SIA) Dr. Malachi Abasiiodiong assured them that the ATC project will be a completed, successful, functional and sustainable project for the benefit of the community, LGA, the State and the nation at large. Household questionnaires were administered to heads of households in the community and relevant baseline data and information were obtained for the SIA.
17/06/25	Community Leaders and Representatives Ipuole Okuku, Public, Regulators, Representatives Cross River State Government Ministries, Professional Associations, Security Services and the Academia	Scoping and Stakeholder Engagement workshop	Presentation of the proposed project and the ESIA studies. Proposed project design, scope and potential impacts. Regulatory requirements (Federal and Cross River State Governments). Traffic and Security, Perceptions, concerns, expectations, potential impacts, mitigation and enhancement measures.

Source: Field Work, 2025



Plate 4.6: Consultation Meeting with the Chairman, Yala LGA, Councilors, Ipuole Okuku



Plate 4.7: Consultation meeting on 27.06.2025 at Sanctus Hotel, Okuku with Ipuole Okuku community elders, youth and women leaders (left); FGD with community elders, youth and women leaders (Middle left); FGD with community women (Middle right); and Key Informant



Plate 4.8: Cross sections of participants at stakeholders engagement / scoping workshops (top left), the FMEnv. Rep making addressing the workshop, surrounded by the Clan Head of Okuku, the Chairman of Yala

LGA and a rep of Clan Head of Adiabo (top middle), and top right, reps of the Nigerian Navy, NSCDC, Customs, among other participants

4.9.7 Background of the Study Area - Yala LGA

4.9.7.1 Historical and Geographical Background

Yala LGA was formerly a part of the old Ogoja Division of Cross River State, but became a full-fledged LGA on 27 August 1989. It is now part of Cross River State's Northern Senatorial District, with headquarters in Okpoma. Yala has an area of 1,739 km². It is bordered by Benue and Ebonyi States to the north/west, and Cross River LGAs (Obubra, Ikom, Ogoja, Bekwarra) on east and south.

4.9.7.2 Political and Governance Structures

The political system in Yala LGA follows the Nigerian local government framework, which is democratic and tiered under the 1999 Constitution (as amended). It consists of elected and appointed officials responsible for lawmaking, executive functions, and community representation. Local governments in Nigeria have the executive and legislative arms. The Executive arm is headed by the Executive Chairman supported by Supervisory Councilors appointed by the Executive Chairman. The legislative arm is made up of elected councilors from all the wards in the LGA. Yala LGA is made up of 10 wards namely Okuku, Okpoma, Ekajuk I/II, Mbube I/II, Nkum Ibor, Nkum Irede, Urban I/II. He current Executive Chairman is Dr. Fred Okem. The tenure of the elected officers is 3 years.

4.9.7.3 History, Governance and Administrative Structures

History of Okuku Clan and Ipuole Village

Okuku is a long-standing community inhabited by the people of Yala tribe. Okuku is a clan, while Ipuole Okuku is a village within Okuku clan. The Okuku people celebrated their 300-year anniversary in 2007 dating the origin of the community back to 1707. The Okuku people migrated from Kwarafa region in present day Taraba state and then moved to Idoma Basin valley in present day Benue State. Finally, they migrated to and settled down in Okuku land in Yala LGA of Cross River State. They speak Yala language.

Leadership and Governance in Okuku Land

Okuku is ruled based on kingdoms and chiefdoms. There are 17 villages in Okuku clan with the headquarters in Ipuole Okuku. The overall King of Okuku clan is called His Royal Highness Ogamode of Okuku. Each village has a village head. The immediate past Ogamode was ostracised and dethroned about 2 years ago. The current Ogamode's name is Adamoglagu and has been on the throne for about 2 years now. The palace of the king is built by the community and every adult male in the village will cut a living stick to plant at a site and this establishes the site as the ground for the king's palace and the acceptance and support of the new king. To dethrone the King (Ogamode), the people will also go and breakdown the fence or cut down the living fence of the palace as a sign of rejection of the king and loss of the support and allegiance of the people. Okuku community is 100% patrilineal and a woman cannot become a chief, but can only be appointed as a woman leader in the community.

Governance and Administrative Structure in Ipuole Okuku

The governance structure and hierarchy in Ipuole Okuku is made up of the following in that order:

1. The Ogamode (Clan/Village head)
2. Adamoglagu (2nd in command)
3. Ogbuole (Custodian of the king)
4. Oduma (The King's Barber)
5. Adamede (Information minister)
6. Oduole Ogrinya (Chief of Defence staff)

The above make up the village council with Ogamode as the head of the council. They appoint other people to work with them example secretary, treasurer etc. They can also setup committees e.g lands allocation to work and report back to them. There is age grade system in the community with interval of 5 years between age grades. The 16-age grade supports community development and serve as the community watch dog. There is also the Youth council – Ipuole Okuku youth council but there is no women council in the community. Women issues are resolved by the youth council and elders.

Role of the Youths in the Community

The youths are made up of males and females in their 20s and 30s and they are traditionally responsible for ensuring internal and external security, enforcing and maintaining law and order, and mobilization for community sanitation. They exert their influence and play their roles through their youth organization – Ipuole Okuku youth council.

Role of Women in the Communities

Traditionally, the communities recognize important roles played by women in the family and society, including supportive roles in traditional administration, social mobilization, and initiation and ownership of developmental projects and programmes. They are also important in attending to welfare needs and conflict management, especially as this concern their members. The women contribute to household income as they work and invest in livelihood activities. They are key in the upbringing of children and community development. Ipuole Okuku is strictly a patrilineal society governed and administrated by men only. As a result, a woman cannot be a chief and there is no women council in the community. A woman can only be appointed as a woman leader. Women issues are resolved by the youth council and elders.

4.9.8 Social Organizations and Support Systems

4.9.8.1 Social Structure and Organization in Ipuole Okuku

Social institutions across the communities comprise families (nuclear and extended) and Community Based Organizations (CBOs). Nuclear and extended families are very basic and important in each of the communities; they confer social identity. Traditionally, nuclear families are single units with a father as the head while each extended family comprises several nuclear families that identify with a

common ancestor who would have lived several generations in the past. The extended family is always headed by a male. Every indigenous resident would traditionally identify with a nuclear and an extended family in the community of residence. The community operates an age grade social organizational system which is one of the major CBOs in the community. The CBOs play specific roles and while membership of some is exclusive, membership of some others is not. For instance, the Women's Groups are exclusive to women either born or married into the community, while the Youth Groups are unisex. There are unisex social groups with membership from indigenous and non-indigenous residents.

4.9.8.2 Socio-Cultural Organisations in Ipuole Okuku Village

Ipuole Okuku operates an age grade system for the community's socio-cultural organisation and administration. There are many age grades for both men and women in the community and come with different names. They perform different social functions for the support and development of their members and the community at large. They serve as social safety nets for their members. These age grades include the following:

1. Peace age grade
2. Emoma
3. Ebimugu
4. Odidoma
5. Ayigamode
6. Odumode
7. Ogbodu
8. Nepa
9. Election
10. Udoji
11. Naira
12. Apollo
13. Jet
14. Elouka
15. Ghana
16. Eminyor
17. Kolta
18. Cinema

Other social organizations in the community apart from the age grades are – Yala Progressive Union (YPU), Women of Likeminds (Oyimotu) for women etc.

4.9.9 Cultural Groups and Cultural Festivals Ipuole Okuku village

There are many cultural societies and groups with their various functions and cultural activities in Ipuole Okuku village namely:

4.9.9.1 Cultural groups

1. Akataka dance for both men and women
2. Ekpatura dance group
3. Worhi dance group for both men and women
4. Ogene dance group
5. Ayita dance group
6. Abakpa dance group
7. Ogrinya dance group
8. Worchia dance group

The Ogrinya dance group is restricted to members only who have been initiated into the group. None members are not permitted to come out when Ogrinya group comes out to display.

4.9.9.2 Festivals in the Community

The major cultural festival in the community is the Yala LGA wide New Yam Festival held every 31st day of August every year.

4.9.10 Ethnic Composition of the Study Area

The communities have a combination of indigenous and non-indigenous residents. Indigenous residents are the Yalas who form the dominant population of the area. There are other residents from various ethnic groups residing in Bekwara, Yache, Igede, Obudu, Efiks, Annangs, Ibibios, Ibos, Yorubas, Hausas among others. The communities do not have any known socio-cultural practices that limit or forbid interactions between residents of different ethnic backgrounds and religious orientations. Ethnic and religious tensions between community members and workers on the proposed project are therefore not expected.

4.9.11 Cultural Heritage

Cultural heritage and resources encompass the tangible and intangible assets of a society or culture that are preserved and passed down through generations. These include physical artifacts like buildings and monuments, as well as intangible elements like traditions, knowledge, and languages. They represent a society's history, identity, and values, and are important for understanding and preserving cultural continuity.

The cultural heritage of the study communities is linked to language, dress and food, festivals and dances. The communities have various similarities in the way they dress, foods they eat and ways they conduct their marriages. Indigenous languages spoken in the communities are some of their cultural heritages. Among all the communities, land is considered a major socio-cultural asset and a heritage that must be bequeathed to succeeding generations. The communities have deities, shrines and sacred places which they have maintained. These deities, shrines, sacred places and traditional

worship are important aspects of the people's cultural heritage. The proposed project is not expected to impact any cultural heritage sites in the community including shrines, grooves, graves and community play grounds where cultural activities are staged as the project site is currently used for farming.

4.9.12 Language and Communication

Yala is the dominant native language spoken in the village. Other indigenous languages spoken in area are Bekwara, Yache, Igede, Obudu, Efik, Annang, Ibibio, Igbo, Yoruba, Hausa etc. Apart from the indigenous languages, more than 50% of residents are able to communicate in English language and Pidgin English.

4.9.13 Gender Issues

Women in Nigeria generally have not had equal access to education, communal decision making, investments and work opportunities with men. There is no constitutional provision barring them, but there are several socio-cultural practices in different communities that do not afford women as much opportunities as men. Their primary role in traditional administration is advisory. Women are also not entrusted with management of family lands which are major socio-cultural assets in the communities. These are cultural inhibitions and indications of gender bias and inequality. It has been noted that socio-cultural and economic factors including lack of funds, lack of interaction with women focused development agencies; domestic violence and cultural discrimination are factors that inhibit women from undertaking certain tasks which have resulted in women performing less than their abilities. Ipuole village is a patrilineal society and strictly deny women opportunities in the leadership, administration and decision- making in the community.

4.9.14 Taboos/Norms

The Okuku community maintains a rich traditional belief system that governs socio-cultural conduct. The following deities and taboos are recognized within the project's area of influence:

- i. Alege Shrine: Located near the southern boundary of Okuku, revered as the guardian deity of harvest and fertility. Rituals are performed annually before the yam festival.
- ii. Ekpe Spirit Grove: A sacred grove along the Okuku stream, traditionally used for purification rites. It is a no-go area for construction or material excavation.
- iii. Burial and Ancestral Sites: Scattered across old family compounds; disturbance is prohibited without community consent.
- iv. Cultural Taboos:
 - Fishing in certain stream segments during the planting season is forbidden.
 - Women in menstruation are not permitted to approach the Alege Shrine area.
 - Women are not allowed to enter boat
 - Killing or harming of pythons ("Ejura") is strictly forbidden, as they are considered sacred messengers of ancestors.

All identified sacred sites have been mapped, and the project layout avoids any interference with these no-go areas. In cases where avoidance is impossible, mitigation will include traditional consultations and rituals as agreed with community elders.

4.9.15 Dispute Resolution

Family disputes are resolved by the family head which is the father of the house; youth disputes are settled by the youth leader, and women disputes by the women leader. In instances where these disputes cannot be settled by these various leaders, the case is always forwarded to the community head, who will then sit with his cabinet members to resolve the case. In situations where the family heads are unable to resolve the dispute, they forward the case to the village Head. Where the matter is not still resolved at this level, it is taken to the council of chiefs and finally to the clan council if the council of chiefs cannot handle the case satisfactorily.

4.9.16 Marriage and Family

The marriage institution is revered. Marriages are contracted between adult males and adult females. There are no known instances of same sex marriages within the area. Monogamy is mainly practiced. The family is a very important social unit in the community and the concepts of nuclear and extended families exist. The typical nuclear family is headed by a father with other members including the mother and the children. The extended family includes members who share common ancestors. Marriage before the age of 20 is common especially for the female gender. Marriage payments/dowries are made to the prospective bride's parents. The marriage payment is shared among the bride's kin, with the father keeping the largest share. The marriage payment traditionally had to be completed before the marriage could be consummated.

4.9.17 Sexual Orientation

The LGBTQ population in Nigeria exists within a challenging legal and socio-cultural environment. The **Same-Sex Marriage (Prohibition) Act (2013)** criminalizes same-sex unions and restricts the public expression and organization of LGBTQ individuals. Violations of this law can attract prison terms of up to 14 years. These legal frameworks are reinforced by prevailing religious and cultural norms, particularly in Cross River State, where traditional beliefs and Christian doctrines dominate. As a result, many LGBTQ persons in the study community and surrounding areas may remain invisible or closeted due to fear of discrimination, persecution, or violence. This legal and societal context limits their ability to participate openly in consultations or benefit equitably from development initiatives.

4.9.18 Mitigation and Inclusion Strategies for Vulnerable Groups

To safeguard the rights and dignity of all vulnerable persons, the following strategies are recommended:

4.9.18.1 Non-Discrimination Policies

The project should incorporate a non-discrimination clause in all Human Resources policies for contractors and partners. This should explicitly prohibit discrimination based on sexual orientation, gender identity, or expression, in line with **AfDB's Operational Safeguards** and **UN Guiding Principles on Business and Human Rights**.

4.9.18.2 Confidential and Safe Grievance Mechanism

The grievance redress mechanism (GRM) should allow anonymous reporting and ensure privacy to protect vulnerable persons and people at risk of social reprisal.

4.9.18.3 Inclusive Communication and Training

Training for project staff, security personnel, and contractors should include modules on human rights, respect for diversity, and prevention of workplace harassment and abuse.

4.9.18.4 Access to Services Without Discrimination

Any community benefits such as health services, microenterprise support, or social investments should be accessible to all residents, regardless of perceived identity.

4.9.18.5 Monitoring and Safeguards

The project's monitoring and evaluation (M&E) framework should track inclusion indicators and flag any reports of exclusion or abuse, including against hidden or vulnerable groups.

4.9.18.6 Limitations and Ethical Considerations

Given the socio-legal context in Nigeria, it is neither ethical nor safe to require the identification or public participation of LGBTQ persons in SIA consultations. Instead, the approach relies on general principles of human rights, anonymity, and safe inclusion practices based on global standards.

4.9.19 Religious Practices and Belief Systems

Among residents of the study community are those who identify as Christians, worshippers of traditional deities and Muslims. Christianity is the major religious belief of 99% of the people in the community and there are many Christian worship centres of various denominations in the community viz: Qua Iboe church, Assemblies of God, Sure Foundation, Faith Tabernacle, Mount Zion Lighthouse, Mount Horeb, Faith and Works etc (Plate 4.9). There are no known communal restrictions on religious beliefs and practice. Residents are at liberty to pursue their religious interests.



The Apostolic Church, Ipuole Okuku

St. Joseph's Catholic Church, Ipuole Okuku

Plate 4.9: Showing Different Church Denominations in Ipuole Village

4.9.20 Archeological Heritage and Resources

Archaeological heritage and resources encompass the material remains of past human activity, including sites, objects, and landscapes that hold historical, cultural, and scientific significance. These resources provide valuable insights into the lives, cultures, and histories of past societies. In Ipuole Okuku village, the people did not report of the existence of any known archeological artefacts or sites in the village. However, they reported of the existence of shrines and sacred groves such as Unuoji sacred grove – a burial ground for chiefs and Ublecho shrine which is at the meeting point of or natural boundary for our 2 communities - Ugaga and Okuku community. Ublecho is reported to be controlling deity of Ipuole village.

4.9.21 Social vices

Consumption of spirits and alcoholic beverages including beers, local gin and palm wine, at cultural and social functions and in private entertainment is common among male and female adult residents. The communities have shops and drinking bars that sell alcoholic beverages without age restrictions. In addition, some residents take concoctions of roots, barks and leaves of plants and trees soaked in local gin (kaikai, ogogoro) for their perceived medicinal value. The elders of the village reported that there were no incidences of armed robbery, drug abuse, alcoholism, rape in the village and that the community does not accept these vices. They indicated that there are no written policies or regulations on these, but unwritten, known and understood by all. There is very severe punishment for anyone who breaks this unwritten law. Such a person will be ostracized from the community.

While the implementation of the ATC project is expected to stimulate economic growth, the influx of construction workers and increased cash flow could temporarily aggravate social vices such as prostitution, theft, and gender-based violence (GBV), if not properly managed.

To mitigate these risks, the following preventive measures will be implemented:

- i. Enforcement of a Workers' Code of Conduct, prohibiting harassment, substance abuse, and violence.
- ii. Mandatory GBV and HIV/AIDS awareness programs for all site workers.
- iii. Community policing and joint security arrangements between local leaders, project security, and the police.
- iv. Local hiring policy to reduce community-worker conflicts and limit influx of outsiders.
- v. Establishment of a Grievance Redress Mechanism (GRM) for early reporting and resolution of social conflicts.

With these controls in place, the project will not significantly aggravate existing social vices but rather contribute to their gradual reduction through improved livelihoods and community engagement.

4.9.22 Demographic Characteristics of the Study Area

Population Size of the Study Area

Nigeria has conducted five national censuses between 1952/53 and 2006. The results from four of the censuses including 2006 were accepted and published. Following 2006 national census, the National Population Commission (NPC), published population figures at national, state and local government levels and did not publish figures of individual communities in the LGAs.

Population Growth

Demographic processes of fertility, mortality and migration determine population growth, and following their interplay the NPC had estimated the annual population growth rate across Nigeria at 2.5% (NPC 2022)

Fertility Rate:

Total Fertility Rate (TFR) refers to the average number of children that would be born alive to a woman (or a group of women) during her lifetime if she were to pass through all her childbearing years conforming to the age-specific fertility rates of a given year. The average number of children a woman would have by the end of her childbearing years if she bore children at the current age-specific fertility rates. If fertility were to remain constant at current levels, a woman in Nigeria would bear an average of 4.8 children in her lifetime. Fertility is much higher in rural areas than in urban areas. On average, women in rural areas give birth to 5.6 children over their lifetime, while urban women give birth to 3.9 children in their lifetime. The TFR in Nigeria has declined consistently over time, from 6.3 children per woman in the 2008 NDHS to 4.8 children per woman in the 2023–24 NDHS, (FMOHSW, NPC, IFC et.al, 2024). The Total Fertility Rate (TFR) for Cross River State was 3.26 in 2022 ((NBS Demographic Statistics Bulletin 2022). This shows a steady decline from 4.74 in 2015 to 3.26 in 2022.

Migration

Migration is induced by socioeconomics, environmental and political factors, and it impacts various development areas at the macro and micro levels (Annual Abstract of Statistics Vol. 1, 2016). The general migration pattern in Nigeria is a rural to urban movement of the population. The study area, Ipuole Okuku being the host community to the ATC will attract many migrants seeking work in the ATC.

Life Expectancy

Life expectancy at birth is an indication of the number of years an average member of the population would live, at the time of their birth. The World Health Organization (W.H.O.) estimates life expectancy at birth in Nigeria for males at 61years and 64years for females (W.H.O. Nigeria Country

Profile, 2021). This is a significant improvement over 2016 estimates which were 53years for males and 55years for females. The 2016 report had indicated that the probability of dying between 15 years and 60 years was 372 per 1000 for males and 333 per 1000 for females (W.H.O. Nigeria Country Profile, 2016). The National Population Commission (NPC) (2022) data shows that life expectancy at birth in Nigeria increased from 2006 to 2022, with both males and females experiencing an increase. Specifically, male life expectancy at birth grew from 48.9 years in 2006 to 55.1 years in 2022, while female life expectancy increased from 50.58 years in 2006 to 57.2 years in 2022. The National Population Commission (NPC) male and female life expectancy at birth projection for Cross River State for year 2022 are 59.6 for males and 65.4 for females. (NPC,2022). Females have historically had a higher life expectancy at birth than males in Nigeria.

The proposed project is expected to impact population growth in the study communities because of influx of project workers job seekers and new businesses that would seek to tap into the opportunities created by the project.

Table 4.19: Projected Populations of Yala LGA, 2025 - 2028.

Community/LGA	Year/Population (Census Figures and Projections)				
	2006 census	2025	2026	2027	2028
Yala LGA	211,557	345,620	354,599	363,766	373,127

Source: NPC Priority Table Vol. IV, 2010 and Field Work, 2025.

Table 4.19 shows population projections for Yala LGA for 2025 – 2028, while Table 4.20 highlights the demographic projections in 2025. These projections were made using average annual growth rate for Cross River rural areas (2.4–2.8%), and midline growth of 2.6% over 19 years for 2025 using the NPC base year 2006 census figure of 211,557 for Yala LGA.

Table 4.20: Projected Demographics for Yala LGA and Ipuole Okuku Village (2025)

Age Group	Population	Percentage
0-14	146,389	42.5%
15-64	185,241	53.6%
65+	13,990	3.9%
Total	345,620	

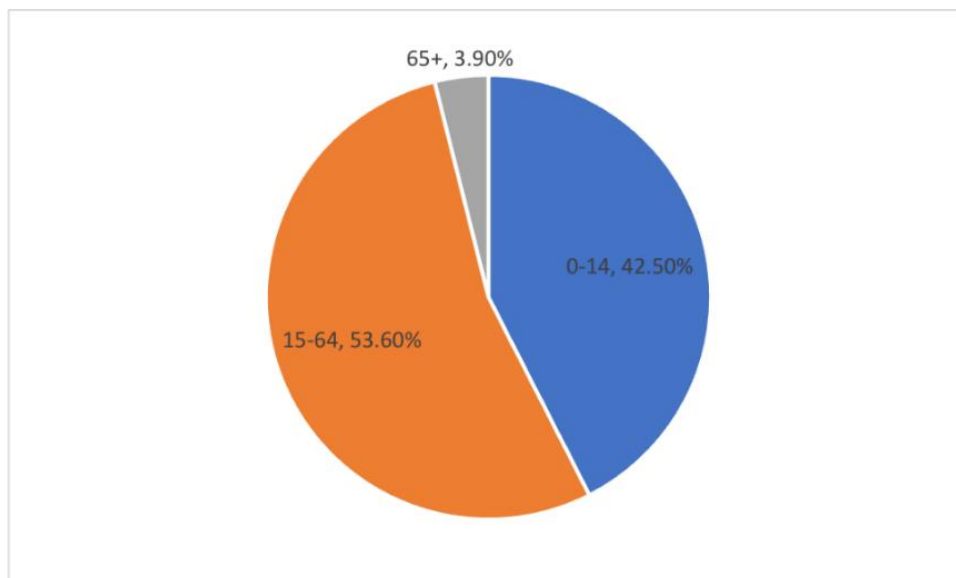


Figure 4.18: Projected Demographics for Yala LGA and Ipuole Okuku Village (2025)

Source: Field Work (2025)

Figure 4.18 shows that **Children (0–14)** make up **42.5% (4 in 10)** of the population, reflecting a **young population structure**, the **working-age population (15–64)** make up **53.6%** is the majority, suggesting a potential for economic productivity — if employment and educational opportunities are available, while the **Elderly (65+)** form a small segment **3.9%**, indicating a relatively **low aging burden** for now. This distribution is an indication of a high **youth dependency burden** and the need for investment in education, child health, and job creation in the LGA.

Figure 4.19 shows the population pyramid for Yala LGA. The population pyramid presents a gendered age structure using synthetic male/female splits. Each bar shows the number of people in an age cohort, separated by sex. The structure shows:

- **A wide base for the (0–14 age groups):** this indicates high birth rates and youthful population — a classic feature of rural areas in Nigeria and developing regions. The high proportion of children implies future population growth even if fertility rates decline. The large youth base points to rising demand for schools, teachers, child services, maternal, child, and adolescent health programmes.
- **A gradual narrowing for the Middle Ages (15–44age group)** which suggests a steady but moderate growth in working-age adults and possible high youth unemployment if job opportunities are scarce. This indicates the urgent need for economic diversification and skill-based training
- **Small elderly segment (65+):** The top of the pyramid is narrow, showing **low life expectancy** or a younger population.

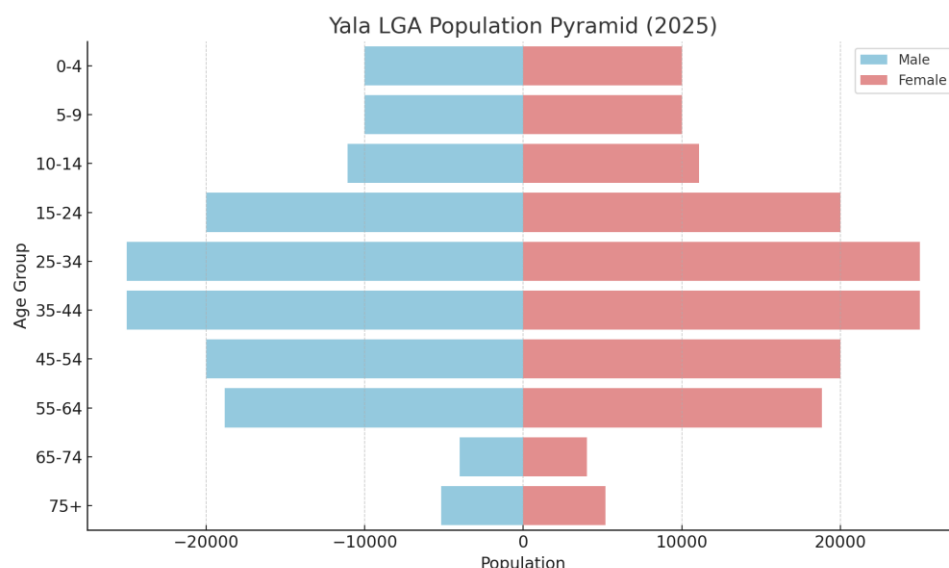


Figure 4.19: 4.40 Population Pyramid for Yala LGA (2025 projection)

Source: Field Work (2025)

Table 4.21: Age Distribution projections for Ipuole Okuku Village for 2025

Age Group	Population	Percentage
0-14	1,761	42.5%
15-64	2,222	53.6%
65+	162	3.9%

Table 4.21 showing the age distribution projections for Ipuole Okuku Village for 2025. Total Population: **4,147** (Estimated at **1.2%** of Yala LGA population)

The chart Figure 4.20 shows that the youth population (0–14) comprises 42.5% (nearly 2 out of every 5 people), indicating high birth rates and a youthful community, the working-age group (15–64) makes up the bulk (53.6%) of the population, suggesting potential for labor-driven development, while the elderly (65+) form a very small fraction (3.9%) of the population, which is typical for rural Nigerian communities with lower life expectancy. This pattern aligns closely with rural demographics in Sub-Saharan Africa — youthful, dependent, and under pressure to transition into a more productive age structure.

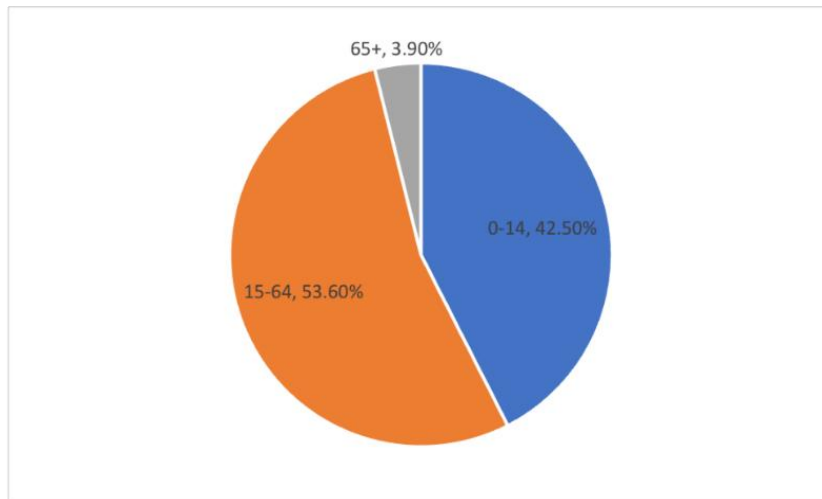


Figure 4.20: Projected age group distribution for 2025 in Ipuole Okuku village.
Source: Field Work (2025)

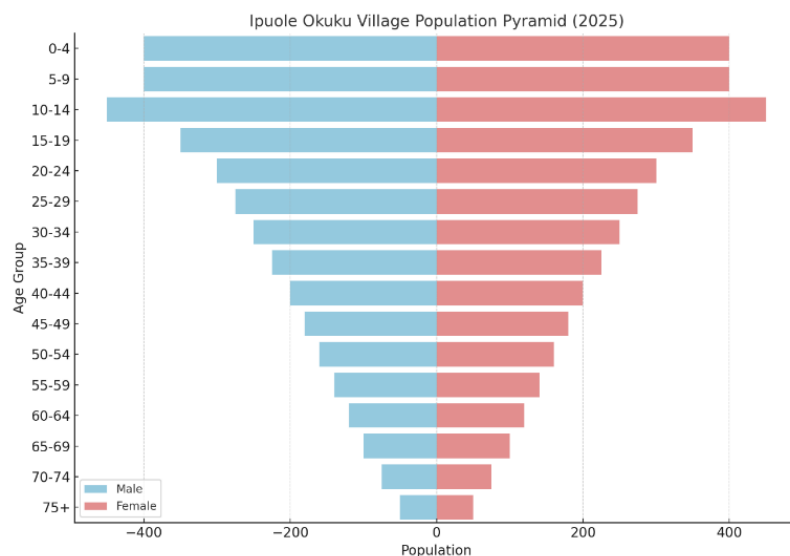


Figure 4.21: Population Pyramid of Ipuole Okuku Village (Based on 2025 population projection)
Source: Field Work (2025)

Figure 4.21 shows the population pyramid of Ipuole Okuku village based on 2025 population projection for the village. A visual analysis of the pyramid shows a Wide base for the (0–14 age group) and this reflects a high fertility rate, typical of rural agrarian societies; a moderate bulge in young adults (15–34) which suggests a growing segment of economically active youth, many likely to be engaged in farming, informal work, or preparing to migrate to urban areas for opportunities, a gradual tapering for the (35–64) age bracket, which indicates declining numbers in older age brackets

due to limited access to healthcare and aging support systems. Narrow top of (65+) age group – (smaller elderly population). This is indicative of **limited** life expectancy and minimal aging burden at the present. The structure also shows near-equal gender distribution, no major gender imbalances, indicating relatively stable gender demographics.

The Ipuole Okuku population pyramid is broad-based, characteristic of a young and growing rural community. If well-managed, the large working-age population can become a demographic dividend rather than a burden. Strategic investment in human capital (education, health, jobs) will be essential to unlocking that potential.

4.9.22.1 Dependency Ratio

The dependency ratio is a demographic measure that compares the population of dependents (those not in the labor force) - children (0–14) and the elderly (65+) to the working-age (15–64) population. It reflects the economic burden on the productive population. Projection based on NPC 2006 census figure of 211,557 and 2.6% annual growth rate for Yala LGA and 1.2% of Yala LGA population for Ipuole Okuku village population.

Table 4.22: 2025 Projected Dependency Ratio for Yala LGA and Ipuole Okuku Village

Area	Total Population (2025)	0–14 Years (%)	15–64 Years (%)	65+ Years (%)	Dependency Ratio
Yala LGA	345,620	42.5% (146,389)	53.6% (185,241)	3.9% (13,990)	86.5
Ipuole Okuku Village	4,147	42.5% (1,761)	53.6% (2,222)	3.9% (162)	86.3

Source: Field Work (2025)

Table 4.22 presents the calculated dependency ratios for Yala LGA and Ipuole Okuku Village based on 2025 projected population data of Yala LGA. The dependency ratio measures the number of dependents (children under 15 and adults over 64) per 100 working-age individuals (15–64 years), providing insight into the socio-economic burden on the productive population. The table shows a dependency ratio of Yala LGA **86.5**:86.3 for Ipuole Okuku village. This means that for every 100 working-age people, there are 86 dependents in the LGA and 86 dependents in Ipuole Okuku village. This means every household with 2 working adults is likely supporting nearly 2 dependents. This indicates a moderately high burden typical of rural Nigerian LGAs. The higher ratios imply that more resources are committed to the care of children and the elderly in households in the LGA and communities. Youthful populations have reduced labour input and income per capita and high dependency ratios. These are characteristic of underdeveloped economies (UNDP, 2006).

4.9.22.2 Implications of the high dependency Ratio

High youth dependency:

This indicates a strong need for expanded education services (teachers, facilities, materials), primary healthcare access (especially maternal and child) and food and nutrition programs.

Modest elderly population:

This suggests that elderly support though not yet burdensome, the support systems should be proactive with future planning for health insurance, elderly support, and pensions.

Labour force support:

High ratio suggests adult workforce must be **economically productive** and the need for job creation in agriculture, informal trade and apprenticeships.

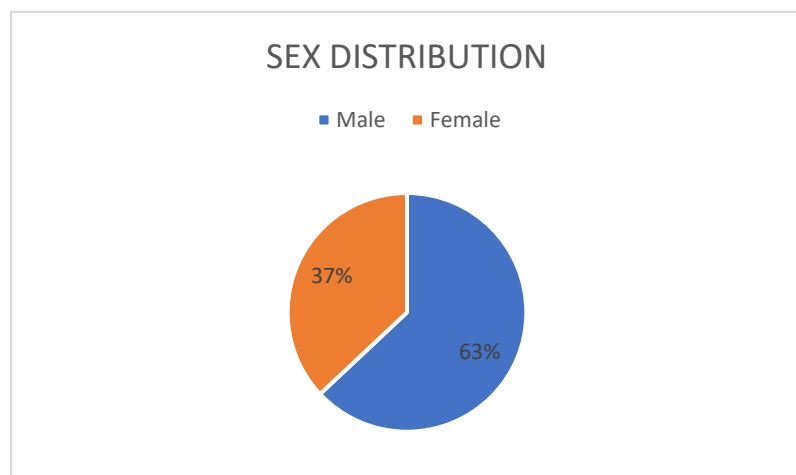


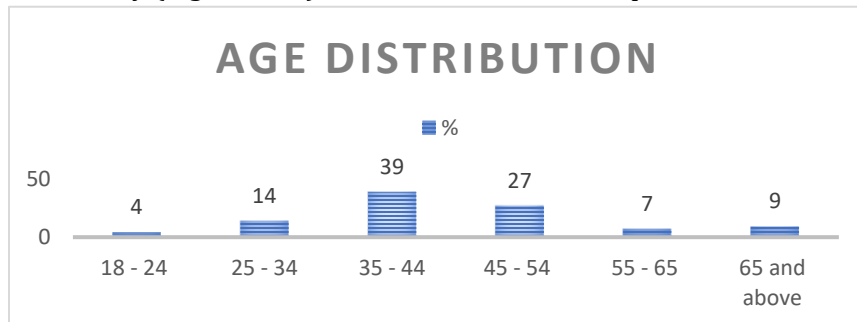
Figure 4.22: Sex Distribution of Respondents in the Study Community

Source: Field Work 2025

The result of the survey (Figure 4.22) shows that 63% of the respondents were males and 37% were females. This is in contrast to what obtains in many rural communities in south-south region of Nigeria where female populations are always higher than that of males. This may be attributed to the apparently low level of awareness creation and mobilization by the community before the survey, coupled with the fact that this is a farming season when women are actively engaged in farming activities. Again, this result does not corroborate with the submissions of the community leaders during focused group discussions that there were more females than males (males – 40% and females – 60%) in the community.

Figure 4.23: Age Distribution of Respondents in the Study Community

The survey (Figure 4.23) shows that 4% of the respondents were between the 18-24 age bracket, 14



% between 25 – 34, 39% between 35–44, 27% between 45–54, 7% between 55 – 64, while 9% were in the 65 and above age brackets. The preponderance of the 25-54 age bracket in the survey result is an indication of the active workforce available in the community. It is expected that a sustainable, job creating, inclusive and profitable ATC business development system and environment will create job opportunities that will employ this large labour force available in the community and stem the tide of rural – urban migration of the youths from the area.

4.9.23 Marital Status

Marriage is a revered institution among residents across the study area. It has been noted that the marital status of an individual is a very important indicator of social responsibility, trust and achievement in Nigeria (Akpogomeh O. S. and Atemie J. D., 2002). Many couples would rather endure their marriages than be separated or divorced because of the importance attached to marital status. Marriages are usually celebrated with merry making and exchange of gifts between families of the bride and groom. They involve family members and friends of the couple and processes including negotiation of a bride price by elders from both families. Marriages in the two communities are monogamous. Marriages in the community are mostly contracted under Customary Law and Ordinance. It is usually between adult males and adult females. There are no known communal restrictions on marriage on the basis of religion, culture, social status or ethnicity. The proposed project is not expected to impact the marriage institution in the study community.

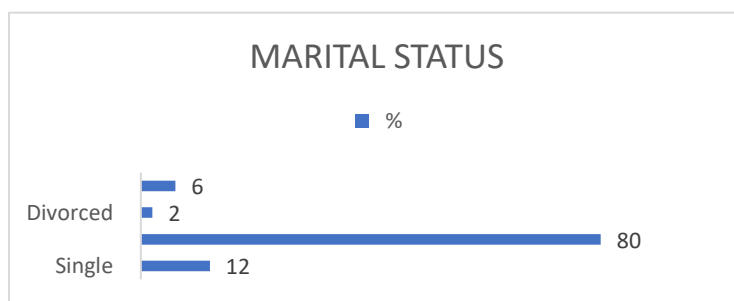


Figure 4.24: Marital Status of Respondents in the Project Community

Source: Field Work 2025

From figure 4.44, 80% of the respondents are married, 12% are singles, 2% are divorced, while 6% are widows/widowers. A stable marriage indicates the level of responsibility and stability of a family and by extension communities.

4.9.24 Household Composition, Structure and Size

Households live together, share same source of food and recognize themselves as a social unit under the authority of a head. Although visitors are excluded, members are not necessarily related biologically. Household size refers to the number of persons in a household which in Nigeria ranges from one to 25, (NPC Priority Table Vol. IX, 2010). The average household in the study area headed by the father and members include his wife, children and wards. The wards include domestic staff (house helps).

Table 4.23: Household Sizes in the Project Community

No. of Persons in Household	% of Households
2	5
3	11
4	24
5 & above	60

Source: Field Work 2025

Table 4.23 shows the household sizes in the project community. As can be seen from the Table, 60% of the households have a household size of 5 and above persons, while 24%, 11% and 5% have household sizes of 4, 3, and 2 persons respectively. Analysis of the data gives an average family size of 5 persons per household in the project community.

4.9.25 Educational Characteristics of the Study Community

Figure 4.25 shows the educational distribution of the respondents in the project community. From the figure above, 20% of the respondents have attained primary level of education, 55% of the population have attained secondary level of education, 16% have attained tertiary level of education, while 9% have had vocational education in Ipuole Okuku village. The high level of educational attainment (over 60% secondary and tertiary combined) indicates availability of literate labour force in the community.

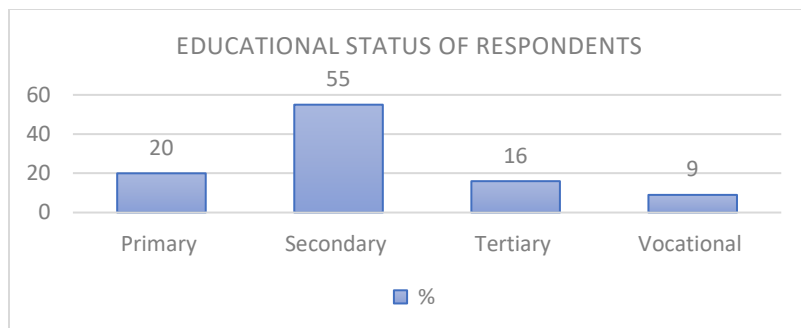


Figure 4.25: Educational Distribution of Respondents

Source: Field Work 2025

4.9.26 Occupational Distribution of Respondents

Figure 4.26 shows the occupational distribution of the respondents in the study area. 85% of the respondents are engaged in farming, 4% each are engaged in trading, artisanal work and transport service respectively, 2% are in the civil service, while 1% is retired. This shows that majority of the population (85%) are engaged in agriculture and therefore any activity that will impact the agricultural resources/ activities of this sector negatively or positively will affect the community and people negatively or positively respectively. The ATC as an agribusiness project, when comprehensively planned, sustainably and inclusively managed and implemented will impact the people and community positively.

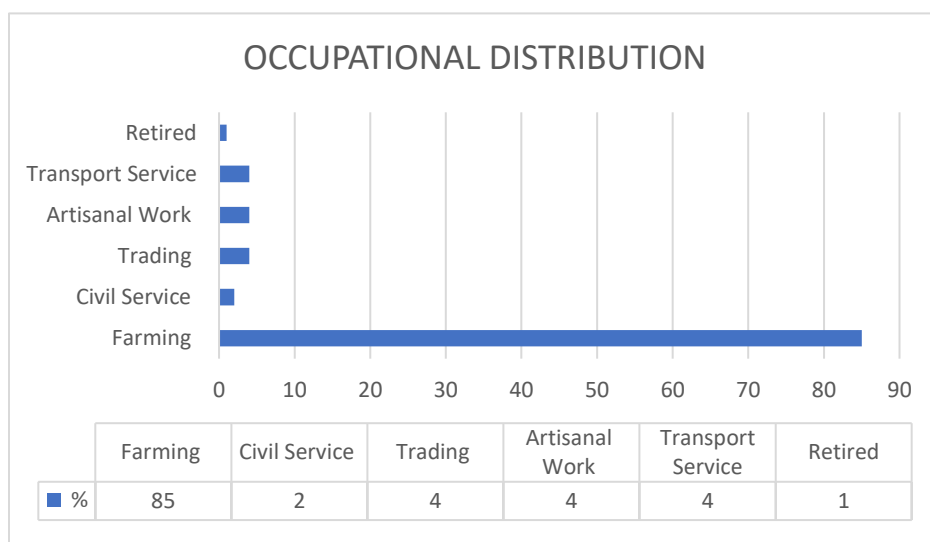


Figure 4.26: Occupational Distribution of Respondents

Source: Field Work, 2025

4.9.27 Income Distribution

From the survey on the income distribution, 30% of the respondents earn between N10,000 and N30,000 monthly, 21% earn between N30,000 and N50,000, 14% each earn N50,000 - N80,000 and N80,000 - N120,000, while 21% claimed to earn N120,000 and above monthly (Figure 4.27). It is expected that the proposed project will boost the income of the people in the area through their employment and contracting opportunities.

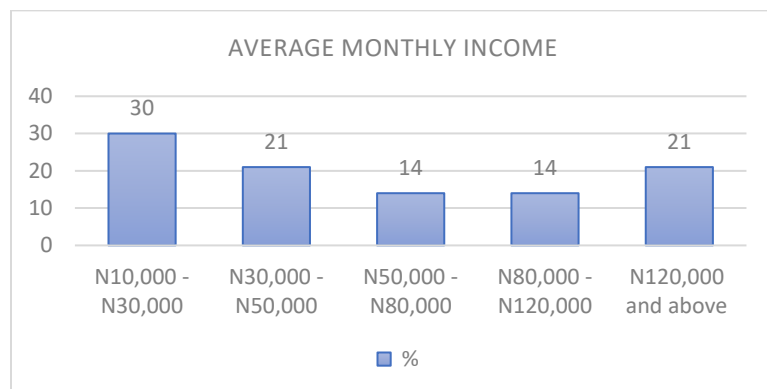


Figure 4.27: Average Monthly Income of Respondents

4.9.28 Household Expenditure Pattern

Table 4.24 Shows the household expenditure pattern of the people in the study area. The analysis shows that majority of the households spend a large proportion (42%) of their income in purchasing food for their families, 10% to provide education for their children, 15% each for fuel for energy and lighting, and cost of transportation respectively, while 6% and 7% go for health care and clothing respectively. This can be attributed to the high cost of food items and increased energy and transport costs currently being experienced in the country occasioned by fuel subsidy removal and devaluation of the naira against international currencies.

Table 4.24: Household Expenditure Pattern

Items of expenditure	% of income spent
Food	42
Education	10
Health	6
Clothing	7
Transport	15
Fuel	15
Others	5

Source: Field Work 2025

4.9.29 Religious Affiliation

Figure 4.28 shows the religious affiliations of the respondents in the project communities. From the figure, 100% of the respondents surveyed claimed to be Christians. This result was corroborated by elders and leaders of the community who informed during the FGD that about 98% of the residents were Christians, while 2% were a mixture of Muslims, African Traditional Religious (ATR) worshipers and Atheists.

4.9.30 Availability of Basic Facilities and Amenities

Table 4.25 presents available sources of drinking water and their usage in the study community. The sources include boreholes, public taps, rivers/streams, hand dug wells and rainwater. Analysis of the usage by the households indicates that 54% of the residents use borehole water as their drinking water source, 24% use public taps, 10% use river/stream water, while 8% and 4% use hand dug wells and rain water respectively.

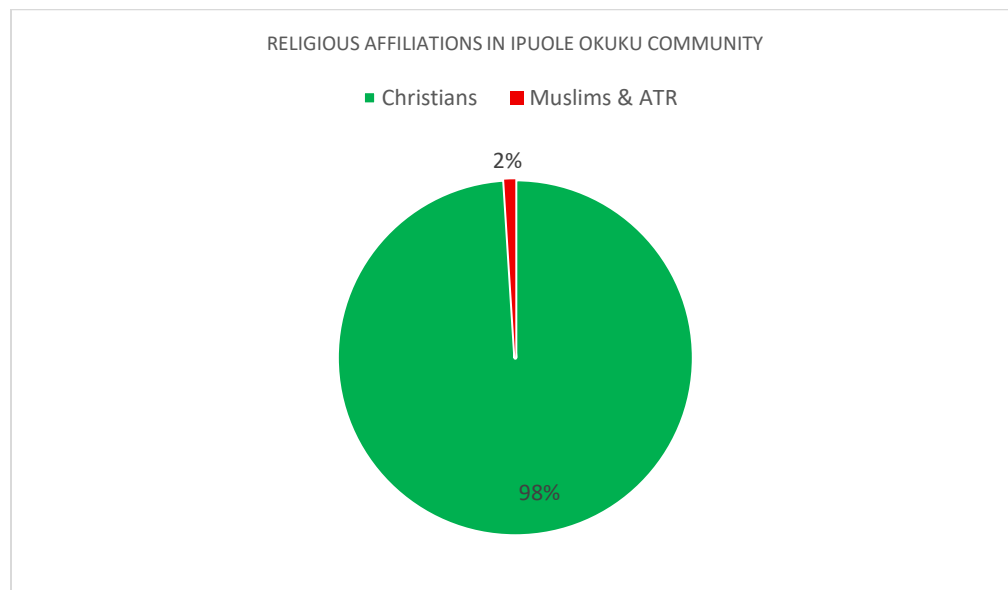


Figure 4.28: Religious Affiliation of Respondents

Source: Field Work 2025

Table 4.25: Available Drinking Water Sources and Usage by Households

Water sources	% of Users
Borehole	54
Public taps	Available but some are nonfunctional 24
River/ Stream	10
Hand dug wells	8
Rainwater	4

Source: Field Work 2025

4.9.31 Availability of Educational Facilities

Table 4.26 shows the availability of different educational facilities in the community. The study shows that Ipuole Okuku village has 10 No. private nursery/primary schools, 3No. public primary schools, 1No. public and 1No. private secondary schools and a tertiary institution – The University of Cross River State, Okuku campus.



Plate 4.10: Public tap (hand pump) for Water Supply In Ipuole Okuku village

4.9.32 Sources of Power Supply for Lighting

90% of the respondents claimed to be connected to the National Grid for electric power supply, however, they complained of very high shortage of power supply and reliance more on generator use

by those who can afford generator and fuel. Other sources of power for lighting in the community include solar panels, kerosene lamps and torchlights.

Table 4.26: Availability of Educational Facilities

Educational facility	Availability	Numbers
Nursery/Primary schools	Yes	10 No. (private)
Primary schools	Yes	3 No.(govt), 2 (private)
Secondary schools	Yes	1 No. (govt), 1 (private)
Tertiary institutions	YES	1 No. (Okuku campus of UNICROSS

Source: Field Work 2025

4.9.33 Available Sources of Energy

Table 4.27 shows the survey results for sources of energy used for cooking in households in Ipuole community. The results show that 66% of the respondents use firewood, 30% claimed to use gas, while 4% use charcoal. The high usage of firewood is occasioned by the high cost of gas. The firewoods are reportedly sourced from the local forests in the area and can lead to deforestation

Table 4.27: Showing Available Sources of Energy for Cooking

Types of energy	% of population
Firewood	66
Gas	30
Charcoal	4

Source: Field Work 2025

4.9.34 Available Means of Commercial Transportation

The available means of commercial transportation in the project community include bicycle, motorcycle and tricycle (Keke) Motorcycle was identified as the major means of transportation in the community.

4.9.35 Transportation cost

The respondents indicated that a drop with a motorcycle (bike) cost between N400-N500/drop within the communities because of bad roads, while keke (tricycle) costs N300/drop

4.9.36 Housing Ownership

Table 4.28 showing housing ownership status of residents of the project community. The table indicates that majority of the respondents 60% and 50% live in their own houses, 20% and 10% live in their family houses, while 30% live in rented houses.

Table 4.28: Housing Ownership Status of Residents

Category	%
Owner	50
Renter	32
Family House	18

Source: Field Work 2025

4.9.37 Building Materials Used in Housing Construction

Table 4.29 presents the type of materials used in roofing houses in the project communities. The table shows that majority of the people, 75% use zinc for roofing, 20% use aluminium for roofing, 3% use asbestos, while 5% use thatch as their roofing material in Ipuole Okuku village.

Table 4.29: Building Materials Used in the Project Communities

Type	%
Cement block wall	78
Brick walls	8
Mud walls	14

Source: Field Work 2025



Plate 4.11: Showing Building Materials Used for Walls & Roof at Ipuole

Table 4.30: Showing Building Materials Used for Walls & Roof

Materials	%
Zinc	75
Aluminum	20
Asbestos	3
Thatch	5

Source: Field Work (2025)

4.9.38 Cost of House Rent in the Project Community

Table 4.30 and Plate 4.11 give details of building materials in the community while Table 4.31 shows the current cost of rent for different house types in the project community. The cost of rent depends on the size and quality of the house. While a single room cost between N60,000 – N84,000 per year, a self-contained costs N120,000-N150,000, a 1-bedroom flat goes for N200,000 - N250,000, while a 2-bedroom flat is reported to cost between N300,000 - N350,000 per year. House rent in the communities may be expected to increase with the coming of the project as it will cause influx of workers to the area, exacerbating the need for rental accommodation. It will also boost the incomes and livelihood of landlords in the area.

Table 4.31: Showing the Current Cost of Rent for Different Types of Houses

HOUSE SIZE	COST OF RENT (N)
One room	N60,000 – N84,000/year
Self – contain	N120,000 – N150,000/year
One bedroom flat	N200,000 – N250,000/year
Two- bedroom flat	N300,000 – N350,000/year
Three-bedroom flat	N450,000 – N600,000/year

Source: Fieldwork Survey (2025)

4.9.39 Community Needs and Priority Ranking of the Needs by the Community (with 1 as the highest and 6 as the lowest priority)

Table 4.32 shows the priority needs of the community and the priority ranking of the needs by the community. The ranking is based on survey results, input from focused group meetings with the elders, youth and women leaders from communities. From the table, the first priority need of the community is the provision of tarred roads to link the community, second, skills acquisition centre, third, potable water, fourth, steady power supply, fifth, improved health facilities and sixth, provision of educational facilities.

Table 4.32: Showing the Priority Needs Ranking by the Community

COMMUNITY NEEDS	Priority ranking level
Portable water supply	3
Steady Power Supply	4
Provision of Educational Facilities	6
Provision of Health Facilities	5
Provision of Skills Acquisition Facilities	2
Provision of Roads to link the communities	1

Source: Fieldwork Survey (2025)

4.9.40 Socio - Economic and Livelihood Activities of the Project Affected Communities

The project community of Ipuole Okuku is basically an agrarian community depending mostly on farming as their major occupation, source of income and livelihood.

4.9.40.1 Crop Farming

Majority of the members of the community are engaged in crop farming and the major crops grown are cassava, yams, rice. Others include vegetables, maize, oil palm, cowpea, guinea corn, potatoes, beniseed, melon, etc. They produce for both home consumption and for sales.

4.9.40.2 Challenges to Crop Farming in the area

Majority of the respondents (80%) identified pests/diseases attack on crops, lack of credit facility and lack of knowledge and information as the major challenges to crop farming in the two communities. This indicates the need to integrate training in integrated pest management, climate smart farming and provision of credit facilities to farmers as deliberate policies of the ATC to improve and enhance the operations of the farmers in the area in order to sustainably provide raw materials to the ATC. This will help boost the profitability, incomes and livelihoods of the farmers. As part of the SIA recommendations to strategically and specifically address the pests' problems.

4.9.40.3 Livestock Farming

Many of the respondents in the community are also engaged in livestock farming such as poultry, goats, pigs, etc. production. They produce for both home consumption and for sales. The major challenge to livestock production is high cost of feeds, poor quality of feeds and diseases especially in poultry production. These challenges can be addressed through the inclusion of quality feed milling facilities as component of the ATC to provide quality feeds at affordable prices to farmers. Majority of the livestock farmers reported not having access to veterinary services. This gap, however, has already been taken into consideration and addressed in the planning and development of the ATC by the provision of a veterinary clinic in the ATC.

4.9.40.4 Artisanship Practices

Artisanship practices in the study communities include welding, electrical and electronic installations and repairs, auto mechanics, electrical works, panel beating, fashion design, hair dressing, pedicure and manicure, food service, carpentry and furniture making, among others. Other livelihood activities in the area include petty trading, transportation services, and sand mining and employment in the public and organized private sectors. Most livelihoods including farming, trading, artisanship practices, transportation services are operated in the informal sector.

4.9.40.5 Experience of External Shocks and Coping Measures

Respondents indicated having experienced external shocks in the last year ranging from floods, late rains, agricultural pests/ diseases, insecurity/violence to theft of crops etc. In the face of these shocks the people reported employing many coping strategies ranging from reduced expenses on

agricultural inputs, borrowing more money than usual, reducing household expenditures on health and education, selling more animals than usual to withdrawing children from school.

4.9.40.6 Natural Resources and their Exploitation for Sustenance

Generations of members of Ipuole Okuku community have depended on the natural resources endowment of their area namely land, forests and water bodies for their sustenance over the years. This has led to encroachment and levels of forest degradation. Land provides space for housing, other physical developments, and farming. Forests in the community provide wood and timber for housing construction, furniture making and firewood for cooking.

Housing, agricultural, infrastructural and industrial developments have encroached significantly on the lands, forests that were traditionally exploited for livelihood.

4.9.40.7 Natural Resource Conservation Practices

Traditional conservation practices in the communities try to control and limit resource exploitation in order to allow for rejuvenation through regrowth. They mostly involve temporary or permanent prohibitions on entry and exploitation of resources in some locations like shrines and the forests around them, ban on cutting economic trees for use as firewood, and encouragement of the practice of shifting cultivation. The use of lands and forests for housing, infrastructural and industrial development has hampered most of these traditional practices. Shifting cultivation and its attendant bush fallow system operates by leaving farmlands fallow for a number of years after cultivation. Farmlands are left fallow for between three and seven years, depending on availability of farmlands. The fallow period allows for natural regeneration.

4.9.41 Land Ownership and Tenure

The legal framework for land ownership, acquisition and resettlement in Nigeria is provided by the Constitution of the Federal Republic of Nigeria (1999) and the Land Use Act CAP 202 LFN 2004. The Act recognizes the State Government's ownership of all lands and it provides the framework for payment of compensation for land acquisition for development purposes. Land has a great socio-economic and socio-cultural significance as it serves as a major livelihood and development asset, and generational inheritance. Therefore, in spite of the law, the communities still practice their traditional land ownership systems which vests ownership of lands in extended families. The families allocate, sell or lease parts of their lands to individuals and corporate organizations as they wish. Such lands can be put to any use including housing, infrastructural and industrial development. Family lands are managed by males in the family.

The major land uses in the community include agriculture, housing, industrial and infrastructural development. These account for more than 90% of land use in the communities.

4.9.42 Employment Situation in Households

According to the National Bureau of Statistics (NBS, 2024), which applies the revised labour-force methodology, the national employment rate stood at 77.4%, while the unemployment rate was 13.6% as of Q1 2024.

In Cross River State, about 72.8% of the economically active population (aged 15–64 years) are engaged in various forms of employment, with agriculture, petty trade, and public service dominating the labour landscape. The field survey corroborates this finding, showing that in Okuku and neighbouring communities:

- 63% of household heads are involved in crop farming and agricultural processing,
- 18% in petty trading,
- 10% in artisanship and transport, and
- 9% in public or private salaried jobs.

Employment opportunities are largely informal, indicating a high dependency on agriculture and low access to structured industrial jobs, which underscores the need for the ATC project to boost local employment and income diversification.

4.9.43 Available Infrastructure and Their Functional Status

Infrastructural facilities comprise physical amenities including access roads, streets, bus stops, telecommunication facilities and meeting halls and social amenities which include water, education, health and electrification facilities. Others are markets, hospitality and security facilities.

4.9.43.1 Roads

There is a tarred road in Okuku town but there is no tarred road in Ipuole Okuku village. All the roads in the village are dirt roads (Plate 4.12) which are bad and very challenging during the rainy seasons.



Plate 4.12: Dirt Road in Ipuole Okuku

4.9.43.2 Telecommunications facility

Residents of the community have access to mobile telecommunication services provided on the GSM networks of MTN, Glo, and Airtel and reported of occasional fluctuations in service.

4.9.43.3 Community Hall

The community has a town hall as shown on Plate 4.13

4.9.43.4 Health Facilities

Ipuole Okuku community has a health centre (Primary Health Centre) and a number of private clinics as can be seen in Plate 4.14.



Plate 4.13: Ipuole Okuku Town Hall (left)

Plate 4.14: Primary Health Care Centre at Ipuole Okuku (middle & right)

4.9.43.5 Educational Facilities

Ipuole Okuku has private Nursery and Primary schools, public primary schools namely: Community Primary School, Ipuole, Holy Child Convent School and St. Joseph's Primary School, etc., Secondary schools which include St. Mathias Offoboche Secondary School, St. Joseph's Secondary School, Model Secondary School (Plate 4.15) and a tertiary institution- the Cross River State University, Okuku Campus (Plate 4.16).

4.9.43.1 Portable Water supply

Ipuole Okuku has different drinking water sources which include boreholes, public taps, rivers/streams, hand dug wells and rain water (Plate 4.17). They complained that some of the public taps have broken down and that they need potable water from borehole.



Plate 4.15: Different educational facilities (St. Mathias Offoboche Secondary School, Holy Child Convent Primary School, St. Joseph's Primary School) in the host community



Plate 4.16: University of Cross River State, Okuku Campus (1st & 2nd - left)

Plate 4.17: Sources of water supply in Ipuole Okuku (3rd & 4th - right)

4.9.43.2 Electricity

90% of the respondents claimed to be connected to the National Grid for electric power supply (Plate 4.18), however, they complained of very high shortage of power supply and reliance more on generator use by those who can afford generator and fuel. Other sources of power for lighting in the community include solar panels, kerosene lamps and torchlights.



Plate 4.18: Electric Power Infrastructure in Ipuole Okuku village (left)

Plate 4.19: Okuku Market (middle & right)

4.9.43.3 Markets

Ipuole Okuku has a very large market – the Okuku market which is a weekly market operating every 5 days (Plate 4.19).

4.9.43.4 Hospitality Centres

The community has a number of hospitality centres viz: Sanctus Hotels, Polygas Hotels, etc.

4.9.43.5 Security in the Study Area

There is a Police Station of the Nigeria Police in the community and they provide public security to the communities.

4.9.43.6 Impact History

Impact history refers to the experience of past projects and other historical events. The elders of the community during focused group meetings and discussions lamented that the community has had a long history and experience of failed and abandoned government projects in the community and that these had negative impacts on the psyche, morale, hope and confidence of the people in government development projects (Plate 4.20). These failed or abandoned projects have taken and occupied large expanse of lands that the people could have used for their farming and improvement of their livelihoods. They gave a list of the existing failed and abandoned projects in the communities to include:

1. The Asbestos roofing and ceiling project – fenced and abandoned
2. The Ceramics production project (abandoned)
3. The large expanse of land taken for the proposed stadium (fenced and abandoned) - Started by Governor Liyel Imoke over 16 years ago. Now used to hold cattle.
4. The Rice Mill built but not operational and a large part of the land has been parcellated and fenced off by an individual without being used.
5. Large expanse of land taken for Airforce base has not been developed and lying fallow.
6. The land taken for Navy school fenced with only one building and not operational
7. The Grain silo built but not operational

Given the litany of the failed and abandoned projects in the communities, the people are worried and hoping that this ATC project will not go the way of past projects.



Plate 4.20: Abandoned projects in Ipuole Okuku (proposed beverages factory (carbonated and soda drinks (left); proposed Roofing Sheets Factory (middle); and proposed site for stadium (right)

4.9.44 Problems Confronting the Community

Members of the community indicated the following as some of the problems confronting the community.

- Lack of employment/ empowerment of the youths and women in the community
- Lack of adequate potable drinking water
- Lack of skills acquisition centre
- Lack of improved health facilities to meet the health needs of the people
- Lack of tarred all season motorable roads
- Flooding and erosion
- Lack of wastes management facilities

4.9.45 Socio-Economic Sensitivities and Vulnerable Groups

The proposed ATC project is a significant project that will take 37.8 hectares of land and its development process will potentially impact public and private assets, livelihoods and incomes. The socio-economic environment will be sensitive to changes that will arise as a result of the project. Sensitivities associated with it will include safeguarding livelihoods and household income levels, and protecting residents and workers from diseases and accidents, Table 4.33.

Table 4.33: Socio-Economic Sensitivities

Socio-Economic Component	Sensitivity and Benefits
Maintaining household income flows through employment and	During the construction phase the project would provide opportunities for employment and contracting which will enhance household incomes. However, it will also lead to the loss of farmlands, livelihoods and unemployment. The ATC project will provide training to enhance farmers productivity, process and add value to farmers' produce and provide ready market to producers. This will help prevent produce spoilage and wastage, increase incomes, enhance the livelihoods of the people

Socio-Economic Component	Sensitivity and Benefits
contracting opportunities.	and reduce poverty. Household income levels will be impacted positively for the employed and adversely for the displaced and unemployed. Household income flows need to be maintained and indeed enhanced. Payment of appropriate compensation and implementation of sustainable Livelihood Restoration and Enhancement Plan (LREP) will help mitigate negative impacts of the project on the people and the community.

Source: Field Work, 2025.

4.9.46 Vulnerable Groups

Project activities will potentially impact differently on different groups and individuals. Some of these will be traditionally vulnerable households which include those headed by women, minors, persons with disabilities and chronically ill persons and the aged. Vulnerability will arise as family farms and crops will be destroyed in the course of the proposed project implementation. This will cause loss of livelihoods and incomes to owners and dependents.

It is envisaged that movement of equipment and vehicles will increase with project construction phase. Residents and frequent users of the roads would be vulnerable to disruptions of traffic and complete closure of portions of the road during the project construction phase. Potentially vulnerable groups include persons with disabilities residents, children and the elderly.

Unemployed community youths will be another vulnerable group. There could be agitations and restiveness if desire for employment is not met due to limited opportunities in the project. The youth are also very energetic and impressionable which could lead to several other vulnerabilities associated with social vices. If drug abuse and commercial sex activities increase in communities in the area due to project activities, the youth would be most vulnerable to the influence of these activities. These vices could have long-lasting impacts on morals and life of the youth.

Payment of appropriate compensation and implementation of sustainable Livelihood Restoration and Enhancement Plan (LREP) will help mitigate the negative socio-economic impacts of the project on the people and the community.

4.9.47 Stakeholder Perceptions, Concerns and Expectations

The proposed project is expected to facilitate economic activities and boost employment in the area. Several stakeholders were identified and engaged. They generally perceived the project is developmental and will benefit residents, businesses and the community, LGA and the state. However, some concerns and expectations were expressed as follows:

4.9.47.1 Community Concerns

The Community's concerns include:

- Loss of land - the proposed project will take 37.837 hectares of land from the community.

- Fear of inadequate compensation and delay in payment
- Neglect of our people in employment opportunities in the ATC
- insecurity that may be occasioned by the influx of job seekers into the communities.
- Population explosion and congestion in the communities
- Waste disposal problems as there are no wastes management facilities in the communities
- Project non-completion and abandonment as happened with many projects in the past.
- Loss of dwelling and commercial buildings around the proposed project site
- Increased flooding of parts of the community during the wet season if provision is not made for adequate drains along the road.
- Movement in the community will be impaired for pedestrians during construction.
- Distribution of benefits like employment during construction phase could cause problems and agitations in the community if not properly managed.
- Movement of construction vehicles and equipment would cause dust and air pollution, road blocks, traffic congestion and accidents.
- Construction activities will cause vibrations that would affect foundations and walls of buildings.

4.9.47.2 Concerns of the National Union of Road Transport Workers and the Federal Road Safety Commission (FRSC)

- Project construction will lead to blockage of sections of the road, traffic congestion and diversion. This will make movement within the communities cumbersome for residents.
- Provision of adequate and safe diversions along the roads to take care of vehicular movements during proposed project construction phase.
- Rehabilitation of roads intended to be used as diversions prior to commencement of the proposed project.
- On completion there will be increased vehicular traffic which would be potentially hazardous for persons with disability residents, children and other community residents. There is a need to protect them from fast moving vehicles while they carry out their normal activities in the communities.
- Provision of adequate road diversions during project construction phase.
- Rehabilitation of roads intended for use as diversions so that vehicles will have minimal damage plying the routes.
- Provision of speed breaks and road signage on portions of the ring road.

4.9.47.3 Expectations and Requests of the Project Host communities

- Employment of members of the communities especially youth and women in skilled and unskilled positions during construction and operational phases of the project.
- Signing of Memorandum of Understanding (MOU) or Community Development Agreement (CDA) with the Community by the project proponents.
- Appointment of liaison officer from the project impacted community.
- Prompt payment of adequate compensation to residents whose properties example crops and other assets will be affected by the proposed project.
- Provision of infrastructural amenities to the community viz: potable water supply, educational facilities, improved healthcare facilities, skills acquisition centre,
- provision of tarred roads in the community to link and open up the communities
- provision of low interest loans and grants to indigent members of the community for business start-up and expansion
- award of contracts to indigenes of the community,
- local sourcing of available raw materials from the community etc.
- Introduction of pedestrian bridges, zebra crossings and speed breaks along the road, especially where the road passes through built up areas in the community.
- Construction of deep drains along the roads to prevent flooding in the community.

5 ASSOCIATED AND POTENTIAL IMPACTS

5.1 Introduction

This chapter presents a comprehensive assessment of the associated and potential environmental and socioeconomic impacts arising from the development and operation of the proposed Agricultural Transformation Centre (ATC). The chapter evaluates the potential interactions between project designs, activities and the surrounding physical, biological, and human environments across all project phases - site preparation, construction, operation, and decommissioning.

The objective of this impact assessment is to identify both adverse and beneficial impacts, determine their significance, and propose appropriate mitigation or enhancement measures. It also considers cumulative effects and aligns the assessment with national regulatory requirements and international best practices. This analysis provides the basis for informed decision-making and the development of effective environmental and social management strategies for the project. The stepwise approach for the assessment is illustrated in Figure 5.1.

5.2 Impact Identification and Evaluation Methodology

Whatever the impact and specific technique used to analyse it, prediction and evaluation are usually based on a sound methodological framework, which covers the following:

- The overall prediction and evaluation process;
- Choice of prediction technique;
- Criteria for evaluating significance;
- The design of mitigation measures; and
- Indirect impacts, long range impacts and uncertainty.

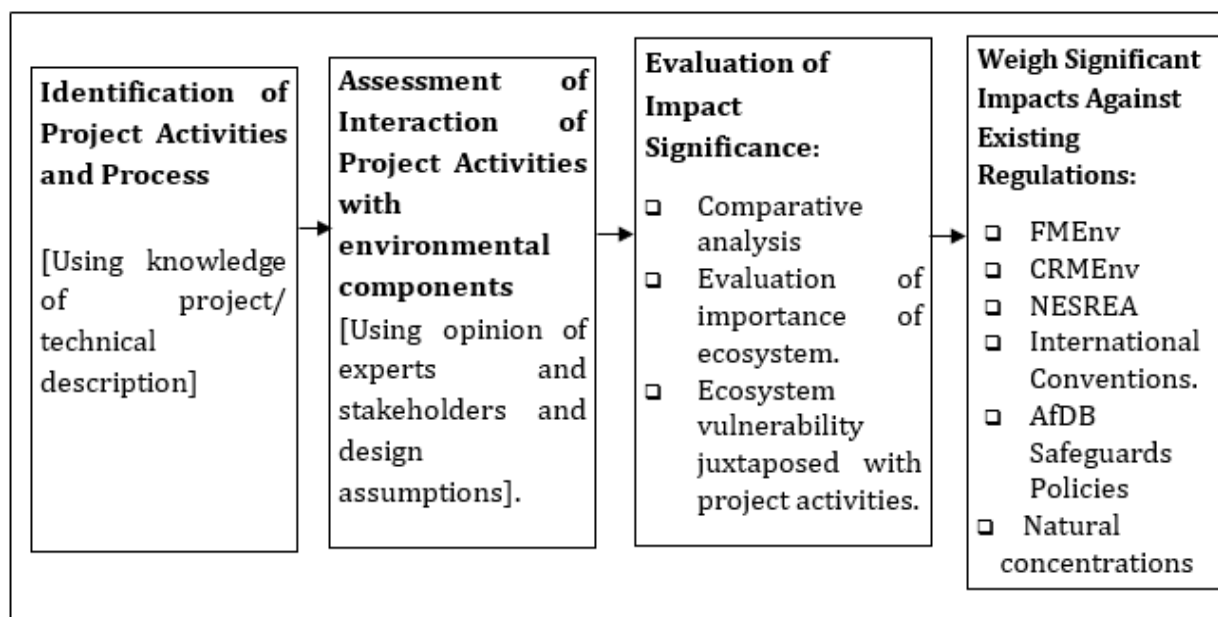


Figure 5.1: Schematic Representation of Potential Impact Assessment Approach

5.3 Summary of Environmental Impact Indicators

The environmental impact indicators are easily observable parameters that will indicate change/deviation, which can be used to monitor the various environmental components, as presented in Table 5.1.

Table 5.1: Environmental and Social Components and Potential Indicators

S/N	ENVIRONMENTAL/SocialCOMPONENTS	IMPACT INDICATORS
Environmental Component		
1.	Air Quality	SPM, CO ₂ , NO _x , SO _x , CO, VOC, CH ₄ , NH ₃ , etc.
2.	Noise	Noise level dB(A)
3.	Soil/Agriculture	Soil type and structure, physico-chemical, heavy metals load and microbiological characteristics, etc.
4	Terrestrial flora and fauna	Spp. abundance and diversity
5	Surface Water Quality	Dissolved and suspended solids, turbidity, toxicity, physico-chemistry, heavy metals content and microbiological char characteristics, etc
6	Ground water quality	Dissolved and suspended solids, turbidity, toxicity, physico-chemistry, heavy metals content and microbiology
7	Hydrology	Seasonality, dissolved and suspended solids, turbidity, toxicity, physico-chemistry, heavy metals content and microbiological char characteristics, etc
Social Component		
8	Community and workplace safety	Accident and incident records
9	Socioeconomic/Health	Needs and concern of host communities, perception on the proposed project/health risks, waste streams, handling treatment and disposal, income/livelihoods, employment, etc.
10	Employment and Livelihoods	Number of local vs. non-local workers employed, skill acquisition training offered, percentage of women/youth employed vs percentage of men, Number of PAPs compensated on-time/Delayed Compensation
11	Labour Management	% of local employee vs % of foreign worker, number of GBV/SEA reported and redress, number of grievances reported and redress
11	Public health and safety	Accident and incident records

5.4 Qualitative and Quantitative Impact Risk Evaluation

The identification of potential impacts of the proposed project was followed by impact prediction using the most commonly used impact prediction tools particularly, the environmental management system (EMS) ISO14001 approach and professional judgement. These impact prediction tools have allowed the prediction of changes that will take place to the baseline environment (biophysical, cultural and socioeconomic). The impacts identified and predicted were characterized. Although the

characteristics of impacts can vary, the assessment took into consideration typical parameters such as the following:

- **Nature of impacts** (beneficial, adverse, direct, indirect, cumulative);
- **Magnitude of impacts** (severe, moderate, low);
- **Extent/location of impacts** (area/volume covered, distribution);
- **Timing of impacts** (during construction, operation, decommissioning, immediate, delayed, rate of change);
- **Duration of impacts** (short term, long term, intermittent, continuous);
- Normality/abnormality of impacts;
- **Likelihood of impacts** (probability, uncertainty or confidence in the prediction).

The potential impacts were then quantified to determine their significance using a set of criteria and weighting scale. The following are the criteria:

- Legal/Regulatory Requirements (L)
- Risk Factor (R)
- Frequency of Occurrence of Impact (F)
- Importance of Impact on Affected Environmental Components (I)
- Public Perception (P)

An ISO14001 Environmental Management System (EMS) approach was adopted for rating of significance of the project impacts and is presented as follows:

1. Legal/Regulatory Requirements (**L**) – The criterion is to essentially determine whether there is a legal/regulatory requirement or permit.

- 0 = There is no legal/regulatory requirement
- 3 = There is legal/regulatory requirement
- 5 = There is a legal/regulatory requirement and permit

2. Risk Factor – A risk assessment matrix (RAM) evaluates the risk factor of the impacts

- 1 = Low risk
- 3 = Medium risk
- 5 = High risk

3. Frequency of impact (F) – What is the frequency rating of impact based on the RAM?

- 1 = Low frequency
- 3 = Medium
- 5 = High frequency

4. Importance of impacts and environmental component affected (I) – What is the rating of importance based on consensus of opinions?

- 1 = Low

3 = Medium

5 = High

5. Public perception/concerns (P) – What is the rating of public perception and concerns on project impacts based on consultations and interviews

1 = Low perception/concerns

3 = Medium perception/concerns

5 = High perception/concerns

The above criteria and rating of potential impacts of the project activities was based on a number of factors including the following:

- The known and likely presence of environmental receptors and resources.
- Vulnerability or sensitivity of affected resources and receptors.
- Ability of receptors or resources to absorb change
- The extent, nature and duration of physical change resulting from the construction and operation of the ATC.

The rating of each of the impacts resulting from the project activities were also based on EMS ISO14001 approach where the criteria are summed up and categorized as either significant or not significant. That is where:

- a. $L+R+F+I+P \geq 15$; $F+I > 6$ or $P=5$, the impact significance is regarded as high;
- b. $L+R+F+I+P \geq 8$ but < 15 the impact significance is regarded as medium; and
- c. $L+R+F+I+P \leq 8$ the impact significance is regarded as low or not significant.

Table 5.2 presents a simplified assessment matrix that summarizes project activities and the associated and potential impacts and their rating. The following abbreviations are used for the impact qualification columns: *Adverse (AD)*; *Beneficial (BN)*; *Long-term (LT)*; *Short-term (ST)*; *Direct (DT)*; *Indirect (ID)*; *Normal (NM)*; *Abnormal (AB)*

Table 5.2: Simplified Assessment Matrix of Project Action and Environmental Impacts

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	
																		High Medium Low
Pre-construction Phase	Equipment and Personnel Mobilization	Noise pollution from heavy duty trucks, equipment, and people	Host Communities	x			x	x		x		0	3	3	3	1	10	Medium
		Air pollution from vehicle emission brought on by elevated concentration of CO, NO ₂ , SPM, SO ₂ , etc	Mobilized construction workers	x			x	x		x		0	3	3	3	2	11	Medium
	Site Clearing	Vegetation loss of about 37.84 ha and habitat disturbance of 12.5 ha	Host Communities	x			x	x		x		3	3	1	3	3	13	Medium
		Removal of top soil of about 97,983.6 m ³ and soil compaction increased erosion potential	Ecosystem	x		x		x		x		0	3	5	5	3	16	High
		Reduced carbon sequestration capacity due to vegetation loss of about 32,220 m ³ amounting to about 164,082m ³ biomass	Ecosystem	x			x	x				3	5	3	3	3	17	High
		Increased noise levels, vibration and air quality degradation from machines and equipment	Host Communities Mobilised Individuals (construction workers)	x			x	x		x		3	3	1	3	3	13	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P		
																		High Medium Low
		Dust generated from about 130,203.6 m ³ soil stockpiles and handling	Host communities Construction workers	x			x	x		x		1	3	1	3	2	10	Medium
		Vegetative waste generation due to trees, shrubs and grasses clearing	Ecosystem	x			x	x		x		3	3	1	3	2	12	Medium
		Increased erosion potential due to vegetation loss		x			x	x		x		3	3	1	3	3	13	Medium
		Reduction in structural stability and percolation ability of soil due to compaction and other engineering activities		x			x	x		x		3	3	1	3	3	13	Medium
Construction Phase	Site Preparation through; Removal of vegetation and soil compaction from 37.84 ha	Increase dust generation from cleared land and windblown stockpiles.	Host communities Construction workers	x			x	x		x		3	1	1	3	3	11	Medium
		Increased soil erosion potential; reduction in structural stability and percolation ability of soil.	Ecosystem	x			x	x		x		5	5	3	3	3	19	High
	Civil and Construction	Noise from the operations of engines, heavy duty construction		x		x		x		x		0	3	3	3	3	12	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	
	n activities through ground levelling, excavation and foundation	machines and motors vehicles on site																High
		Air quality impacts due to emissions of about 164,082 m ³ from the operation of heavy-duty construction machines such as bulldozer and motors vehicles on site		x		x		x		x		0	3	3	3	3	12	Medium
	Cement mixing, concrete batching and handling	Contamination of surface water sources		x			x	x			x	2	1	3	3	3	12	Medium
		Poor air quality to the release fine dust, including PM _{2.5} and PM ₁₀ , into the air		x			x	x			x		1	3	3	3	10	Medium
		Batching plants and mixing sites generate construction waste of about 51 m ³ in form of cement bag, formwork waste, scrap metals and fasteners		x			x	x		x		3	3	1	3	3	11	Medium
		Spills of chemicals, fuels, or other pollutants can contaminate the soil.		x			x	x		x		3	1	1	3	3	11	Medium
		Leaks from vehicles or equipment can also lead to soil contamination.		x			x	x		x		3	1	1	3	2	10	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	
																		High Medium Low
	Haulage of construction/building materials	Increased GHG emissions from trucks, heavy duty machines and equipment of about 164,082 tCO ₂ e		x			x	x			x	2	3	3	2	3	13	Medium
		Increased SPM due to wind blowing particles from operation trucks hauling sands and aggregates		x			x		x		x	3	3	3	3	3	15	Medium
	Extraction, processing, and transportation of quarried materials (such as sand, and stone)	Alteration of landscapes due to the removal of topsoil, excavation of large pits, and creation of spoil heaps.	Ecosystem	x		x	x	x			x	3	2	2	3	3	13	Medium
		Heavy machinery on and around the quarry can also compact soil, inhibiting future vegetation growth.		x			x	x		x		3	1	1	3	2	10	Medium
		Quarrying activities like drilling, blasting, crushing, and transporting materials generate large amounts of dust.		x			x	x			x	3	2	3	3	3	14	Medium
		Heavy machinery and frequent blasting create significant noise and vibrations that can disturb wildlife and communities near the quarry.	Host communities	x			x	x			x	2	1	3	3	3	12	Medium
		Increase air quality pollution and greenhouse gas emission due to machinery used in quarries emits	Construction workers	x			x	x			x	3	2	2	3	3	13	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P		
																		High Medium Low
		pollutants like nitrogen oxides and carbon dioxide (CO ₂)																
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site	Ecosystem	x		x		x		x		2	2	5	4	5	18	High
		Disruption of wildlife migration patterns		x			x	x		x		3	1	1	3	2	10	Medium
		Introduction of pollutants (such as cement dust, leftover cement mix) into nearby water bodies through run-off	Host communities	x			x	x			x	2	1	3	3	3	12	Medium
		Soil contamination due to improper disposal of construction materials waste (e.g. cement bag, formwork waste, scrap metals and fasteners etc.)	Host communities Ecosystem	x		x		x		x		2	2	5	4	5	18	High
Operational Phase	CR SAPZ-ATC facilities and operations	Increase noise level from the operations of various machines and equipment such as power plant	Host communities	x		x		x		x		1	1	4	3	2	12	Medium
		The daily release of nitrogen oxides (NO _x), carbon monoxide (CO), hydrocarbons, and particulate matter (PM _{2.5} , PM ₁₀) from	Ecosystem	x			x	x		x		3	1	1	3	2	10	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P		
		machineries and equipment directly affects local air quality																High
		Streams of agricultural waste generate such as peeling process, separations of raw materials and processed waster from production		x		x		x	x			3	2	4	3	2	14	Medium
		Increase soil pollution potential due to spilled fuel, spent oil, lubricants, aluminum oxide paint etc. during routine maintenance of the operating machineries and equipment																
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Increase noise level and dust generation due to the demolition and removal of camps components and other structures	Construction worker	x		x		x		x		1	1	4	3	3	12	Medium
		Increase noise and air quality pollution due to transfer of heavy-duty equipment and construction machineries	Host communities Construction worker	x			x	x			x	1	1	4	3	3	12	Medium
		Solid waste generation and improper disposal waste facility		x		x		x		X		1	1	4	3	2	11	Medium

Table 5.3: Simplified Assessment Matrix of Project Action and Social Impacts

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	
Pre-construction Phase	Land takeover (repossession) of 37.8 ha	Economic displacement of 340 people across 68 households losing farmlands and crops	Host communities	x		x		x		x		5	5	4	5	5	24	High
		Conflicts may emerge due to insufficient stakeholders' engagement and/or perceived inadequate compensation for farmland and crops loss or perceived		x		x		x		x		5	3	2	3	5	18	High

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		disparity in compensation																
	Equipment and Personnel Mobilization	Population surge of about 50 workers leading to pressure on available resources (e.g. water, space etc.)	Host Communities Mobilised Individuals (construction workers)	x		x		x		x		0	1	1	3	5	10	Medium
		Outbreaks of communicable diseases (eg. Flu, Tuberculosis, Ringworm)		x		x		x		x		0	2	1	3	5	11	Medium
		Worsening anti-water and anti-sanitation practices;		x		x		x		x		0	1	1	3	5	10	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Social interactions including sexual relations between workers and community members may lead to increased incidence of sexually transmitted infections (STI) including HIV/AIDS		x		x		x		x		0	3	1	3	1	8	Medium
		Risk of respiratory diseases in personnel and members of the community		x			X	x		x		0	3	2	3	3	11	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Reducing aesthetic value of the area.		x			x	x		x		3	1	1	3	3	11	Medium
		Population surge of about 50 workers will increase the domestic waste generation by ~300 m ³ of solid waste leading to sanitation challenges.		x			x	x			x	2	2	5	2	3	14	Medium
	Site Clearing	Increased earnings to local laborer from the clearing of vegetation and site preparation Improved	Host Communities		x		x	x		x		N	N	N	N	N		

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		standard of living																
		Reduce crime and social vices due to various engagement through job opportunities			x		x	x		x		N	N	N	N	N		
		Reduced local landscape aesthetic value due to natural vegetation clearing		x			x	x			x	2	1	1	1	2	7	Low
		Clearing activities may eliminate access to plant used for medicinal purpose and other cultural practices		x			x	x			x	2	1	1	1	2	7	Low

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	
Construction Phase	Site Preparation through; Removal of vegetation and soil compaction from 37.94 ha	Disruption of established social ties and support networks due to the displacement of farming household	Host Communities	x			x	x		x		3	1	1	3	3	11	Medium
	Civil and Construction activities through ground levelling, excavation and foundation	Destruction of crops and farm lands due to excavation and grading of farmland	Host Communities	x			x	x		x		3	1	1	3	3	11	Medium
		Respiratory illness from airborne dust due to earthwork activities could		x			x	x		x		2	3	1	3	3	12	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		lead to common colds, flu, asthma etc.																
		Prolonged exposure to noise from earthwork activities can cause stress, hearing loss, and sleep disturbance.		x			x	x		x		2	3	1	3	3	12	Medium
	Hiring of construction personnel	Employment of community locals	Host communities		x	x		x		x								
		Boost of local economy and improvement of standard of living through job opportunities and high purchasing rate			x		x	x		x								

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Provision or improvement of local infrastructure and amenities			x	x		x		x								
		Conflicts may emerge during site clearing and preparation activities due to insufficient stakeholder engagement and/or perceived disparities in employment opportunities		x		x		x			x	2	3	3	2	3	13	Medium
	Cement mixing, concrete batching and handling	Water-related health conditions due to water source contamination	Host communities Construction workers	x			x	x			x	2	1	3	3	3	12	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Occupational, health and safety concerns for the workers due to potential skin and eye irritation, respiratory and allergic concerns.	Construction Workers	x		x	x	x			x	5	5	3	3	3	19	High
		Abrasive damage to the lung due to inhalation of airborne dust from cement and silica.		x		x	x	x			x	5	5	3	2	3	18	High
		Damage to the natural landscapes due to quarrying for raw materials	Ecosystem	x		x		x	x		x	5	5	2	2	2	16	High
		Destruction of flora and fauna		x		x		x	x		x	5	5	2	2	2	16	High

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		habitats and potentially disrupting ecological balance due to quarrying for raw materials																
	Haulage of construction/building materials	Aggregates falling off and hitting and damaging third party windshields and causing other forms of injuries	Road Users	x			x	x			x	3	2	2	3	3	13	Medium
		Deterioration of existing roads	Host Communities Road Users	x		x		x			x	2	3	3	2	3	13	Medium
		Increased accident rate due to increased	Road Users Construction workers	x		x		x			x	2	4	3	2	3	14	Medium

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		movement of trucks and other earth-moving vehicles																
	Extraction, processing, and transportation of quarried materials (such as sand, and stone)	Provide employment for the locals	Host Communities		x		x	x		x		N	N	N	N	N		
		Large and unmanaged quarry pits poses safety risks to community members		x			x	x			x	1	1	2	3	3	10	Medium
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site cause stress, hearing	Host Communities Construction workers	x		x		x		x		1	3	3	3	3	13	Low

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	
		loss, and sleep disturbance.																High
		Impact on water quality if hazardous wastes are discharged to watercourses or from runoff from inappropriately stored hazardous waste		x			x	x			x	2	2	5	2	3	14	Medium
Operational Phase	CR SAPZ-ATC facilities and operations	Employment of community locals	Host communities		x	x		x		x								
		Boost of local economy and improvement of standard of living through job opportunities			x		x	x		x								

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		and high purchasing rate																
		Provision or improvement of local infrastructure and amenities			x	x		x		x								
		Reduction in crime and social vices through engagement of local youth		x		x		x		X								
		Enhance socio-economic potential of the locals and increase interaction beyond immediate localities			x	x	x	x	x	x								

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	High Medium Low
		Pressure on local housing and infrastructure due to influx of people seeking for job opportunity and those working in the area		x	x	x		x	x	x		1	2	5	4	3	15	Medium
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Job opportunity for the demolition exercise	Host Communities		x		x	x	x									
		Positively improve living standard of the youth			x		x	x	x									
		Reduction in crime and social vices through			x		x	x	x									

Project Phase	Project Activity	Potential Impact	Impact Receptors	Impact Qualification								Impact Quantification					Overall Rating	Project Phase
				Adverse	Beneficial	Long-term	Short-term	Direct	Indirect	Normal	Abnormal	L	R	F	I	P	L+R+F+I+P	
		engagement of local youth																High
		Health and safety risks to workers from demolition activities	Construction worker	x			x	x		x		1	1	4	4	3	13	Medium

5.5 Description of Potential Impacts

The potential impacts of the project across its different phases (Pre-Construction, Construction, Operational, and Decommissioning) involves specific activities with varying levels of interaction with the biophysical and socio-economic environment. The impacts are categorized as adverse or beneficial, direct or indirect, short-term or long-term, local or regional, and are rated based on their significance.

5.5.1 Pre-Construction Phase

Equipment and Personnel Mobilization

Environmental Impacts

- **Noise pollution from heavy-duty trucks, equipment, and personnel movement:** The mobilization of heavy trucks, construction machinery, and workers will introduce continuous noise into the project area. This is an **adverse, short-term, direct, and normal impact**, because it results from routine mobilization activities. Although temporary, the noise can cause considerable disturbance to the host environment, affecting both human comfort and ecological balance. Considering its limited duration but widespread effect, the **overall significance is Medium**.
- **Air pollution from vehicle emissions:** Exhaust emissions from mobilized vehicles and equipment will increase the concentration of pollutants such as carbon monoxide, nitrogen oxides, sulphur oxides, and suspended particulate matter in the atmosphere. This is an **adverse, short-term, direct, and normal impact**, as it originates directly from fuel combustion and dissipates after mobilization ends. However, poor air circulation may worsen its immediate effects on local air quality, making the **overall significance Medium**.

Social Impacts

- **Population surge and pressure on local resources:** The influx of approximately 50 workers will create a sudden increase in demand for food, water, housing, and other social amenities. This situation is **beneficial, short-term, direct, and normal** in terms of stimulating local economic activity and service demand, but simultaneously **adverse, short-term, direct, and normal** as it overstretches already limited community resources. The competing outcomes balance each other, with an **overall significance of Medium**.
- **Outbreaks of communicable diseases:** High population density and increased interaction between mobilized workers and the local community increase the likelihood of disease transmission. Respiratory illnesses such as flu and tuberculosis, as well as skin infections like ringworm, could spread easily. This is an **adverse, short-term, direct, and abnormal impact**, as it introduces public health risks beyond normal community conditions. Because of its potential to affect both workers and residents, the **overall significance is Medium**.
- **Poor sanitation and hygiene practices:** Influx of workers may lead to indiscriminate waste disposal, inadequate toilet facilities, and increased water contamination, resulting in declining sanitation levels. This constitutes an **adverse, short-term, direct, and abnormal**

impact, since it could trigger public health challenges not typical of the community under normal conditions. The **overall significance is Medium**.

- **Risk of sexually transmitted infections (STIs), including HIV/AIDS:** The arrival of new groups of workers introduces different social dynamics and relationships, which may increase exposure to STIs and HIV/AIDS. This is an **adverse, long-term, indirect, and abnormal impact**, as the effects extend beyond the mobilization period and have lasting health and social consequences. The **overall significance is Medium**.
- **Respiratory health risks:** Exposure to exhaust fumes and dust from mobilized vehicles and equipment may cause short-term respiratory conditions such as coughing, asthma aggravation, and eye irritation. This is an **adverse, short-term, direct, and normal impact**, as it arises directly from vehicle use. The **overall significance is Medium**.
- **Reduction in local aesthetic value:** Increased movement of vehicles, dust emissions, and temporary worker camps will degrade the visual appeal of the project environment. This is an **adverse, short-term, indirect, and normal impact**, as it does not directly damage environmental components but reduces the attractiveness of the locality. The **overall significance is Medium**.
- **Increase in solid waste generation:** The influx of 50 workers will result in an estimated 300 m³ of domestic waste, which requires proper collection and disposal. If not managed, this becomes an **adverse, short-term, direct, and normal impact**, as poor waste handling can cause pollution and health hazards. The **overall significance is Medium**.

Site Clearing

Environmental Impacts

- **Vegetation loss and habitat disturbance:** Clearing of approximately 37.94 hectares of land and disturbance of 12.5 hectares of habitat will significantly alter the ecological setting. This is an **adverse, long-term, direct, and normal impact**, as it directly removes natural vegetation and reduces available habitat for wildlife. Biodiversity depletion is expected, and natural regeneration may be slow. The **overall significance is Medium**.
- **Topsoil removal and soil compaction:** The extraction of about 97,983.6 m³ of topsoil coupled with soil compaction will degrade soil fertility and increase erosion susceptibility. This represents an **adverse, long-term, direct, and abnormal impact**, as it permanently alters soil structure and productivity. Given the scale of soil disturbance, the **overall significance is High**.
- **Reduced carbon sequestration:** Clearing of 37.94 hectares of vegetation will reduce the carbon storage capacity of the environment, resulting in a biomass loss of about 164,082 m³. This is an **adverse, long-term, direct, and abnormal impact**, as it weakens the area's role in climate regulation. The **overall significance is High**.
- **Noise, vibration, and degraded air quality from equipment:** Operation of clearing equipment will release noise, vibration, and exhaust gases, leading to deterioration of local air quality and temporary disturbance of the environment. This is an **adverse, short-term, direct, and normal impact**, with an **overall significance of Medium**.

- **Dust generation from soil stockpiles:** Movement and storage of excavated soil will generate dust particles, lowering ambient air quality and increasing respiratory risks. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance of Medium**.
- **Vegetative waste generation:** Large quantities of shrubs, grasses, and tree debris will be produced, requiring proper handling and disposal. This is an **adverse, short-term, direct, and normal impact**, as unmanaged waste could create secondary environmental concerns. The **overall significance is Medium**.
- **Increased erosion potential:** Vegetation removal leaves soils exposed to wind and water erosion, potentially leading to land degradation. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance rated Medium**.
- **Reduced soil structural stability and percolation:** Heavy equipment use during clearing will compact soils, reducing their ability to absorb water and sustain vegetation. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance considered Medium**.

Social Impacts

- **Increased earnings for local laborers:** Engagement of local workers during site clearing provides jobs and income, improving household livelihoods. This is a **beneficial, short-term, direct, and normal impact** with positive implications for poverty reduction.
- **Reduction in crime and social vices:** Employment opportunities reduce idleness among youth, helping to minimize crime and anti-social behaviors. This is a **beneficial, short-term, indirect, and normal impact**, contributing to community stability.
- **Reduction in local aesthetic value:** Loss of vegetation reduces the scenic appeal of the project area. This is an **adverse, long-term, indirect, and normal impact**, with the **overall significance rated Low**.
- **Loss of medicinal and cultural plant resources:** Clearing activities may remove species used for traditional medicine or cultural practices. This is an **adverse, long-term, indirect, and normal impact**, with an **overall significance of Low**.

Land Takeover (Repossession of 37.84 ha)

Social Impacts

- **Economic displacement of households:** About 340 people across 68 households will lose farmland and crops due to land repossession, disrupting their primary means of livelihood. This is an **adverse, long-term, direct, and abnormal impact** with profound socio-economic implications. Because the displacement is permanent and affects household income security, the **overall significance is High**.
- **Conflicts due to inadequate or unequal compensation:** Where compensation for land and crops is perceived as inadequate or unfairly distributed, disputes and grievances are likely to arise. This represents an **adverse, long-term, indirect, and abnormal impact**, as it undermines community cohesion and may escalate into social conflict. The **overall significance is High**.

5.5.2 Construction Phase

Site Preparation (Removal of Vegetation and Soil Compaction from 37.84 ha)

Environmental Impacts

- **Increase in dust generation from cleared land and stockpiles:** The removal of vegetation and exposure of bare soils will generate dust, particularly when stockpiles are dispersed by wind. This is an **adverse, short-term, direct, and normal impact**, since it results directly from site preparation activities and will reduce once surfaces are stabilized. The impact contributes to reduced air quality and discomfort in nearby areas, with the **overall significance rated Medium**.
- **Increased soil erosion and reduction in structural stability:** Soil compaction and vegetation removal will leave the ground vulnerable to erosion, while also diminishing its structural integrity and water infiltration capacity. This is an **adverse, long-term, direct, and abnormal impact**, as it fundamentally alters soil properties beyond natural recovery without intervention. Given its persistence and severity, the **overall significance is High**.

Social Impacts

- **Disruption of established social ties and support networks:** Farming households that depend on the land may experience displacement and disruption of long-standing social and economic support systems. This is an **adverse, long-term, indirect, and abnormal impact**, since it affects the socio-cultural structure of communities in a way that is not easily reversible. The **overall significance is Medium**.

Civil and Construction Activities (Ground Levelling, Excavation, and Foundation Works)

Environmental Impacts

- **Noise from engines, machinery, and vehicle operations:** The operation of heavy-duty construction equipment and vehicles will produce significant noise on the site. This is an **adverse, short-term, direct, and normal impact**, persisting for the duration of construction but diminishing once the phase is complete. The **overall significance is Medium**.
- **Air quality impacts due to emissions from heavy-duty equipment and vehicles:** Construction machinery will release exhaust gases, including CO, NOx, and particulate matter, which degrade air quality in the immediate area. This is an **adverse, short-term, direct, and normal impact**, continuing for as long as machines are in use. The **overall significance is Medium**.

Social Impacts

- **Destruction of crops and farmlands:** Excavation and grading works may encroach on croplands, leading to direct loss of agricultural output. This is an **adverse, short-term, direct, and normal impact**, as it stems directly from construction earthworks. The **overall significance is Medium**.

- **Respiratory illness from airborne dust:** Dust released during earthworks can lead to respiratory ailments such as asthma and bronchitis. This is an **adverse, short-term, direct, and normal health impact**, with the **overall significance considered Medium**.
- **Stress, hearing loss, and sleep disturbance from prolonged noise exposure:** Workers and residents near the construction site may experience stress, fatigue, and hearing impairment from persistent exposure to construction noise. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance rated Medium**.

Cement Mixing, Concrete Batching, and Handling

Environmental Impacts

- **Contamination of surface water sources:** Runoff from batching activities may carry cement residues and chemicals into surface water bodies, causing contamination. This is an **adverse, short-term, direct, and abnormal impact**, introducing pollutants that are not naturally occurring in these waters. The **overall significance is Medium**.
- **Poor air quality from release of fine dust (PM_{2.5}, PM₁₀):** Dust emissions from batching and handling processes reduce ambient air quality, especially near mixing sites. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance assessed as Medium**.
- **Generation of construction waste (51 m³ of debris):** Batching and mixing will produce waste in the form of cement bags, formwork scraps, and metals. This is an **adverse, short-term, direct, and normal impact**, contributing to solid waste challenges on site. The **overall significance is Medium**.
- **Soil contamination from chemical or fuel spills:** Accidental spills of fuels, lubricants, or cement residues can degrade soil quality. This is an **adverse, long-term, direct, and abnormal impact**, as soil contamination may persist over time. The **overall significance is Medium**.

Social Impacts

- **Water-related health conditions from contamination:** Communities relying on affected water sources may suffer gastrointestinal and other waterborne diseases. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance rated Medium**.
- **Occupational health and safety risks to workers:** Workers exposed to cement dust and chemicals are at risk of skin and eye irritation, respiratory ailments, and allergic reactions. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance assessed as High**.
- **Abrasive lung damage from inhalation of dust:** Prolonged inhalation of cement and silica dust particles can cause severe lung damage. This is an **adverse, long-term, direct, and abnormal impact**, considered of **High significance**.

Haulage of Construction and Building Materials

Environmental Impacts

- **Greenhouse gas emissions from haulage trucks and machinery:** The transportation of materials will emit CO₂ and other greenhouse gases, contributing to air pollution and climate change. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance of Medium**.
- **Increased suspended particulate matter from haulage operations:** Windblown particles from trucks hauling sand and aggregates will degrade air quality. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance rated Medium**.

Social Impacts

- **Falling aggregates causing road accidents and injuries:** Poorly secured loads may fall from moving trucks, endangering other road users. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance of Medium**.
- **Deterioration of existing roads:** Heavy vehicle use will degrade road surfaces and accelerate wear and tear. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance considered Medium**.
- **Increased accident rate from high truck movement:** The rise in traffic involving large trucks increases the likelihood of accidents. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance rated Medium**.

Extraction, Processing, and Transportation of Quarried Materials

Environmental Impacts

- **Alteration of landscapes through excavation and spoil heaps:** Large pits and heaps formed during quarrying alter the natural landscape permanently. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance assessed as Medium**.
- **Soil compaction from heavy machinery:** Frequent use of quarry machinery compacts soils, reducing their ability to support vegetation recovery. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance rated Medium**.
- **Dust emissions from quarrying activities:** Blasting, drilling, and crushing of materials generate significant dust, reducing air quality. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance of Medium**.
- **Noise and vibrations from blasting and heavy machinery:** Quarry operations generate continuous noise and vibrations that disturb communities and wildlife. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance considered Medium**.
- **Air pollution and GHG emissions from quarry machinery:** The use of heavy equipment in quarries releases greenhouse gases and pollutants such as NO_x and CO₂. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance assessed as Medium**.

Social Impacts

- **Employment opportunities for local workers:** Quarrying activities will create jobs for locals, providing economic benefits. This is a **beneficial, short-term, direct, and normal impact** with positive socio-economic significance.
- **Safety risks from unmanaged quarry pits:** Abandoned or poorly managed pits present hazards to community members, particularly children. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance rated Medium**.

Construction of Fences, Buildings, and Utilities

Environmental Impacts

- **Noise from engines, heavy machinery, and vehicles:** Construction works will generate substantial noise over extended periods. This is an **adverse, short-term, direct, and normal impact**, with the **overall significance assessed as High**.
- **Disruption of wildlife migration patterns:** Fences and buildings may interfere with natural wildlife movement routes. This is an **adverse, long-term, indirect, and normal impact**, with the **overall significance of Medium**.
- **Introduction of pollutants into nearby water bodies:** Runoff from construction sites carrying cement residues and chemicals contaminates water sources. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance considered Medium**.
- **Soil contamination from improper waste disposal:** Cement bags, scrap metals, and formwork waste can pollute soil if disposed of improperly. This is an **adverse, long-term, direct, and abnormal impact**, with the **overall significance rated High**.

Social Impacts

- **Noise-induced stress and health impacts:** Prolonged noise from construction activities may lead to stress, fatigue, and hearing challenges. This is an **adverse, long-term, direct, and normal impact**, with the **overall significance assessed as Medium**.
- **Water quality impacts from hazardous waste runoff:** Hazardous construction materials stored or disposed of inappropriately may contaminate watercourses. This is an **adverse, short-term, direct, and abnormal impact**, with the **overall significance rated Medium**.

5.5.3 Operational Phase

CR SAPZ-ATC Facilities and Operations

Environmental Impacts

- **Increase in noise levels from operational machinery and equipment:** The continuous operation of machinery, including power plants and processing equipment, will elevate noise levels within and around the facility. This is an **adverse, long-term, direct, and normal impact**, as it is a natural consequence of facility operations. While persistent throughout the operational life, its effects are localized. The **overall significance is Medium**.

- **Air quality degradation from machinery emissions:** The daily release of pollutants such as nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons, and particulate matter (PM_{2.5} and PM₁₀) from operational machinery will reduce local air quality. This is an **adverse, long-term, direct, and normal impact**, as it is tied directly to ongoing facility functions. The persistence of emissions makes the **overall significance Medium**.
- **Generation of agricultural waste streams:** Processing activities such as peeling, separation of raw materials, and production will generate significant volumes of agricultural waste. This is an **adverse, long-term, direct, and normal impact**, as it occurs regularly throughout operations. If not effectively managed, it may contribute to environmental pollution. The **overall significance is Medium**.
- **Soil pollution from spills and maintenance activities:** Routine maintenance of machinery, including the use of fuels, lubricants, and aluminum oxide paints, poses a risk of soil contamination from spills and leakages. This is an **adverse, long-term, direct, and abnormal impact**, as contamination introduces pollutants not naturally present in soils and persists over time. The **overall significance is Medium**.

Social Impacts

- **Employment of community members:** Facility operations will create direct and indirect jobs for community members, boosting household incomes. This is a **beneficial, long-term, direct, and normal impact**, contributing positively to livelihoods and poverty reduction.
- **Boost to local economy and standard of living:** Employment and trade opportunities associated with the facility will enhance purchasing power and improve living standards. This is a **beneficial, long-term, indirect, and normal impact**, with broad socio-economic benefits.
- **Improvement of local infrastructure and amenities:** Facility development and associated services may improve roads, utilities, and other community infrastructure. This is a **beneficial, long-term, indirect, and normal impact**, which strengthens community development.
- **Reduction in crime and social vices:** Engagement of local youths in gainful employment will reduce idleness, helping to minimize crime and antisocial behavior. This is a **beneficial, long-term, indirect, and normal impact**, supporting social stability.
- **Enhanced socio-economic interactions:** The presence of the facility will increase opportunities for trade, collaboration, and social exchange beyond local boundaries. This is a **beneficial, long-term, indirect, and normal impact**, fostering regional integration.
- **Pressure on housing and infrastructure due to population influx:** Influx of workers and job seekers will create pressure on housing, water, and other local infrastructure. This is an **adverse, long-term, indirect, and normal impact**, as it results from increased demand beyond existing capacity. The **overall significance is Medium**.

5.5.4 Decommissioning Phase

Demolition and Removal of Camps, Cabins, and Equipment

Environmental Impacts

- **Increase in noise and dust generation from demolition activities:** The dismantling of camps, cabins, and associated structures will produce significant noise and dust emissions. This is an **adverse, short-term, direct, and normal impact**, arising naturally from demolition operations. While temporary, it can affect both the environment and human comfort. The **overall significance is Medium**.
- **Increase in noise and air pollution from transfer of heavy-duty equipment:** The removal and transportation of heavy-duty construction machinery will elevate noise levels and release vehicular emissions. This is an **adverse, short-term, direct, and normal impact**, with effects ceasing once equipment is evacuated from the site. The **overall significance is Medium**.
- **Generation of solid waste from dismantled facilities:** Demolition will generate substantial volumes of solid waste, including debris from structures and equipment parts. Improper disposal of this waste poses risks of soil and water contamination. This is an **adverse, short-term, direct, and abnormal impact**, as it introduces waste materials that are not naturally present in the environment. The **overall significance is Medium**.

Social Impacts

- **Job opportunities from demolition activities:** The decommissioning process will create employment for local workers involved in demolition, waste handling, and equipment removal. This is a **beneficial, short-term, direct, and normal impact**, improving short-term household incomes.
- **Improvement in youth livelihoods and reduction in social vices:** Engagement of local youths during decommissioning may enhance their living standards and reduce crime or antisocial behavior by providing productive opportunities. This is a **beneficial, short-term, indirect, and normal impact**, contributing positively to social wellbeing.
- **Health and safety risks to demolition workers:** Workers engaged in demolition activities face risks of accidents, injuries, dust inhalation, and other occupational hazards. This is an **adverse, short-term, direct, and normal impact**, given the physically intensive and hazardous nature of demolition works. The **overall significance is Medium**.

6 IMPACTS MITIGATION MEASURES

6.1 INTRODUCTION

This chapter presents environmental and social mitigation measures that have been identified through the impact assessment process. As presented earlier in Chapter 5, the proposed ATC project will definitely impact on various components of the biophysical, health and social environments and the identified negative impacts have been ranked accordingly. To mitigate the significant medium and high-ranking negative impacts identified as a result of the proposed development, a number of steps

have been taken as well as enhance those impacts identified as positive to preserve the environment. The mitigation measures proposed for the predicted impacts took cognizance of the following:

- Environmental laws in Nigeria and permissible limits for waste streams (FEPA, 1991);
- AfDB's guidelines for mitigation measures are designed to:
- Integrate environmental and social considerations into all aspects of project planning and implementation.
- Minimize negative impacts on the environment and communities.
- Promote sustainable development and social inclusion.
- Ensure accountability and transparency in project management.
- Best Available Technology for sustainable development;
- Feasibility of application of the measures in Nigeria;
- Concerns and views of stakeholders during extensive consultations conducted during the study, and
- The residual effects that arise despite the mitigation measures have also been discussed for effective mitigation to a low level.

The mitigation measures for both the impacts before, and during the construction and operational phases are discussed in Table 6.1, with respective environmental monitoring and management requirements.

6.2 Impact Mitigation Measures

For those associated/potential impacts that were identified during the pre-construction phase, the proposed mitigation measures are addressed as presented in Table 6.1.

Table 6.1: Impact Mitigation Measures across the Project Phases

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
Pre-construction Phase	Equipment and Personnel Mobilization	Noise pollution from heavy-duty trucks, equipment, and personnel movement	Host Communities Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: ▪ Restrict mobilization of heavy-duty trucks, equipment, and personnel to daylight hours. ▪ Maintain machinery with functional silencers ▪ Install temporary noise barriers near sensitive receptors such as school area, religious area etc. ▪ Limit engine idling times.	Low
		Air pollution from vehicle emissions (CO, NO ₂ , SPM, SO ₂)	• Host Communities • Mobilised Individuals (construction workers)	Medium	CR-SAPZ shall: ▪ Ensure low-emission or fuel-efficient heavy-duty trucks, equipment is mobilised for the project ▪ Conduct periodic emission testing to ensure low emission output ▪ Enforce “no idling” policy for resource maximization	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Use low-sulfur fuels where possible.	
	Site Clearing	Vegetation loss of about 37.94 ha and habitat disturbance of 12.5 ha	- Host Communities - Ecosystem	Medium	CR-SAPZ shall: - Give adequate notice to tenant farmers before clearing - Target post-harvest period for clearing to ensure farmers have harvested their crops - Restrict clearing to project footprint; - Replant native species; - Prepare and implement a flood and erosion control plan.	Low
		Removal of top soil of about 97,983.6 m ³ and soil compaction increased erosion potential	- Host Communities - Ecosystem	High	CR-SAPZ shall: - Strip and store topsoil separately (to a depth of 150–300 mm) before excavation for later re-use in site rehabilitation. - Limit clearing and topsoil removal to the smallest area necessary at any one time to reduce exposure.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Avoid heavy machinery movement on wet soils to minimize compaction.	
		Reduced carbon sequestration capacity due to vegetation loss of about 32,220 m ³ amounting to about 164,082m ³ biomass	Ecosystem	High	CR-SAPZ shall: - Clear the vegetation from the project footprint selectively; - Implement compensatory afforestation by planting native species of trees and shrubs along the entire site perimeter and internal fences and the proposed internal major and minor road network at 10 m interval. This will give about 868 trees. At maturity, in 4-6 years, these will increase the annual carbon sequestration capacity of the site by 12.1 tons of CO₂. - Avoid ecologically sensitive area by preserving the 6.5 ha of riparian vegetation along the water/ drainage channel within the ATC site (BMP refers)	Low
		Increased noise levels, vibration and	Host Communities	Medium	CR-SAPZ shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		air quality degradation from machines and equipment	Mobilised Individuals (construction workers)		- Schedule noisy operations to avoid early mornings (6 am - 10 am) and nights (7pm – 6am). - Maintain equipment in good working condition to reduce noise output and emission. - Apply water sprays to suppress dust.	
		Dust generated from about 130,203.6 m ³ soil stockpiles and handling	- Host communities - Construction workers	Medium	CR-SAPZ shall: - Cover stockpiles with tarpaulins. - Wet exposed surfaces during dry periods. - Limit vehicle speeds on unpaved roads to ≤ 20 km/h (Traffic MP refers) - 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.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Evacuate vegetative waste as soon as they generated to avoid putrefaction	
		Vegetative waste generation due to trees, shrubs and grasses clearing	Ecosystem	Medium	CR-SAPZ shall: Reuse chipped material for mulching or erosion control.	Low
		Increased erosion potential due vegetation loss	Ecosystem	Medium	CR-SAPZ shall: - Install silt fences and sediment traps - Restrict machinery movement to defined access routes and stabilize exposed soil promptly.	Low
		Reduction in structural stability and percolation ability of soil due to compaction and other engineering activities	Ecosystem	Medium	CR-SAPZ/DBOC shall: - De-compact soils in non-structural areas post-works - Use light-weight equipment where possible. - Construct silt fences to prevent the wash away of the topsoil	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Construct sediment basins to capture sediment-laden runoff from rainfall	
Construction Phase	Site Preparation through; Removal of vegetation and soil compaction from 37.94 ha	Increase dust generation from cleared land and windblown stockpiles.	- Host communities - Construction workers	Medium	- CR-SAP shall: - Regularly spray water on exposed soil surfaces and stockpiles, especially during dry or windy conditions. - Cover stockpiles with tarpaulin, geotextile sheets, or fast-growing ground cover vegetation to reduce wind erosion. - Restrict vehicle speeds on unpaved surfaces to ≤ 20 km/h to reduce dust from movement. - Schedule high-dust-generating activities (e.g., grading, excavation) during periods of low wind speeds. - Evacuate vegetative waste as soon as they generated to avoid putrefaction	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Provide and enforce the use of appropriate PPE OHSP & LMP refer)	
		Increased soil erosion potential; reduction in structural stability and percolation ability of soil.		Medium	CR-SAPZ/DBOC shall : - Strip and store topsoil separately for later use in site restoration - Limit clearing to the minimum area of about 37.94 ha - Avoid machinery movement on wet soils. - Install erosion controls (silt fences, sediment basins) before earthworks. - Maintain buffer vegetation along waterways (FECP refers).	Low
	Civil and Construction activities through ground levelling, excavation and foundation	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site		Medium	CR-SAPZ/DBOC shall: - Monitor noise levels regularly to ensure compliance with FMEEnv standards. - Use temporary noise barriers or acoustic screens near	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					sensitive receptors (schools, hospitals, residences). ▪ Provide hearing protection (ear muffs/plugs) to workers exposed to noise >85 dB(A). ▪ Maintain all machinery to manufacturer specifications to minimise noise. ▪ Fit equipment with functional silencers/mufflers. ▪ Restrict noisy operations to 07:00–18:00 and avoid night-time work.	
		Air quality impacts due to emissions of about 164,082 m ³ from the operation of heavy-duty construction machines such as bulldozer and motors vehicles on site		Medium	CR-SAPZ/DBOC shall: ▪ Regularly spray water on exposed soil surfaces and haul roads during dry conditions. ▪ Cover soil stockpiles with tarpaulin to prevent wind erosion. ▪ Limit vehicle speeds on unpaved surfaces to ≤ 20 km/h.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	Cement mixing, concrete batching and handling				Use low-emission or well-maintained machinery and vehicles	
		Contamination of surface water sources		Medium	CR-SAPZ/DBOC shall: - Site batching plants at least 200 m away from water bodies and outside flood-prone zones. - Prevent direct discharge of wastewater into drains or watercourses. - Implement spill prevention and response protocols for cement and additives	Low
		Poor air quality to the release fine dust, including PM _{2.5} and PM ₁₀ , into the air		Medium	CR-SAPZ/DBOC shall: - Store cement in sealed silos or under cover to prevent wind exposure. - Fit cement silos with dust filters and use enclosed transfer systems - Spray water or use fogging systems at aggregate transfer points.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					- Enforce the use of PPE (P2/N95 masks) for workers handling dry cement.(OHSP and LMP refer) - Limit drop heights during loading/unloading to reduce airborne dust.	
		Batching plants and mixing sites generate construction waste of about 51 m ³ in form of cement bag, formwork waste, scrap metals and fasteners		Medium	CR-SAPZ/DBOC shall: - Implement a waste minimization plan to avoid over-mixing. - Segregate concrete waste for reuse in backfilling or road base where feasible. - Collect and store non-recyclable residues in designated waste areas. - Dispose of hardened waste through licensed waste contractors. - Maintain accurate waste disposal records for compliance tracking.	Low
		Spills of chemicals,		Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		fuels, or other pollutants can contaminate the soil.			- Store fuels, oils, and chemical admixtures in bunded areas with impermeable flooring. - Use drip trays during refueling and equipment servicing. - Train workers in safe handling of chemicals and emergency spill response - Keep spill kits accessible at all batching and storage locations - Immediately clean contaminated soil and dispose of as hazardous waste.	
		Leaks from vehicles or equipment can also lead to soil contamination.		Medium	CR-SAPZ/DBOC shall: - Conduct daily inspections of mixers, pumps, and other equipment for leaks. - Repair or replace defective equipment immediately.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					▪ Park machinery on impermeable surfaces with containment bunds. ▪ Capture leaks with absorbent pads or trays and dispose of them appropriately. ▪ Maintain a preventive maintenance schedule for all batching equipment.	
	Haulage of construction/building materials	Increased GHG emissions from trucks, heavy duty machines and equipment of about 164,082 tCO ₂ e		Medium	CR-SAPZ/DBOC shall: ▪ Use fuel-efficient or low-emission vehicles for all construction activities. ▪ Implement a preventive maintenance schedule to ensure engines operate efficiently. ▪ Optimize delivery routes to minimize travel distance and idle time. ▪ Enforce “no-idling” policy for stationary vehicles. ▪ Monitor fuel consumption and emissions regularly to track efficiency improvements.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		Increased SPM due to wind blowing particles from operation trucks hauling sands and aggregates		Medium	CR-SAPZ/DBOC shall: ▪ Cover all loads with tarpaulin before transportation. ▪ Avoid overloading trucks to prevent spillage. ▪ Apply water spraying to haul roads during dry conditions. ▪ Restrict haulage truck speeds to ≤ 30 km/h in communities and unpaved areas (Traffic MP refers). ▪ Install wheel-wash facilities at site exits to reduce dust tracking onto public roads.	Low
	Extraction, processing, and transportation of quarried materials (such as sand, and stone)	Alteration of landscapes due to the removal of topsoil, excavation of large pits, and creation of spoil heaps.	Ecosystem	Medium	CR-SAPZ/DBOC shall: ▪ Restrict quarrying to approved and licensed areas. ▪ Maintain buffer zones around sensitive habitats and water bodies.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					- Implement progressive rehabilitation by regrading and re-vegetating disturbed areas. - Use visual screening (vegetative buffers or berms) to minimize landscape intrusion.	
		Heavy machinery on and around the quarry can also compact soil, inhibiting future vegetation growth.		Medium	CR-SAPZ/DBOC shall: - Limit heavy machinery movement to designated haul routes. - Use low ground-pressure machinery where feasible. - De-compact soils in non-operational areas through scarification or ripping after use. - Apply mulch or ground cover vegetation to restore infiltration and prevent erosion.	Low
		Quarrying activities like drilling, blasting, crushing, and transporting		Medium	CR-SAPZ/DBOC shall: Use water spray systems at crushers, conveyors, and loading points.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		materials generate large amounts of dust.			- Enclose conveyors and material handling systems where possible. - Schedule blasting during low-wind conditions and notify nearby communities in advance. - Monitor dust levels and adjust suppression measures as needed. - Require workers in dusty areas to wear approved PPE (P2/N95 masks) (OHSP and LMP refer)	
		Heavy machinery and frequent blasting create significant noise and vibrations that can disturb wildlife and communities near the quarry.	- Host communities - Construction workers	Medium	CR-SAPZ/DBOC shall: - Limit blasting to designated times and avoid night-time operations. - Maintain and fit machinery with noise-reducing devices. - Install seismographs to monitor vibration levels and ensure they remain below damage thresholds.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					- Notify local communities at least 24 hours before blasting. - Provide hearing protection to workers in high-noise areas.	
		Increase air quality pollution and greenhouse gas emission due to machinery used in quarries emits pollutants like nitrogen oxides and carbon dioxide (CO ₂)		Medium	CR-SAPZ/DBOC shall: - Maintain engines to operate at peak efficiency. - Use fuel-efficient or low-emission equipment. - Optimize operational schedules to reduce idle times. - Monitor fuel use and emissions regularly.	Low
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site	Ecosystem	High	CR-SAPZ/DBOC shall: - Maintain machinery in good working condition and fit silencers/mufflers. - Restrict high-noise operations to between 11 am –4 pm.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					- Install temporary acoustic barriers near noise-sensitive receptors - Provide hearing protection (ear muffs/plugs) to workers. - Conduct periodic noise monitoring to ensure compliance with FMEnv standards.	
		Disruption of wildlife migration patterns		Medium	CR-SAPZ/DBOC shall: - Incorporate wildlife crossings (culverts, underpasses) where feasible. - Avoid construction during peak breeding or migration seasons. - Maintain vegetative corridors where possible. - Limit night-time work and use down-shielded lighting to reduce disturbance.	Low
		Introduction of pollutants (such as cement dust,	Host communities	Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		leftover cement mix) into nearby water bodies through run-off			- Install sediment barriers, silt fences, or sediment basins to capture runoff. - Collect cement slurry and wash water in lined containment pits. - Dispose of concrete debris through licensed waste handlers. - Prevent construction materials from entering drainage channels and water bodies.	
		Soil contamination due to improper disposal of construction materials waste (e.g. cement bag, formwork waste, scrap metals and fasteners etc.)	- Host communities - Ecosystem	Medium	CR-SAPZ/DBOC shall: - Store hazardous materials in bunded, leak-proof containers. - Designate and manage hazardous waste storage areas. - Engage FMEnv-approved contractors for hazardous waste disposal.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					- Train workers in proper handling of asphalt, paints, and chemical additives. - Clean spills immediately and dispose of contaminated soil as hazardous waste.	
Operational Phase	CR SAPZ-ATC facilities and operations	Increase noise level from the operations of various machines and equipment such as power plant	Ecosystem	Medium	CR-SAPZ shall: - Install acoustic enclosures, silencers, or mufflers on noisy equipment. - Schedule high-noise activities during daytime working hours to minimize community disturbance. - Implement preventive maintenance to reduce unnecessary noise from faulty machinery. - Provide hearing protection devices (earplugs, earmuffs) to workers in high-noise zones (OHSP and LMP refers). - Establish a noise monitoring program to ensure	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					compliance with permissible limits. Introduce green buffer zones (trees/shrubs) around the facility to dampen noise propagation (BMP refers_	
		The daily release of nitrogen oxides (NO _x), carbon monoxide (CO), hydrocarbons, and particulate matter (PM) from traffic directly affects local air quality		Medium	CR-SAPZ/ shall: - Promote regular maintenance of company vehicles and machinery to ensure optimal combustion and reduced emissions. - Encourage shuttle buses, or non-motorized transport for staff to reduce traffic volume. - Establish dust suppression measures (e.g., water spraying on unpaved roads). - Implement traffic management plans to avoid congestion within and around the site. - Monitor air quality periodically and report findings	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					to relevant environmental authorities. Use fuel-efficient driving practices and train drivers accordingly.	
		Streams of agricultural waste generate such as peeling process, separations of raw materials and processed waster from production	- Host communities - Ecosystem	Medium	CR-SAPZ shall: - Implement waste segregation at the source (separate organic, recyclable, and non-recyclable waste). - Adopt waste-to-compost or waste-to-energy systems for organic waste. - Install sedimentation tanks or filter screens in wastewater discharge points to trap solid waste. - Establish agreements with local farmers for reuse of organic waste as animal feed or soil conditioners (where safe). - Regularly monitor effluent quality to ensure compliance with environmental standards.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Provide staff training on proper waste handling and disposal.	
		Increase soil pollution potential due to spilled fuel, spent oil, lubricants, aluminum oxide paint etc. during routine maintenance of the operating machineries and equipment		Medium	CR-SAPZ shall: - Create designated maintenance areas with impermeable flooring and oil interceptors to prevent soil infiltration. - Implement spill prevention and response plans, including spill kits and trained personnel. - Store fuels, lubricants, and chemicals in bundled (contained) storage facilities. - Dispose of spent oil and hazardous waste through licensed waste management companies. - Conduct regular inspection and maintenance of storage tanks, pipelines, and machinery. - Use drip trays under parked or idle equipment to catch leaks.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Prohibit direct disposal of any hazardous materials into the environment.	
Decommissioning Phase	Demolition and Removal of camps, cabins, equipment etc.	Increase noise level and dust generation due to the demolition and removal of camps components and other structures	Construction worker	Medium	CR-SAPZ/DBOC shall: - Restrict demolition works to daylight hours (11 am – 4pm) to minimize disturbance. - Maintain and fit demolition machinery with effective silencers/mufflers - Use controlled dismantling methods rather than high-impact demolition where possible. - Install temporary noise barriers near sensitive receptors. - Provide hearing protection to workers and monitor noise levels to comply with FMEnv standards (OHSP refers)	Low
		Increase noise and air quality pollution due to transfer of	Host communities	Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		heavy-duty equipment and construction machineries	Construction worker		- Spray water on debris and demolition areas to suppress dust during operations. - Cover trucks transporting debris with tarpaulins. - Store demolition waste in enclosed or covered areas. - Restrict vehicle speeds on unpaved surfaces to ≤ 20 km/h - Require all workers in dusty areas to wear dust masks (P2 or N95) (OHSP refers).	
		Solid waste generation and improper disposal waste facility		Medium	CR-SAPZ/DBOC shall: - Segregate demolition waste into recyclable (metal, timber) and non-recyclable fractions. - Reuse or recycle materials where feasible (e.g., scrap metal to recycling plants). - Store waste in designated, secure areas before disposal. - Engage licensed waste disposal contractors for final disposal.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Maintain waste tracking documentation for regulatory compliance.	
	Decommissioning traffic diverted road for road users as alternative during construction	Dust emissions from temporary diversion dismantling or degradation	Ecosystem	Medium	CR-SAPZ/DBOC shall: - Water exposed surfaces during dismantling - Clear debris promptly and dispose of it at approved sites. - Re-vegetate disturbed areas immediately - Use erosion control structures where needed.	Low
		Soil compaction or damage during diversion closure		Medium	CR-SAPZ/DBOC shall: - De-compact soils in affected areas using tillage methods. - Restore topsoil and plant native vegetation. - Ensure drainage systems are functional after closure - Monitor restored areas for 6–12 months.	Low

Table 6.2: Social Impact Mitigation Measures across the Project Phases

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
Pre-construction Phase	Land takeover (repossession) of 37.8 ha	Economic displacement of 340 people across 68 households losing farmlands and crops	Host communities	High	CR-SAPZ shall: Prepare and implement a Livelihood Restoration/Enhancement Plan (LRP) which will aim at improving the PAPs' livelihood through agro-industrial productivity and earnings and subsequently integrate the identified tenant-farmers who currently use the 37.84 ha designated for the proposed ATC into the SAPZ Program.	Low
		Conflicts may emerge due to insufficient stakeholders' engagement and/or perceived inadequate compensation for farmland and crops loss or perceived disparity in compensation		High	CR-SAPZ shall: - Establish a transparent and inclusive stakeholder engagement plan (refer Cap 7, page xxx) - Disclose the eligibility and entitlement criteria of the LRP during stakeholder engagement workshop (details in CAP 4 page xxx), - Deploy independent grievance redress mechanism (GRM) to the PAPs with community/PAPs representative (refer CAP 7, page xxx) - Promptly implement the LRP, GRM, & stakeholder engagement plan (SEP) and ensure transparency	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Work with community-appointed CLO	
	Equipment and Personnel Mobilization	Population surge of about 50 workers leading to pressure on available resources (e.g. water, space etc.)	- Host Communities - Mobilised Individuals (construction workers)	Medium	CR-SAPZ/DBOC shall: - Provide separate project accommodation, water, and sanitation for workers. - Coordinate with local authorities to manage resource use. - Avoid reliance on community water supply systems.	Low
		Outbreaks of communicable diseases (eg. Flu, Tuberculosis, Ringworm)		Medium	CR-SAPZ/DBOC shall: - Conduct pre-employment health screening for workers. - Maintain an on-site clinic with trained medical staff.-Organize regular health awareness programs for workers and communities.	Low
		Worsening anti-water and anti-sanitation practices;		Medium	CR-SAPZ/DBOC shall: - Install adequate and gender-segregated toilet facilities. - Enforce daily cleaning and waste management procedures. - Provide potable water for drinking and cooking.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		Social interactions including sexual relations between workers and community members may lead to increased incidence of sexually transmitted infections (STI) including HIV/AIDS		Medium	CR-SAPZ/DBOC shall: - Conduct awareness and prevention campaigns. - Provide free condoms and voluntary HIV testing. - Partner with local health NGOs for outreach.	Low
		Risk of respiratory diseases in personnel and members of the community		Medium	CR-SAPZ/DBOC shall: - Provide workers with PPE such as N95 masks. - Maintain dust suppression measures in work areas. - Schedule dust-generating activities during low-wind periods.	Low
		Reducing aesthetic value of the area.		Medium	CR-SAPZ/DBOC shall: - Screen camps and laydown areas with green fencing. - Maintain cleanliness and landscaping in project areas.	Low
		Population surge of about 50 workers will increase the domestic waste generation by ~300 m ³ of solid waste		Medium	CR-SAPZ/DBOC shall: - Use dedicated project water sources. - Install rainwater harvesting systems for non-potable uses.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		leading to sanitation challenges.			- Segregate waste and recycle where feasible. - Engage licensed waste disposal contractors. - Prohibit indiscriminate dumping.	
	Site Clearing	Increased earnings to local labourer from the clearing of vegetation and site preparation	Host communities		- CR-SAPZ/DBOC shall: - Prioritize recruitment of local labour from host and neighbouring communities. - Offer fair wages aligned with or above local market rates. - Provide short-term contracts that allow multiple community members to benefit. - Offer on-the-job skills training to improve employability beyond the project.	Low
		Improved standard of living			CR-SAPZ/DBOC shall: - Facilitate prompt payment to workers to support household needs. - Provide financial literacy sessions to help workers manage increased income. - Support community infrastructure initiatives (e.g., water points, sanitation	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					facilities) from project social investment funds. Encourage local procurement of goods and services to boost community economy.	
		Reduce crime and social vices due to various engagement through job opportunities			CR-SAPZ/DBOC shall: - Ensure job opportunities are widely publicized within the community to avoid favouritism perceptions. - Engage unemployed youth and vulnerable groups in project employment. - Combine employment with life skills and vocational training programs. - Establish a transparent recruitment process to enhance trust and social cohesion.	Low
Construction Phase	Site Preparation through; Removal of vegetation and soil compaction from 37.94 ha	Disruption of established social ties and support networks due to the displacement of farming household	Host Communities	Medium	CR-SAPZ/DBOC shall: - Conduct early and inclusive stakeholder engagement sessions to understand community linkages before clearance. - Stage clearing works to minimize prolonged disruption and ensure temporary connections remain open.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	Civil and Construction activities through ground levelling, excavation and foundation				Document and monitor social impacts, adjusting mitigation in collaboration with community leaders.	
		Destruction crops and farm lands due to excavation and grading of farmland		Medium	CR-SAPZ/DBOC shall: - Carry out detailed asset and crop inventory with community representatives before works. - Provide compensation at full replacement value before disturbance. - Confine machinery to designated work areas to prevent accidental damage.	Low
		Respiratory illness from airborne dust due to earthwork activities could lead to common colds, flu, asthma etc.		Medium	CR-SAPZ/DBOC shall: - Apply continuous dust suppression using water spraying, especially during dry and windy periods. - Provide high-grade PPE (N95 or equivalent) to all exposed workers. - Limit earthworks during peak wind conditions and ensure material stockpiles are covered. - Monitor ambient air quality and adjust suppression measures as needed.	Low
		Prolonged exposure to noise from earthwork activities can cause		Medium	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		stress, hearing loss, and sleep disturbance.			▪ Restrict high-noise activities to 11 am –4 pm to reduce disturbance. ▪ Maintain equipment silencers/mufflers and replace defective components immediately. ▪ Install portable noise barriers near sensitive receptors such as schools and residences. ▪ Provide certified hearing protection to all workers in high-noise zones and rotate shifts to limit exposure duration.	
	Hiring of construction personnel	Employment of community locals	Host Communities		CR-SAPZ/DBOC shall: ▪ Implement a “Local First” hiring policy with clear targets for local workforce participation. ▪ Publicly advertise job openings in community meeting points and through local leaders. ▪ Provide on-the-job training to enhance transferable skills for post-project employment. ▪ Maintain transparent recruitment records to build trust.	Low
		Boost of local economy and improvement of standard of living through job			CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		opportunities and high purchasing rate			- Source consumables, food supplies, and basic services from local businesses where feasible. - Provide vendor development training to help local suppliers meet quality and safety requirements. - Ensure prompt payment to contractors and suppliers to maintain cash flow in the community. - Encourage the hiring of local transporters and service providers.	
		Provision or improvement of local infrastructure and amenities			CR-SAPZ/DBOC shall: - Work with community representatives to identify priority infrastructure needs. - Use durable, low-maintenance materials for any amenities provided. - Employ local labour during construction to maximize community benefit. - Commit to periodic maintenance during the project life.	Low
		Conflicts may emerge during site clearing and preparation activities due to insufficient consultations and/or		Medium	CR-SAPZ/DBOC shall: Establish a transparent and inclusive stakeholder engagement plan (refer Cap 7, page xxx) that structure structured	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		perceived disparities in employment opportunities			consultations before and during recruitment, ensuring participation of women, youth, and vulnerable groups. - Clearly communicate job selection criteria, wage rates, and timelines. - Operate a grievance redress mechanism accessible to all community members (refer CAP 7, page xxx). - Conduct regular social monitoring to detect and address tensions early through independent grievance redress mechanism (GRM) (refer CAP 7, page xxx) - Work with community-appointed CLO	
	Cement mixing, concrete batching and handling	Water-related health conditions due to water source contamination	Host communities Construction workers	Medium	CR-SAPZ/DBOC shall: - Locate batching plants at least 200 m from community water sources. - Install impermeable containment for wash water and cement residue. - Treat all wastewater before discharge. - Monitor water quality regularly during batching operations.	Low
		Occupational, health and safety concerns for the workers due to potential	Construction workers	High	CR-SAPZ/DBOC shall:	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		skin and eye irritation, respiratory and allergic concerns.			- Provide full PPE (gloves, goggles, masks, protective clothing) for all cement handling operations. - Conduct regular safety training on handling hazardous materials. - Ensure availability of eye wash stations and emergency showers. - Implement health monitoring for early detection of occupational illnesses.	
		Abrasive damage to the lung due inhalation of airborne dust from cement and silica.		High	CR-SAPZ/DBOC shall: - Use enclosed or covered systems for cement transfer and storage. - Apply local exhaust ventilation in enclosed workspaces. - Issue high-efficiency particulate respirators to all workers in dusty areas. - Minimize manual handling of dry cement and keep handling areas damp where possible.	Low
		Damage to the natural landscapes due to quarrying for raw materials	Ecosystem	High	- CR-SAPZ/DBOC shall:: - Restrict quarrying strictly to approved and designated extraction zones as per environmental permits.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					- Implement phased extraction to limit the exposed area at any one time. - Undertake progressive reclamation by backfilling and re-vegetating quarried sections immediately after use. - Preserve visual aesthetics by maintaining vegetative buffers and using natural landscaping techniques to screen disturbed areas from public view.	
		Destruction of flora and fauna habitats and potentially disrupting ecological balance due to quarrying for raw materials		High	CR-SAPZ/DBOC shall:: - Conduct baseline biodiversity surveys prior to extraction to map critical habitats (reference BMP for details). - Establish and enforce ecological buffer zones where no quarrying is allowed. - Schedule extraction activities to avoid sensitive breeding and nesting periods for wildlife. - Implement habitat restoration programs, including replanting native species and creating alternative habitats to offset ecological losses.	Low
		Aggregates falling off and hitting and	Road Users	Medium	CR-SAPZ/DBOC shall::	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	Haulage of construction materials	damaging third party windshields and causing other forms of injuries			- Require that all loads to be covered with tarpaulins before leaving the site - Develop and enforce a project-specific Traffic Management Plan (Available in Chapter 7). - Enforce strict speed limits through speed governors and GPS tracking. - Position traffic marshals at critical community crossings.	
		Deterioration of existing roads	Host Communities Road Users	Medium	CR-SAPZ/DBOC shall: - Require all loads to be covered with tarpaulins before leaving the site - Use secure load restraint systems to prevent spillage. - Conduct regular inspections of truck loading practices. - Enforce penalties for non-compliance.	Low
		Increased accident rate due to increased movement of trucks and other earth-moving vehicles	Road Users Construction workers	Medium	CR-SAPZ/DBOC shall: - Use designated haulage routes agreed with local authorities. - Schedule heavy loads to avoid peak traffic times. - Repair any project-related road damage promptly.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Monitor road conditions weekly and take corrective action as needed.	
	Extraction, processing, and transportation of quarried materials (such as laterite, sand, and stone)	Provide employment for the locals	Host Communities		CR-SAPZ/DBOC shall: - Award labour and transport contracts to local businesses and individuals. - Offer job-specific training to improve quality and safety performance. - Provide fair wages and good working conditions. - Ensure transparent selection to avoid favouritism.	Low
		Large and unmanaged quarry pits pose safety risks to community members	Host Communities	Medium	CR-SAPZ/DBOC shall: - Erect fencing or barriers around active and inactive pits. - Post clear warning signage in local languages. - Rehabilitate and backfill unused pits promptly. - Conduct regular inspections to ensure safety measures remain intact.	Low
	Construction of fence, buildings and utilities	Noise from the operations of engines, heavy duty construction machines and motors vehicles on site cause	Host Communities	Medium	CR-SAPZ/DBOC shall: Limit noisy operations to daylight hours (11 am – 5 pm).	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		stress, hearing loss, and sleep disturbance.	Construction workers		▪ Maintain silencers/mufflers on machinery. ▪ Provide hearing protection to all workers. ▪ Monitor noise at sensitive locations and adjust activities if limits are exceeded.	
		Impact on water quality if hazardous wastes are discharged to watercourses or from runoff from inappropriately stored hazardous waste		Medium	CR-SAPZ/DBOC shall: ▪ Construct bunded and covered hazardous waste storage areas with impermeable flooring located away from water bodies; ▪ Install spill containment and drainage interception systems ▪ Implement strict waste labelling and segregation protocols	Low
Operational Phase	CR SAPZ-ATC facilities and operations	Employment of community locals	Host Communities		CR-SAPZ/DBOC shall: ▪ Develop and implement a transparent recruitment policy prioritising local labour ▪ Collaborate with community leaders to identify suitable candidates; ▪ Provide vocational and on-the-job training;	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Establish fair wages and safe working conditions to retain local workforce	
		Boost of local economy and improvement of standard of living through job opportunities and high purchasing rate			CR-SAPZ/DBOC shall: - Encourage local procurement of goods and services; - Provide business capacity-building workshops for local entrepreneurs; - Facilitate microcredit or small loan schemes for community-based suppliers; - Support the creation of cooperatives to meet project supply needs.	
		Provision or improvement of local infrastructure and amenities			CR-SAPZ/DBOC shall: - Collaborate with local government to identify infrastructure gaps; - Co-fund or contribute to road, water, and power upgrades; - Maintain project-built infrastructure for community use; - Ensure accessibility and sustainability of amenities post-project.	
		Reduction in crime and social vices through			CR-SAPZ/DBOC shall:	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		engagement of local youth			- Create targeted youth employment programs; - Partner with NGOs for vocational training and mentorship schemes; - Integrate conflict resolution and life skills training into employment programs.	
		Enhance socio-economic potential of the locals and increase interaction beyond immediate localities			- CR-SAPZ/DBOC shall: - Promote local products through project-linked supply chains; - Provide internet connectivity and ICT training to expand market access.	
		Pressure on local housing and infrastructure due to influx of people seeking for job opportunity and those working in the area			- CR-SAPZ/DBOC shall: - Develop worker housing plans to minimise strain on community resources; - Implement local recruitment to reduce external migration - Coordinate with authorities to upgrade water, sanitation, and transport systems; - Establish rent control measures in partnership with local government to prevent inflation.	Low
Decommissioning Phase		Job opportunity for the demolition exercise	Host Communities		CR-SAPZ/DBOC shall:	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
	Demolition and Removal of camps, cabins, equipment etc.				▪ Prioritize hiring from host and adjoining communities to maximize local benefit. ▪ Offer short-term training in demolition safety, waste handling, and equipment operation to improve skills for future employment. ▪ Maintain transparent recruitment processes with publicized criteria and timelines. ▪ Ensure fair wages and prompt payment to all workers engaged in decommissioning activities.	
		Positively improve living standard of the youth			CR-SAPZ/DBOC shall: ▪ Facilitate prompt wage disbursement to support household income stability. ▪ Encourage local expenditure by sourcing goods and services from community businesses. ▪ Provide financial literacy sessions to help workers manage increased income effectively. ▪ Support local service providers (e.g., catering, transport) to supply the demolition workforce.	

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
		Reduction in crime and social vices through engagement of local youth			- CR-SAPZ/DBOC shall: - Actively recruit unemployed youth for demolition-related roles. - Pair work engagement with vocational and life-skills training to create post-project livelihood options. - Partner with community leaders to identify at-risk individuals for priority hiring. - Maintain worker engagement in structured activities to reduce idle time and the risk of anti-social behaviour.	
		Health and safety risks to workers from demolition activities	Construction workers	Medium	CR-SAPZ/DBOC shall: - Provide full PPE (hard hats, steel-toe boots, gloves, safety goggles, high-visibility vests, and dust masks) to all demolition workers. - Conduct comprehensive safety briefings before starting demolition tasks. - Use controlled demolition techniques to minimize collapse hazards and debris spread. - Maintain clearly marked exclusion zones to protect workers and the public.	Low

Project Phase	Project Activity	Potential Impact	Receptor	Significance (Pre-mitigation)	Mitigation Measures	Significance (Post-mitigation)
					Ensure first-aid facilities, trained medical personnel, and emergency response plans are in place and functional on-site (refer OHSP).	

7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

Environmental and Social Management Planning is a critical component of sustainable project development. The Environmental and Social Management Plan (ESMP) serves as a practical tool to guide the implementation of mitigation and enhancement measures identified in the Environmental and Social Impact Assessment (ESIA). It ensures that potential adverse environmental and social impacts arising from the proposed project, are managed effectively, while positive impacts are enhanced and leveraged for community development. Therefore, a robust ESMP is needed to:

- Minimize project-related environmental degradation,
- Promote community health and safety,
- Enhance employment and livelihood benefits, and
- Ensure compliance with Nigerian environmental regulations and international environmental best practices.

This chapter elaborates the management plans (MPs) monitoring responsibilities, capacity-building initiatives, reporting protocols, and budget estimates to ensure the project's alignment with principles of environmental sustainability and social equity.

7.1 Objectives of the ESMP

The long-term objectives of the ESMP are to:

- Translate the ESIA findings into implementable actions.
- Provide a structured approach for the prevention, minimization, and control of environmental and social impacts.
- Outline institutional arrangements and roles for implementing and supervising mitigation and monitoring actions.
- Ensure the participation of all stakeholders, including local communities, in the management of project impacts.
- Promote compliance with national environmental policies, state laws, and relevant international guidelines such as those from the AfDB, and the International Labour Organization (ILO).

7.2 Scope of the ESMP

The scope of this ESMP includes giving guidelines to all parties involved in the implementation of the proposed project in fulfilment of its environmental and social requirements. The ESMP has the following long-term objectives:

- Ensuring that environmental management conditions and requirements are implemented during the construction and post-construction period;
- Ensuring that the interests of the general public and other stakeholders are considered throughout the construction and operational phases of the project; and
- Ensuring that maximum socioeconomic benefits accrue to the project area and the entire country.

7.3 Institutional Arrangements and Responsibilities

The institutions and responsibilities, presented in Table 7.1, include but are not limited to:

- CR SAPZ: Overall ESMP implementation, monitoring oversight, and reporting.
- DBO Contractors: Daily implementation of mitigation measures and reporting incidents.
- Federal Ministry of Agriculture and Food Security (FMAFS): Interface and coordination of the stakeholders representing as the national program coordination unit (NPCU)
- Federal Ministry of Environment (FMEnv): Regulatory oversight, periodic audits, and ESIA approval.
- Cross River State Ministry of Environment: Monitoring of compliance with state-specific environmental standards.
- Community Liaison Officers (CLOs): Engagement, grievance management, and feedback loop between project and host communities.
- Independent Environmental Consultant: Monitoring, reporting, and auditing of ESMP implementation.

Table 7.1: Institutional Arrangements and Responsibilities

Institution/Entity	Responsibility
CR SAPZ	ESMP oversight, policy enforcement, budgeting, inter-agency coordination, compliance reporting and grievance redress mechanism (GRM)
Project Contractors	Day-to-day ESMP implementation, incident reporting, corrective actions
Federal Ministry of Environment (FMEnv) & NESREA	ESIA approval, regulatory inspections, enforcement of national environmental regulations
Cross River Ministry of Environment	State-level monitoring, local compliance checks, community engagement support
Community Liaison Officers (CLOs)	Local stakeholder engagement, conflict mediation, grievance logging
Independent Environmental Consultants	Periodic environmental monitoring and reporting to regulators
Third-Party Auditors (if required)	Independent verification of ESMP implementation and performance assessments

7.4 Environmental and Social Monitoring Plan

The Environmental and Social Monitoring Plan (ESMoP) is a vital element of the Environmental and Social Management Plan (ESMP), designed to ensure continuous assessment of the project's environmental and social performance over time. Its primary goal is to track the effectiveness of mitigation measures, verify compliance with applicable laws and standards, and identify any emerging issues that require corrective actions.

Given the extent of the project and interaction with various environmental media, monitoring is necessary. Monitoring data provides the basis for evaluating environmental trends, engaging stakeholders meaningfully, and making evidence-based decisions throughout the life cycle of the project.

7.4.1 Objectives of the Environmental and Social Monitoring Plan

The key objectives of the Environmental and Social Monitoring Plan include:

- Ensuring that the proposed mitigation and enhancement measures are effectively implemented.
- Detecting unanticipated adverse impacts and providing early warning signals.
- Establishing accountability by tracking environmental performance indicators.
- Ensuring compliance with Nigerian environmental laws, sectoral guidelines, and international best practices (e.g., AfDB's ISS, ISO 14001).
- Providing a feedback loop to improve future environmental and social management.

7.4.2 Monitoring Parameters and Indicators

To effectively monitor the impacts and outcomes of the project, a wide range of environmental and social indicators have been identified and are presented in Table 7.2. These are based on baseline data, predicted impacts, and regulatory requirements.

Table 7.2: Key Monitoring Indicators

Environmental/Social Component	Key Indicators	Monitoring Frequency	Method/Standard
Air Quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO, VOCs	Quarterly (construction & operation)	APHA 2017 / FMEnv guidelines
Noise and Vibration	Ambient noise (dB(A)), vibration levels	Monthly	WHO/FEPA Noise Standards
Surface Water Quality	pH, DO, BOD ₅ , COD, TSS, oil & grease, heavy metals (Pb, Cd, Fe), E. coli	Quarterly	APHA 2017
Groundwater Quality	pH, EC, TDS, nitrate, chloride, iron, manganese, coliform	Bi-annually	APHA 2017
Soil Quality	pH, organic carbon, heavy metals (Cd, Pb, Zn, Fe), hydrocarbons	Bi-annually	ASTM D4972 / FMEnv

Environmental/Social Component	Key Indicators	Monitoring Frequency	Method/Standard
Biodiversity (Flora/Fauna)	Species abundance, diversity index, wildlife sightings, invasive species occurrence	Bi-annually	Field survey / transect method
Vegetation Cover	Percentage vegetation cleared vs. replanted, tree survival rate	Quarterly	Field inspection
Waste Management	Quantity and type of waste generated, segregation efficiency (%), volume recycled, compliance with disposal protocol	Monthly	Inspection, weighbridge records
Effluent Management	pH, BOD ₅ , COD, TSS, oil & grease before and after treatment	Monthly	IFC/WB EHS Guidelines
Gaseous Emissions (Generator, Processing)	CO ₂ , NO _x , SO ₂ , particulate matter	Quarterly	Stack monitoring / IFC standards
Occupational Health and Safety (OHS)	Number of incidents, LTIs, PPE compliance rate (%), first aid availability	Monthly	HSE audit / ILO guidelines
Community Health & Safety	Number of grievances, communicable disease cases, GBV/SEA incidents, road accidents	Quarterly	Medical records / GRM reports
Socio-Economic Indicators	Employment (male/female ratio), number of local workers, livelihood restoration status	Bi-annually	Survey / field verification
Stakeholder Engagement	Number of meetings held, grievance resolution rate (%)	Quarterly	GRM & engagement logs
Decommissioning Phase (if applicable)	Volume of waste dismantled, % recycled/reused, soil/water contamination status	Once (at closure)	Environmental Audit

7.4.3 Monitoring Approach and Methodology

A combination of **qualitative** and **quantitative** methods will be applied to collect accurate, replicable, and timely data. **Monitoring Methods Include:**

- **Air and Noise Monitoring:** Portable air quality samplers and dosimeters will be used in compliance with FMEnv and NESREA standards.
- **Water and Soil Sampling:** Samples will be collected quarterly and tested at certified laboratories according to WHO and NESREA protocols.
- **Visual Inspections:** Routine site assessments by the HSE team and environmental officers to evaluate compliance.
- **Social Surveys and Interviews:** Periodic household surveys, focus group discussions (FGDs), and key informant interviews (KIIs) to assess community perceptions.
- **Occupational Safety Audits:** Internal inspections and external audits to review adherence to OHS protocols.

7.4.4 Monitoring Frequency and Locations

Monitoring will be conducted at different frequencies depending on the project phase (pre-construction, construction, operation) and the sensitivity of the component involved as presented in Table 7.3.

Table 7.3: Proposed Monitoring Schedule

Component	Location	Frequency	Responsibility
Air Quality	Power plant, processing facilities	Monthly	HSE Unit/Environmental Consultant
Noise	Nearby residential and project boundary	Monthly	Environmental Officer
Surface/groundwater	Nearby boreholes, estuary points	Quarterly	Water Analyst/Consultant
Soil Quality	Fuel storage, workshop areas and other spill-prone areas	Bi-annually	Environmental Consultant
Waste Management	entire facility	Weekly	Waste Coordinator/Site Engineer
Employment Metrics	HR office, local community	Quarterly	HR Unit/CSR Officer
Community Health	Local health facilities, community	Quarterly	Public Health Consultant
Safety & Accidents	Entire project site	Monthly	Safety Officer
Biodiversity	Site & environs	Bi-annually	Ecologist
Grievance Redress	CLO office, project office	Monthly	CLO/Community Grievance Desk

7.4.5 Monitoring Reporting and Documentation

All monitoring activities will be thoroughly documented and reported in a timely and transparent manner. **Reporting Structure:**

- **Daily Site Logs** (kept by Site Environmental and Safety Officers)
- **Weekly Progress Reports** (submitted to CR SAPZ Program Management)
- **Monthly Environmental and social Reports** (reviewed by internal compliance team)
- **ESMP Performance Reports** (submitted to FMEnv quarterly and monthly to AfDB)
- **Annual Environmental and social Audit Reports** (prepared by independent auditors)

All reports will include:

- Summary of findings,
- Analysis of trends,
- Comparison with baseline values and legal thresholds,
- Non-conformance and corrective actions taken,
- Lessons learned and continuous improvement recommendations.

7.4.6 Roles and Responsibilities

Clear roles and responsibilities are outlined to ensure efficient implementation of the monitoring plan (Table 7.4)

Table 7.4: Roles in Monitoring plan

Stakeholder	Role in Monitoring
CR SAPZ (Project Proponent)	Budgetary provision, overall supervision, data compilation
Contractors/Subcontractors	Routine field monitoring, immediate reporting of incidents
Independent Environmental Consultants	Conduct specialized monitoring and lab analyses
FMEEnv & Cross River Ministry of Environment	Regulatory oversight, spot checks, legal enforcement
Community Liaison Officer (CLO)	Stakeholder interface, grievance resolution tracking
External Auditors (if required)	Third-party compliance verification

7.4.7 Key Performance Indicators (KPIs)

The following KPIs will be used to evaluate ESMP implementation success:

Environmental KPIs:

- Effluent Quality
- Ambient air level
- % of planted trees (re-vegetation)
- <5% deviation from baseline environmental conditions
- 100% waste segregation and proper disposal.
- Surface and groundwater quality level and rating

Social KPI

- 95% compliance with mitigation actions.
- 80% of community grievances resolved within 14 days.
- Zero fatality and <1 LTIFR (*Lost Time Injury Frequency Rate*) annually.
- >50% of workforce sourced locally.

7.5 Capacity Building and Training

Capacity building and training are essential components for the successful implementation of environmental and social mitigation and monitoring plans throughout the life cycle of the CR-SAPZ's ATC project. A well-structured capacity development strategy ensures that both project personnel and relevant stakeholders including contractors, host communities, and regulatory institutions possess the knowledge, skills, and tools necessary to comply with environmental standards, occupational health and safety protocols, and social engagement obligations.

The goals are to:

- Enhance technical and managerial capabilities of project staff for effective environmental and social management.

- Equip the workforce with knowledge and skills to ensure health and safety, waste management, pollution control, and emergency response.
- Foster local community participation in environmental stewardship and benefit-sharing.
- Strengthen the institutional capacity of local authorities and project proponents to oversee and enforce compliance measures.

7.5.1 Identified Training Needs

Training needs were identified through a gap analysis of expected job functions, existing staff capacities, and stakeholder roles. Key thematic areas for capacity development are presented in Table 7.5.

Table 7.5: Key thematic areas for capacity development

Training Theme	Topics Covered	Budget (N)
Environmental Management	ESMP implementation, pollution prevention, air and water quality management, biodiversity protection, ESIA compliance	1,500,000
Health and Safety (HSE)	Hazard identification, use of PPE, fire safety, confined space entry, first aid, occupational health, OS4 community health/safety	500,000
Waste Management	Segregation, storage, transportation, treatment and disposal of general and hazardous waste, GBV/SEA sensitization training for contractors and workers, OS2 labor, OS5 vulnerable groups	500,000
Social Safeguards	Stakeholder engagement, grievance redress mechanism, gender sensitivity, community relations	Check with SEP & GRM
Emergency Response	Spill response, fire drills, evacuation protocols, natural hazard response	1,000,000
Monitoring and Evaluation	Data collection, environmental audits, reporting procedures, corrective actions	1,000,000
Regulatory Compliance	Nigerian laws, AfDB's ISS, ISO 14001/45001 awareness	500,000
		5,000,000

7.5.2 Training Schedule and Facilitator

Capacity building is vital for ensuring that all personnel involved in project implementation understand their environmental and social responsibilities as shown in Table 7.6.

Table 7.6: Training Schedule and Facilitator

Training Topic	Target Audience	Frequency	Facilitator
ESMP Implementation, HSE Protocols & Waste mgt	Contractor Staff, Supervisors	Bi-annually	DBOC, HSE Consultant
Community Engagement & Conflict Management	CLOs and Community Representatives	Annually	Social Specialist
Emergency Response and Spill Control	Security, Staff, Maintenance Team	Quarterly	SEMA, Fire Department, FRSC / Environmental Firm
Environmental Standards and Regulations	Project Managers, Legal Advisors	Annually	FMEEnv/CRMEEnv, NESREA

7.6 Budget for ESMP Implementation

To effectively implement the environmental and social management measures necessary budgetary provisions have been made for this ESMP. The budgets for the ESMP include the environmental and social management costs other than the good engineering practices, cost of environmental and resettlement monitoring. All administrative costs for implementing the ESMP shall be budgeted for as part of the project costing. The cost of each measure has been estimated and included in the overall ESMP budget as indicated in Table 7.7

Table 7.7: ESMP Budget Summary

S/No	Element	Responsible	N
1	Mitigation Measures	SPIU, DBOC	171,000,000.00
2	Special Initiatives for ESMP Implementation		12,000,000.00
2	Monitoring & Audit	SPIU, DBOC, ESIC	57,000,000.00
3	Training	SPIU, DBOC/HSE Officer, ESIC,	5,200,000.00
Sub-total			245,200,000.00
	10% contingency		24,520,000.00
Grand total			269,720,000.00

Implementation Schedule

The provisional time schedule for preparing contract documents, awarding of tenders and start of construction has to be taken into consideration in the implementation schedule for the ESMP (Table 7.8).

The contractor is expected to prepare and submit a plan of action covering the means by which the construction related environmental and social mitigation measures recommended in the ESMP will be implemented once a notice to proceed is received.

The DBOC shall strictly follow the Action plan, mitigation action required at the pre-construction phase which would have been implemented

The key elements of the implementation schedule plan which are shown in Table 7.8 are as listed below:

- Preparation and submission of the Action plan;
- Nominating Environmental Management Representative;
- Finalizing site and layout plans for construction camps/temporary yards incorporating environmental requirements;
- Preparation and submission of construction schedule;
- Implementation of mitigation and enhancement measures;
- Environmental auditing (SPIU, ESIC /FMEnv);
- Monitoring and reporting on ESMP implementation (SPIU, FMEnv &ESIC)

Table 7.8: ESMP Implementation Schedule

Activity	Responsible	Pre-construction				Construction					Operation				
		Q3 25	Q4 25	Q1 26	Q2 26	Q3 26	Q4 26	Q1 26	Q2 26	Q3 26	Q4 26	Q1 26	Q2 26	Q3 26	Q4 26
Disclosure of E& S Instruments	SPIU/FMEnv														
Allocation Budget for ESMP	SPIU														
Appointing Support Staff for ESMP	SPIU														
Review of Approval of Contractor's ESMP & Safety Plan	SPIU														
Finalizing site and layout plan of construction plan	SPIU														
Implementation of Mitigation Measures	SPIU/ESIC & FMEnv														
Supervising ESMP Implementation	SPIU/ESIC														
Environmental Audit	SPIU/ESIC & FMEnv														
Monitoring & Reporting on ESMP Implementation	SPIU/ESIC & FMEnv														
Environmental Training	SPIU & ESIC														

7.7 The ESMP

The recommended environmental and social management measures required to mitigate the identified impacts of the proposed project activities during pre-construction, construction, commissioning and operation phases for various components is presented in **Error! Reference source not found.** and **Error! Reference source not found.**

Table 7.9: Environmental Management Plan for all Phases of the proposed Project

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Pre-Construction Phase							
Land take and potential physical/cultural heritage disturbance	Conduct chance-find procedure; avoid sensitive cultural/religious sites; compensate land-takers appropriately; buffer zones for sacred areas	CR-SAPZ/DBOC	N1 million	Physical buffer zones for sacred areas, records of compensation	FMEnv / State Min. Env.		N1 million
Traffic and community safety risks from mobilization of equipment	Traffic management plan; warning signage; community awareness; trained drivers	CR-SAPZ/DBOC	N2 million	Installed signages, record of community awareness campaigns and drivers training	FMEnv / State Min. Env. FRSC	Quarterly	N500,000
Greenhouse gas (GHG) emissions from site preparation activities	Energy-efficient machinery; limit unnecessary trips; tree planting offset program	CR-SAPZ/DBOC	N2 million	Planted trees	FMEnv / State Min. Env.	During pre-construction	N500,000
Noise pollution from heavy-duty trucks, equipment, and personnel movement	Restrict mobilization to daylight hours; maintain silencers; install temporary noise barriers; limit idling times	CR-SAPZ/DBOC	₦2 million	Noise level dB(A) at site boundary	FMEnv / State Min. Env.	Monthly	₦4 million
Air pollution from vehicle emissions (CO, NO ₂ , SPM, SO ₂)	Use low-emission trucks/equipment; conduct periodic emission testing; enforce “no idling” policy	CR-SAPZ/DBOC	₦1 million	Air quality readings (NO _x , PM)	FMEnv / NESREA	Monthly	₦500,000
Vegetation loss of about 37.94 ha and habitat disturbance of 12.5 ha	Restrict clearing to project footprint; replant native species; implement flood and erosion control plan	CR-SAPZ/DBOC	₦4 million	Area cleared vs. replanted; biodiversity survey	FMEnv / State Min. Env.	Quarterly	N1 million
Construction Phase							

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Groundwater contamination from fuel storage, lubricants, chemicals	Bunded storage; drip trays; groundwater monitoring wells; spill response kits. Waste management issues (general solid waste, packaging, food waste)						
Dust generation from cleared land and stockpiles	Regularly spray water on exposed soil; cover stockpiles; restrict vehicle speeds; schedule high-dust activities during low wind	CR-SAPZ/DBOC	₦5 million	PM ₁₀ /PM _{2.5} readings at site boundary	FME _{env} / NESREA	Weekly	₦500,000
Increased soil erosion potential; reduction in structural stability and percolation ability of soil	Strip and store topsoil separately; limit clearing; avoid machinery on wet soils; install erosion controls	CR-SAPZ/DBOC	₦10 million	Soil stability tests; erosion evidence	FME _{env} / NESREA	Quarterly	₦5 million
Noise from operations of engines and heavy-duty construction machines	Monitor noise levels; use temporary barriers; provide hearing protection; maintain machinery; restrict noisy operations to 07:00–18:00	CR-SAPZ/DBOC	₦1 million	Noise level dB(A)	FME _{env} / State Min. Env.	Monthly	₦500,000
Contamination of surface water from cement mixing, concrete batching and handling	Site batching plants ≥200 m from water; prevent discharge into drains; implement spill prevention and response	CR-SAPZ/DBOC	₦2.5 million	Water quality (pH, turbidity, hydrocarbons)	FME _{env} / NESREA	Quarterly	₦1 million
Alteration of landscapes due to quarrying	Restrict quarrying to approved areas; maintain buffer zones; implement progressive rehabilitation; use visual screening	CR-SAPZ/DBOC	₦5 million	Quarry inspection reports; landscape restoration progress	FME _{env} / State Min. Env.	Quarterly	₦1 million
Operational Phase							
Increase noise level from the operations of various machines and equipment such as power plant	Install acoustic enclosures; schedule high-noise activities daytime; preventive maintenance; hearing protection; noise monitoring	CR-SAPZ	₦1 million	Noise level dB(A) within facility and boundary	FME _{env} / State Min. Env.	Quarterly	₦500,000

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Daily release of nitrogen oxides (NO _x), carbon monoxide (CO), hydrocarbons, and particulate matter (PM) from traffic directly affects local air quality	Maintain vehicles and machinery; encourage shuttle buses; dust suppression; traffic management plans; monitor air quality	CR-SAPZ	₦1 million	Air quality (NO _x , CO, PM)	FMEnv / NESREA	Quarterly	₦ 500,000
Streams of agricultural waste generated such as peeling process, separation of raw materials and processed waste from production	Implement waste segregation; adopt waste-to-compost or energy; install sedimentation tanks; agreements with farmers for reuse; effluent quality monitoring	CR-SAPZ	₦1 million	Waste volume; effluent quality	FMEnv / State Min. Env.	Quarterly	₦500,000
Increase soil pollution potential due to spilled fuel, spent oil, lubricants, paints during routine maintenance of operating machineries and equipment	Designated maintenance areas; spill prevention; bunded fuel storage; licensed hazardous waste disposal; regular inspection	CR-SAPZ	₦2 million	Soil contamination reports	FMEnv / NESREA	Quarterly	₦1 million
Decommissioning Phase							
Increase noise level and dust generation due to demolition and removal of camps components and other structures	Restrict demolition works to daylight hours; maintain silencers; controlled dismantling; install noise barriers; provide hearing protection	CR-SAPZ/DBOC	₦1 million	Noise level dB(A); dust concentration	FMEnv / State Min. Env.	Monthly	₦500,000

Potential Impact	Mitigation Measures	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Increase noise and air quality pollution due to transfer of heavy-duty equipment and construction machineries	Spray water on debris; cover trucks; store demolition waste enclosed; restrict vehicle speeds; require dust masks	CR-SAPZ/DBOC	₦1 million	Air quality; dust levels	FMEnv / NESREA	Monthly	₦ 500,000
Solid waste generation and improper disposal waste facility	Segregate demolition waste; reuse/recycle materials; store waste securely; engage licensed contractors; maintain waste tracking	CR-SAPZ/DBOC	₦500,00	Waste audit records	FMEnv / State Min. Env.	Quarterly	₦200,000
			₦40 million				₦19.2 million

Table 7.10: Social Management Plan for all Phases of the proposed Project

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Pre-Construction Phase							
Economic displacement of 340 people across 68 households losing farmlands and crops	Prepare and implement Livelihood Restoration Plan (LRP); integrate tenant farmers into SAPZ Program before land acquisition	CR-SAPZ	₦70 million	% PAPs compensated; # of livelihood activities implemented	FMEnv / Independent RAP Consultant	Quarterly	₦5 million
Conflicts due to inadequate or unequal compensation	Establish transparent and inclusive stakeholder engagement; deploy independent grievance redress mechanism	CR-SAPZ	₦5 million	# disputes resolved; stakeholder satisfaction surveys	FMEnv / Independent RAP Consultant	Quarterly	₦1 million

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Exclusion of vulnerable groups in compensation and support	Conduct inclusive consultations with women, youth, tenant farmers; provide targeted livelihood support	CR-SAPZ	₦4 million	% vulnerable PAPs included; # targeted supports delivered	FMEnv / State Min. Women Affairs	Bi-annually	₦1 million
Loss of access to communal resources (forests, grazing)	Provide alternative resource access and support community forest management programs	CR-SAPZ	₦5 million	Records of alternative sites provided	State Min. Agriculture / Forestry	Annually	₦2 million
Loss of cultural heritage / sacred sites (if encountered during land take)	Conduct a cultural heritage and archaeological survey before land clearing, Implement a Chance-Find Procedure (CFP) aligned with AfDB OS1 and Nigerian heritage regulations. Engage traditional councils and elders to identify and protect sacred sites. Halt work immediately upon discovery of artefacts and notify relevant authorities.	CR-SAPZ	₦1 million	Number of heritage screening reports prepared. - Evidence of CFP implementation. - Documentation of consultations with traditional leaders.	CR-SAPZ SPIU / FMEnv / Ministry of Culture & Tourism	Pre-construction and as required	₦1,500,000
Poor stakeholder engagement and resentment	Establish CLO system; regular community meetings; information disclosure in local language	CR-SAPZ/Contractor CLO	₦4 million	# of meetings held; community satisfaction surveys	FMEnv / State Min. Env.	Quarterly	₦1 million
Mistrust and misinformation about project objectives	- Conduct proactive awareness and information campaigns. - Use local radio, town criers, and translated leaflets for communication. - Deploy Community Liaison Officers	CR-SAPZ SPIU / CLO / Contractor	₦1.5 million	- Number of sensitization sessions held. - Level of community awareness.	CR-SAPZ SPIU / Ministry of Information / AfDB E&S Team	Monthly during pre-construction	₦800,000

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
	(CLOs) to sustain dialogue. Establish feedback channels (notice boards, grievance registers).			Functioning grievance redress channels.			
Construction Phase							
Influx of migrant workers leading to social tension and pressure on housing	Enforce worker code of conduct; prioritize local hiring; provide separate worker housing through camps	CR-SAPZ/Contractor	₦ 3 million	Worker demographic records; local rental costs	FMEEnv / State Min. Labour	Quarterly	₦1 million
Security risks (petty theft, crime)	Collaborate with local security agencies; issue worker ID cards; secure camps	CR-SAPZ/Contractor	₦2 million	# security incidents recorded	CLO / Police	Quarterly	₦1 million
Gender-based violence (GBV) and sexual exploitation/abuse (SEA)	Implement GBV Action Plan; awareness campaigns; zero-tolerance policy; partner NGOs	CR-SAPZ/NGO partner	₦1.5 million	# GBV cases reported/resolved	FMEEnv / State Min. Women Affairs	Quarterly	₦ 500,000
Child labour risks	Enforce Labour Act; monitor recruitment; contractor penalties for under-age workers	CR-SAPZ/Contractor	₦1 million	Worker age records; inspection reports	State Min. Labour	Continuous	₦ 500,000
Pressure on water/food resources	Provide boreholes for camps; regulate sourcing from local markets; coordinate with local councils	CR-SAPZ/Contractor	₦2 million	Water use records; community complaints	State Min. Water Resources	Monthly	₦500,000

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
Disruption to community transport and trade routes	Provide safe diversions; signage; consult traders before road closures	CR-SAPZ/Contractor	₦1 million	# of complaints; accident records	FRSC / State Min. Works	Monthly	₦500,000
Dust and noise impacts on sensitive receptors (schools, hospitals, markets)	Create buffer zones; wetting near receptors; schedule works off-peak hours	CR-SAPZ/Contractor	₦1.5 million	Health statistics; community complaints	State Min. Health / FMEnv	Quarterly	₦500,000
Operational Phase							
Strain on local infrastructure (schools, clinics, water supply) due to operational workforce	CSR support to upgrade facilities; joint planning with LGAs	CR-SAPZ	₦5 million	# of CSR projects implemented; capacity usage rates	State Govt / LGA	Annually	₦1 million
Occupational fatigue and psychosocial stress among workforce	Limit working hours; rest breaks; wellness checks and counselling	CR-SAPZ	₦1.5 million	Worker OHS records; absenteeism	HSE Unit / FMEnv	Quarterly	₦500,000
Loss of social cohesion due to long-term influx of non-local workers	Promote cultural integration programs; respect local customs; support community events	CR-SAPZ/CLO	₦1 million	Records of community events supported	Traditional Councils	Annually	₦500,000
Occupational accidents and injuries (falls, machinery, electrocution, etc.)	• Develop and implement a comprehensive OHS Management Plan. • Enforce mandatory use of PPEs. • Conduct daily toolbox talks and periodic safety training. • Maintain on-site	Contractor / CR-SAPZ SPIU / State Ministry of Labour	₦5 million	• Number of OHS trainings conducted. • PPE compliance rate. • Record	CR-SAPZ SPIU / AfDB Supervision Mission / FMEnv	Weekly and quarterly audits	₦1. million

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
	first aid stations and emergency response systems. • Display safety signage and restrict unauthorized access.			of accidents/incidents and corrective actions.			
Spread of communicable diseases (HIV/AIDS, STIs, COVID-19, malaria)	- Organize health awareness and sensitization programs. - Provide voluntary testing, counselling, and free PPE for workers. - Distribute condoms and promote good hygiene. - Collaborate with local health centres for periodic outreach. - Maintain sanitation and vector control in worker camps.	Contractor / Local Health Centres / CR-SAPZ SPIU	₦ 2 million	- Number of awareness campaigns held. - Number of workers tested and trained. - Health surveillance and incident reports.	CR-SAPZ SPIU / Ministry of Health / FMEnv	Quarterly	₦ 500,000
Inflationary pressure on local goods and services (housing, food, transport)	- Promote local procurement to stabilize prices. - Create price-monitoring committees with community leaders. - Provide temporary staff accommodation to reduce pressure on local housing. - Liaise with local government to regulate rent increases.	CR-SAPZ SPIU / Contractor / Local Government Council	₦ 1 million	- Evidence of local procurement policy implementation. - Periodic price trend monitoring reports. - Number of worker	CR-SAPZ SPIU / Local Government / FMEnv	Quarterly	₦ 500,000

Potential Impact	Mitigation Measures (Summary)	Implementation		Monitoring			
		Responsibility for Implementation	Cost	Monitoring Indicators	Responsibility for Supervision	Frequency of Monitoring	Estimated Cost (₦)
				accommodations provided.			
Marginalization of women and youth in employment opportunities	- Implement gender- and youth-inclusive employment policy. - Provide training and skill-building programs for local women and youth. - Ensure equal pay and fair participation in project jobs. - Track participation data by gender and age.	Contractor / CR-SAPZ SPIU / Ministry of Women Affairs	₦ 2 million	- Percentage of women/youth employed. - Training attendance records. - Employment database showing gender distribution.	CR-SAPZ SPIU / Ministry of Women Affairs / AfDB E&S Team	Monthly during construction	₦ 1 million
Decommissioning Phase							
Loss of livelihoods for local workers after decommissioning	Prepare and implement workforce transition/exit plan; support retraining	CR-SAPZ	₦5 million	# of workers retrained; post-exit employment rates	FMEEnv / State Min. Labour	Annually	₦5 million
Community grievances during site closure	Maintain active grievance redress system throughout decommissioning; publicize closure schedule	CR-SAPZ/CLO	₦5 million	# grievances logged/resolved	FMEEnv / State Min. Env.	Monthly	₦ 1million
TOTAL	-	-	₦131 million				₦27.8 million

7.8 Specific E&S Management Plans (MPs)

Specific E&S management plans have been prepared, complementary to this document, to comply with the nine AfDB's OSs triggered by the proposed ATC, as presented in Table 7.10 and the sections following. The SEP, LRP and PMP have been prepared as stand-alone E&S instruments.

Table 7.10: Specific E&S Management Plans & their Triggered AfDB's Operational Safeguards

Operational Safeguard	Management Plan
Environmental and Social Operational Safeguard 1: Assessment and Management of Environmental and Social Risk and Impact	Environment & Social Mgt Plan
Environmental and Social Operational Safeguard 2: Labour and Working Conditions	Labour Mgt. Plan
Environmental and Social Operational Safeguard 3: Resources Efficiency and Pollution Prevention and Management	Waste Mgt Plan
	Pest Mgt Plan
Environmental and Social Operational Safeguard 4: Community Health, Safety and Security	OHSP
	Traffic Mgt Plan
Environmental and Social Operational Safeguard 5: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement	Livelihood Restoration Plan
Environmental and Social Operational Safeguard 6: Habitat and Biodiversity Conservation, and Sustainable Management of Living Natural Resources	Biodiversity Mgt Plan
	Climate Change Mgt Plan
	Flood & Erosion Control Plan
Environmental and Social Operational Safeguard 8: Cultural Heritage	Cultural Heritage Mgt Plan
Environmental and Social Operational Safeguard 10: Stakeholder Engagement and Information Disclosure	Stakeholder Engagement Plan

7.9 Stakeholder Engagement Plan (SEP)

Stakeholder Engagement Plan (SEP) has been prepared as a stand-alone document for the Cross River State Special Agro-Industrial Processing Zone (CR-SAPZ) Program, covering the proposed Agro-Industrial Hub (AIH) at Adiabo, Odukpani LGA, and the Agricultural Transformation Centre (ATC) at Okuku, Yala LGA. This section provides a comprehensive overview of the Stakeholder Engagement Plan (SEP) document. The SEP outlines the framework for transparent, inclusive, and continuous engagement with stakeholders across the project lifecycle – from pre-construction through operation to decommissioning.

The document details:

- The background, objectives, and scope of the CR-SAPZ program.
- Project descriptions, benefits, and sustainability considerations.

- Applicable policy, legal, and institutional frameworks at national, state, and international levels.
- Stakeholder identification, mapping, and categorisation, including provisions for vulnerable groups.
- Records of engagement conducted to date and key issues raised.
- The guiding principles, objectives, and strategies for ongoing stakeholder engagement.
- Processes for information disclosure, roles and responsibilities of institutions, and resource allocation.
- A structured Grievance Redress Mechanism (GRM) for managing community concerns fairly and transparently.
- Monitoring, evaluation, and reporting frameworks, including Key Performance Indicators (KPIs).
- Capacity-building programs for both project teams and communities.
- A dedicated budget and implementation schedule for effective SEP delivery.

The SEP serves as both a **strategic tool and social contract**, ensuring that project implementation aligns with Nigerian laws, AfDB Integrated Safeguards System, IFC Performance Standards, and the Sustainable Development Goals (SDGs). It is designed to foster trust, manage risks, and maximize shared benefits among host communities, government, investors, and development partners.

Methodology of Stakeholder Engagement

The engagement process combined both qualitative and participatory approaches, ensuring inclusiveness, transparency, and representativeness. Key stages and methods included:

- i. Stakeholder Identification and Mapping: Stakeholders were categorized into primary (directly affected) and secondary (indirectly affected or interested) groups. These included local communities (Adiabo, Ikot Omin, Ikot Effanga, Ikot Udo Ossiom, and Ikot Okon Edem), traditional institutions, women's associations, youth groups, farmers, transport unions, and vulnerable persons (widows, elderly, and persons with disabilities).
- ii. Notification and Sensitization: Official letters, radio announcements, and community briefings were used to inform stakeholders ahead of meetings. Sensitization meetings were held in coordination with the Cross River State Ministry of Agriculture and Natural Resources and local government representatives.

Engagement Techniques

- i. Community-wide consultations and town hall meetings were conducted using focus group discussions (FGDs), key informant interviews (KIIs), and open plenary sessions.
- ii. Separate sessions for vulnerable and women's groups were organized to ensure open dialogue on gender-specific and inclusion concerns.
- iii. Visual aids and local interpreters were used to enhance participation and comprehension.

Documentation and Validation

All meetings were recorded through attendance sheets, photographs, and minutes, later validated with community representatives to ensure accuracy and mutual understanding.

Description of Stakeholder Engagement Activities

- i. Consultations were carried out between May - June 2025, covering all project-affected communities and institutional stakeholders.
- ii. Discussions focused on project objectives, potential environmental and social impacts, land access, compensation, employment opportunities, and community development expectations.
- iii. Representatives from government ministries (Environment, Agriculture, Lands, Women Affairs), local NGOs, and traditional councils participated actively.
- iv. Photographs are presented in Plate 7.21, Plate 7.22, Plate 7.23, Plate 7.24, and Plate 25, while the full records are compiled in Annex 4: Stakeholder Engagement Documentation.



Plate 7.21: Consultation Meeting with the Chairman, Yala LGA, Councilors, Ipuole Okuku



Plate 7.22: Consultation meeting on 27.06.2025 at Sanctus Hotel, Okuku with Ipuole Okuku community elders, youth and women leaders (left); FGD with community elders, youth and women leaders (Middle left); FGD with community women (Middle right); and Key Informant



Plate 7.23: (Right): Focused Group Meeting with Elders of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot Communities at Adiabo Town Hall On 18.06.2025

Plate 7.24: (Left): Consultation Meeting with Leaders of Adiabo Ikot Mbo Otu and Adiabo Esine Ufot at Adiabo Town Hall on 18.06.2025



Plate 25: Cross sections of participants at the stakeholders engagement/scoping workshop (top left), NESREA Rep. making his contribution (top-middle); CR-SAPZ Rep. fielding questions from participants (top right); FMEnv. Rep sitting among Adiabo contingent at the work (down left), the FMEnv. Rep making addressing the workshop, surrounded by the Clan Head of Okuku, the Chairman of Yala LGA and a rep of Clan Head of Adiabo (down middle) and reps of the Nigerian Navy, NSCDC, Customs, among other participants (down right).




Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adiabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Stakeholders Engagement

Date 17 June / 2025 Venue Hogis Hotel, 7 Akim Close, State Housing, Calabar Meeting Type Stakeholders Engagement / Scoping Workshop

SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	David Edim	CRGIA	08099350518	edimdwiel@yahoo.com	[Signature]
2.	David Edim				
3.	Antan Eso Okor	Office of the SA/Hall	08037912768	antangpfd@gmail.com	[Signature]
4.	Alim Frederic	SAPZ	07037467622	alimchameli@gmail.com	[Signature]
5.	Chelen Pledge Egho	SAPZ	08062890973	Egho23@gmail.com	[Signature]
6.	Ude Anthony C.	Public Health	08038814668	udeanthony7@gmail.com	[Signature]
7.	Dr. Omoshoro O. Afenai	PAM	09054439308	omoshoroafenai@gmail.com	[Signature]
8.	Chief Oku Idek	Adiabo			
9.	Okwari Edutery	PAM	09064552618	okwari.edutery@gmail.com	[Signature]
10.	Dassey Uzodinma	PAM	08037135576	08	
11.	Stella Chobon	PAM	08124253846	stella.chobon@yahoo.com	[Signature]
12.	Enagha Oji	PAM	08064012422	enagha.oji@gmail.com	[Signature]
13.	Ilumina Okuma	PAM	04026544677	ilumina.okuma@gmail.com	[Signature]
14.	Chief Oku Idek	Adiabo			
15.	Dr. Edeji Afolabi	PAM	09169604008	emohideji@yahoo.com	[Signature]

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  Cross River State Special Agro-Industrial Processing Zone Program Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adilabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State Stakeholders Engagement Date <u>16-06-2025</u> Venue <u>Palace Of the Obang Of Calabar</u> Meeting Type <u></u>					
SN	Name	Community / Organization & Designation	Phone Number	Email address	Signature
1.	HH Chief (C/L) P. E. EDET	Village Head	08032223635		
2.	HH Chief (C/L) P. E. EDET	Adilabo	08136686374		
3.	HH Chief (C/L) P. E. EDET	"	08165951790		
4.	HH Chief (C/L) P. E. EDET	"	08039178461		
5.	Chief (C/L) P. E. EDET	"			
6.	Chief (C/L) P. E. EDET	"	08661652751		
7.	Chief (C/L) P. E. EDET	"	08037562803		
8.	Chief (C/L) P. E. EDET	"	0806460516		
9.	BRIAN E. EDET	Public Health	0806460516		
10.	Chief (C/L) P. E. EDET	"	0806460516		
11.	Chief (C/L) P. E. EDET	"	0806460516		
12.	Chief (C/L) P. E. EDET	"	0806460516		
13.	Chief (C/L) P. E. EDET	"	0806460516		
14.	Chief (C/L) P. E. EDET	"	0806460516		
15.	Chief (C/L) P. E. EDET	"	0806460516		

Plate 7.6: Attendance from the Stakeholder Engagement Workshop Held at Hogis Hotel, Calabar on 17/07/2025

Inclusion of Vulnerable Groups

Special efforts were made to ensure vulnerable persons were heard and their interests incorporated:

- Women-only focus groups addressed concerns over livelihood disruption, domestic water access, and inclusion in project jobs.
- Elderly and widows emphasized security of tenure and compensation fairness.
- Persons with disabilities raised mobility and access concerns during construction. Inputs from these groups directly informed mitigation measures related to employment, compensation, and accessibility.

Analysis of Stakeholder Inputs and Influence on ESIA Outcomes

Stakeholder feedback substantially shaped the ESIA's environmental and social management approach:

- Concerns about land acquisition and livelihood loss led to inclusion of a Livelihood Restoration Plan within the ESMP (and other concerns summarize in the Table 7.11)
- Requests for local employment and skills training informed the capacity-building component of the ESMP.
- Fears about environmental pollution and health risks guided specific mitigation on waste handling, water protection, and construction monitoring.

- iv. The need for continuous dialogue led to establishment of a Grievance Redress Mechanism (GRM), anchored at community level.

Table 7.11: Summary of Stakeholder Concerns and Responses

S/N	Stakeholder Group / Community	Key Concerns Raised	ESIA Response / Mitigation Measure
1	Okuku Community	Fear of land loss and crop displacement	Land acquisition plan with fair compensation and livelihood restoration framework included in ESMP.
2	Ipuole	Employment opportunities for youths	Local hiring policy and capacity-building programme incorporated.
3	Women Associations (Ipuole)	Disruption of domestic water sources and markets	Borehole rehabilitation and water source protection during construction.
4	Farmers' Cooperative	Access to farmlands post-construction	Construction scheduling to avoid planting season; alternative access routes planned.
5	Vulnerable Groups (Elderly, Widows, PWDs)	Inclusion in compensation and project activities	Dedicated inclusion plan and GRM accessibility provisions.
6	Traditional Leaders and Chiefs	Cultural heritage and community recognition	Respect for traditional protocols; community liaison officer appointed.
7	Cross River State Ministries (Environment, Agriculture, Lands)	Compliance with state environmental and land laws	ESIA aligned with FMEnv/CRSMEnv requirements and AfDB ISS.
8	Youth Associations	Fear of insecurity and lack of information	Regular information sharing through community committees and periodic site meetings.

Reference is made to the, complete Stakeholder Engagement Plan (SEP) document prepared for the CR-SAPZ Program (August 2025) for full details on methodology, engagement records, technical frameworks, budgetary provisions, and monitoring mechanisms.

7.10 Grievance Redress Mechanism (GRM)

The development of the ATC at Okuku in Yala LGA will affect diverse communities through land acquisition, economic displacement, environmental disturbances, and social interactions between workers and host communities. Inevitably, grievances may arise. A Grievance Redress Mechanism (GRM) is therefore required to provide an accessible, transparent, and fair process for receiving, assessing, and resolving complaints related to the project.

The GRM is intended to:

- Ensure concerns of Project Affected Persons (PAPs), workers, and stakeholders are addressed promptly.
- Prevent escalation of disputes into social conflict or litigation.
- Build trust between the project and host communities.

- Strengthen compliance with Nigerian laws, FMEnv/NESREA requirements, World Bank safeguard standards and African Development Bank's Integrated Safeguards System (ISS).

Objectives of the GRM

The objectives of the GRM include:

- Provide multiple accessible channels for lodging complaints.
- Establish a structured process for receiving, recording, and addressing grievances.
- Ensure PAPs and vulnerable groups have equal access to resolution mechanisms.
- Promote timely and transparent resolution of issues.
- Strengthen accountability of the proponent, contractors, and government institutions.

Scope of the GRM

The GRM covers grievances related to:

- Land acquisition & compensation (delays, inadequate compensation, eligibility disputes).
- Livelihood restoration (loss of farmland, access to natural resources, employment).
- Environmental issues (dust, noise, vibration, water pollution, waste mismanagement).
- Occupational Health & Safety (OHS) (worker safety, accidents, poor PPE compliance).
- Community health & safety (traffic accidents, communicable diseases, GBV/SEA).
- Social conflicts (labour influx, cultural site disturbance, conflicts over jobs).
- Contractor behavior (misconduct, corruption, disrespect for local customs).

Principles Guiding the GRM

Every effective GRM must be built on a foundation of guiding principles that guarantee fairness, accessibility, and accountability. These principles are critical in ensuring that grievances are not only resolved, but that communities, workers, and stakeholders trust the process and view it as legitimate. For ATC, the principles reflect both international safeguard standards (ESS10, ESS5) and local socio-cultural realities, balancing formal procedures with traditional methods of dispute resolution.

Key Principles:

- **Accessibility:** Grievance channels must be free, simple, and available to all (including vulnerable groups).
- **Inclusivity:** Women, youth, elderly, disabled, and marginalized groups must have equal access.
- **Transparency:** Procedures, timelines, and outcomes must be communicated clearly to complainants.
- **Timeliness:** Complaints must be addressed promptly to avoid escalation.

- Fairness and Neutrality: Resolutions must be impartial and acceptable to all parties.
- Confidentiality: Sensitive cases, especially GBV/SEA, must be handled discreetly with survivor protection.
- Cultural Sensitivity: Traditional and community-based conflict-resolution mechanisms should be respected and incorporated.
- Accessibility: Free, simple, and open to all affected stakeholders.
- Inclusivity: Special provisions for women, youth, elderly, and persons with disabilities.
- Transparency: Clear communication on procedures and outcomes.
- Confidentiality: Sensitive grievances (e.g., GBV/SEA, labour disputes) handled discreetly.
- Timeliness: Strict timeframes for each resolution step.
- Fairness: Neutral and unbiased review, ensuring both complainants and project parties are heard.
- Cultural Appropriateness: Incorporates traditional dispute-resolution mechanisms where acceptable.

GRM Structure and Levels

The GRM for ATC adopts a multi-tiered structure, ensuring that complaints are resolved as close to the source as possible while providing clear escalation channels for unresolved issues. This structure balances local ownership (community level) with formal oversight (project, state, federal levels), creating a transparent system that allows grievances to flow upwards when necessary. The GRM structure and levels for the ATC is presented in Table 7.11.

Table 7.11: GRM Structure and Levels for the CAS Project Section 1

Level	Responsible Institutions/Actors	Scope of Responsibilities	Timeframe for Resolution
Level 1 – Community Level (First Contact)	- Community Liaison Officers (CLOs) - Community Grievance Committees (CGCs) - Traditional & Religious Leaders	- First point of contact for PAPs and local communities. - Register complaints in logbooks. - Attempt informal resolution through dialogue and local mediation. - Verify complaints before escalation.	≤ 7 days
Level 2 – Project Level (Operational Resolution)	- Project Grievance Redress Committee (PGRC) chaired by CR-SAPZ Social Specialist. - Contractor HSE & Social Officers. - CLOs & PAP rep.	- Hear unresolved grievances from community level. - Investigate technical, social and environmental issues. - Provide binding project-level resolutions. - Maintain grievance database and reporting.	≤ 30 days

Level	Responsible Institutions/Actors	Scope of Responsibilities	Timeframe for Resolution
	- State Ministry rep. - NGOs/CSOs (observers).		
Level 3 – State Level (Oversight Resolution)	- Cross River State Ministry of Environment - Ministry of Lands - Ministry of Women Affairs - Ministry of Health	- Address complex or escalated grievances. - Oversee land acquisition, compensation, and gender-based issues. - Provide state-level enforcement and support.	≤ 45 days
Level 4 – Federal Level (Policy & Enforcement)	- Federal Ministry of Environment (FMEEnv). - NESREA (enforcement). - Federal Ministry of Agriculture and Food Security (FMAFS) - AfDB - Independent Consultants (auditors). -	- Final project-level oversight and enforcement. - Handle systemic grievances affecting multiple states. - Review and enforce compliance with safeguards. - Ensure corrective action for unresolved cases.	≤ 60 days
Level 5 – Judicial Recourse (Last Resort)	- Nigerian Courts of Law	- Provides legal recourse for complainants dissatisfied with project/state/federal outcomes. - Acts as ultimate appeal mechanism outside GRM.	Dependent on legal process

GRM Process

The Grievance Redress Mechanism (GRM) process defines the step-by-step pathway for receiving, recording, investigating, resolving, and closing complaints. Given the size and sensitivity of ATC project under CR-SAPZ program, grievances may range from routine nuisances (e.g., dust, traffic delays) to serious issues (e.g., compensation disputes, environmental contamination, GBV/SEA cases). The process therefore adopts a tiered structure, starting with community-level resolution (informal, fast, and low-cost), escalating to project and institutional levels only when necessary. This ensures that most grievances are resolved close to the source, while retaining higher-level mechanisms for oversight and accountability.

Table 7.12 outlined the steps towards GRM process which ensure timeliness, transparency, and fairness, while balancing community dispute-resolution traditions with formal project obligations.

Table 7.12: Steps towards GRM Process

Step	Process Description	Actors Involved	Key Outputs/Tools	Timeline
1. Submission of Complaints	Stakeholders submit grievances through multiple accessible channels: CLOs, CGCs, suggestion boxes, hotline, SMS, email, NGOs (for GBV/SEA). Submissions may be verbal, written, or anonymous.	PAPs, CLOs, NGOs/CSOs	Complaint form, verbal intake records, suggestion box slips	Immediate (continuous)
2. Registration & Categorization	Complaint logged in Grievance Register with unique ID. - Categorized as: - A (Urgent: OHS, GBV/SEA, accidents) - B (High Priority: land/compensation, major environmental issues) - C (Routine: nuisances like dust, noise).	CLOs, Contractor HSE/Social Officers	Grievance Register, acknowledgement slip to complainant	Within 2 working days
3. Acknowledgement	Complainant formally acknowledged, informed of category, expected resolution time, and contact person.	CLOs, Contractor	Acknowledgement slip or verbal confirmation	Within 48 hours
4. Assessment & Investigation	Investigation conducted: - Community verification (elders, CGCs). - Technical inspection (Contractor HSE/engineers). - Social assessment (CR-SAPZ Social Specialist). - Confidential handling for GBV/SEA.	CLOs, Contractor HSE, Engineers, CR-SAPZ Social Specialist, NGOs	Investigation reports, site visit records	Initiated within 5 working days
5. Resolution Proposal	Options discussed with complainant: corrective actions, compensation adjustments, worker sanctions, or RAP support. Solution agreed and documented.	PGRC, CLOs, Contractor, PAP reps	Resolution proposal form, signed agreement	≤ 14–30 days (depending on category)
6. Implementation & Feedback	Corrective measures implemented. CLO verifies satisfaction. Complainant signs off resolution. If unsatisfied, grievance escalated.	Contractor, CLOs, PGRC	Corrective action records, signed closure form	As per agreed resolution timeframe
7. Escalation	If unresolved, grievance escalated to: - Level 2: PGRC (project level). - Level 3: State Ministries (Environment, Lands, Women Affairs). - Level 4: Federal (CR-SAPZ, FMAFS, FMEnv, NESREA). - Level 5: Nigerian Courts (final resort).	CLOs, PGRC, State Ministries, FMEnv, NESREA, Courts	Escalation records, hearing minutes	Depending on level: 30–60 days
8. Closure	Resolved grievance marked “closed” in register. Outcome documented and shared with complainant and community. Closed cases reviewed in quarterly reports.	CLOs, Contractor, PGRC	Updated grievance log, quarterly reports	Upon resolution

Institutional Roles and Responsibilities

Effective implementation depends on clear roles across community, project, state, and federal levels. Table 7.13 presents the details of the institutional roles and responsibilities for the GRM.

Table 7.13: Institutional Roles and Responsibilities

Institution/Actor	Roles and Responsibilities
Community Liaison Officers (CLOs)	- First point of contact for grievances. - Register complaints in logbook. - Conduct initial screening and categorization. - Facilitate informal resolution with community leaders. - Provide feedback to complainants.
Community Grievance Committees (CGCs)	- Comprised of elders, women, youth, vulnerable group representatives. - Support CLOs in verifying complaints. - Provide culturally sensitive advice on resolutions.
Contractors (HSE/Social Officers)	- Implement corrective actions for environmental, health, and safety grievances. - Report incidents and accidents. - Maintain grievance database at project level.
Project Grievance Redress Committee (PGRC)	- Chaired by CR-SAPZ Social Specialist. - Includes CLOs, Contractor HSE, PAP representatives, NGO observer. - Reviews unresolved grievances. - Provides binding resolutions at project level.
Cross Rivers SAPZ	- Ensure financing and oversight of GRM. - Integrate grievance reports into ESMP/RAP monitoring.
Federal Ministry of Environment (FMEnv)	- Provides regulatory oversight. - Monitors implementation of grievance resolutions. - Reviews quarterly reports.
NESREA	- Ensures environmental grievances (pollution, waste, emissions) comply with national standards. - Enforces sanctions where necessary.
State Ministries (Environment, Lands, Labour, Women Affairs, Health)	- Provide oversight of land, compensation, labour rights, gender issues. - Step in for state-level grievance resolution.
NGOs/CSOs (e.g., Women's groups, health NGOs)	- Act as independent observers. - Provide safe channels for GBV/SEA reporting Support vulnerable groups in accessing grievance channels.
Independent Consultant/Auditor	- Conduct periodic audits of GRM effectiveness. - Verify records, timeframes, and outcomes.

Monitoring and Reporting

Monitoring Indicators

1. Input Indicators
 - Number of CLOs trained.
 - Budget allocated for GRM operations.
2. Process Indicators
 - Number of grievances received by category (land, environment, health, GBV, etc.).
 - % of grievances acknowledged within 48 hours.
 - % of grievances investigated within 14 days.
3. Output Indicators
 - % of grievances resolved at community level (Level 1).
 - % of grievances escalated to PGRC or FMEnv.
 - Average time taken to resolve grievances.
4. Outcome Indicators
 - Stakeholder satisfaction rate (measured via surveys).
 - Reduction in conflict incidents (land disputes, protests).
 - Number of GBV/SEA cases referred to service providers.

Reporting Mechanism

- Monthly Reports: CLOs submit logs of complaints received, resolved, or pending.
- Quarterly Reports: Contractors compile grievance statistics and outcomes, submitted to CR-SAPZ and FMEnv/NESREA.
- Annual Public Report: Summary of grievances, resolutions, and trends disclosed to stakeholders in simple, non-technical formats (e.g., pamphlets, community meetings).
- Independent Audits: Annual third-party verification of GRM effectiveness.

Budget for GRM

Implementing a functional GRM requires dedicated financial resources. Without a budget, the system risks becoming a “paper mechanism” without operational capacity. For ATC, the budget covers institutional set-up, capacity building, communication tools, monitoring, and independent audits, ensuring that grievances are handled professionally, transparently, and in line with national and international safeguards. Details of the GRM budget is presented in Table 7.14

Table 7.14: Budget for GRM

Activity	Description	Estimated Cost (₦)	Responsible Party
Establishment of GRM Committees	Formation of CGCs in all host communities; set-up of PGRC at project level	4m	CR-SAPZ/DBOC
Training of CLOs, CGCs, Contractors, PGRC	Initial training + annual refresher on grievance handling, mediation, GBV response	6m	FMEnv / Independent Consultants

Awareness Campaigns	Radio jingles, posters, flyers, community theatre, info boards on GRM	4m	CLOs / NGOs
IT & Data Management System	Digital grievance register, SMS hotline, database management	3m	CR-SAPZ/DBOC
GBV/SEA Confidential Mechanisms	Female focal persons, safe houses, referral support, NGO partnerships	8m	DBOC/ NGO
Independent Audits & Evaluations	Annual third-party audits of GRM effectiveness	5m	Independent Consultant

Total GRM Budget: ₦30 million

Conclusion

The expanded Grievance Redress Mechanism (GRM) provides a structured, multi-level system that ensures timely, fair, and transparent handling of complaints across ATC project. With clearly defined roles, robust monitoring, tailored capacity building, and adequate budgetary provisions, the GRM strengthens the project's social license to operate and reduces risks of conflict, litigation, and reputational damage.

7.11 Capacity Building for GRM

The effectiveness of the GRM for ATC project depends on the competence, preparedness, and awareness of all actors involved. Since the project cuts across multiple states and involves communities with varying literacy levels, traditional governance systems, and social dynamics, a comprehensive capacity-building programme is required.

This programme will ensure that:

- CLOs, contractors, and grievance committees are skilled in handling complaints.
- Regulators and ministries are prepared to supervise and provide technical backstopping.
- Communities and PAPs are aware of their rights, know how to access the GRM, and trust it to deliver fair outcomes.
- Sensitive grievances (e.g., GBV/SEA) are addressed in a survivor-centered and confidential manner.

Capacity building will therefore combine formal training, awareness-raising, mentoring, and periodic refreshers across all levels of the GRM structure.

Capacity Building Objectives

The key objectives are to:

1. Build the technical capacity of GRM actors to manage grievances fairly, efficiently, and transparently.
2. Strengthen conflict resolution and mediation skills at community and project levels.
3. Develop confidential and sensitive handling skills for GBV/SEA grievances.
4. Enhance the capacity of PAPs and communities to understand their rights and use the GRM effectively.

5. Institutionalize monitoring and reporting practices so grievance data can inform project decisions.
6. Ensure long-term sustainability of the GRM by embedding skills in both formal institutions (ministries, regulators) and informal ones (traditional leaders, CGCs).

Target Groups and Training Focus

The GRM for ATC project involves a diverse set of actors operating at different levels from community representatives who are the first point of contact, to contractors and project committees that manage day-to-day operations, to state and federal ministries responsible for oversight and enforcement. Each group requires tailored training that matches its specific roles, responsibilities, and level of influence within the grievance process.

Capacity-building efforts must therefore be differentiated:

- Community actors (CLOs, CGCs, PAPs) need training in communication, grievance intake, and mediation, with strong emphasis on local language and cultural sensitivity.
- Project actors (Contractors, PGRC) require technical and procedural training to ensure grievances are investigated, documented, and resolved fairly.
- Institutional actors (State Ministries, CR-SAPZ, FMEnv, NESREA) need higher-level training on policy, oversight, and systemic monitoring of grievance data.
- Specialized actors (NGOs, GBV/SEA focal points) must be prepared to handle sensitive cases confidentially and provide survivor-centered support.

By focusing training on the unique roles and needs of each group, the project ensures that the GRM is responsive, inclusive, and effective across all levels of implementation. The details of the target groups and training focus of all actors/stakeholders is presented in Table 7.15.

Table 7.15: Target Groups and Training Focus

Target Group	Capacity-Building Focus	Training/Support Activities	Estimated Cost (₦ Million)	Remark
Community Liaison Officers (CLOs)	- Complaint intake & documentation. - Mediation and community conflict management. - Gender-sensitive engagement.	- Training workshops on grievance intake & database use. - Mentoring by FMEnv specialists.	- 3.0	- Covers 3-day workshop logistics, facilitator fees, and materials
Community Grievance Committees (CGCs)	- Local dispute mediation. - Cultural and gender inclusivity. - Verification of complaints.	- Village-level mediation training - Participatory learning with role-play.	- 2.5	- Community-level facilitation and training sessions
DBOCs (HSE & Social Officers)	- Investigation of technical/environmental grievances.	- On-site technical drills. - Workshops on grievance	- 3.0	- Contractor-based technical training modules

Target Group	Capacity-Building Focus	Training/Support Activities	Estimated Cost (₦ Million)	Remark
	- Corrective action planning. - OHS and labour grievance handling.	- reporting protocols.		
Project Grievance Redress Committee (PGRC)	- Mediation and arbitration. - Transparency and accountability. - Documentation and disclosure of resolutions.	- Multi-stakeholder workshops. - Mock arbitration sessions.	- 2.5	- Cost includes venue, documentation, and expert facilitators
State Ministries (Environment, Lands, Women Affairs, Health)	- Oversight of escalated grievances. - Land acquisition & compensation disputes. - Gender and health-related grievance resolution.	- Technical policy seminars. - Study visits to projects with effective GRMs.	- 4.0	- Includes travel, accommodation, and expert sessions
FMEEnv & NESREA Officers	- National safeguard monitoring. - Evaluation of grievance data trends. - Enforcement mechanisms.	- Federal-level training on monitoring tools. - Cross-ministerial coordination sessions.	- 3.5	- Cost derived from regulatory training benchmarks
NGOs/CSOs & GBV/SEA Focal Points	- Survivor-centered case management. - Confidentiality protocols - Referral pathways to health, psychosocial, and legal support.	- Specialized NGO-led GBV/SEA training. - Partnership building with service providers.	- 2.0	- Cost for specialized facilitators and sensitization materials
PAPs & Host Communities	- Awareness of GRM rights and procedures. - How to lodge complaints effectively. - Role of community committees in ensuring fairness.	- Town-hall meetings in local languages - Community theatre and radio awareness campaigns.	- 2.5	- Communication materials, radio airtime, and logistics
			- 23.0 million	-

Capacity-Building Methods

To ensure training is practical, sustainable, and inclusive, the following approaches will be adopted:

1. Formal Training Workshops – Structured training sessions for CLOs, contractors, and government officers.

2. On-the-Job Mentoring – CLOs and CGCs supported by FMEnv and independent consultants during actual grievance handling.
3. Community Awareness Campaigns – Flyers, posters, radio programs, and community theatre in local languages.
4. Simulation Exercises – Mock grievance-handling and GBV/SEA case management exercises.
5. Exchange Visits – Exposure of state officers and PGRC members to other projects with best-practice grievance systems.
6. Refresher Courses – Annual training updates based on lessons learned and audit findings.

Expected Outcomes of Capacity Building

By the end of the programme:

- CLOs and CGCs will be confident in receiving, documenting, and resolving grievances.
- PGRC members will handle complex disputes with transparency and fairness.
- State and federal regulators will have robust monitoring systems for grievance tracking.
- NGOs and GBV/SEA focal points will ensure safe, survivor-centered grievance channels.
- Communities will feel empowered, informed, and able to hold the project accountable.

7.12 Institutional Arrangement for SEP and GRM Implementation

The implementation of the SEP and the GRM for ATC project requires a multi-tiered institutional framework. This structure ensures that responsibilities are clearly allocated across federal, state, local, project, and community levels, while also creating coordination and oversight mechanisms to guarantee transparency, accountability, and timely action. The institutional arrangement also integrates capacity building and training measures, recognizing that many local actors (e.g., CLOs, community committees, PAP representatives) require new skills to handle stakeholder engagement and grievance management effectively.

Institutional Structure and Roles

The ATC project involves a wide range of stakeholders and institutions with different responsibilities. To ensure smooth implementation of the SEP and the GRM, a multi-tiered institutional structure has been adopted (details in Table 7.16).

This structure ensures that:

- Federal institutions provide policy direction, financing, and regulatory oversight.
- State ministries handle local oversight, especially on land acquisition, environmental management, and gender inclusion.
- Local governments serve as facilitators, mobilizing communities and supporting engagement at grassroots level.
- Project-level institutions (Contractors, PGRC, Independent Monitors) manage day-to-day implementation, corrective measures, and reporting.
- Community-level institutions (CLOs, Community Grievance Committees, traditional leaders) are the first contact point for project-affected persons (PAPs) and ensure culturally appropriate engagement.

By distributing responsibilities across these levels, the arrangement promotes accountability, efficiency, and inclusivity, while ensuring that grievances and engagement are managed close to the source before escalation.

Table 7.16: Institutional Levels and Roles

Institutional Level	Key Institutions/Actors	Roles and Responsibilities
Federal Level	- FMAFS - Federal Ministry of Environment (FMEnv) - NESREA	- Provide overall project oversight and financing. - Approve ESIA and supervise compliance with environmental and social safeguards. - Review quarterly SEP and GRM reports. - Monitor grievance resolution trends and enforce corrective measures. - Provide technical capacity support to project and state actors.
State Level	- CR-SAPZ - Cross Rivers State Ministries of Environment - State Ministry of Lands, Housing & Urban Development - State Ministry of Women Affairs & Social Development - State Ministry of Health	- Provide state-level monitoring of SEP and GRM activities. - Address escalated grievances from project and community levels. - Oversee land acquisition and compensation disputes. - Ensure women, vulnerable groups, and health concerns are integrated into engagement and grievance handling. - Participate in Project Grievance Redress Committee (PGRC).
Local Government Level	- Local Government Authorities (LGAs) of the project corridor	- Mobilize and sensitize communities for consultations. - Support RAP verification and compensation distribution. - Facilitate local grievance hearings alongside CLOs. - Participate in Community Grievance Committees (CGCs).
Project Level	- Contractor (HSE & Social Officers) - Project Grievance Redress Committee (PGRC) - Independent Consultant/Monitor	- Manage day-to-day SEP and GRM implementation. - Investigate and resolve project-related grievances. - Maintain grievance registers and databases. - Implement corrective actions for environmental, social, and OHS issues. - Conduct annual independent audits of SEP and GRM performance.

Institutional Level	Key Institutions/Actors	Roles and Responsibilities
		- Report monthly and quarterly to CR-SAPZ and FMEnv.
Community Level	- Community Liaison Officers (CLOs) - Community Grievance Committees (CGCs) - Traditional & Religious Leaders-NGOs/CSOs	- Serve as first point of contact for PAPs and local communities. - Register and categorize grievances, attempt resolution at community level. - Verify and escalate unresolved complaints to project level. - Facilitate consultations, FGDs, and information disclosure. - Act as cultural mediators in dispute resolution. - Provide safe channels for GBV/SEA cases and awareness campaigns.

Communication and Escalation Flow

The institutional arrangement for ATC project is designed to resolve issues as close to the source as possible, while retaining higher levels of authority for oversight and final decision-making. The communication and escalation flow of the ATC project follow a bottom-top-approach.

- **Community Level (First Contact):** Project Affected Persons (PAPs) and local residents raise grievances through Community Liaison Officers (CLOs) or Community Grievance Committees (CGCs). Minor grievances are resolved locally with support from traditional leaders and NGOs. Unresolved cases are escalated upward.
- **Project Level (Operational Resolution):** The Contractor's HSE and Social Officers investigate issues, and unresolved grievances are presented to the Project Grievance Redress Committee (PGRC). The PGRC includes representatives of CR-SAPZ, contractors, CLOs, PAPs, State Ministries, and NGOs, ensuring transparency. If still unresolved, complaints are escalated to state-level institutions.
- **State Level (Oversight & Dispute Management):** The State Ministries of Environment, Lands, Women Affairs, and Health provide state-level oversight and address complex grievances, particularly those related to compensation, land acquisition, and social inclusion. State-level institutions can enforce corrective measures and refer escalated cases to federal level.
- **Federal Level (Policy & Enforcement):** Federal Ministry of Environment (FMEnv) and NESREA enforce compliance with environmental and social standards. They review quarterly reports and provide direction on systemic issues.
- **Independent Oversight:** Independent consultants/auditors verify SEP and GRM effectiveness annually. Their findings inform both the project proponent and regulatory authorities, ensuring transparency and accountability.

Key Features of the Institutional Framework

- Bottom-up escalation: Issues move from community to project to state to federal, ensuring early resolution and limiting burden on higher authorities.
- Horizontal support: NGOs/CSOs, traditional leaders, and community committees support cultural sensitivity and inclusiveness.
- Independent oversight: Annual audits ensure credibility and trust.
- Integration with SEP and GRM: The same structure supports stakeholder engagement (SEP) and grievance handling (GRM), reducing duplication.

Implementation Schedule for SEP and GRM

The implementation schedule provides a time-bound plan for executing the SEP and the GRM throughout the project lifecycle (details in Table 7.17). It ensures that activities are not only well-sequenced but also matched with institutional responsibilities, enabling effective monitoring and accountability.

Table 7.17: Implementation Schedule of SEP and GRM by Project Phase

Project Phase	Activity	Description	Responsible Institutions	Frequency/Timing
Pre-Construction	Stakeholder Identification & Mapping	Detailed mapping of PAPs, vulnerable groups, NGOs, state actors	DBOCs, FMEnv, CLOs, Independent Consultant	Once, before RAP finalization
	Disclosure of ESIA & RAP	Translate and share ESIA/RAP summaries with communities	DBOCs, CLOs, NGOs	Once, prior to land acquisition
	Community Sensitization Meetings	Awareness campaigns on project impacts, rights, and GRM access	CLOs, LGAs, Traditional Leaders	Bi-monthly
	Establishment of GRM Structures	Formation of CGCs, appointment of CLOs, PGRC set-up	FMAFS, DBOCs, State Ministries	One-time, before construction
	Training of CLOs, CGCs, PGRC Members	Training on grievance handling, mediation, GBV/SEA protocols	FMEnv, NGOs, Consultants	One-time + annual refresher
	Initial Engagement with PAPs	RAP consultations, livelihood restoration planning	DBOCs, CLOs, State Ministries	Before displacement
Construction	Regular Community Consultations	Meetings on employment, safety,	DBOCs, CLOs, CGCs, NGOs	Monthly

Project Phase	Activity	Description	Responsible Institutions	Frequency/Timing
		and impacts (dust, noise, traffic)		
	Disclosure of Work Schedules	Notice of blasting, road closures, diversions	DBOCs, CLOs	Weekly (where relevant)
	Operation of GRM	Receipt, registration, investigation, and resolution of grievances	CLOs, DBOCs, PGRC, State Ministries	Continuous
	GBV/SEA Awareness Programs	Sensitization on zero tolerance for abuse and survivor pathways	NGOs, CLOs, Women Affairs Ministry	Quarterly
	Monitoring & Reporting	Monthly grievance logs; quarterly SEP/GRM reports to FMEnv	DBOCs, FMEnv, NESREA	Monthly/Quarterly
Operation	Stakeholder Engagement Forums	Dialogue on road safety, tolling, environmental monitoring	CR-SAPZ, State Ministries, CLOs	Quarterly
	Continued GRM Operation	Handle complaints (accidents, road safety, compensation follow-ups)	CLOs, PGRC, FMEnv	Continuous
	Annual Stakeholder Survey	Assess satisfaction with SEP/GRM effectiveness	Independent Consultant	Annually
	Refresher Capacity Training	Update training for CLOs, PGRC, and State staff	FMEnv, NGOs, Consultants	Annually
Decommissioning	Early Consultation with Communities	Discuss closure, site restoration, and land use transition	CR-SAPZ, DBOCs, CLOs, LGAs	At least 6 months before closure
	Disclosure of Decommissioning Plan	Share timelines and mitigation measures	CR-SAPZ, CLOs	Once, before decommissioning begins
	GRM Continuity	Ensure unresolved grievances are addressed during closure	CLOs, PGRC, FMEnv	Continuous during closure

Project Phase	Activity	Description	Responsible Institutions	Frequency/Timing
	Final Evaluation & Lessons Learned	Independent review of SEP & GRM performance	Independent Consultant, FMEnv, NESREA	Once, post-closure

Key Features of the Schedule

- Early Action in Pre-Construction: GRM structures must be in place before land acquisition.
- High Intensity During Construction: Frequent community consultations and grievance handling to address active impacts.
- Steady Engagement in Operation: Focus shifts to road safety, tolling, and residual livelihood concerns.
- Closure with Accountability: Transparent decommissioning plans and lessons learned feed into future projects.

8 DECOMMISSIONING AND ABANDONMENT

Decommissioning covers the ATC project cessation of operations and the removal of inventory to obtain a state of passive safety. This phase though quite unlikely should be discussed for completeness of this report.

In other words, during the planning of any project, it is important to put in place plans to recover and/or restore the project site to its original state after the project is closed or decommissioned. This requires the good understanding of all the environmental components of the project on the ecosystem during its lifespan. It is therefore environmentally wise to take into cognisance, this component during the planning stage.

8.1 Decommissioning Activities

At the completion of the life of this Asphalt and Concrete project, SPIU shall follow regulatory standard procedures for decommissioning. A decommissioning team shall plan and implement the guidelines for decommissioning to ensure that the best and practicable methods available to clean up the project site have been used. The following activities are involved in decommissioning:

The likely impacts will be:

- Soil erosion resulting from improper reinstatement of excavated sites
- Hazards and associated accidents with decommissioning
- Waste management problems

8.1.1 Rehabilitation Activities

The statutory regulations require project owner to rehabilitate the area to be relinquished to the satisfaction of the FMEnv. The biological objective, amongst others, of any such rehabilitation programme is to ensure that an ecologically functional system to enable satisfactory flora growth is achieved. In line with this, SPIU shall put in place a policy to carry out a restoration programme at the end of project's economic life. In carrying out this programme, the following shall be considered.

- Asphalt - the objective is to prevent the asphalt which is a petroleum derivative from melting and leaking into the environment. These should be removed for disposal by certified hazardous materials Disposal Company. The base concrete materials shall be removed from locations and may be used as landfill materials in designated sites.
- Site restoration upon completion (suspension or abandonment), all excavation shall be filled. Beyond this, the procedures to be applied in the restoration of cleared areas shall be the subject of a detailed integrated study. This study shall utilize the services of ecological and

hydrological specialists who will assist in determining strategies for site restoration. The goal of the study shall be a detailed field-specific restoration plan. The success of any restoration process is measured by the similarity of the vegetation on the restored land to that of its surroundings. However, this success is a manifestation of the reinstatement of the physical, chemical and hydrological characteristics of the soil, bearing in mind that the single most significant factor, which will likely inhibit re-vegetation, is compaction / cementing of soil surface. The ripping apart of the compacted/cemented areas will be a major key to a successful restoration programme. The restoration operations will take intensive management for a number of years to ensure success.

- The site remediation measures shall depend on the environmental characterization of the project area as well as the predicted potential and associated impacts based on the assessment that shall be carried out then.

Suffice it to say, however the following measures shall be planned for implementation after de-commissioning/closure:

- All debris shall be removed from the environment
- Reinstatement of all excavated routes to their original status to minimise negative impacts
- Grading of site to its original landscape to prevent erosion
- Good waste management plan shall be put in place
- Appropriate pension schemes shall be put in place for project workers for their up keep when the project is closed or de-commissioned.

8.1.2 Clean-Up and Restoration

The corridor and coterminous areas shall be cleared of all debris, rubbish and unused materials and disposed of in accordance with the waste management plan.

9 CONCLUSION

The Environmental Impact Assessment of the ATC project shows that the project will have significant economic benefits in the local, state and national economy. The project also indicated positive impact on the socio-economic life of the people by way of skilled and unskilled employment and provision of social amenities. Increase evacuation of food from rich rural agricultural areas of Cross River State will impact positively on the national, State and local economy as well as on the internal revenue base of the State. The economic gains of the proposed project to the economy of Nigeria cannot be overemphasized. However, there will be some temporary (short-term) negative impacts particularly on the soil and air quality and occurring mostly during the construction and operations activities.

9.1 Outcome

The ESIA of the proposed project shows that the project can be executed and operated with minimal negative impacts on the surrounding environment and humans by strict adherence and implementation of the recommended mitigation measures. The ESIA has also developed an Environmental and Social Management Plan (ESMP), which incorporates various mitigation measures that will eliminate or reduce the potential impacts of the proposed project implementation on the environment. Mitigation measures were subsequently developed for adverse impacts based on industry best practice, available technology and HSE considerations.

9.2 Conclusion

Given the foregoing, the following conclusions can be made:

The proposed project is quite desirable because of its obvious economics, and social benefits, which are considered to out-weigh the negative environmental and social impacts.

Impacts on other environmental resource and the social environment are considered minimal and localized in nature.

Appropriate institutional framework, working with relevant regulatory authorities shall be set up to implement the mitigation measures recommended while the proposed monitoring programmes shall be set in motion as soon as possible.

The ESMP shall be implemented and maintained throughout the duration of the project with the adverse impacts mitigated to as low as reasonably practicable levels. Impact mitigation monitoring shall also be carried out with the involvement of regulators to check compliance with the ESMP.

The proposed project can be executed within the ambit of sustainable development and this indeed forms the basis for the actual project implementation.

9.3 Recommendation

Against the foregoing background, we strongly recommend the proposed ATC project for ESIA Approval because the mitigation measures that have been proffered will adequately address the identified impacts from the project; and the CR-SAPZ is committed to ensuring strict implementation of the project's ESMP.

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<https://www.sciencedirect.com/science/article/pii/S0021904572900306>

APPENDICES

APPENDIX 1.1: Terms of Reference



FEDERAL MINISTRY OF ENVIRONMENT

Environment House

Independence Way South, Central Business District, Abuja -FCT.

Email: info@ead.gov.ng, www.ead.gov.ng, www.eia@ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMENV/EA/EIA/8725/VOL.1/108

22nd July, 2025.

The State Program Coordinator,
Special Agro-Industrial Processing Zones Program,
5 Donald Duke Boulevard, Diamond Hill,
Calabar,
Cross River State.

RE: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED CROSS RIVER AGRICULTURAL TRANSFORMATION CENTER (ATC) LOCATED AT OKUKU, YALA LGA, CROSS RIVER STATE.

Please refer to your letter dated 25th May, 2025 and the Ministry's letter Ref: FMENV/EA/EIA/8725/VOL.1/67 dated 13th June, 2025 on the above project.

2. Following the conclusion of the Site Verification, Scoping Workshop and Data Gathering Exercises, I am directed to inform you that the Ministry has placed the project in EIA Category One (1) with One(1) season Baseline Data Gathering exercise already conducted. I am further directed to request you to forward to the Ministry the report of the Scoping workshop incorporating significant issues raised during the exercise and also to inform you that the next stage of the EIA process is Laboratory Analysis of the samples collected.
3. Please note that the Laboratory analysis of the samples must be carried out in an FMENV accredited laboratory and shall be witnessed by officials of the Ministry. You are to ensure Quality Assurance /Quality Control measures for the laboratory analyses in line with standard practices and notify the Ministry in good time to enable adequate participation in the exercise.
4. The following should be forwarded to the Federal Ministry of Environment before submission of the draft EIA report:
 - i. Evidence of accreditation by the Federal Ministry of Environment for the laboratory where the samples analyses would be carried out.
 - ii. Chain of Custody form for the samples collected for analysis.
 - iii. Certificate of analysis duly stamped and signed by the laboratory Manager.
 - iv. Evidence of Laboratory analysis witnessing by Federal Ministry of Environment.
5. Upon completion of the EIA study, you are required to submit to the Ministry Two (2) hard and two (2) electronic copies of the draft EIA report and also email a copy to eia@ead.gov.org and copy info@ead.gov.ng. Furthermore, additional hard copies should be placed at Cross River State Ministry of Environment, Federal Ministry of Environment, Calabar, Cross River State and the Local Government Area affected by the proposed project.
6. Thank you for your cooperation.


Engr. (Mrs) Charity B. Malgwi
For: Honourable Minister

Appendix 4.1

Table A4.1: Field meteorological measurements

Sample code	Temperature (°C)	Rel. humidity (%)	Pressure (mmHg)	Wind speed	Wind direction
OATC/FM/01	35.6	68.0	764.92	0.50	221° NW
OATC/FM/02	36.5	65.8	768.62	0.90	45° NE
OATC /FM/03	35.8	67.4	766.00	1.10	104° NW
OATC /FM/04	35.0	66.6	767.50	0.85	98° NW
OATC /FM/05	36.1	68.4	765.55	1.13	245° SW
CTRL	36.2	73.6	768.50	0.88	80° NE
Mean±SD	35.82±0.4	66.84±1.0	767.12±2.1	0.71±0.3	-
Range	35.4 – 36.5	65.8-68.4	764.87-768.62	0.50-1.13	-

Table A4.1.1: Annual Rainfall (MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	TOTAL
1994	40.7	0	167.3	328.2	255.3	294.2	609.5	424.5	290	265.2	229.7	0	242.05	0	609.5	2904.6
1995	Trace	21.1	366.1	248.3	208.6	375.2	632.4	467.4	696.8	496.1	243.8	69.7	347.8	21.1	696.8	3825.5
1996	2.4	162.2	161.5	314.5	299.5	435.3	401.1	425.4	615.2	357.4	40.5	106.8	276.8	2.4	615.2	3321.8
1997	61	0	139.4	228.7	328.2	633.1	796.6	492.6	211.2	319.1	214.3	68.2	291	0	796.6	3492.4
1998	25.4	6	174	119.1	211.6	504.5	255.2	353.7	365	437.1	286.3	33.6	230.9	6	504.5	2771.5
1999	86	49.3	203	311.4	180	270.3	349.9	494.5	368.3	463.7	207.2	0.3	248.7	0.3	494.5	2983.9
2000	66	0	95.9	166.4	217	250.6	597.9	392	577.6	232.9	153.6	57.5	233.9	0	597.9	2807.4
2001	0	11.6	151.7	371.8	491.4	390.5	268.5	457	455.7	381	217.1	5.7	266.8	0	491.4	3202
2002	0	13.5	154.6	383.2	301.3	344.6	274.1	623.5	284.3	285.8	126	6.8	233.1	0	623.5	2797.7
2003	26.7	103.2	226.6	283	315.3	202.2	327.4	398.6	399.2	224.1	148.5	2.9	221.4	2.9	399.2	2657.7
2004	19.9	73.5	278.4	270.2	308	303.5	391.9	335.5	196.4	168.3	0.6	25.6	197.7	0.6	391.9	2371.8
2005	33.8	35.3	295.9	299.9	263.9	615.6	808.2	624	230.4	279.8	182.3	32.9	308.5	32.9	808.2	3702
2006	84.7	57.1	323	166.1	430.8	227.7	484.9	273.4	536.3	175.3	134.4	0.1	241.2	0.1	536.3	2893.8
2007	0	51.1	181.6	265.9	384.2	583.5	492.2	415.5	561.7	197.9	262.1	33.1	285.7	0	583.5	3428.8
2008	15.1	1	184.1	216.4	386.8	437	597.7	510.2	217.9	315	102.5	77.1	255.1	1	597.7	3060.8
2009	89.7		87.5	150.5	308.9	218.3	577.4	507.1	273.9	148.1	126.9	0	226.2	0	577.4	2488.3
2010	31.8	88.2	63.6	130.4	306.5	611.3	382.6	406.7	451.3	325.1	27.2	56.7	240.1	27.2	611.3	2881.4
2011	TR	153.4	123.1	208.5	340.9	388.6	648.6	573.7	251.8	519.9	325.2	43.8	325.2	43.8	648.6	3577.5
2012	32.6	376.7	36	99.9	439.4	498.8	637.1	861.3	619.4	410.4	126.5	30.6	347.4	30.6	861.3	4168.7
2013	44.26	39.48	167.96	185.86	363.44	415.56	506.96	422.58	408.22	232.28	130.62	33.4	245.9	33.4	507	2950.62
2014	34.15	58.74	127.98	194.34	345.46	447.74	539.7	482.64	351.32	301.2	168.78	42.14	257.8	34.15	539.7	3094.19
2015	42.3	123.9	98.86	161.14	356.5	430.8	568.68	571.8	362.86	343.7	141.66	41.64	270.32	41.64	571.8	3243.84
2016	33.43	39.5	185.72	245.8	337.65	380.44	472.98	449.41	380.43	248.48	134.65	27.13	244.6	27.13	472.98	2935.62

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	TOTAL
2017	30.17	53.45	188.19	249.63	348.91	392.98	477.59	465.93	350.81	274.57	150.25	25.88	250.7	25.88	477.59	3008.36
2018	36.86	63.01	153.74	207.35	350.39	413.5	513.18	478.47	370.73	280.05	145.19	34.04	253.88	34.04	513.18	3046.51
2019	35.38	67.72	150.9	211.65	347.78	413.09	514.43	489.65	363.23	289.6	148.11	34.17	255.48	34.17	514.43	3065.71
2020	35.63	69.52	155.48	215.12	348.25	406.16	509.37	491.05	365.61	287.28	143.97	32.57	255	32.57	509.37	3060.01
2021	34.29	58.64	166.81	225.91	346.6	401.24	497.51	474.9	366.16	275.99	144.43	30.76	251.94	30.76	497.51	3023.24
2022	36.01	64.11	160.8	225.88	347.92	407.26	519.59	489.07	365.11	286.31	144.65	32.22	256.58	32.22	519.59	3078.93
2023	35.77	56.29	145.9	210.99	346.81	410.16	502.32	473.29	370.57	281.95	145.54	30.84	250.87	30.84	502.32	3010.43
2024	35.02	65.21	149.5	217.69	347.4	406.95	504.44	496.93	366.39	277.22	146.8	31.14	253.72	31.14	504.44	3044.69
MEAN	36.17	65.43	169.84	229.48	327.89	403.57	505.16	478.14	387.87	302.61	158.04	33.78	260.2	17.96	566.94	3093.54
MIN	0	0	36	99.9	180	202.2	255.2	273.4	196.4	148.1	0.6	0	197.7	0	391.9	2371.8
MAX	89.7	376.7	366.1	383.2	491.4	633.1	808.2	861.3	721.2	519.9	325.2	106.8	347.8	43.8	861.3	4168.7
TOTAL	1049.07	1962.77	5265.14	7113.76	10164.71	12510.68	15659.95	14822.32	12023.84	9380.83	4899.35	1047.33	8066.34	556.84	17575.21	95899.75

Table A4.1.2: Relative Humidity

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	Total
1994	76	80	84	85	85	87	94	94	90	87	84	69	84.6	69	94	1015
1995	72	78	84	85	85	88	90	90	88	87	82	86	84.6	72	90	1015
1996	85	81	86	84	82	86	91	92	91	86	83	84	85.9	81	92	1031
1997	84	71	80	84	84	89	90	91	86	85	86	82	84.3	71	91	1012
1998	73	77	78	82	82	85	88	90	89	87	86	83	83.3	73	90	1000
1999	81	86	83	87	84	85	88	89	89	89	88	80	85.8	80	89	1029
2000	81	70	78	81	84	85	91	92	91	88	86	79	83.8	70	92	1006
2001	82	70	83	85	84	87	90	93	89	87	86	85	85.1	70	93	1021
2002	67	75	85	84	84	86	88	91	87	87	85	81	83.3	67	91	1000
2003	81	82	82	84	86	86	87	92	90	85	86	82	85.3	81	92	1023
2004	87	80	76	85	82	90	90	86	87	87	86	81	84.8	76	90	1017
2005	78	79	86	82	85	90	89	90	89	87	85	84	85.3	78	90	1031.3
2006	86	85	81	84	84	84	88	90	87	84	84	87	85.3	81	90	1024
2007	87	82	80	85	86	87	89	84	90	87	86	86	85.8	80	90	1029
2008	89	86	84	82	84	88	92	91	89	86	86	85	86.8	82	92	1042
2009	86	85	82	85	84	87	89	91	88	89	86	85	86.4	82	91	1037
2010	85	84	82	87	85	88	89	90	89	85	85	83	86	82	90	1032
2011	82	70	83	85	84	87	90	93	89	87	86	85	85.1	70	93	1021
2012	67	75	85	84	84	86	88	91	87	87	85	81	83.3	67	91	1000
2013	83	80	83	85	85	87	90	90	89	87	86	84	85.75	80	90	1029
2014	82	80	83	85	84	87	90	91	88	87	86	84	85.58	80	91	1027

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	MIN	MAX	Total
2015	81	79	83	85	84	87	89	91	88	87	86	84	85.3	79	91	1024
2016	80	79	82	84	84	87	90	91	89	87	85	82	85	79	91	1020
2017	83	80	82	84	84	87	89	90	89	86	86	84	85.3	80	90	1024
2018	81.8	79.6	82.6	84.6	84.2	87.0	89.6	90.6	88.6	86.8	87.54	82.75	85.5	79.6	90.6	1025.69
2019	81.56	79.52	82.52	84.52	84.04	87.0	89.52	90.72	88.52	86.76	86.22	83.68	85.4	79.52	90.72	1024.58
2020	81.47	79.42	82.42	84.42	84.05	87.0	89.42	90.66	88.62	86.71	86.55	82.55	85.27	79.4	90.66	1022.19
2021	81.57	79.51	82.31	84.31	84.06	87.0	89.51	90.6	88.75	86.65	84.28	83.64	85.18	79.51	90.6	1022.9
2022	81.45	79.57	82.65	84.48	83.83	86.94	89.45	90.75	88.52	86.76	85.23	82.68	85.19	79.57	90.75	1107.5
2023	81.67	79.56	82.6	84.58	84.13	86.71	89.55	90.53	88.67	86.67	84.54	81.46	85.06	79.56	90.53	1020.67
2024	81.43	79.41	82.41	84.39	83.99	87.03	89.51	90.69	88.74	86.63	86.47	83.59	85.36	79.41	90.69	1024.29
Mean	79.6	79.4	82.4	84.0	84.3	87.2	89.9	90.9	88.8	87.1	85.64	81.5	85.09	79	91	1020.74
Min	50	66	75	78	79	83	87	84	86	84	82	69	82.4	50	87	923
Max	89	87	88	88	88	92	94	94	92	89	90	87	94	87	94	1078
Total	2508.95	2450.59	2552.51	2614.3	2607.3	2694.68	2775.56	2807.55	2748.42	2687.98	2650.83	2566.35	2638.69	2386.57	2818.55	31757.12

Table A4.1.3: Annual Maximum Temperature (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Min	Max	Total
1994	31.7	33.2	32.6	32.1	31.2	29.8	27.5	27.4	28.8	29.7	30.9	32.5	Mean	Min	Max	Total
1995	32.7	34.1	32.6	32.4	31.5	30.9	29.4	29.3	30.3	30.1	30.5	31.5	30.6	27.4	33.2	367.4
1996	32.6	33.8	31.7	32.1	31.9	29.8	28.3	27.3	28.1	29.3	31.5	32.5	31.3	29.3	34.1	375.3
1997	31.9	33.6	32.7	30.8	31	29.4	28.7	28	29.9	30.7	31.4	32.3	30.7	27.3	33.8	368.9
1998	32.9	35	34.2	33.1	32.5	31.1	29.5	28	29.2	30.3	31.5	31.1	30.9	28.0	33.6	370.4
1999	31.9	32.3	32.3	31.1	30.8	30.1	29.3	29.2	28.7	29.3	30.4	32.3	31.5	28.0	35.0	378.4
2000	32.7	33.8	34.3	32.2	31.6	30.5	29	28.2	28.7	29.8	31.3	32	31.3	28.7	32.3	367.7
2001	32.4	34.3	32.5	32	31.6	30.1	28.5	27.1	28.2	30.2	31.3	32.2	31.2	28.2	34.3	374.1
2002	32.5	34.3	32	32	31.9	30.2	29.6	28.2	29.6	29.7	31.2	32.1	30.9	27.1	34.3	370.4
2003	33.1	34.2	33.3	32.1	31.4	30.2	30.2	28.7	29.8	31	31.5	31.6	31.4	28.2	34.3	373.3
2004	32.4	34	32	31	30	30	28	30	30.2	30	32	31.9	31.4	28.7	34.2	377.1
2005	32.6	34	32.4	32.5	31.2	29.1	28	26.7	29	29.5	31.3	30.8	31.0	28.0	34.0	371.5
2006	31.8	32.6	30.2	31.7	30.2	28.2	28.2	27.8	28.2	30.1	30.6	32	30.6	26.7	34.0	367.1
2007	29.9	31.3	32.1	31.9	30.8	29.6	27.3	27.8	27.7	29.2	30.3	31.2	30.1	27.8	32.6	361.6
2008	31.3	32.5	32.1	32.3	30.9	28.7	27.9	27.3	28.6	29.3	30.8	31.3	29.9	27.3	32.1	358.1
2009	30.8	31.8	32.1	31	30.7	29.2	27.4	26.4	27.5	28.9	29.9	30.4	30.3	27.3	32.5	363.0
2010	33.8	33.1	33	33.1	31.5	29.8	28.8	28.2	28.9	31.8	30.8	31.7	29.7	26.4	32.1	356.1
2011	32.5	34.3	32	32	31.9	30.2	29.6	28.2	29.6	29.7	31.2	32.1	31.2	28.2	33.8	374.5
2012	33.1	34.2	33.3	32.1	31.4	30.2	30.2	28.7	29.8	31	31.5	31.6	31.2	28.2	34.3	373.3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Min	Max	Total
2013	31.90	32.87	32.43	32.07	31.20	29.62	28.53	27.77	28.68	29.98	30.75	31.38	31.4	28.7	34.2	377.1
2014	32.23	33.13	32.49	32.09	31.27	29.62	28.74	27.76	28.85	30.11	30.83	31.41	30.6	27.77	32.87	366.2
2015	32.39	33.23	32.55	32.06	31.33	29.77	28.88	27.84	28.89	30.25	30.83	31.43	30.7	27.76	33.13	368.53
2016	31.92	33.39	32.58	31.74	31.06	29.75	28.24	27.75	28.74	29.55	30.84	31.47	30.8	27.84	33.23	369.45
2017	32.01	33.40	32.50	31.82	31.08	29.71	28.38	27.81	28.80	29.70	30.89	31.49	30.6	27.75	33.39	367.03
2018	32.09	33.2	32.51	31.96	31.19	29.69	28.55	27.79	28.79	29.92	33.4	33.7	30.6	27.81	33.40	367.79
2019	32.13	33.27	32.53	31.93	31.19	29.71	28.56	27.79	28.81	29.91	31.4	31.2	31.1	27.79	33.7	372.89
2020	32.11	33.3	32.53	31.9	31.17	29.73	28.52	27.8	28.81	29.86	32.3	33.6	30.7	27.79	33.27	368.43
2021	32.05	33.31	32.53	31.87	31.14	29.72	28.45	27.79	28.79	29.79	33.2	32.0	31.0	27.8	33.6	371.73
2022	32.07	33.29	32.53	32.04	31.1	29.83	28.54	27.86	28.84	29.97	31.8	31.7	31.0	27.79	33.31	370.64
2023	32.13	33.1	32.5	31.95	31.15	29.65	28.41	27.82	28.77	30.07	33.1	31.2	31.0	27.86	33.29	369.76
2024	31.99	33.36	32.35	31.96	31.32	29.72	28.44	27.84	28.97	30.01	32.6	30.5	30.8	27.82	33.1	369.85
MEAN	32.0	33.4	32.5	31.8	31.1	29.7	28.4	27.8	28.8	29.7	31.5	31.7	30.8	27.3	34.3	369.6
Min	29.9	31.3	30.2	30.8	30.0	28.2	27.3	26.4	27.5	28.9	29.9	30.4	29.7	26.4	32.1	356.1
Max	33.8	35.0	34.3	33.1	32.5	31.1	30.2	30.0	30.3	31.8	33.4	33.7	31.5	28.7	35.0	378.4
Total	992.0	1035.9	1007.1	986.8	964.7	921.2	880.6	861.8	892.6	921.9	976.4	981.8	954.7	846.5	1063.3	11450.6

Table A4.1.4: Annual Minimum Temperature (°C)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	Min	Max	Total
1994	22.6	24.1	23.5	23	22.4	21.9	21.5	22.7	22.8	22.6	22.6	21.1	22.6	21.1	24.1	271.8
1995	21.9	23.1	22.6	23.1	22.6	22	21.6	21.7	21.6	21	22.5	21.9	22.1	21.0	23.1	265.0
1996	21.9	23.7	23.2	22.6	22.9	22	21.5	21.4	21.4	21.1	22.4	22.7	22.2	21.1	23.7	266.8
1997	22.5	21.6	22.9	22.1	22	21.7	21.1	22.6	23.2	22.8	22.8	22.6	22.3	21.1	23.2	267.9
1998	21.5	24.7	24.3	23.8	23.3	23.2	22.6	22.3	22.3	22.3	22.6	21.9	22.9	21.5	24.7	274.8
1999	22	22.5	22.2	22.3	22.2	21.9	21.1	21.4	22.6	22.7	22.9	22.6	22.2	21.1	22.9	266.4
2000	23.9	23.2	24.3	23.6	23.7	23.1	22.8	22.5	23	23	23.4	22.5	23.3	22.5	24.3	279.0
2001	22.4	23.4	23.7	23.7	23.7	23	22.8	22.6	22.8	23.2	23.7	24.1	23.3	22.4	24.1	279.1
2002	22.5	23.5	24.3	24	23.6	23.4	23.5	22.9	23.3	23.1	23.4	23.3	23.4	22.5	24.3	280.9
2003	23.4	24.4	24.4	23.6	23.6	23.3	23	23.1	22.9	23.4	23.6	23.3	23.5	22.9	24.4	281.0
2004	24	25	24	24	23	23	23	23	22.7	23	23	23.4	23.4	22.7	25.0	280.1
2005	21.7	25.2	24	24.6	23.8	23.7	23	22.9	23.3	23.1	23.8	23.3	23.5	21.7	25.2	282.4
2006	24.6	24.3	23.6	24.3	23.6	23.2	23.2	23.3	23.2	23.3	23.6	23.1	23.6	23.1	24.6	283.3
2007	21.1	22.9	22.5	22.8	22.9	22.3	22.5	22.1	22.3	22.4	22.3	23	22.4	21.1	23.0	269.1
2008	22.3	22.9	23	23.1	23	22.6	22.4	22.7	22.7	22.6	22.6	22.7	22.7	22.3	23.1	272.6
2009	22.6	23.4	23	23	22.8	22.5	22.1	21.7	21.9	21.8	22.2	22.3	22.4	21.7	23.4	269.3
2010	24.3	25	24.7	24.4	24.5	23.5	23.3	23	23	23.4	23.1	22.6	23.7	22.6	25.0	284.8
2011	22.6	21.4	23.4	24	23.8	22.5	22.8	21.9	22.9	22.7	23.4	19.8	22.6	19.8	24.0	271.2

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	Min	Max	Total
2012	19.4	21.8	24.6	23.9	23	23	21.9	21.7	22.6	22.3	22.1	20.2	22.2	19.4	24.6	266.5
2013	22.05	22.90	23.53	23.53	23.33	22.73	22.50	22.18	22.57	22.53	22.62	21.77	22.68	21.77	23.53	272.24
2014	22.21	22.90	23.71	23.66	23.41	22.81	22.50	22.20	22.61	22.56	22.67	21.56	22.73	21.56	23.71	272.80
2015	22.19	22.90	23.82	23.75	23.47	22.84	22.52	22.11	22.60	22.55	22.68	21.37	22.73	21.37	23.82	272.80
2016	22.48	23.44	23.59	23.49	23.22	22.77	22.46	22.38	22.65	22.62	22.97	22.52	22.88	22.38	23.59	274.59
2017	22.43	22.62	23.79	23.84	23.60	23.32	22.87	22.51	22.50	22.60	22.70	23.05	22.99	22.50	23.84	275.83
2018	22.27	22.95	23.69	23.65	23.41	22.89	22.57	22.28	22.59	22.57	23.6	22.63	22.92	22.27	23.69	275.10
2019	22.32	22.96	23.72	23.68	23.42	22.93	22.58	22.3	22.59	22.58	23.44	25.17	23.14	22.30	25.17	277.69
2020	22.34	22.97	23.72	23.68	23.42	22.95	22.6	22.31	22.59	22.58	22.56	25.22	23.16	22.31	25.22	277.94
2021	22.37	22.99	23.7	23.67	23.41	22.97	22.62	22.36	22.58	22.59	24.16	23.48	23.16	22.36	24.16	277.90
2022	22.26	22.87	23.87	23.54	23.39	22.89	22.53	22.33	22.77	22.67	22.51	24.05	23.05	22.26	24.05	276.68
2023	22.21	23.0	23.72	23.56	23.46	22.99	22.41	22.3	22.7	22.66	23.67	23.26	23.08	22.30	23.72	276.94
2024	22.47	23.21	23.61	23.83	23.37	22.91	22.55	22.33	22.57	22.5	23.11	26.10	23.21	22.33	26.10	278.56
MEAN	22.6	23.8	23.8	23.6	23.3	22.9	22.5	22.5	22.6	22.7	23.0	22.7	22.9	21.8	23.9	274.6
MIN	19.4	21.4	22.2	22.1	22.0	21.7	21.1	21.4	21.4	21.0	22.1	19.8	22.1	19.4	22.9	265.0
MAX	24.6	25.2	24.7	24.6	24.5	23.5	23.5	23.3	23.3	23.4	24.1	26.1	23.7	22.7	26.1	284.8
TOTAL	700.2	737.0	737.8	731.3	723.0	709.6	697.8	696.3	701.8	702.8	713.2	703.3	711.2	676.2	740.4	8514.2

Table A4.2: Air quality measurements

Sample code	NO ₂ (ppm)	SO ₂ (ppm)	H ₂ S (ppm)	CO (ppm)	CO ₂ (ppm)	NH ₃ (ppm)	Cl ₂ (ppm)	HCN (ppm)	TVOC (mg/m ³)	CH ₄ (ppm)	CH ₂ O (mg/m ³)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)
OATC/AQ/01	<0.1	0.1	0.2	2.0	708	4.0	<0.1	1.0	0.771	0.5	0.090	51	90
OATC/AQ/02	0.1	0.2	0.1	2.0	689	7.0	0.1	1.0	0.702	2.0	0.065	65	134
OATC/AQ/03	0.2	0.2	0.2	4.0	711	7.0	0.2	2.0	0.558	1.5	0.035	57	121
OATC/AQ/04	0.2	0.1	0.2	3.0	672	5.0	0.1	2.0	0.543	1.0	0.082	53	118
OATC/AQ/05	0.1	0.2	0.2	3.0	662	5.0	0.1	1.0	0.518	1.5	0.067	67	166
CTRL	0.1	0.1	0.1	2.0	580	5.0	0.1	1.0	0.321	0.5	0.045	55	112
Mean±SD	0.1±0.1	0.16±0.1	0.18±0.04	2.8±0.8	688.4±21.6	5.6±1.3	0.08±0.1	1.4±0.5	0.618±0.1	1.3±0.6	0.068±0.02	58.6±7.1	125.8±27.6
Range	<0.1-0.2	0.1-0.2	0.1-0.2	2.0-4.0	662-711	4.0-7.0	<0.1-0.2	1.0-2.0	0.518-0.771	0.5-2.0	0.035-0.090	51-67	90-166
FME limits (1991)	0.04-0.06	0.01-0.1	-	10.0-20.0		200	-	-	-		-	250	250

Table A4.3: Noise levels of the study area

Sample code	Noise level [dB(A)]	Minimum [dB(A)]	Maximum [dB(A)]
OATC/NL/01	70.4	62.6	73.1
OATC/NL/02	68.8	61.8	75.5
OATC/NL/03	65.7	60.6	68.2

OATC/NL/04	59.7	55.4	61.8
OATC/NL/05	64.5	58.8	66.2
CTRL	62.1	58.7	67.3
Mean±SD	65.82±4.2	59.84±2.9	68.96±8.4
Range	59.7-70.4	55.4-62.6	61.8-75.5
FME limit (1991)	90 [dB(A)]		

Table A4.4: Results of the Physicochemical Characteristics of Ground Water Soil Samples

Parameter	GW ₁	GW ₂	GW ₃	Control	Mean±SD	Range	WHO Limit	FMENV Limit
Color (Pt Co Units NCASI)	1.58	1.71	1.62	1.22	1.64±0.1	1.58-1.71	5.0-15	-
pH	5.47	5.33	5.28	5.52	5.36±0.1	5.33-5.47	6.5-8.5	6.5-9.0
Temperature (oC)	27.3	27.6	27.4	27.9	27.4±0.2	27.3-27.6	-	-
Turbidity (NTU)	0.77	0.84	0.82	0.60	0.81±0	0.77-0.84	5	5
Salinity as Cl ⁻ (mg/l)	22.00	22.22	22.06	22.31	22.09±0.1	22.00-22.22	-	-
Total Hardness (mg/l)	30.5	31.2	30.6	29.7	30.77±0.3	30.5-31.2	250	250
Conductivity (μS/cm)	79.5	80.3	79.7	80.6	79.83±0.4	79.5-80.3	1000	400
Dissolved Oxygen (mg/l)	0.18	0.27	0.25	0.19	0.23±0.04	0.18-0.27	5	>4.0
Biological Oxygen Demand (mg/l)	0.66	0.75	0.83	0.57	0.75±0.1	0.66-0.83	-	-
Chemical Oxygen Demand (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	150
Total Hydrocarbon Content (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Phosphate (mg/l)	0.33	0.37	0.35	0.38	0.35±0.02	0.33-0.37	-	-
Sulphate (mg/l)	5.82	6.14	6.22	6.08	6.06±0.2	5.82-6.22	250	250
Nitrate (mg/l)	0.75	0.88	0.79	0.81	0.81±0.1	0.75-0.88	10	10
Total Dissolved Solids (mg/l)	39.75	40.15	39.85	40.3	39.92±0.2	39.75-40.15	1000	1000
Total Suspended Solids (mg/l)	0.32	0.35	0.34	0.25	0.34±0.01	0.32-0.35	-	-
Copper (mg/l)	0.48	0.75	0.77	0.67	0.67±0.2	0.48-0.77	1	0.01
Iron (mg/l)	1.05	1.23	1.18	1.33	1.15±0.1	1.05-1.23	0.36	0.36
Lead (mg/l)	0.215	0.166	0.154	0.175	0.178±0.03	0.154-0.215	0.05	<1.0
Zinc (mg/l)	1.08	1.14	1.11	1.15	1.11±0.2	1.08-1.14	3	<1.0
Cadmium (mg/l)	0.055	0.068	0.073	0.084	0.065±0	0.055-0.073	0.003	<1.0
Chromium (mg/l)	0.065	0.057	0.059	0.064	0.060±0	0.057-0.065	0.05	0.05
Potassium (mg/l)	0.74	0.66	0.77	0.72	0.72±0.1	0.66-0.77	-	-
Barium (mg/l)	0.22	0.17	0.23	0.25	0.21±0.03	0.17-0.23	-	-
Faecal Coliform (cfu/100ml)	0	0	0	0	0	0	0	0
Total Coliform (cfu/100ml)	0	0	0	0	0	0	0	0
Total Heterotrophic Bacteria (cfu/ml)	15	17	14	17	15.33±2	14-17	100	100

Table A4.5: Results of the Physicochemical Characteristics of Surface Water Samples

Parameter	WS ₁			CTRL			Mean±SD	Range	WHO limit	FME _{env} Limit
	US	MS	DS	US	MS	DS				
Color (Pt Co Units NCASI)	17.4	16.5	17.7	17.3	16.8	17.7	17.2±0.6	16.5-17.7	5.0-15.0	-
pH	8.74	8.54	8.88	8.25	8.09	8.43	8.72±0.2	8.54-8.88	6.5-8.5	6.5-9.0
Temperature (°C)	27.3	28.6	30.5	27.8	27.4	28.1	28.8±2	27.3-30.5	-	-
Turbidity (NTU)	28.72	28.64	28.81	28.33	28.16	28.45	28.72±0.1	28.64-28.81	5	5
Salinity as Cl ⁻ (mg/l)	41.5	41.1	42.3	44.3	43.8	44.9	41.6±0.6	41.1-42.3	-	-
Hardness (mg/l)	70.2	69.8	70.7	71.4	70.8	71.6	70.23±0.5	69.8-70.7	250	250
Conductivity (µS/cm)	71.6	69.9	83.7	90.6	89.9	90.8	75.1±7.5	69.9-83.7	1000	400
Dissolved Oxygen (mg/l)	6.77	6.68	6.81	7.08	6.88	7.23	6.75±0.1	6.68-6.81	5	>4.0
BOD (mg/l)	1.42	1.38	1.52	1.22	1.14	1.38	1.44±0.1	1.38-1.52	-	-
COD (mg/l)	0.76	0.61	0.83	0.47	0.31	0.57	0.73±0.1	0.61-0.83	-	150
THC (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Phosphate (mg/l)	0.86	0.81	0.92	0.78	0.72	0.83	0.86±0.1	0.81-0.92	-	-
Sulphate (mg/l)	0.37	0.31	0.47	0.35	0.31	0.39	0.38±0.1	0.31-0.47	250	250
Nitrate (mg/l)	3.32	3.13	3.41	3.08	3.04	3.12	3.29±0.1	3.13-3.32	10	10
TDS (mg/l)	50.8	49.4	63.9	44.3	43.7	44.8	54.7±8	49.4-63.9	1000	1000
TSS (mg/l)	11.96	11.95	12.00	11.80	11.73	11.85	11.97±0.02	11.95-12.00	-	-
Copper (mg/l)	1.551	1.532	1.565	1.235	1.227	1.255	1.549±0.02	1.532-1.565	1	0.01
Iron (mg/l)	7.52	7.33	7.63	7.05	6.83	7.12	7.49±0.2	7.33-7.63	0.36	0.36
Lead (mg/l)	0.572	0.546	0.577	0.473	0.466	0.477	0.565±0.02	0.546-0.577	0.05	<1.0
Zinc (mg/l)	5.28	5.16	5.37	5.21	5.12	5.25	5.27±0.1	5.16-5.37	3	<1.0
Cadmium (mg/l)	0.045	0.038	0.051	0.033	0.027	0.037	0.044±0.01	0.038-0.051	0.003	<1.0
Chromium (mg/l)	0.021	0.016	0.029	0.017	0.011	0.022	0.022±0.01	0.016-0.029	0.05	0.05
Potassium (mg/l)	2.14	2.09	2.19	2.11	2.09	2.17	2.14±0.1	2.09-2.19	-	-
Barium (mg/l)	1.43	1.37	1.53	1.33	1.26	1.39	1.44±0.1	1.37-1.53	-	-
Faecal Coliform (cfu/100ml)	15	11	17	16	12	19	14.3±3	11.0-17.0	0	0
Total Coliform (cfu/100ml)	17	14	20	15	13	21	17.00±3	14.0-20.0	0	0
Total Heterotrophic Bacteria (cfu/ml)	1.6 × 10 ⁵	1.1 × 10 ⁵	1.8 × 10 ⁵	1.4 × 10 ⁵	1.1 × 10 ⁵	1.7 × 10 ⁵	1.5 × 10 ⁵ ±0.4	1.1 × 10 ⁵ -1.8 × 10 ⁵	100	100

Table A4.6: Results of the Physicochemical Characteristics of Soil Samples

Parameter	SS ₁		SS ₂		SS ₃		SS ₄		SS ₅		CTRL		Mean±SD	Range
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS		
Permeability (%)	25.3	20.3	21.2	19.4	22.8	20.3	21.8	19.6	24.1	21.7	24.5	22.1	21.65±2	19.4-25.3
Porosity (%)	40.2	37.6	42.5	40.3	40.6	38.9	38.6	35.2	40.1	37.6	44.6	41.6	39.16±2.0	35.2-42.5
Bulk density (mg/kg)	1.15	1.22	1.23	1.43	1.31	1.44	1.27	1.32	1.33	1.47	1.35	1.40	1.32±0.1	1.15-1.47
% Sand	55.3	57.2	55.6	58.3	56.4	58.4	53.6	57.2	55.6	57.1	56.3	58.2	56.47±1	53.6-58.4
% Silt	14.7	10.8	16.4	8.7	14.6	7.6	20.4	14.8	17.4	10.9	20.7	14.8	13.63±4	7.6-20.4
% Clay	30	32	28	33	29	34	26	28	27	32	23	27	29.9±3	26.0-34.0
pH	4.71	5.25	4.52	5.48	4.82	6.03	4.88	5.49	4.76	5.47	5.23	5.79	5.14±0.5	4.52-6.03
Conductivity (dS/m)	0.05	0.08	0.07	0.11	0.14	0.17	0.12	0.18	0.08	0.12	0.05	0.10	0.11±0	0.05-0.18
Moisture content (%)	28.6	31.6	30.6	32.8	29.4	30.2	27.7	30.2	28.6	30.4	29.3	30.7	30.01±2	27.7-32.8
Nitrate (mg/kg)	33.3	28.7	35.8	31.6	35.2	33.5	35.4	32.8	31.5	30.3	36.3	33.4	32.81±2	28.7-35.8
Phosphate (mg/kg)	13.8	12.9	14.5	12.9	13.6	12.3	15.3	13.6	13.7	11.6	14.5	13.1	13.42±1	11.6-15.3
Sulphate (mg/kg)	24.5	20.6	25.9	23.6	25.3	23.7	27.8	25.5	31.2	29.5	25.3	22.7	25.76±3	20.6-31.2
Calcium (cmol/kg)	4.88	4.35	4.70	4.19	5.01	4.29	4.67	4.27	4.78	4.21	4.14	4.03	4.54±0.3	4.19-5.01
Magnesium (cmol/kg)	1.22	1.03	1.46	1.32	1.42	1.37	1.27	1.11	1.45	1.36	1.50	1.41	1.30±0.1	1.03-1.46
Potassium (cmol/kg)	1.18	1.12	1.22	1.18	1.28	1.21	1.39	1.35	1.49	1.33	1.26	1.14	1.28±0.1	1.03-1.49
Sodium (cmol/kg)	0.24	0.15	0.23	0.17	0.25	0.19	0.22	0.16	0.21	0.18	0.24	0.19	0.2±0	0.15-0.25
THC (mg/kg)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium (mg/kg)	0.562	0.492	0.625	0.577	0.914	0.887	0.567	0.514	0.725	0.715	0.552	0.487	0.66±0.1	0.492-0.887
Nickel (mg/kg)	0.672	0.558	0.723	0.718	0.523	0.499	0.624	0.572	0.726	0.713	0.527	0.518	0.633±0.1	0.499-0.726
Iron (mg/kg)	15.25	13.57	16.23	15.09	15.66	15.17	15.26	15.07	16.32	16.28	15.26	14.11	15.39±0.8	13.57-16.32
Lead (mg/kg)	2.555	2.424	2.351	2.256	2.315	2.228	2.432	2.421	2.228	2.165	2.332	2.214	2.338±0.1	2.165-2.432
Copper (mg/kg)	7.28	7.09	7.45	7.36	7.45	7.38	7.23	7.19	7.29	7.16	7.33	7.16	7.29±0.1	7.09-7.45
Zinc (mg/kg)	18.53	18.46	17.25	17.14	17.65	17.47	16.28	16.17	16.20	16.08	15.26	15.11	17.12±0.9	16.08-18.53

Table A4.7: Physicochemical Characteristics of Sediment Samples

Parameter	SED ₁			CTRL			Mean±SD	Range
	US	MS	DS	US	MS	DS		
pH	8.77	8.68	8.86	8.45	8.37	8.54	8.77±0.1	8.68-8.86
E C (μS/cm)	89.3	88.7	89.7	76.3	75.7	76.8	89.2±0.5	88.7-89.7
TOC (%)	6.22	6.14	6.33	5.38	5.31	5.47	6.23±0.1	6.14-6.33
Av. P (mg/kg)	3.12	3.09	3.17	2.74	2.68	2.77	3.13±0.04	3.09-3.17
NO ₃ ⁻ (mg/kg)	7.34	7.27	7.47	6.11	6.05	6.17	7.36±0.1	7.27-7.47
SO ₄ ²⁻ (mg/kg)	1.13	1.09	1.18	1.33	1.25	1.38	1.13±0.04	1.09-1.18
Na (meq/100g)	21.32	21.27	21.31	18.63	18.55	10.68	21.3±0.02	21.27-21.31
K (meq/100g)	5.77	5.68	5.83	5.17	5.14	5.24	5.76±0.1	5.68-5.83

Parameter	SED ₁			CTRL			Mean±SD	Range
	US	MS	DS	US	MS	DS		
Ca (meq/100g)	58.08	58.00	58.17	53.56	53.47	53.59	58.08±0.1	58.00-58.17
Mg (meq/100g)	10.14	10.11	10.27	10.08	10.03	10.18	10.17±0.1	10.11-10.27
Fe (mg/kg)	12.34	12.27	12.37	12.12	12.08	12.18	12.33±0.1	12.27-12.37
Mn (mg/kg)	4.33	4.29	4.45	4.25	4.18	4.37	4.36±0.1	4.29-4.45
Zn (mg/kg)	4.89	4.75	4.93	4.55	4.49	4.62	4.86±0.1	4.75-4.93
Cu (mg/kg)	0.104	0.095	0.112	0.121	0.117	0.126	0.104±0.01	0.095-0.112
Pb (mg/kg)	0.217	0.209	0.223	0.225	0.218	0.231	0.216±0	0.209-0.223
Cd (mg/kg)	0.033	0.025	0.037	0.028	0.023	0.034	0.032±0	0.025-0.037
V (mg/kg)	0.027	0.023	0.032	0.045	0.039	0.047	0.027±0	0.023-0.032
Cr (mg/kg)	0.031	0.025	0.041	0.045	0.041	0.047	0.032±0	0.025-0.041

Source: Fieldwork (2025)

Table A4.8: Microbiological Characteristics of Sediment Samples

Parameter	SED ₁			CTRL		Microorganisms identified	
	US	MS	DS	US	DS	Bacteria	Fungi
THB (cfu/g)	3.3 × 10 ⁵	2.9 × 10 ⁵	3.7 × 10 ⁵	3.3 × 10 ⁵	2.7 × 10 ⁵	<i>Acinetobacter</i> sp., <i>Nocardia</i> sp., * <i>Bacillus subtilis</i> , <i>Desulfobacterium</i> sp., <i>Desulfobulbus</i> sp., <i>Desulfovibrio</i> sp., <i>Methanococcus</i> Sp., <i>Methanohalophilus</i> sp., <i>Methanosarcina</i> sp., <i>Clostridium</i> sp., <i>Fusobacterium</i> sp., <i>Desulfuromonas</i> sp., <i>Bacteroides</i> sp., <i>Achromobacter</i> sp., <i>Bacteroids</i> sp., <i>Bacillus</i> sp., * <i>Micrococcus</i> sp., * <i>Pseudomonas</i> sp., <i>Paracoccus</i> sp,	<i>Aspergillus fumigatus</i> , <i>Fusarium</i> sp, <i>Rhizopus</i> sp., <i>chytridium</i> sp., <i>Fusarium</i> sp, <i>Aspergillus niger</i> , * <i>Candida</i> <i>tropicalis</i> , <i>Alternaria</i> sp, * <i>Candida</i> sp. <i>Rhizophydium</i> sp., <i>Pythium</i> sp., <i>Phytophthora</i> sp., <i>Mucor</i> sp., * <i>Candida</i> <i>albicans</i> , * <i>Penicillium</i> sp.
THF (cfu/g)	2.4 × 10 ⁵	2.1 × 10 ⁵	2.7 × 10 ⁵	2.5 × 10 ⁵	2.7 × 10 ⁵		
HUB (cfu/g)	1.4 × 10 ⁵	1.1 × 10 ⁵	1.8 × 10 ⁵	1.5 × 10 ⁵	1.7 × 10 ⁵		
HUF (cfu/g)	1.0 × 10 ⁵	1.0 × 10 ⁵	1.2 × 10 ⁵	1.3 × 10 ⁵	1.6 × 10 ⁵		

Source: Laboratory Analysis (2025)

Table A4.9: Microbial characteristics of soil samples

Parameter	SS ₁		SS ₂		SS ₃		SS ₄		SS ₅		CTRL	
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS
THB (cfu/g)	3.3 × 10 ⁵	2.4 × 10 ⁵	3.5 × 10 ⁵	2.2 × 10 ⁵	3.7 × 10 ⁵	3.4 × 10 ⁵	3.9 × 10 ⁵	3.1 × 10 ⁵	2.9 × 10 ⁵	2.6 × 10 ⁵	3.1 × 10 ⁵	2.9 × 10 ⁵
THF (cfu/g)	3.5 × 10 ⁵	3.1 × 10 ⁵	3.7 × 10 ⁵	2.9 × 10 ⁵	3.5 × 10 ⁵	2.8 × 10 ⁵	3.8 × 10 ⁵	3.3 × 10 ⁵	3.2 × 10 ⁵	2.7 × 10 ⁵	3.5 × 10 ⁵	3.3 × 10 ⁵
HUB (cfu/g)	1.5 × 10 ⁵	1.1 × 10 ⁵	1.5 × 10 ⁵	1.4 × 10 ⁵	1.7 × 10 ⁵	1.5 × 10 ⁵	1.5 × 10 ⁵	1.2 × 10 ⁵	1.3 × 10 ⁵	1.1 × 10 ⁵	1.5 × 10 ⁵	1.2 × 10 ⁵
HUF (cfu/g)	1.7 × 10 ⁵	1.3 × 10 ⁵	1.7 × 10 ⁵	1.3 × 10 ⁵	1.6 × 10 ⁵	1.4 × 10 ⁵	1.5 × 10 ⁵	1.2 × 10 ⁵	1.4 × 10 ⁵	1.1 × 10 ⁵	1.3 × 10 ⁵	1.1 × 10 ⁵

THB = Total Heterotrophic Bacteria THF = Total Heterotrophic Fungi HUB = Hydrocarbon Utilizing Bacteria; HUF = Hydrocarbon Utilizing Fungi

Table A4.10: Microorganisms Identified in Soil

Isolate	SS ₁		SS ₂		SS ₃		SS ₄		SS ₅		CTRL		%Occurrence
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	
Bacteria													
<i>*Pseudomonas</i> sp	-	-	+	-	+	+	+	+	+	-	+	-	60
<i>E. coli</i>	+	-	+	-	-	-	-	-	+	-	+	-	30
<i>*Bacillus subtilis</i>	+	-	-	-	+	+	+	-	-	-	+	-	40
<i>Clostridium titanii</i>	+	+	+	-	-	-	+	+	-	-	+	-	50
<i>Clostridium perfringens</i>	+	+	+	-	+	-	+	+	+	-	+	+	70
<i>Staphylococcus</i> sp.	+	-	+	-	-	-	+	-	+	-	+	-	40
<i>Acinetobacter</i> sp.	+	+	-	-	+	-	+	-	+	-	+	-	50
<i>Agromobacter</i> sp.	+	-	-	-	+	-	-	-	+	-	+	-	30
<i>*Pseudomonas aeruginosa</i>	+	+	+	+	+	-	+	-	+	+	+	+	80
<i>*Bacillus</i> sp.	+	+	+	-	-	-	+	+	+	-	+	+	60
<i>*Clostridium</i> sp	+	-	+	-	+	+	+	-	-	-	+	+	50
<i>Klebsiella</i> sp	+	-	-	-	+	-	-	-	+	-	+	-	30
<i>Enterobacter</i> sp	-	-	+	+	+	-	-	-	-	-	+	-	30
<i>Streptococcus</i> sp.	+	+	-	-	+	-	-	-	+	-	+	-	40
<i>Salmonella</i> sp.	+	-			+	-	-	-	-	-	+	-	20
Fungi													
<i>Penicillium chrysogenum</i> ,	+	-	+	-	-	-	-	-	-	-	+	-	20
<i>Penicillium citrinum</i>	-	-	+	-	-	-	-	-	-	-	+	-	10
<i>Fusarium oxysporum</i> ,	-	-	-	-	+	-	-	-	-	-	+	-	10

Isolate	SS ₁		SS ₂		SS ₃		SS ₄		SS ₅		CTRL		%Occurrence
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS	
<i>Tylospora</i> sp.	+	-	-	-	-	-	-	-	-	-	+	-	10
<i>Acrmonium</i> sp.	-	-	+	-	-	-	-	-	-	-	+	-	10
<i>Fusarium solani</i>	+	+	+	-	-	-	-	-	-	-	+	-	30
<i>Rhizopus stolonifer</i>	-	-	-	-	+	+	-	-	-	-	+	-	20
<i>Aspergillus fumigatus</i>	+	+	+	+	+	-	+	+	+	-	+	+	80
<i>Aspergillus niger</i>	+	+	+	-	+	+	+	+	-	-	+	+	70
<i>Aspergillus flavus</i>	+	-	+	-	+	-	+	-	+	-	+	-	50
<i>Fusarium</i> sp	-	-	+	-	+	-	+	-	-	-	+	-	30
<i>Candida albicans</i>	+	+	-	-	-	-	+	-	-	-	+	+	30
<i>Trichoderma</i> sp.	+	-	+	+	-	-	-	-	-	-	+	-	30
<i>Mucor</i> sp	+	+	-	-	+	+	-	-	+	+	+	-	10
* <i>Candida tropicalis</i>	+	-	+	-	+	+	-	-	-	+	+	-	50
<i>Cadophora</i> sp.	+	-	-	-	-	-	-	-	-	-	-	-	10

*Hydrocarbon degrader TS = Top Soil, SS = Sub Soil

Table A4.11: Geographical Details and Individual Names of the Trees

SN	Name	Latitude	longitude
1.	<i>Anacardium occidentale L</i>	6° 41' 7.530" N	8° 47' 0.650" E
2.	<i>Azadirachta indica</i>	6° 41' 15.256" N	8° 47' 2.429" E
3.	<i>Azadirachta indica</i>	6° 41' 16.203" N	8° 47' 5.410" E
4.	<i>Borassus aethiopum Mart</i>	6° 41' 14.310" N	8° 46' 58.807" E
5.	<i>Ceiba pentandra</i>	6° 41' 0.391" N	8° 47' 8.092" E
6.	<i>Daniellia oliveri</i>	6° 41' 14.500" N	8° 47' 5.677" E
7.	<i>Dialium guineense wild</i>	6° 41' 3.732" N	8° 47' 2.566" E
8.	<i>Elaeis guineensis</i>	6° 41' 15.322" N	8° 47' 5.993" E
9.	<i>Elaeis guineensis</i>	6° 41' 14.509" N	8° 47' 5.722" E
10.	<i>Elaeis guineensis</i>	6° 41' 14.751" N	8° 47' 7.132" E
11.	<i>Elaeis guineensis</i>	6° 41' 15.169" N	8° 47' 7.084" E
12.	<i>Elaeis guineensis</i>	6° 41' 16.756" N	8° 47' 6.948" E
13.	<i>Elaeis guineensis</i>	6° 41' 17.152" N	8° 47' 6.707" E
14.	<i>Elaeis guineensis</i>	6° 41' 11.956" N	8° 46' 57.347" E
15.	<i>Elaeis guineensis</i>	6° 41' 11.896" N	8° 46' 57.219" E
16.	<i>Elaeis guineensis</i>	6° 41' 10.911" N	8° 46' 56.598" E
17.	<i>Elaeis guineensis</i>	6° 41' 11.227" N	8° 46' 56.401" E

SN	Name	Latitude	longitude
18.	<i>Elaeis guineensis</i>	6° 41' 11.029" N	8° 46' 53.631" E
19.	<i>Elaeis guineensis</i>	6° 41' 10.432" N	8° 46' 51.604" E
20.	<i>Elaeis guineensis</i>	6° 41' 9.497" N	8° 46' 51.711" E
21.	<i>Elaeis guineensis</i>	6° 41' 8.791" N	8° 46' 51.963" E
22.	<i>Elaeis guineensis</i>	6° 41' 8.694" N	8° 46' 51.388" E
23.	<i>Elaeis guineensis</i>	6° 41' 7.693" N	8° 46' 51.288" E
24.	<i>Elaeis guineensis</i>	6° 41' 5.765" N	8° 46' 51.821" E
25.	<i>Elaeis guineensis</i>	6° 40' 57.889" N	8° 46' 58.091" E
26.	<i>Elaeis guineensis</i>	6° 40' 58.922" N	8° 47' 0.002" E
27.	<i>Elaeis guineensis</i>	6° 41' 2.054" N	8° 46' 56.406" E
28.	<i>Elaeis guineensis</i>	6° 41' 2.864" N	8° 46' 56.978" E
29.	<i>Elaeis guineensis</i>	6° 41' 3.761" N	8° 46' 57.205" E
30.	<i>Elaeis guineensis</i>	6° 41' 5.932" N	8° 46' 57.400" E
31.	<i>Elaeis guineensis</i>	6° 41' 7.616" N	8° 46' 59.862" E
32.	<i>Elaeis guineensis</i>	6° 41' 7.613" N	8° 47' 7.613" E
33.	<i>Elaeis guineensis</i>	6° 41' 0.740" N	8° 47' 4.070" E
34.	<i>Elaeis guineensis</i>	6° 41' 8.639" N	8° 47' 8.153" E
35.	<i>Elaeis guineensis</i>	6° 41' 8.790" N	8° 47' 8.693" E
36.	<i>Elaeis guineensis</i>	6° 41' 5.428" N	8° 47' 8.156" E
37.	<i>Elaeis guineensis</i>	6° 41' 4.470" N	8° 47' 7.210" E
38.	<i>Elaeis guineensis</i>	6° 41' 4.394" N	8° 47' 7.426" E
39.	<i>Elaeis guineensis</i>	6° 41' 3.221" N	8° 47' 7.246" E
40.	<i>Elaeis guineensis</i>	6° 41' 2.245" N	8° 47' 7.807" E
41.	<i>Elaeis guineensis</i>	6° 41' 0.636" N	8° 47' 7.764" E
42.	<i>Gmelina arborea</i>	6° 41' 16.722" N	8° 47' 6.906" E
43.	<i>Gmelina arborea</i>	6° 41' 11.197" N	8° 46' 56.903" E
44.	<i>Gmelina arborea</i>	6° 41' 8.742" N	8° 46' 49.556" E
45.	<i>Gmelina arborea</i>	6° 41' 8.945" N	8° 47' 0.035" E
46.	<i>Gmelina arborea</i>	6° 41' 0.395" N	8° 47' 7.807" E
47.	<i>Gmelina arborea</i> Roxb	6° 41' 14.651" N	8° 47' 2.414" E
48.	<i>Inga laurina</i>	6° 41' 16.052" N	8° 47' 4.501" E
49.	<i>Irvingia gabonensis</i>	6° 41' 5.654" N	8° 47' 1.878" E
50.	<i>Khaya senegalensis</i>	6° 41' 16.070" N	8° 47' 4.736" E
51.	<i>Mangifera indica</i>	6° 41' 14.282" N	8° 47' 5.606" E
52.	<i>Mangifera indica</i>	6° 41' 4.798" N	8° 47' 7.249" E
53.	<i>Mangifera indica</i> L.	6° 41' 14.147" N	8° 47' 0.991" E

SN	Name	Latitude	longitude
54.	<i>Morinda lucida Benth</i>	6° 41' 10.044" N	8° 46' 53.137" E
55.	<i>Musa acuminata</i>	6° 41' 0.287" N	8° 47' 7.426" E
56.	<i>Musa paradisiaca</i>	6° 41' 10.866" N	8° 46' 56.441" E
57.	<i>Parkia biglobosa</i>	6° 41' 15.724" N	8° 47' 3.530" E
58.	<i>Peltophorum africanum</i>	6° 41' 6.274" N	8° 47' 1.867" E
59.	<i>Peltophorum africanum sond</i>	6° 41' 6.274" N	8° 47' 1.866" E
60.	<i>Psidium guajava</i>	6° 41' 10.898" N	8° 46' 56.758" E
61.	<i>Tamarindus indica L</i>	6° 41' 8.682" N	8° 46' 58.321" E
62.	<i>Tectona grandis</i>	6° 41' 5.042" N	8° 47' 0.773" E

APPENDIX 4.3: ATTENDANCE LISTS




Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adilabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Stakeholders Engagement

Date 17/June/2025 Venue HOGIS HOTEL, TARIKUM CROSS STATE HOUSE, CALABAR Meeting Type STAKEHOLDERS ENGAGEMENT / SCOPING WORKSHOP

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Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adiabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Stakeholders Engagement
Date: 17/June/2025 Venue: HOGIS HOTEL, 7 AKIN CLOSE, STATE HOUSING, CAMEROON Meeting Type: STAKEHOLDERS ENGAGEMENT / SCOPING WORKSHOP

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Cross River State Special Agro-Industrial Processing Zone Program

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Stakeholders Engagement
Date: 17/June/2025 Venue: HOGIS HOTEL, 7 AKIN CLOSE, STATE HOUSING, CAMEROON Meeting Type: STAKEHOLDERS ENGAGEMENT / SCOPING WORKSHOP

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Stakeholders Engagement

Date 17/JUNE/2025 Venue HOGIS HOTEL, TAKIM CLOSE, STATE HOUSE, CACABAR Meeting Type STAKEHOLDERS ENGAGEMENT / SCOPING WORKSHOP

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2	HH Chief Oron Olu Inok	Esin Uket Adilabo	07086121046	
3	HH Chief Ukpabio D. N. Olu	Adilabo	08032087947	
4	HH Chief Oron Ede Olu	Adilabo	08039178161	
5	Chief Michael Eyo	"	08061652751	
6	Ede Oron Ehin	"	0702953452	
7	Nancy's Dominic Hagan	"	0806348400	Youth
8	Bassey Ede Esien	"	08067289372	Youth
9	Ehin Mark	"	07062054204	
10	Solomon Oron Udo	Esien Uket Adilabo	08066153941	
11	Deborah Olu	Adilabo	08104517508	
12	Offiong Ede Eyo	Adilabo	07038380558	
13	Rose Okalaky Effiong	"	08066384696	
14	Bassey Thompson	"	08038700609	
15	Gabriel Oron Njoku	"	08020890868	Youth Leader
16	Ehin Effiong Ede	"	09028255984	Youth
17	Nene Effiong Ehin Ita	"	07089377661	
18	Samuel Nya Effiong	"	08138810492	
19	Ede Ede Ehin	"		
20	Mary Ehin Ede	"	09079153932	
21	Ayi Oron Ehin	"	07062191540	
22	Bassey Oron Effiong	"	07033749186	
23	Ikwe Philip Ukpou	"	08025919787	

S/N	NAME	COMMUNITY	PHONE NUMBER	POSITION	SIGN
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25	Glory Oron Ehin	"		"	
26	Amos Ede Ede	"		"	
27	Queeneth Ede Archibant	"	08138807105138890171	"	
28	Peace Chukwuma Ede	"	09024621357	Youth	
29	Veronica Emmanuel Ede	"	08064312195		
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Stakeholders Engagement

Date 17-JUNE-2025 Venue Hogis Hotel, 7 Akim Close, State Housing Camp Meeting Type Stakeholders Engagement

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Stakeholders Engagement

Date 16-JUNE-2025 Venue Palace of the Obang of Adilabo Meeting Type Stakeholders Engagement

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Stakeholders Engagement
Date 17 JUNE 2025 Venue HOGIS HOTEL, 7 AKIM CLOSE, STATE HOUSE, CALABAR Meeting Type STAKEHOLDERS ENGAGEMENT / SCOPING & WORKSHOP

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Stakeholders Engagement
Date 17-JUNE-2025 Venue HOGIS HOTEL, 7 AKIM CLOSE, STATE HOUSE, CALABAR Meeting Type STAKEHOLDERS ENGAGEMENT / SCOPING & WORKSHOP

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Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adiabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Date 17 June 2025 Venue Hogis Hotel, 7 Akim Close, State Housing, Calabar Meeting Type Stakeholders Engagement / Scoping Workshop

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Cross River State Special Agro-Industrial Processing Zone Program

Environmental and Social Impact Assessment (ESIA) and preparation of Resettlement Action Plan (RAP) for Agro-Industrial Hub (AIH) at Tinapa Road, Adiabo and Agricultural Transformation Centre (ATC) at Okuku, Yala LGA, Cross River State

Date 17 June 2025 Venue Hogis Hotel, 7 Akim Close, State Housing, Calabar Meeting Type Stakeholders Engagement / Scoping Workshop

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APPENDIX 7: Management Plans

• LABOUR MANAGEMENT PLAN (LMP)

INTRODUCTION

Labour is a critical component of project success, especially for large-scale infrastructure and agricultural processing projects like the Agricultural Transformation Centre (ATC) at Okuku, Yala Local Government Area in Cross Rivers State under the Cross River Special Agricultural Processing Zones (CR-SAPZ) program. Labour activities must be managed to safeguard workers' rights, prevent social risks, and promote sustainable development.

This LMP serves as a guiding document to:

- Define policies, procedures, and standards for labour management across the project lifecycle (pre-construction, construction, operation, decommissioning).

- Address potential labour risks, including unfair recruitment, occupational hazards, worker grievances, child labour, forced labour, discrimination, sexual exploitation, and community tension.

- Promote compliance with Nigerian Labour Laws, AfDB Safeguard Requirements (OS2), ILO Conventions, and other relevant regulations.

This LMP applies to:

- Direct workers (hired by CR-SAPZ or its implementing partners)

- Contracted workers (hired by contractors and subcontractors)

- Primary supply workers (involved in the provision of core project inputs)

- Community workers (where applicable in social or community-driven activities)

OBJECTIVES OF THE LMP

The LMP is designed to achieve the following:

1. Ensure fair, safe, and respectful treatment of all project workers.
2. Prevent exploitation, discrimination, harassment, and abuse.

3. Establish transparent recruitment and labour relations processes.
4. Provide safe working environments, minimizing accidents and health risks.
5. Mitigate adverse effects of labour influx on host communities.
6. Prevent child labour and forced labour.
7. Promote grievance redress for all worker categories.
8. Support skills development and socio-economic opportunities, especially for vulnerable groups such as women, youth, and persons with disabilities.
9. Align labour practices with applicable laws, standards, and community expectations.

OVERVIEW OF PROJECT WORKFORCE

Categories of Workers

The project anticipates the following labour classifications:

Direct Workers: Employed directly by CR-SAPZ or its affiliated agencies for management, supervision, administration, or operational roles. Includes permanent and temporary employees.

Contracted Workers: Employed through contractors, subcontractors, or service providers for construction, equipment installation, logistics, security, cleaning, etc.

Primary Supply Workers: Workers engaged by vendors supplying essential materials (e.g., construction aggregates, machinery, agricultural equipment) where procurement is critical to project function.

Community Workers: Residents from nearby communities engaged for specific project-support activities, especially in environmental conservation or small infrastructure works.

Estimated Workforce Size

The workforce of the proposed project will be determined as the project commences.

Phase	Estimated Size	Notes
Pre-construction	TBD	Includes site clearance and preparatory works
Construction	TBD	Covers civil works, structural erection, utilities
Operation	TBD	Processing plant staff, administration, technical support
Decommissioning	TBD	Based on project lifespan, specialized roles

TBD: To be determine

Labour Sourcing Strategy

Transparent, merit-based recruitment practices with preference for qualified local candidates.

Advertisement of vacancies through community channels, local authorities, and public notice boards.

Engagement with community representatives to maximize local hiring and skills transfer.

Contractors required to adopt fair labour practices aligned with the LMP.

LEGAL FRAMEWORK AND APPLICABLE STANDARDS

The project's labour management is governed by:

National Legislation

Labour Act CAP L1, LFN 2004 – Governs employment contracts, wages, working conditions, child labour prohibition.

Factories Act CAP F1, LFN 2004 – Occupational health and safety requirements for industrial operations.

Employee Compensation Act, 2010 – Compensation for work-related injuries, disabilities, and fatalities.

National Minimum Wage Act, 2024 effective from July 2024 Prescribes ₦70,000 per month as the national minimum wage, subject to periodic revision.

National Policy on Occupational Safety & Health, 2021 – Strengthens workplace health, safety, and welfare.

Violence Against Persons (Prohibition) Act, 2015 – Criminalizes harassment, Gender-based Violence (GBV), Sexual Exploitation and Abuse (SEA), and workplace abuse.

Trade Unions Amendment Act, 2005 – Regulates freedom of association and collective bargaining rights.

International Standards

ILO Core Conventions (Freedom of Association, Forced Labour, Child Labour, Equal Remuneration, Non-discrimination).

AfDB Operational Safeguard 2 – Labour and Working Conditions.

United Nations Guiding Principles on Business and Human Rights.

TERMS AND CONDITIONS OF EMPLOYMENT

Employment Contracts

- All project workers will receive written contracts specifying:
 - Job roles and responsibilities.
 - Wages, benefits, and allowances.
 - Working hours, overtime provisions.
 - Leave entitlements (annual, maternity/paternity, sick leave).
 - Termination clauses.
 - Disciplinary procedures.

Contracts must be in a language understandable to the worker, with clear explanation provided.

Wages and Remuneration

Wages meet or exceed the national minimum wage.

Overtime compensated according to Nigerian labour laws.

Timely payment, not exceeding monthly intervals.

Benefits aligned with applicable laws (pensions, health insurance, accident cover).

Working Hours and Rest Periods

- Maximum 48 hours per week (6 working days).
- Minimum one full rest day per week.
- Overtime is voluntary and capped at legal limits.

Non-Discrimination and Equal Opportunity

No discrimination based on gender, ethnicity, religion, disability, age, or sexual orientation.

Active encouragement of female participation, especially in non-traditional roles.

Reasonable accommodation for persons with disabilities.

OCCUPATIONAL HEALTH AND SAFETY (OHS)

OHS Management

Site-specific Health and Safety Plan (HASP) prepared before construction.

Hazard identification and risk assessments conducted regularly.

Strict compliance with Nigerian OHS laws, Factories Act, and ILO OSH Guidelines.

Health and Safety Measures

Provision and mandatory use of appropriate PPE (hard hats, boots, gloves, etc.).

Safety induction and periodic refresher training for all workers.

Establishment of first aid posts, emergency medical services, and evacuation protocols.

Installation of safety signage, fencing of hazardous areas, and traffic control.

Accident and Incident Management

Immediate reporting and investigation of all incidents.

Maintenance of an incident register.

Corrective actions implemented promptly.

GRIEVANCE REDRESS MECHANISM FOR WORKERS

A dedicated GRM will be in place to:

Allow workers to report complaints or concerns confidentially.

Offer multiple channels: suggestion boxes, direct HR contacts, anonymous reporting lines.

Ensure resolution within 14 working days where possible.

Protect whistle-blowers and ensure non-retaliation.

Track grievances, with regular monitoring and reporting to management.

LABOUR INFLUX MANAGEMENT

Risks of Labour Influx

Increased demand for accommodation, water, and health services during the construction and operational phase of the project.

Social tensions with host communities.

Risk of GBV, SEA, and communicable disease transmission.

Mitigation Measures

Local recruitment prioritized for unskilled/semi-skilled positions.

Code of Conduct addressing respectful behaviour towards host communities.

Health screenings and awareness programs for workers.

Stakeholder engagement with local leaders and authorities through stakeholder engagement workshop, focus group discussion and key informant interviews.

PREVENTION OF GBV, SEA, HARASSMENT AND GENDER INEQUALITY

Mandatory signing of a Worker Code of Conduct prohibiting:

Sexual harassment.

Exploitation, abuse, or violence.

Disrespectful treatment of women, children, and vulnerable persons.

GBV/SEA risk assessments integrated into project planning such as gender management plan (GMP).

Gender equality will be duly considered and gender-specific job opportunities will be integrated to the (GMP).

Partnerships with local NGOs for survivor support services.

Clear, survivor-centered GBV reporting mechanisms, with confidentiality maintained.

Regular training sessions for workers on gender sensitivity and GBV prevention.

ROLES AND RESPONSIBILITIES

The role and responsibilities of the stakeholders for the proposed project are highlighted below.

Stakeholder	Responsibilities
CR-SAPZ Management	Overall LMP oversight, contractor compliance monitoring, reporting
Contractors	Full LMP compliance, worker welfare, OHS implementation
OHS Officers	Enforce safety measures, training, risk assessments

HR Personnel/Cross River	Recruitment, contracts management, grievance administration
State Ministry of Wealth	
Creation and Employment	
Independent Auditors	Periodic labour audits, verification of standards

Monitoring, Evaluation, And Reporting

Internal Monitoring

Monthly reports on workforce composition, OHS incidents, grievances, and GBV cases.

Random inspections of worksites, accommodations, and facilities.

Contractor performance reviews.

External Monitoring

Engagement of independent monitors during peak labour phases.

Collaboration with government labour inspectors.

Inclusion of labour indicators in environmental and social monitoring frameworks.

Capacity Building And Training

- Comprehensive induction training for all workers on:

OHS requirements.

Workers' rights and responsibilities.

GRM procedures.

GBV and SEA prevention.

- Contractor management training on LMP obligations.
- Ongoing refresher courses at regular intervals.

Budget and Resources

The budget and resources provided for the LMP of the ATC at Okuku (**Error! Reference source not found.**) were developed to ensure full compliance with national labour laws, international standards, and operational best practices. Table below presents the breakdown of activities/events and the financial resources allocated for implementing the LMP effectively.

Table 9.1: Estimated budget for implementing the LMP

S/N	Items	NGN	USD
	Worker Welfare and Housing		
1	Construction and Maintenance of worker housing and sanitation facilities (especially for migrant workers)	DBOC	
2	Provision of basic amenities – potable water, electricity, toilets, beds, fans, etc.	DBOC	
3	Recreational and welfare facilities – common rooms, open spaces, notice boards.	DBOC	
4	Catering or food subsidy services (where applicable)	DBOC	
5	Transportation arrangements for daily commuting where accommodation isn't provided	DBOC	
	Personal Protective Equipment (PPE) and Safety Gear		
6	Procurement of PPE (helmets, safety boots, reflective jackets, gloves, goggles, hearing protection, etc.) for all labour categories.	DBOC	
7	First-aid kits and safety signage at all operational locations.	DBOC	
8	Maintenance and replacement of worn-out safety gear	DBOC	
9	Provision of fire extinguishers, emergency kits, and eye-wash stations at critical points.	DBOC	
10	Special gear for high-risk tasks (e.g., harnesses for rope access or welding shields)	DBOC	
	Vocational and Safety Training Programs		
11	Induction training for new employees on workplace ethics, rules, and expectations.	DBOC	
12	Health and safety training including fire drills, hazard awareness, emergency response, and safe tool handling.	DBOC	
13	Technical upskilling for welders, technicians, NDT workers, marine operators, and rope access teams	DBOC	
14	Training of supervisors and foremen on supervisory responsibilities, leadership, and OHS monitoring.	DBOC	
15	Inclusive training for women and youth in trades or skills relevant to site operations.	DBOC	
	Monitoring, Grievance Handling, and Community Engagement		
16	Operation of a Grievance Redress Mechanism (GRM)	Embedded in SEP	
17	Regular staff audits and compliance reviews by internal or external HR consultants	DBOC	
18	Community consultation sessions on labour impacts, local employment expectations, and feedback collection.	DBOC	
20	PIU/ ESIC	3,500,000.00	2258.065

S/N	Items	NGN	USD
19	CLO facilitation costs, including transport and communication for engaging with communities	DBOC	
20	Documentation, reporting, and archiving of all grievance cases and community feedback.	DBOC	
	Total	3,500,000.00	2258.065

Conclusion

This LMP provides a robust framework to manage the project's labour force in compliance with Nigerian laws, AfDB safeguards, and international labour standards. It protects workers' rights, promotes welfare, manages social risks, and enhances local development. Continuous monitoring, capacity building, and stakeholder engagement will ensure its effectiveness throughout the project lifecycle.

• WASTE MANAGEMENT PLAN

INTRODUCTION

The government of Cross River State proposes to establish an agricultural hub in the state which will be located in Ipuole Community, Yala Local Government Area. The proposed hub is a critical development project and it has become a known fact that waste generation is an integral part of any developmental project. It is also true that some of the generated wastes could be injurious to human health and the ecosystem generally. Consequently, the need arises for a systematic waste management practice that will provide a balance between project objectives and environmental sustainability. Waste management is the application of techniques that will ensure the orderly execution of the functions of collection, transportation, processing, treatment and disposal of solid waste. (Robinson, W.D., 1986). As a part of the EIA processes for this proposed project, a study was necessary to provide inputs for the development of a Waste Management Plan for the proposed project.

BASELINE WASTE MANAGEMENT OF THE PROJECT AREA

The generation and management of wastes to a large extent depends on the environment, occupation and other livelihood activities of a people. The Ipuole people are largely agrarian people with large dependency on the agricultural land and other natural resources within their environment for both household use, economic activities and leisure. Other economic activities include, livestock rearing, transportation, petty trading and artisanship. The daily activities of the people generate huge amounts of solid wastes which litter the environment due to indiscriminate

disposal and management of the wastes by majority of the dwellers and indigenes of the communities.

The wastes commonly observed include:

Farm produce wastes

Woods

Papers

Nylons Plastics, putrescible, electronics, wood, textile, furniture, cans, glass

kitchen/food processing wastes

Waste Disposal Systems in Ipuole Communities

It was observed during the study that the people suffer from total lack of government presence in terms of waste management as no public receptacles were found in the study area. This has led to the residents improvising on ways to best manage their waste in a bid to save their immediate environment. From observations and investigations, the people of Ipuole dispose those wastes in various ways. These are discussed below in order of prevalence.



Plate 9.1: Open Dumping: Typical Waste Disposal Method in the Study Area.

Open dumping: This is a predominant method of waste disposal in the area. Wastes are dumped in open areas, often at the back of the houses and nearby bush patches. In another variant, some community members who have vehicles collect wastes in private dustbins and periodically empty them at a waste dump. These wastes accumulate for long period of time without proper handling. Studies revealed that the waste management practices by the residents of the study area are

grossly inadequate as the effects of stray wastes and indiscriminately disposed waste can be seen around the communities' environment.

The effects of indiscriminate dumping of refuse in the open are far reaching and are never in anyone's interest. Apart from the menace of defacing aesthetic resources, there is the danger of clogging drainage lines which results in the flooding of the environment during the rainy season. This form of waste management creates breeding sites for disease vectors and agents such as flies, mosquitoes and other insects, and also provide food and shelter for rodents. Indiscriminate dumping of wastes can also lead to the contamination of water bodies and increase the risk of waterborne diseases. The proliferation of sickness and diseases lead to economic loss to affected families and loss of manpower to the nation's economy.

Burning: This is widely practiced in the study area. In the absence of public waste collection services, community members resort to wastes burning as a convenient way to manage household wastes. This poses environmental risks such as air pollution to the people.

Burying: Although not very common, it is still practiced by the people. Households usually dig a pit where wastes are dumped and covered when the pit is filled. This is not an effective waste management method especially where nylon and plastics are involved.

Challenge of CRSWMA: When the Waste Management Study Team visited the CRSWMA in inquest to why Yala has not felt government presence in its waste management, the Agency decried the lack of adequate funding and infrastructures to extend its services to Yala and also cited the 311km distance as a major challenge.

- Waste Stream Classification

All waste types anticipated during the project lifecycle are identified and categorized as follows:

Waste Stream	Source	Category
Domestic waste	Workers' camps, canteens, offices	Non-hazardous solid waste
Construction debris	Excavation, clearing, concrete, scrap metal, packaging	Non-hazardous inert waste
Hazardous waste	Used oil, fuel residues, spent batteries, solvents, paints	Hazardous waste

Agricultural by-products	Crop residues, husks, peels, and organic remains	Biodegradable waste
Medical waste	First aid facilities and clinics	Biohazardous waste
E-waste	Obsolete electrical/electronic equipment	Hazardous recyclable waste
Gaseous emissions	Machinery exhaust, incineration, organic decomposition	Gaseous waste

Each waste category will have specific handling, treatment, and disposal measures to prevent pollution and ensure safety.

Management of Human Waste

Investigations revealed that about 72% of the household members dispose human waste by pit toilets. There is the practice of open defecation in bushes by farmers and defecation into the water bodies by fishermen.

Table 9.2: Sources of Waste Streams in the Project Area

Sources of Wastes	Activities	Types of Waste Generated	Composition	Current Disposal Method(s)
Domestic	Domestic activities from households.	Plastics, putrescible, electronics, wood, textile, furniture, cans, glass	Biodegradables, wood products, textiles and other non – biodegradable wastes	Mainly open dumps and open burning.
Commercial	Open markets, restaurants, shops, agricultural products processing and other commercial activities.	Plastics, putrescible, paper, cardboard, cans, glass.	Biodegradable and non-biodegradables	Mainly open dumps, occasional burning.
Construction, Artisanry and other industries.	Small scale artisanry activities, chemical and hydrocarbon activities, construction and manufacturing industries, associated activities and provision of personal services.	Debris from demolition, concrete materials, packaging from construction materials, electrical and electronics, plastics,	Biodegradable and non-biodegradables	Burying of waste, open dumps and sales of demolition debris for reuse.

Sources of Wastes	Activities	Types of Waste Generated	Composition	Current Disposal Method(s)
		chemicals, iron cuttings and oil sludge.		
Institutional	Churches, Schools, Clinics/TBAs etc.	Large volume of papers, cardboards, putrescible, electronics, plastics, cans, furniture materials, medical waste etc.	Readily and non-readily degradable wastes.	Open dumps and open burning.

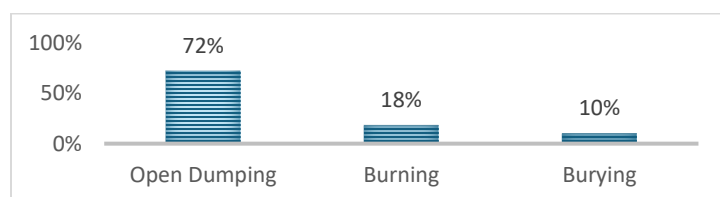


Figure 9.1: Current Human Waste Disposal Method in the Study Area

Source: Fieldwork 2025

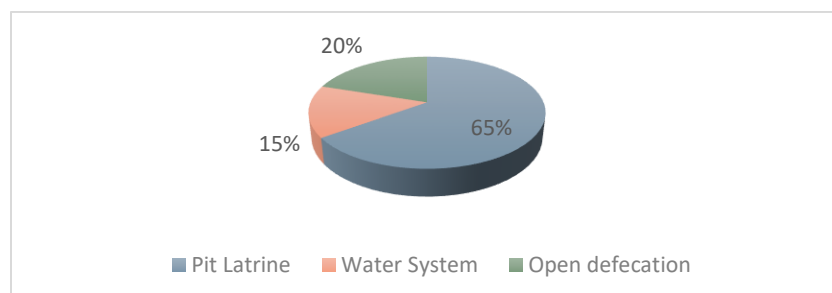


Figure 9.2: Current Solid Waste Management Systems in the Study Area

Source: Fieldwork 2025

Waste Management Hierarchy

The CR-SAPZ Project will adopt the “4R hierarchy”—Reduce, Reuse, Recycle, Recover, and Dispose—as a guiding principle:

- Reduce: Avoid unnecessary material use and minimize waste at source.
- Reuse: Encourage reusing construction materials (e.g., wooden pallets, metal scraps).
- Recycle: Facilitate recycling of plastics, paper, and metallic waste through approved recyclers.
- Recover: Recover energy from biodegradable waste where feasible.

v. Dispose: Final disposal at approved and environmentally compliant dumpsites only. This approach reduces landfill dependence, lowers carbon footprint, and promotes resource efficiency.

Waste Segregation

- i. Waste shall be segregated at source using color-coded bins and clearly labelled containers (e.g., green for biodegradable, yellow for recyclables, red for hazardous).
- ii. Contractors and site personnel shall be trained in segregation procedures.
- iii. Separate collection points will be designated for hazardous waste to prevent contamination of non-hazardous materials.
- iv. The SPIU Environmental and Social Officer will conduct weekly audits of segregation practices.

Waste Collection, Storage, and Transportation

- i. Waste shall be collected daily and transported by licensed waste handlers approved by the Cross River State Waste Management Agency (CRSWMA).
- ii. Temporary onsite storage facilities shall be bunded, roofed, and ventilated to prevent leachate and odor generation.
- iii. Vehicles transporting waste shall be covered, leak-proof, and labelled in accordance with NESREA transportation standards.
- iv. Waste manifests will be used to track all hazardous waste movements until final disposal.

Waste Treatment and Disposal

- i. Non-hazardous waste will be transported to the Calabar Municipal Dumpsite and other CRSWMA-approved landfill sites for final disposal.
- ii. Hazardous waste (used oil, paint, batteries) shall be collected and handed over to FMEnv-licensed hazardous waste contractors for treatment and safe disposal.
- iii. Organic waste from agricultural operations shall be composted or used for biogas generation where feasible.
- iv. Medical waste from clinics shall be treated via autoclaving or incineration at an approved facility.
- v. Disposal sites will be periodically monitored for compliance and environmental integrity.

Gaseous Waste Management

To minimize gaseous emissions:

- i. Use low-emission machinery and conduct regular maintenance.
- ii. Prohibit open burning of waste on-site.
- iii. Ensure generators and incinerators are fitted with emission control devices.
- iv. Monitor ambient air quality quarterly for CO, SO₂, NO₂, PM₁₀, and PM_{2.5} against NESREA and WHO standards.

- v. Maintain a log of fuel usage and emission records to track performance.

Based on the foregoing baseline waste management situation in the project area, the following provisions are recommended:

The Overall Waste Management Objectives related to the proposed project should include-

- Ensure effective procurement and use of bought- in materials in order to minimise waste generation
- Maximise the re-use /recycling of relevant wastes
- Proper classification of wastes
- Prudent disposal of non-reusable/non-recyclable wastes
- All waste management facilities should be designed and installed according to specifications
- Provision of any permitting requirement for waste treatment and disposal
- Timely and efficient monitoring and inspection of all waste management facilities
- Ensure proper record keeping on waste activities
- Provision of effective training to staff and Contractor personnel.
- Finally, identify and engage third party contractors for proper waste handling.

Table 9.3: Expected Wastes Streams from the Proposed Project

Project Phase	Activities	Type of Waste	Composition
Mobilization	Land clearing, Site grading, equipment delivery and setup, temporary structures -site office, security posts, storage)	Top soil, Vegetative waste, wood, metals, plastics etc. Emissions of atmospheric pollutants from vehicle /machinery exhausts Dust, Noise from machinery and equipment, spent oil	Bio-degradable and non-biodegradable wastes
Construction	Building and Infrastructure construction, Welding and fabrication, Internal Roads.	Cement/concrete, cartons, papers, nylon, wood pieces, zinc and other metals, rags, POP droppings, paints, paint containers etc.	Bio-degradable and non-biodegradable wastes
Decommissioning	Decommissioning Activities: Dismantling of temporary and permanent structures, Removal of machinery and equipment, dismantling of utility	Concrete, bricks, tiles, wood, steel, used oil, chemicals, agrochemical containers, plant residues, food waste, manure, batteries, old panels,	Construction & Demolition waste, Hazardous waste, Organic waste, electronic waste,

Project Phase	Activities	Type of Waste	Composition
	infrastructure, Excavation and restorations of land, Waste from decontamination and clean-up, Disposal of organic and agricultural residues, Sanitary facility closure, and packing and relocation.	wiring, control boxes, pipes, sheets, frames, fencing wires, packaging materials, papers, plastics, PPEs, sewage, and cleaning waste	Scrap metals, General solid waste, and Sanitary waste.

At the project site all the components of the project shall adopt the best waste management practice, whereby sorting of the waste for proper management will be done at the various waste streams. Labelled Receptacles with various type of waste shall be placed at the various component of the projects site. All the waste from the various receptacles shall be conveyed to the waste management unit for proper disposal by a retained accredited waste management contractor.

Waste Quantification

This section seeks to quantify waste that will emanate from the proposed project. For the quantification, a universally acceptable formula for the quantification of the various types of waste shall be adopted. Therefore, the following assumptions will be adopted to ease the calculations as actual mass of excavations and demolitions cannot be exact. However, the assumptions will help to estimate an adequate budget and equipment planning for the site clearance exercise as stated in **Error! Reference source not found.**

The evaluation of the potential impacts associated with waste management is conducted with the consideration of Nigerian legislations and Cross River State legislation (see, *Legal and Administrative Frameworks*). The intention for the development is that storage, handling and disposal of hazardous and non-hazardous waste will be consistent with good EHS practice for waste management and widely adopted tropical land development ESIA/ESMP studies (e.g, FAO, IPCC, Nigerian forestry manuals).

The project proposes tree planting and conservation of the existing trees within the proposed project site for the purpose of conserving the already depleted biodiversity of the area. With this development, there is no envisaged tree clearing in the site preparation phase of the project.

Table 9.4: Quantification of Waste

SNo.	ITEM	QUANTITY	UNIT
1.	Woodland		

SNo.	ITEM	QUANTITY	UNIT
a.	Tree trunk Total land mass	370,000	m ²
	Total volume of tree trunk waste	0	m ³
b.	Tree crown Total volume of tree crown waste	0	m ³
c.	Shrubs - Area occupied by shrubs (0.3% of land mass) - Shrub height - Assumed volume bulking factor	1,100 1 2	m ² m m ³
	Total volume of shrub waste	2,220	m ³
d.	Grassland - Grass height (shaded) - Grass covering area (5% of 300,000 available for clearing landmass) - No. of grass per square meter - Assumed volume reducing factor	0.5 15,000 10 0.4	m m ² m ² m ³
	Total volume of grass waste	30,000	m ³
	Total volume of tree trunk waste	0	m ³
	Total volume of tree crown waste	0	m ³
	Total volume of shrub waste	2,220	m ³
	Total volume of grass waste	30,000	m ³
	TOTAL VEGETATION WASTE VOLUME	32,220	m ³
SNo.	ITEM	QUANTITY	UNIT
2.	Top soil		
a.	Total area for project - Excavation depth (graded) - Assumed volume bulking factor	300,000 0.25 1.3	m ² m ³ m ³
	Total top soil volume removed in the landmass	97,500	m ³
b.	Perimeter fencing excavation - Excavation depth - Excavation width - Approximate perimeter - Assumed volume bulking factor	0.25 0.6 2,480 1.3	m m m m ³
	Total soil volume removed for fencing	483.6	m ³
	Total top soil volume removed in the landmass Total soil volume removed for fencing	97,500	m ³

SNo.	ITEM	QUANTITY	UNIT
		483.6	m ³
	TOTAL TOPSOIL WASTE VOLUME	97,983.6	m ³
TOTAL	ITEM	QUANTITY	UNIT
	TOTAL VEGETATION WASTE VOLUME	32,220	m ³
	TOTAL TOP SOIL WASTE VOLUME	97,983.6	m ³
	TOTAL CLEARANCE WASTE BY VOLUME	130.203.6	m³

NB: See **Appendix 1** for notes on Waste Quantification

Other forms of waste quantified based on defined assumptions include the following:

CONSTRUCTION WASTE FROM TEMPORARY BUILDINGS & STORAGE

Assumptions:

Temporary setup = 2 admin buildings + 2 warehouses

Total waste types: cement bags, wood offcuts, plastics, metal scraps

Estimates based on medium-scale temporary facility

Table 9.5: Construction Waste Calculation

Material Type	Volume Estimate
Cement bag waste (500 bags @ 0.04 m ³)	20 m ³
Plastic packaging & polythene	10 m ³
Cartons, wood offcuts, formwork waste	15 m ³
Scrap metals and fasteners	6 m ³
Total: 20 + 10 + 15 + 6 = 51 m³	51 m³

Estimated Construction Waste (Temporary Setup): ~51 m³

(Typical bulk density range for mixed construction & demolition (C&D) waste ~300-600 kg/m³. Assumption adopted: 500 kg/m³ (0.5 t/m³) for tonnes to cubic meter conversion)

Estimated Domestic Waste Generation

Assumptions:

Average domestic waste per worker per day: 0.5 kg

Workdays per month: 25 days

Number of workers/duration: 50 workers for 12 months

These assumptions align with construction site norms and standards from UNEP/FAO waste management guidance in tropical developing countries.

Calculations:

Workforce: 50 men

Duration: 12 months × 25 workdays = 300 days

Total workers/duration: 50 workers × 300 days = 15,000 man-days

Total waste:

= 15,000 man-days × 0.5 kg/day = 7,500 kg (7.5 tonnes) (30 m³)

(Average density of uncompressed mixed municipal solid waste = 250 kg/m³ for tonnes to cubic meter conversion)

Recommended Waste Handling Measures

Provide Labeled Bins: Ensure color-coded bins for segregated waste collection (organic/inorganic).

Engage Licensed Waste Collectors: Contract registered domestic waste contractors for evacuation.

Onsite Composting: Organic waste may be composted and used during agricultural operations later.

Sanitation Maintenance: Provide and service portable toilets or onsite latrines.

Worker Orientation: Conduct awareness campaigns on hygiene and waste disposal best practices.

Waste Tracking: Monitor and record volume trends to improve planning and minimize pollution risks.

Estimated Greenhouse Gas Emissions

Assumptions:

Fuel Type: Diesel

Diesel Emission Factor: 2.68 kg CO₂ per litre (IPCC default for diesel combustion)

Average Machinery Diesel Use/Day: 400 litres/day (medium-scale land clearing, 5–7 heavy machines)

Workdays/Month: 25 days (excluding Sundays and rain delays)

Key Duration for Estimation: 12 months

Calculations:

Duration = 12 months × 25 workdays/month = 300 days

Fuel consumed = 400 litres/day × 300 days = 120,000 litres

Emissions = 120,000 litres × 2.68 kg CO₂/litre = 321,600 kg CO₂

Total Emissions ≈ 321.60 tonnes CO₂ (164,082 m³)

(STP 0°C (273.15 K) and 1 atm, while Density of CO₂ at STP: ≈ 1.96 kg/m³ for tonnes to cm³ conversion)

Commitments to Reduce Emissions

Use low-emission or biodiesel-compatible machinery

Ensure machines are well-maintained to optimize fuel efficiency

Minimize idling time and apply efficient work planning

Offset carbon with tree planting programs or carbon credits

Table 9.6: Summary Table of Estimated Waste Volumes

Waste Type	Estimated Volume (m ³)	Source/Activity
Vegetation Waste (biomass)	~32,220	Trees, shrubs, grasses (Vegetation clearance)
Topsoil clearing/Fence excavation	~97,983.6	Organic-rich upper soil layer and trenching perimeter fence
Construction Packaging Waste	~51	Temporary buildings and storage erection
Domestic Waste Generation	~30	Daily consumables by onsite workers
Greenhouse Gas Emissions (CO ₂)	~164,082	Combustion of diesel by heavy duty machinery
Total Estimated Volume	294,366.6	Site Preparation (Mobilization + Construction) waste volume

Table 9.7: Recommended Waste Handling Options

Waste Type	Suggested Handling
Vegetation Waste	Composting, mulching, biomass reuse
Topsoil	Stockpiling for landscaping and erosion control
Excavated Soil	Filling low-lying areas or access roads
Construction/Domestic Waste	Segregation, reuse, or safe disposal

Environmental Considerations

Avoid open burning of cleared biomass, promote composting instead

Establish temporary waste segregation areas onsite.

Install silt fencing for topsoil stockpiles to prevent erosion and runoff into surrounding areas

Use impermeable liners beneath temporary waste storage areas.

Table 9.8: Waste Handling Options

S/N	ENVIRONMENTAL COMPONENTS	IMPACT INDICATORS
1	Air quality	SPM, CO ₂ , NO _x , SO _x , CO, VOC, CH ₄ , NH ₃ , etc.
2	Noise	Noise level dB(A)
3	Soil/Agriculture	Indiscriminate municipal waste dumping, hazardous waste and tailings, etc., on arable lands
4	Surface water	Waste dumped into rivers, entrainments from storm water emptying into the rivers
5	Ground water	Ground water contamination through infiltration of decomposing wastes
6	Socio-economic/Health	Waste management concerns of host communities, perception on the proposed project/health risks, waste streams, handling treatment and disposal.

Table 10: Waste Management Matrix

Waste	Waste Source	Character	Frequency	Estimated Quantity (12 Months Duration)	Treatment Method	Transport	Final Disposal	Responsible Party	Regulatory/ Permitting
Vegetative Waste	Land clearing	Solid	Initial Construction phase	7,245 tonnes (32,220 m ³)	Mulching, composting	Accredited Third Party Contractor	Landscaping/ Soil amendment/Sales to Farmers as manure	CR-SAPZ	
Removed Top Soil/Fence Trenching	During Excavation	Solid	Construction phase	7,245 tonnes (97,983.6 m ³)	Accredited Third Party Contractor	Accredited Third Party Contractor	Landscaping/ Soil amendment	CR-SAPZ	
Domestic Waste	Domestic Activities	Solid	Daily	7.5 tonnes (30 m ³)	Segregation, collection	Accredited Third Party Contractor	Recycle, compost, landfill	CR-SAPZ	
Emission Waste (CO ₂)	Fumes from Automobiles	Gaseous	Daily	321.6 tonnes (164,082 m ³)	Scrubbers. Filtration, Maintenance		Emissions control, Carbon offset	CR-SAPZ	CR-SAPZ
Construction Waste	During Construction activities	Solid	Construction Phase	25.5 tonnes (51 m ³)	Source separation	Accredited Third Party Contractor	Reuse or disposal in authorised site/ landfill	CR-SAPZ	

Assumptions and Calculations for Clearance Waste

- a. Calculation for shrub waste = total shrub occupied area x shrub height x assumed volume reducing factor
- b. Calculation for Grass waste = Grass occupied area/No. of grass/m² x Grass height x assumed reduction factor
- a. Calculation for top soil waste:
 - (i) Total landmass area x excavation depth (graded) x assumed volume bulking factor
 - (ii) Total fencing area x Assumed volume bulking factor

Budget Estimation

The budget estimation outlines the financial requirements needed to implement the WMP effectively. It includes provisions for waste sorting infrastructure, equipment procurement, contractor services, training, hazardous waste handling, and ongoing monitoring. The projected costs are aligned with industry best practices and local waste management regulations, ensuring compliance with Nigerian environmental laws and AfDB safeguard standards. Details of the budget is presented in **Error! Reference source not found..**

Table 9.9: WMP Implementation Budget Estimation

Main Item	Activities/Description	NGN	USD
Waste Sorting & Collection Infrastructure	Provision of labelled bins (colour-coded), sorting stations across the site (at least 30 bins, signs, stands)	DBOC	
Waste Handling Equipment	Wheelbarrows, waste carts, compactors, PPEs for handlers	DBOC	
Vegetation Waste Handling	Shredding, mulching, composting equipment (e.g., 1 mobile shredder + compost setup)	DBOC	
Soil/Excavated Waste Management	Stockpiling, erosion control (tarpaulins, bunding, fencing)	DBOC	
Construction Waste Management	Segregation, reuse (formwork wood, metals), offsite transport for disposal	DBOC	
Domestic Waste Handling	Waste bins, plastic liners, daily pickup, composting setup for food waste	DBOC	
Waste Evacuation (Third Party)	Monthly evacuation by licensed contractors (12 months)	DBOC	
Hazardous Waste Management	Collection drums, PPE, spill kits, safe temporary storage (used oil, contaminated PPE, e-waste, etc.)	DBOC	

Main Item	Activities/Description	NGN	USD
Training and Capacity Building	Monthly training for staff and contractors on safe handling, sorting, spill response	DBOC	
Awareness and Signage	Awareness campaigns, posters, leaflets for site workers on segregation and recycling	DBOC	
Monitoring and Reporting Tools	Logbooks, digital tracking, reporting dashboards, volume tracking tools	DBOC	
PIU / ESIC		3,500,000.00	2258.065
Waste Facility Maintenance	Regular cleaning of bins, repair/replacement of equipment	DBOC	
TOTAL		3,500,000.00	2258.065

• Emergency Preparedness for Waste-Related Incidents

Emergency protocols have been established for accidental waste spills, fires, or contamination events:

- Prepare a Waste Spill Response Plan and maintain spill kits at critical areas.
- Train staff on emergency procedures, containment, and reporting.
- Provide Personal Protective Equipment (PPE) for cleanup teams.
- Report all major incidents to FMEnv and CRSMEEnv within 24 hours.
- Maintain an Incident Register for all waste-related emergencies.

Institutional Responsibilities

Institution	Responsibilities
SPIU Environmental Officer	Oversee implementation of the WMP, reporting, and audits.
DBO Contractor	Implement waste management procedures on-site; maintain records.
CRSWMA	Approve waste transporters and final disposal sites.
FMEnv / NESREA	Regulatory oversight, compliance monitoring, and environmental audits.
Community Representatives	Support community awareness and monitoring of waste management practices.

Key Performance Indicators (KPIs)

Indicator	Target / Frequency
Percentage of waste segregated at source	≥ 90% of total waste generated
Frequency of waste collection	Daily during construction; twice weekly during operation

Number of waste-related incidents	Zero incidents per quarter
Volume of waste recycled or reused	≥ 40% of total waste
Staff trained in waste handling	100% of workforce annually
Compliance with FMEnv/NESREA standards	100% compliance, verified by quarterly audit

• Monitoring and Reporting

- Waste management performance will be **monitored monthly** by the SPIU E&S Unit.
- Quarterly environmental reports will be submitted to **FMEnv, NESREA, and AfDB** detailing waste quantities, treatment methods, and compliance status.
- Annual third-party audits will evaluate long-term effectiveness and recommend improvements.

• OCCUPATIONAL HEALTH AND SAFETY PLAN (OSHPP)

The Occupational Health and Safety Plan is established to provide an overview of CR-SAPZ commitment to safe operation of the Agricultural Transformation Centre facility. CR-SAPZ proposes to develop an Agricultural Transformation Centre in Okuku, Yala Local Government Area of Cross River State. The proposed infrastructure will include office buildings, training centres, general services fencing, internal access roads / parking, drainage, power supply, water, and sewerage, effluent management, health, and safety. Specialized services will include quarantine, quality control, laboratory and certification centres, breeding centres, business support services (administrative knowledge/ICT/procurement/employment centres, and activities to implement the Environmental and Social Management Plan.

Commitment to Health, Safety and Environment

- CR-SAPZ operates a Sustainability Policy and Commitment, which has been developed over the years and applies to all its operations. It comprises three main elements:

CR-SAPZ Commitment on Safety;

CR-SAPZ Commitment on Environment; and

CR-SAPZ Commitment on Communities.

- The policy commitments have been elucidated in CR-SAPZ's HSEMS. The primary vehicles through which CR-SAPZ shall meet its HSE policy and commitments are its comprehensive HSE Management System and the associated planning documents.

Leadership And Commitment

In order to achieve a continuous improvement in the CR-SAPZ's HSE performance during project execution and operations; an HSE Management System that will be commensurate with potential risks associated with the project has been put in place. To this end, Health, Safety and Environment (HSE) policies have been developed, signed and dated by the chief executive. These policies are on display in our offices after having been discussed with each employee. The issuance of this document is guided by and in compliance with existing regulatory framework, which includes Acts and legislations enforceable by relevant environmental and occupational health and safety regulatory bodies, mainly the Federal Ministry of Environment (FMEnv): National Guidelines on Environmental Management System (EMS) in Nigeria (FEPA 1991).

Policy Statement and Strategic Objectives

HSE Policy Statement

CR-SAPZ places great emphasis on maintaining the highest standard of safety, health and environmental protection. The purpose of this safety management plan is to outline how CR-SAPZ intends to implement its HSE Management principles during the implementation of the proposed Agricultural Transformation Centre project and operations. All CR-SAPZ employees must perform their activities in compliance with the HSE policy. Every employee is responsible for their safety and that of their colleagues at work. Any activity must be suspended when the employee believes that it cannot be carried out in compliance with the policy, and must report this immediately to his/her supervisor.

Strategic Objectives

- CR-SAPZ wishes to achieve these set HSE goals, which provide the basis for judging progress and achievement.
- **Community Affairs:**
 - To maintain a very good relationship with the communities around our areas of operation and to be sensitive to their needs.
- **Safety:**
 - To maintain a Zero Lost Time Injury.
 - To maintain a Zero Fatality.

To maintain a Zero Road Traffic Accident.

To improve skill and competence on the job and in HSE by training at least 90% of the workforce

- **Health:**

To ensure that all members of staff are physically/mentally fit for their job.

To carry out a regular inspection of project, accommodation and toilet facilities.

To ensure that a clinic and an ambulance are available for staff use.

To ensure that toilet facilities are provided and are in good condition at all times.

- **Environment:**

To maintain a policy of “NO POLLUTION” at all times, in all our areas of operation.

To ensure proper disposal of domestic waste generated.

To participate in the promotion of better environment through rehabilitation.

- **Security:**

To reduce the frequency of thefts of tools and equipment.

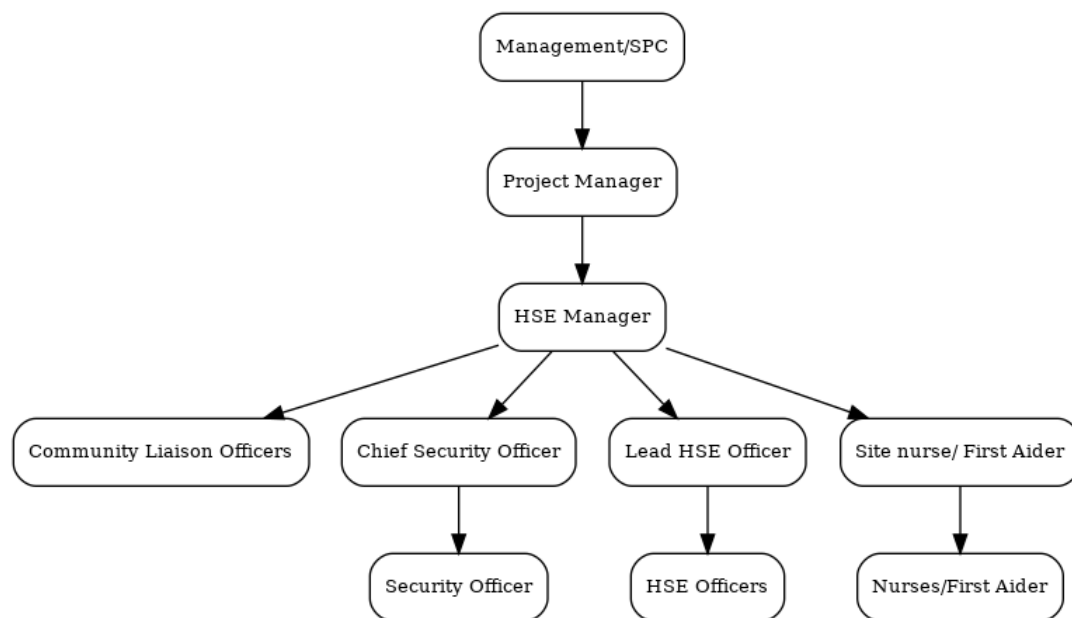
To prevent arson on staff and company property.

To raise security awareness of all staff.

HSE Organization, Responsibilities, Resources, Standard and Document

HSE Organization

- Successful handling of HSE matters will be a line responsibility. That is, those directly involved in all phases of operations (the staff and supervisors up to the SPC) are responsible for applying the HSE MS to the various activities.



-
- *Agricultural Transformation Centre HSE Organization*

Roles and Responsibilities

Management

- CR-SAPZ management comprises the State Program Coordinator (SPC) and top management staff. Management is responsible for ensuring availability of adequate resources (personnel, equipment, etc.) for effective operation of the HSE management on site.
- Individual departments shall identify their human resources needs and forward their requirement to management.

•

• **Project /Operations Manager**

- The project and operations manager will ensure that safety programs and the resources provided are adequate for the project/operations:

To assess project safety performances

To participate in project safety, steering team meeting

To ensure that the management personnel participate actively in the safety program implementation

To ensure that all laws and regulations in matters of HSE are complied with.

HSE Manager

- The HSE Manager will:

Conduct regular inspections in association with line supervision, to ensure that only safe methods of work are in operation and that all safety requirements, including statutory regulations, are being observed. The HSE coordinator will take action to rectify faults in compliance with company policy.

Maintain current knowledge of published safety literature, safety regulations and other communications and notices requiring management attention.

Carry out investigations to determine the cause of accidents and dangerous occurrences and recommend measures to prevent a recurrence of incidents.

Collaborate with the project manager in the development of required revisions to existing procedures, rules and regulations in addition to proposing change.

Make thorough analysis of statistical data and inspection, delineate problem area and make recommendations; keep an up-to-date record of all information connected with accident prevention, including accident/injury reports and an analysis of accident trends.

Conduct independent audit to ensure compliance and ensure daily permit-to-work is obtained.

Participate in making job hazard analysis (JHA) with the project manager.

Take part in the review of all accidents and assists in investigating the accident.

Ensure proper use of PPE.

Collaborate with the project manager in the development and preparation of the agenda for safety meetings at a monthly/weekly interval.

Carry out routine safety check on the operation of all divisions in the organisation.

Safety Officer

Attend all safety issues.

Conduct site and project HSE orientation for all personnel visiting the site for the first time.

Ensure investigation of minor incidents, first aid cases and near misses

Participate in the delivery of toolbox meetings and HSE-related meetings on site.

Prepare HSE Report.

Ensure the implementation of HSE procedures of work activities.

Ensure that all employees and subcontractors have received appropriate HSE information, induction and training.

Line Supervisors (Site Manager, Site Engineers & Foremen)

Attend HSE meetings

Actively promote all HSE programs on the project site during all operations

Participate actively in all safety issues as required on the project

To ensure the work permits are approved prior commencement of work to be carried out that day.

Implement work methods, statement, and risk assessments for work that is to be carried out in their areas of responsibility.

Obligations of all Personnel

To keep safety rules at worksite

To attend Safety orientation briefings

To wear PPE at all times

Promoting HSE through active participation in the execution of ATC HSE plans.

Participating in incident/accident investigation as required

Endorsement of the project partnership philosophy of GOAL ZERO.

Performance target is met through targeting ZERO LTI, ZERO TRIR, no serious illness, and no malaria cases.

Resources

Management of CR-SAPZ shall demonstrate her commitment to the achievement of the HSE policies by allocating sufficient resources, including finances and materials and systems, for the effective operation of the HSE MS.

The following issues are considered in resource allocation:

Prompt rectification of identified HSE deficiencies.

Training to bridge competence gaps or enhance competencies.

Emergency response facilities.

Provision of required personal protective equipment (PPE).

Availability of management for HSE audits and reviews.

Competency and training

CR-SAPZ maintains a policy that an effective and efficient Community Affairs, Safety, Health, Environment and Security (CASHES) training programme shall always be in place as part of enhancing its HSE MS. This has led to the adoption of some principles of which the minimum requirements could be “software” issues (procedures, documentation, etc.) or “hardware” items (resources, PPEs, etc.). These shall be in place for CR-SAPZ’s HSE MS to be considered as acceptable. Best HSE MS can only be achieved through adequate training of the entire work force.

- CR-SAPZ is responsible for generating, maintaining, and enhancing a high level of HSE awareness amongst its workers engaged in the execution of studies for any project at all times.

- The HSE induction package shall include, but not limited to the following;
 - The CR-SAPZ’s Community Affairs, Safety, Health, Environment and Security Policies

These are simple and concise statements of the HSE beliefs of the company, signed by the SPC and gives the following messages;

Preservation of health and safety of all company and contractor personnel and members of the public

Preservation of the integrity and security of company assets.

- Minimization of the impact of operations on the environment.
- Safety training shall be provided for all category of staff on the following;

Fire alarms

Fire extinguishers and their locations

Emergency escape routes and muster points

Personal protection equipment

- The effectiveness and relevance of training should be measured through briefing and debriefing of staff before and after training courses, and monitoring of improvement after training.

Communication

CR-SAPZ maintains the policy that all incidents and accidents shall be reported immediately through the available means of communication to the appropriate authorities. The severity of such incident or accident shall determine the level of urgency required for such reports. For instance, a fatal accident must be reported immediately through the line within 24 hours. Such immediate notification shall be followed by a full report within the periods specified from reporting of details of various categories of accidents.

HSE meetings

HSE meetings shall be held at various levels throughout the duration of the execution of the project, with information cascaded accordingly. It is mandatory for all staff to attend an organized HSE meeting at least once a month throughout the duration of the project. This is to continuously increase HSE awareness, ensure effective dissemination and communication of HSE issues with Management. Attendance at these meetings shall be recorded as part of staffer's individual tasks and targets. Records of such HSE meetings shall be made and kept in the custody of the HSE Manager.

Toolbox Talks

This is a pep talk given to workers by the HSE Manager, geared towards preparing the workers first thing in the morning before the commencement of work. Before the commencement of work each day, the HSE Manager shall assemble all the workers at the muster point and spend about 10 minutes to brief them on the nature of the day's job and the potential hazards associated with it. All workers must be present during this briefing, and any absentee will not be allowed to carry out his/her job for that day.

Staff shall at this meeting present their thoughts regarding safe practices and procedures and provide the group with any knowledge of hazardous conditions or actions in their operations.

Toolbox talks are very effective (if properly carried out) for:

- Sharing information with many people quickly.
- Stimulating group ideas and interaction.
- Giving inspirational boost.
- Helping to build cooperative communication climate.
- Providing last form of personal training before work commencement.

Standards and Documents

- Proper documentation will enhance HSE management by making relevant information readily available, promoting awareness of responsibilities and correct task performance and demonstrating the existence of systems and practices. For the execution of projects/studies, the following records shall be kept:

Staff exposure man-hours and HSE performance statistics

Minutes of HSE meetings

Toolbox talks: topics discussed, name of presenter, attendance and activity for the day.

Results of hazards and effect management.

Field HSE inspection.

HSE audits/performance review and follow up of recommendations.

HSE suggestions.

Incident and accident records and investigation report.

Preventive/routine maintenance schedule and reports

Staff records

Planning and Procedure

CR-SAPZ shall maintain procedures for monitoring the relevant aspects of HSE performance and for establishing and maintaining records of the results, with a view to knowing the extent to which planned objectives and performance criteria have been met. Monitoring will result in corrective actions with measures to prevent recurrence, whenever there are deviations from set performance criteria.

Personal Protective Equipment: Workers must ensure regular use of PPE equipment.

Lifting Equipment: Every lifting equipment must be checked and ensured to be in safe working condition before use.

Equipment Operations: In the process of operating the equipment, safety precautions must be taken to avoid accidents.

Transportation Safety: CR-SAPZ will ensure that equipment to be used is in good working condition to transport material to site.

Housekeeping: All wastes generated must be evacuated to the designated disposal areas.

Warning Signs and Instructions: When there is warning sign, workers will be notified and instructed on further action.

Safety Awareness: Workers must be at safety awareness at all times.

Hot Work: Every equipment for hot work must be in good condition before usage. Fire extinguishers and other fire apparatus will be in place before hot work is done. Permit for Hot work must be granted before hot work is done.

Firefighting Drills and Training: Workers will be kept physically fit by drills and trained to fight fire. Fire equipment will be available.

Procedure When Fire is Discovered:

Raise alarm

Assess the magnitude and location of the fire

Activate muster point

Direct all workers to muster point

To direct all workers out of the place to a safe zone

The fire man on duty to fight the fire must be well dressed with complete PPE.

Extinguish the fire with the appropriate firefighting equipment.

Equipment Control: When fire erupts, workers on site will disconnect every equipment under pressure to avoid more problems. Remove every material on walk way to allow free access for fire personnel.

Personnel Control Movement: Security of workers in and out of the premises must be regulated by security personnel.

Scaffolding Security: Scaffold must be used when installation have gone up. Every fabricator/worker working at height must wear safety harness belt and a life line must be provided.

Emergency Response Procedure: On observing the alarm or approved signal, each personnel shall:

1. Stop work immediately, take precaution for safe evacuation e.g. disconnect valves under pressure and keep tools out of walkway
2. Leave the workplace to a muster point closer to him/her
3. Remain at the muster point for roll call by the supervisor to identify any missing person(s).

In case of medical evacuation from site, victims will be taken to the clinic.

Implementation, Monitoring and Corrective Action

CR-SAPZ management shall ensure the implementation of the procedures and actions in the HSE plan by providing leadership, resources, and engaging appropriate management mechanisms for responsibility compliance at all levels, as well as monitoring, in line with the HSE Management Plan.

Monitoring

- Active HSE performance monitoring, which provides information in the absence of any incident, ill-health or damage to the environment shall involve the following;

Regular monitoring of progress in implementing HSE plans.

Regular inspection of facilities and equipment.

Health surveillance of staff, including exposure monitoring and medical surveillance

Recording of minutes of HSE related meetings.

Recording of training needs and training records.

- Reactive HSE performance monitoring, which provides information on incidents: near-miss incidents, ill-health or environmental damage and equally provides insights into the means of preventing similar incidents in the future shall be monitored as follows:

Reporting on situation of non-compliance with HSE requirements.

Reporting on incidents (including near-misses), which affected or could have affected HSE performance.

Investigations to identify the root causes for the foregoing and to determine measures to prevent reoccurrence.

Recording of hazards observed and action to prevent reoccurrence.

Recording of HSE performance statistics: exposure man-hours, LTI, MTC, FAC.

Following up on audit/review.

Corrective Action

Appropriate response shall be given to conditions of non-conformance of our operations and activities with set HSE objectives and the principles of good environmental management.

Management has responsibility to handle and investigate non-conformance.

The HSE Manager, has a role in timely remedial actions to mitigate any impacts, initiate and complete corrective and preventive actions.

Budget Estimation

CR-SAPZ management shall maintain appropriate budgetary system and implementation to provide for all requirements necessary to achieve company's HSE policies and objectives.

Table OHS 1: Budget Estimation

Main Item	Activities/Description	NGN	USD
PPE Supply	Safety boots, helmets, gloves, coveralls, earplugs, harnesses for ~500 workers	DBOC	
Safety Signage & Visual Aids	Hazard signs, evacuation maps, fire safety signage, hazard tapes	DBOC	
Onsite Medical Facility & Equipment	Setup of a basic first-aid clinic, beds, medical kits, thermometer, stretcher, ambulance	DBOC	
HSE Induction & Awareness Training	Monthly toolbox talks, induction training, hazard awareness, health campaigns	DBOC	
Emergency Preparedness	Fire extinguishers, muster points, alarms, emergency drills, response team mobilization	DBOC	
Routine Site Safety Inspections	Daily/weekly inspections, hazard logs, supervisor walkdowns, fuel/equipment checks	DBOC	
Health Surveillance	Regular staff medical checks, malaria and hygiene control programs	DBOC	
HSE Audits & Performance Review	Quarterly audits, KPI tracking, corrective actions, compliance scoring	DBOC	
Fire Safety Equipment	Fire extinguishers, blankets, hose reels, smoke detectors	DBOC	
Safety Documentation & Manuals	HSE plans, incident logs, SOPs, manuals for workers and contractors	DBOC	
Safety Monitoring Devices	Gas detectors, noise meters, safety cameras	DBOC	
HSE Staff & Consultant Support	Hiring of safety officers, external HSE consultants, auditing specialists	DBOC	
PIU/ESIC		3,500,000.00	2258.065
Total		3,500,000.00	2258.065

-
-
- **Audit**
 - CR-SAPZ shall maintain procedures for audits to be carried out as part of normal business control to determine whether the HSE management system elements and activities are adequate for achieving the HSE policies and objectives and are being implemented effectively, and to identify improvements.
 - HSE audits shall address the following elements of the HSE management system:
 - Organization, resources and documentation.

Hazards and effects management.

Planning.

Implementation and monitoring.

- Audits may be internal (by CR-SAPZ's staff) or external. CR-SAPZ HSE Audit plan covers the following:

HSE MS audit

Departmental/cross-departmental HSE audits

Technical HSE audit

Hazard management audit

Occupational Health audit

Audit training.

Review

Top management of CR-SAPZ, including the SPC and senior management, shall review at appropriate intervals the HSE management system and its performance to ensure its continuing suitability and effectiveness. The review will address, as a minimum, the following:

Whether or not there are changes to the HSE management system elements such as policies, objectives, HSE and emergency plans etc.

Resource allocation for HSE management system implementation and maintenance.

Audit reports and the status of implementation of recommendations.

Any concerns/suggestions expressed by stakeholders such as employees, clients and government agencies.

- The review process will be documented and its results recorded to facilitate the implementation of the agreed changes.

-

Waste Management

CR-SAPZ shall be fully responsible for the disposal of any waste generated during the execution of any project. Dumping of waste into creeks, rivers, and other watercourses is strictly prohibited. Dumping of waste on land shall only be at an appropriately designated dumping site approved by the local authorities or regulatory agency, provided such waste is non-toxic. The method of dumping shall be such as would not affect any ground water sources.

CR-SAPZ 's waste management policy ensures:

Commitment to waste management by ensuring and reviewing environmental policies.

All practical and reasonable measures shall be taken to minimise the generation of waste, as well as to manage / dispose of unavoidable waste in an environmentally acceptable manner.

Waste Management Plan shall catalogue waste identification, quantification and appropriate disposal methods.

Waste streams shall be monitored and recorded, while efforts will be taken to progressively reduce emission or discharge of waste known to have a negative impact on the environment with the eventual aim of eliminating them.

Chemicals shall only be used when operationally necessary. In selecting chemicals for use, the HSE aspects shall be considered together with commercial and process performance attributes with the aim of choosing the least harmful.

All chemicals shall be transported, stored, used and disposed of in accordance with statutory regulations and in a safe/environmentally acceptable manner.

No new chemical shall be accepted from a supplier without the Materials Safety Data Sheet (MSDS).

Every chemical shall be covered with a Safe Handling of Chemicals (SHOC) card and shall be acquired, used and disposed of in compliance with FMEnv regulations.

All chemical handlers shall be specifically trained in the Safe Handling of Chemicals.

Conclusion

CR-SAPZ believes that good HSE performance is an integral part of efficient and profitable business management. We recognize that HSE management is a line responsibility hence management and employees are committed to the principle of safe operations to safeguard health, promote safety and security of life and property, as well as minimize or eliminate the impact of activities on the environment in delivering on the Agricultural Transformation Centre project and its operation.

BIODIVERSITY MANAGEMENT PLAN (BMP)

INTRODUCTION

The Biodiversity Management Plan (BMP) is a crucial component of the Environmental and Social Impact Assessment (ESIA) for the Agricultural Transformation Centre (ATC) at Okuku, Yala Local Government Area in Cross Rivers State. The BMP outlines comprehensive strategies to identify, mitigate, monitor, and manage the biodiversity impacts associated with the development, construction, and operation of the ATC. This document draws on field studies, ecological assessments, and regulatory frameworks to provide a robust framework for biodiversity conservation.

OBJECTIVES OF THE BIODIVERSITY MANAGEMENT PLAN

The overarching objectives of this BMP are:

- To conserve and enhance biodiversity within and surrounding the project area.
- To prevent, reduce, or offset adverse impacts on species, habitats, and ecosystem services.
- To promote the sustainable use of biological resources by local communities.
- To support regulatory compliance and alignment with AfDB's Operational Safeguard 6, Convention on Biological Diversity (CBD), and Nigerian environmental laws.
- To engage stakeholders and local communities in biodiversity stewardship.

BASELINE ECOLOGICAL DESCRIPTION

Flora

A total of 62 mature trees were georeferenced and recorded for in-situ conservation (presented in Plate 4.36). Dominant species include *Elaeis guineensis*, *Mangifera indica*, *Gmelina arborea*, *Khaya senegalensis*, *Azadirachta indica*, and *Ceiba pentandra*.

Fauna

The area supports small mammals (e.g., rodents), birds (e.g., sunbirds, weavers), reptiles (e.g., lizards, snakes), amphibians, and pollinator insects.

No endangered species were recorded, but amphibians and semi-aquatic species utilize stream habitats.

Riparian and Aquatic Features

Two streams (1195.7m and 1292.1m) and one tributary run through the site.

Sparse but ecologically significant riparian vegetation serves as habitat and waterway protection.

IMPACT IDENTIFICATION AND ASSESSMENT

Every phase of a development project presents potential risks to biodiversity, ranging from habitat loss to pollution and ecosystem fragmentation. This section identifies and categorizes the likely adverse impacts the ATC project could pose to flora, fauna, and ecological systems (**Error! Reference source not found.**). The assessment considers pre-construction, construction, operational, and decommissioning phases to ensure a lifecycle approach to risk management.

Table 9.10: Potential Impact on Biodiversity

Project Phase	Potential Impact	Ecological Feature Affected
Pre-Construction	Vegetation clearance, soil exposure	Flora, riparian zones
Construction	Habitat fragmentation, pollution, noise	Fauna, streams
Operation	Pollution runoff, human encroachment	Streams, fauna
Decommissioning	Invasive species, soil degradation	General biodiversity

Other Potential Impacts

- Habitat fragmentation and loss from land clearing resulting to biomass of ~32,220 m³ (as indicated in WMP).
- Reduction of carbon sequestration capacity of the site by an estimated 164,082 m³ of greenhouse gas emissions (CO₂).
- Noise, dust, and air pollution disturbing wildlife.
- Increased risk of invasive species introduction.

Impact Significance

The construction phase is expected to have the most significant impacts due to extensive land use changes. If not managed, these impacts may lead to irreversible biodiversity loss. Operational phase impacts are relatively moderate and more manageable with mitigation.

Biodiversity Conservation and Management Measures

To ensure that the project operates within the limits of ecological sustainability, specific conservation and mitigation strategies are proposed in this section. These include tree preservation efforts, afforestation programs, erosion and flood control mechanisms, faunal protection measures, and pollution management strategies. The interventions are designed to

minimize biodiversity loss, restore ecological functions, and enhance overall environmental performance throughout the project lifecycle.

Tree Conservation and Afforestation

Tree planting and conservation are central to the site's ecological resilience. The proposed afforestation plan along streams and site perimeters, using native species that align with the ecological characteristics of the area (**Error! Reference source not found.**). It also covers the preservation of the 62 identified mature trees and defines the spatial parameters for planting interventions. Details of the tree proposed is presented in **Error! Reference source not found.**.

Table 9.11: Details of the Proposed Tree Planting

Location	Length (m)	Trees Proposed
Stream One (Right)	1195.7	240
Stream One Tributary	253.1	50
Stream Two (Left)	1292.1	258
Stream Crossing	319.0	64
Perimeter of project site (10m gaps)	2564.4	256
Total	—	868

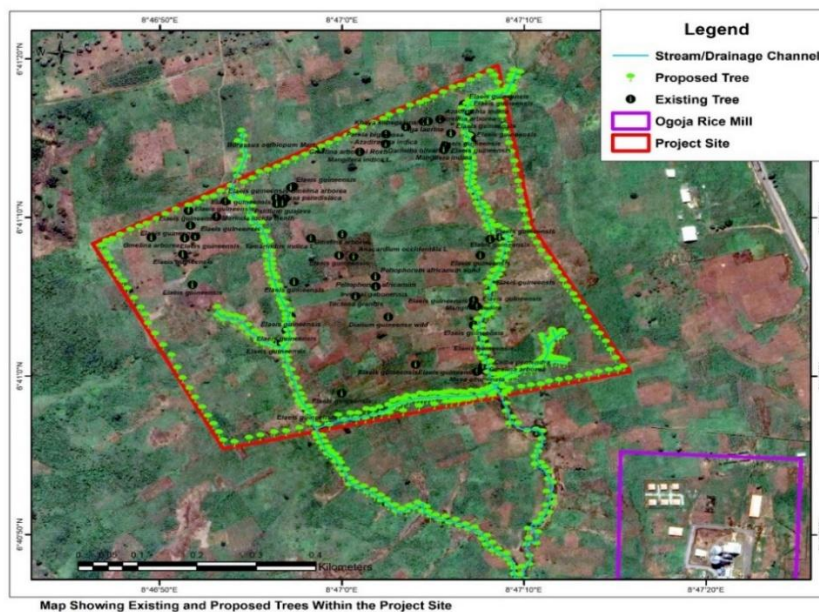


Figure 9.3: Distribution of Proposed Trees Planting Within ATC Project Area

Use native species like *Khaya senegalensis*, *Irvingia gabonensis*, *Gmelina arborea*, *Azadirachta indica* and *Tectona* for tree planting.

Maintain a minimum 10m riparian buffer on both stream banks.

Preserve a minimum of 70% of the 62 identified trees within the development footprint.

Label and monitor these trees using geotagged coordinates.

Fauna Protection

Project development may result in the displacement or disruption of local wildlife species. There are measures to protect faunal populations, maintain movement corridors, reduce noise and habitat disturbance, and discourage poaching. It integrates species-specific needs with broader landscape-level conservation planning.

Restrict vegetation clearing to non-breeding seasons for birds and amphibians.

Train workers to avoid hunting or disturbing native species.

Create wildlife corridors connecting the two stream ecosystems

Pollution Control

Pollution from construction and operational activities, if unmanaged, can severely degrade biodiversity. This subsection describes mechanisms for controlling chemical runoff, waste discharge, and air and noise pollution to preserve ecological integrity, especially within the hydrologically sensitive zones of the site

Prevent fuel, lubricant, or chemical leaks near streams.

Establish a buffer drain system that filters runoff before reaching watercourses.

Avoidance Measures

Site key infrastructures away from sensitive habitats (the two streams as indicated in Figure 4.1).

Avoid clearance during critical breeding/nesting periods.

Minimization Measures

Use low-impact vegetation clearing methods such as forestry mulching, selective land clearing and manual clearing using hand tools.

Install silt fences and erosion control near streams (refer to FECF).

Enforcement of endangered species act which prohibit bushmeat hunting of certain animals and illegal logging activities by workers and the public.

Restoration and Rehabilitation

The restoration and rehabilitation action considered the dual approach of evaluating both IUCN status and ecosystem service delivery of the tree species. This approach will ensure that conservation efforts are ecologically meaningful and socioeconomically beneficial.

Restore disturbed areas using native species such as *Khaya senegalensis*, *Gmelina arborea*, *Irvingia gabonensis*, *Azadirachta indica*, *Tectona grandis*.

Maintain ecological corridors for species movement.

Alien and Invasive Species Management

Conduct pre-import inspections of materials.

Manually remove invasive species with mechanical techniques such as hand-pulling, mulching and cutting.

Educate workers on alien species identification.

Replacement Strategy Plan

In alignment with the tree planting initiative for the ATC (ATC), a future replacement strategy for trees planted along riparian buffer zones is been developed. This strategy anticipates the natural aging, senescence, or potential loss of these trees after three decades, ensuring the sustained ecological integrity and protective functions of the riparian corridor. The long-term replacement strategy is designed to:

Maintain continuous riparian buffer functionality including erosion control, water quality regulation, and habitat protection.

Avoid ecosystem service degradation due to tree senescence or mortality after 30 years.

Strategic Framework for Planted Tree Replacement (Year 30+)

Year 15 and 25: Conduct a comprehensive ecological audit of the riparian buffer areas to evaluate the health, canopy density, root stability, and biomass of existing planted trees.

Identify dead, declining, or high-risk trees for phased removal and replacement.

Implement succession planting using native and resilient species identified in the original afforestation plan: *Elaeis guineensis* (Oil Palm), *Mangifera indica* (Mango), *Azadirachta*

indica (Neem), *Anacardium occidentale* (cashew), *Khaya senegalensis* (African mahogany), *Gmelina arborea* (gmelina), *Azadirachta indica* (neem) and *Tectona grandis* (teak).

Apply a staggered replanting approach (between year 15 and year 25) between the 10m gap of the planted tree to avoid canopy gap creation and allow continuous ecological functions during transition.

Maintain species diversity and consider emerging climate-resilient varieties, based on updated ecological assessments.

Benefits of the BMP

The implementation of a Biodiversity Management Plan (BMP) for the Agricultural Transformation Centre (ATC) in Okuku offers multiple environmental, social, and economic benefits that extend beyond regulatory compliance. These benefits include:

Environmental Benefits

Biodiversity Conservation – Protects and maintains native flora and fauna, including ecologically valuable species and habitats such as riparian zones and mature tree stands.

Habitat Connectivity – Maintains and restores wildlife corridors, enabling species movement between fragmented habitats.

Water Quality Protection – Prevents sedimentation and chemical pollution in streams through buffer zones and erosion control measures.

Ecosystem Services Preservation – Ensures continued provision of ecosystem functions such as carbon sequestration, pollination, nutrient cycling, and climate regulation.

Social and Community Benefits

Improved Livelihood Opportunities – Engages local communities in afforestation, ecological monitoring, and sustainable land management activities.

Cultural Value Preservation – Conserves plant species and landscapes of cultural or traditional significance to the host communities.

Education and Awareness – Enhances local understanding of biodiversity through training and participatory conservation programs.

Disaster Risk Reduction – Reduces risks of flooding, erosion, and land degradation, protecting community infrastructure and farmlands.

Economic Benefits

Long-Term Project Sustainability – Minimizes environmental liabilities that could cause project delays or sanctions.

Cost Savings – Reduces maintenance costs over time through natural erosion control, flood management, and pest regulation by healthy ecosystems.

Ecosystem-Based Business Opportunities – Supports potential eco-tourism, sustainable forestry, and non-timber forest products.

Regulatory and Institutional Benefits

Compliance Assurance – Aligns with Nigerian environmental regulations, Cross River State biodiversity protection laws, and AfDB Operational Safeguard 6.

Reputational Gains – Demonstrates corporate environmental responsibility, enhancing the project's credibility with financiers, regulators, and communities.

Framework for Continuous Improvement – Provides a structured monitoring and evaluation system that enables adaptive management of biodiversity issues.

BIODIVERSITY MONITORING PLAN

Parameter	Methodology	Frequency	Responsible Entity
Tree survival rate	Tagging, geo-referencing	Quarterly	Environmental Units of CRSAPZ & DBOC / ESMP Implementation Consultant
Stream water quality	Sampling (DO, pH, turbidity)	Monthly	Environmental Units of CRSAPZ & DBOC / ESMP Implementation Consultant
Wildlife presence	Transect and camera surveys	Bi-annually	Environmental Units of CRSAPZ & DBOC / ESMP Implementation Consultant
Invasive species emergence	Visual inspection, quadrats	Bi-annually	Environmental Units of CRSAPZ & DBOC / ESMP Implementation Consultant
Erosion signs	Visual + drone imagery	Post-rainy season	Environmental Units of CRSAPZ & DBOC / ESMP Implementation Consultant

Institutional Framework and Responsibilities

CR-SAPZ Project Management: Overall accountability for BMP implementation.

Environmental/HSE Officer: Day-to-day monitoring and enforcement.

Third-party Ecological Consultant: Technical studies, validation, reporting.

Community Stakeholders: Watchdog roles, participatory monitoring.

Federal & Cross River State Ministries of Environment: Oversight, permitting, compliance checks.

CAPACITY BUILDING AND COMMUNITY ENGAGEMENT

Train staff on ecological conservation and BMP procedures.

Establish community biodiversity committees.

Organize workshops on sustainable agriculture and bushmeat alternatives.

Engage in school biodiversity clubs and awareness campaigns.

Table 9.12: BMP Implementation Monitoring Budget Estimate

Items	Activities	NGN	USD
Restoration and native planting	Site preparation, seedling procurement, and planting of native trees	DBOC	
Invasive species control	Manual/mechanical removal, community sensitization, and monitoring	DBOC	
Community outreach and education	Workshops, training sessions, production of IEC materials	DBOC	
PIU / ESIC		3,500,000.0	2258.065
Contingency (10%)	Buffer for unforeseen expenses and project risks	DBOC	
Total		3,500,000.0	2258.065

Reporting And Compliance

Quarterly progress reports to CR-SAPZ and FMEnv and monthly to AfDB

Annual biodiversity compliance audits.

Public disclosure of ecological performance which will be embedded in the Stakeholder Engagement Plan (SEP).

Mid- and end-term BMP evaluations tied to project milestones.

CONCLUSION

The ATC project in Okuku presents both challenges and opportunities for biodiversity. Through this robust Biodiversity Management Plan, ecological integrity will be maintained, ecosystem services sustained, and legal/regulatory compliance ensured. Restoration, conservation, and proactive environmental stewardship will remain key to the project's long-term sustainability.

• TRAFFIC MANAGEMENT PLAN

Introduction

- A well-designed plan can reduce the risk of accidents involving vehicles, personnel, and equipment, especially during loading, unloading, and transportation of potentially hazardous materials. By streamlining traffic flow and access routes, the plan can improve efficiency and reduce delays, leading to faster exploration and production cycles. A traffic management plan should include protocols for emergency evacuations, spill response, and other potential hazards, ensuring the safety of personnel and minimizing environmental damage. Hence, the following strategies are summarized for effective traffic management in the project area.
- **An overview of the Traffic Situation in the Area**
- The proposed Cross River State Special Agro-Industrial Processing Zone (SAPZ) project site in Okuku, Yala LGA is located at latitude 6°41'5.05"N; longitude 8°47'0.45"E along Ogoja-Yala highway in Okuku, Yala LGA, about 0.35km north of Ogoja Rice mill, 700m from Godwin Ali Cantonment, 1.6km from Army Barracks, 3.8km from Okuku market, 1.6km from Bakor polytechnic Ogoja, 2.7km from Cross River State University of Technology, Okuku, 2.47km from Pollygals hotel, among other features (**Error! Reference source not found.**).

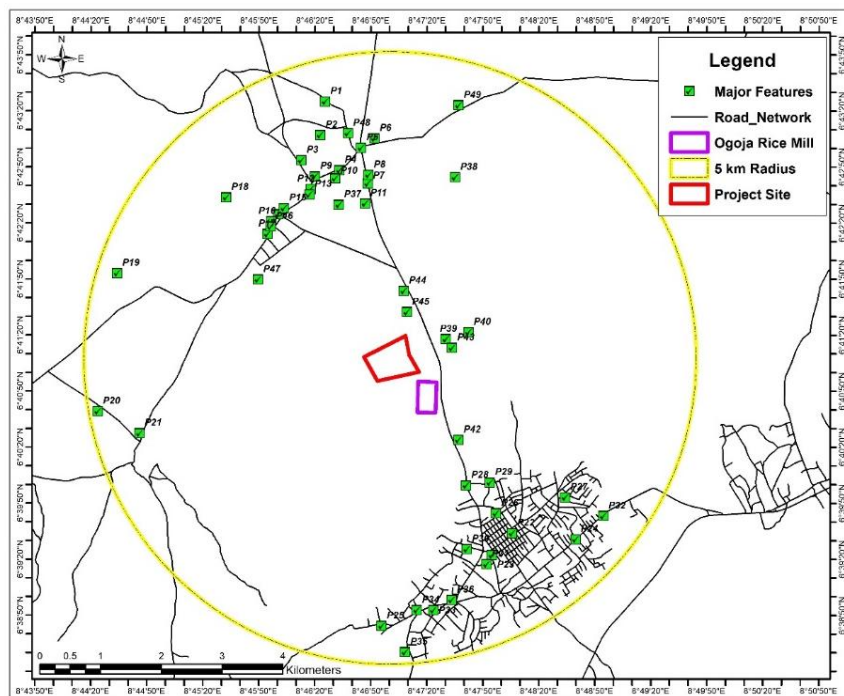


Figure 9.4: Road Network Analysis and Major Features within the Project Area

Objectives and Scope of the Traffic Management Plan (TMP)

This Traffic Management Plan (TMP) is designed to ensure the safe, efficient, and coordinated movement of vehicles, equipment, materials, and personnel in and around the SAPZ Project Site. The plan supports construction, logistics, operational, and emergency requirements with minimal disruption to surrounding communities and road users. This plan covers: the construction phase, operational phase, internal site traffic, external (access road) traffic, traffic safety, controls, and emergency procedures. In summary, the objectives of the TMP are:

- a) To reduce the risk of traffic accidents
- b) To manage construction and operational logistics effectively
- c) To ensure smooth traffic flow within and around the ATC
- d) To minimize disruption to nearby communities

Traffic Demand, Classification and Vehicle Types

At all the phases of the project, there are various traffic demands and associated vehicles. For instance, during the initial construction phase, the plan might involve diverting traffic on a specific road to allow for heavy vehicle access to the site. Consequently, flagmen would be stationed at key intersections to manage traffic flow and ensure safety. On the other hand, once the SAPZ is operational, the plan could include designated delivery zones and parking areas, as well as traffic calming measures like speed bumps to control traffic speeds within the zone. Public transportation options would also be considered. However, the traffic demands, classification and vehicle types are summarized herein based on the major phases:

Construction Phase

Several vehicles which may disrupt traffic flows will be used. These as summarized in **Error! Reference source not found.** include: heavy vehicles (e.g., excavators, dump trucks, concrete mixers), delivery trucks (e.g., raw materials, machinery), personnel buses and light vehicles, fuel and water tankers, among others.

Table 9.13: Vehicular Demands and their Purpose During Construction Phase

Vehicle Type	Estimated Volume	Purpose
Heavy-duty trucks (e.g. dumpers, concrete mixers)	50–70/day	Earthworks, concrete delivery

Construction equipment (excavators, cranes)	10–20/day	Site preparation and structure erection
Light vehicles & pickups	40–60/day	Engineers, supervisors, logistics
Personnel buses	5–10/day	Labour transport

Operational Phase

During the operational phase, major vehicles needed include agricultural produce delivery trucks, export container trucks, employee and visitor vehicles, waste management trucks, among others. Their functions are summarized in **Error! Reference source not found.**

Table 9.14: Vehicular Demands and their Purpose During Operational Phase

Vehicle Type	Estimated Volume	Purpose
Produce delivery trucks (5–20 tons)	80–100/day	Input and output transport
Container trucks	20–40/day	Processed goods export
Waste management trucks	5/day	Residue & waste removal
Staff cars and motorcycles	100–150/day	Employee commute
Visitors/official cars	10–30/day	Inspections and business visits

- **Traffic Management Model**
- **Error! Reference source not found.** clearly illustrates the management plan for traffic within the facility showing the proposed entry/exit points, parking lots, no parking, among others. The parking lot allocate suitable parking space for staff and visitors at each of the facility. Meanwhile, the objective of designing and operating parking areas involves providing an access point capacity more than the peak rate of traffic flow that traverses the driveway. On the other hand, parking restriction sign (No Parking) allows for free flow of traffic across the facility (**Error! Reference source not found.**).

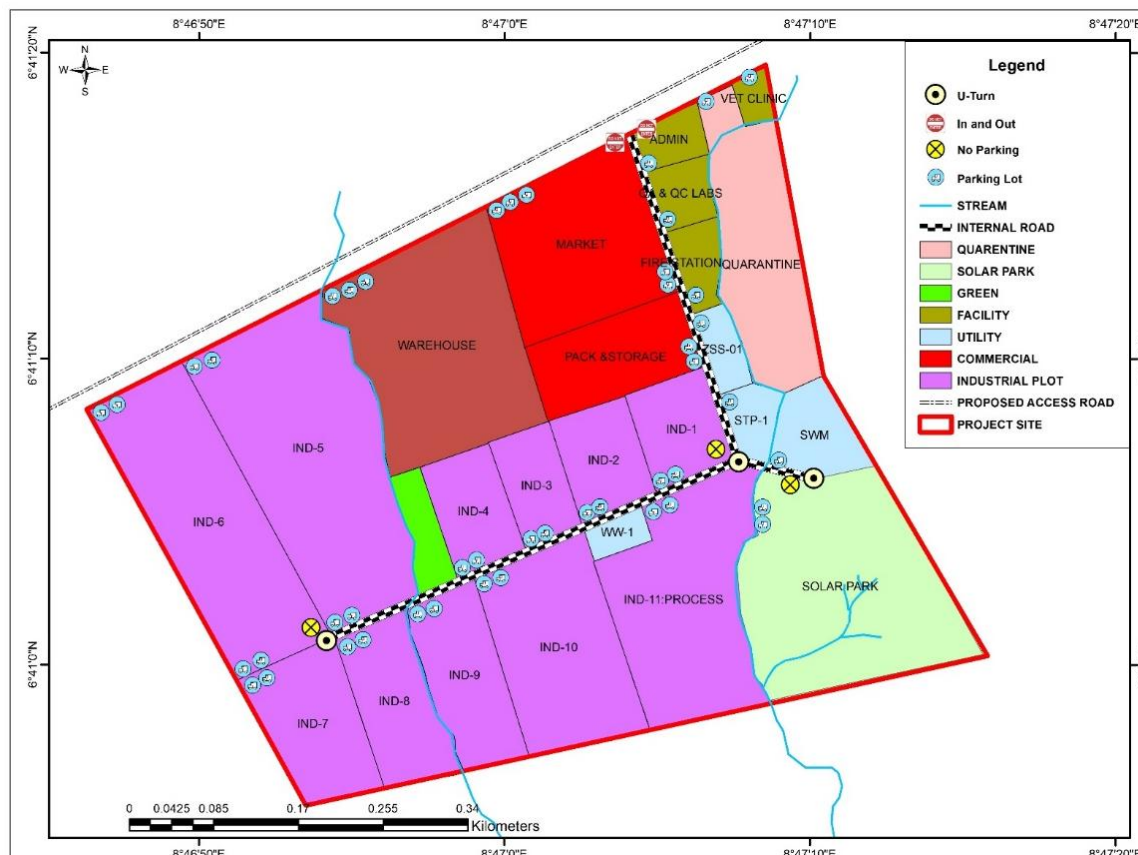


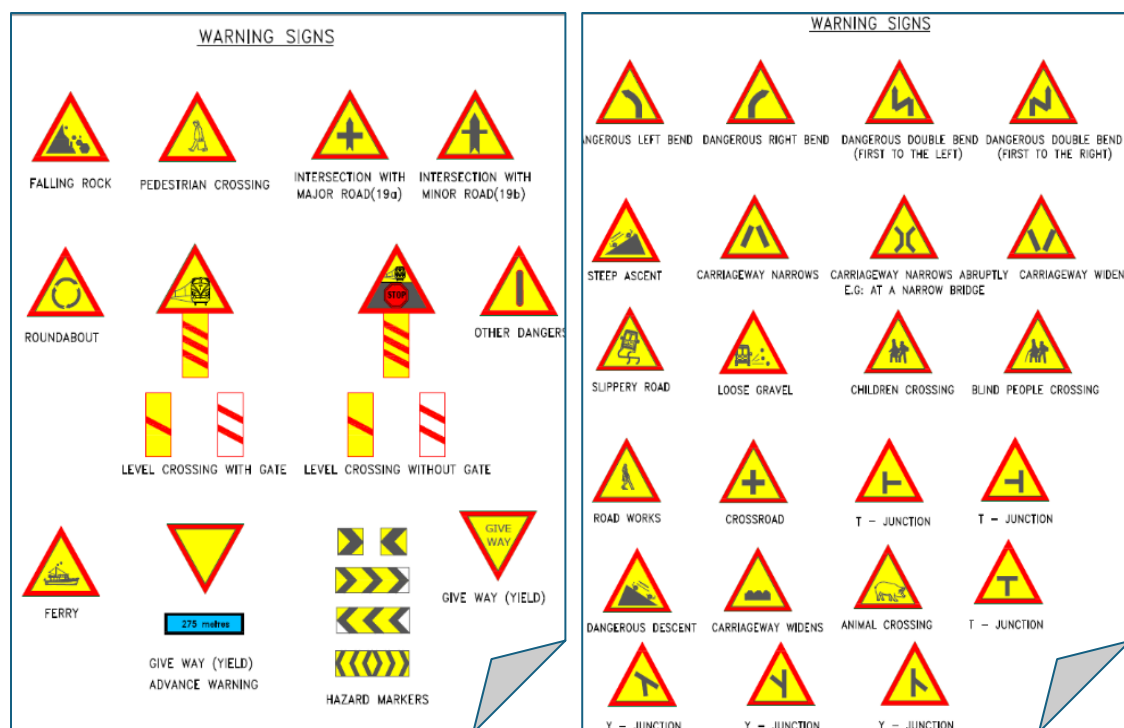
Figure 9.5: Site Plan Showing Traffic Management Plan within the Project Environment

MANAGEMENT, MONITORING AND ENFORCEMENT

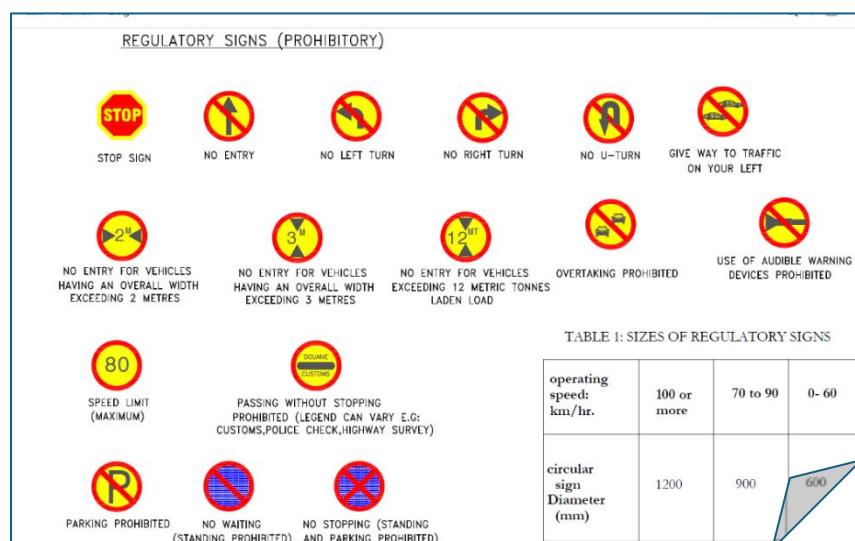
Effective traffic management shall comprise of traffic coordinator, traffic marshals, security officers, among others and their role is summarized in **Error! Reference source not found..**

Figure 9.6: Traffic Control Team

SN	Role	Responsibility
1	Traffic Coordinator	Oversees plan implementation
2	Traffic Marshals	Enforce compliance and report violations
3	Security Officers	Control gate access and vehicle logs



Road signs



REGULATORY SIGNS (MANDATORY)

DIRECTION TO BE FOLLOWED
(PROCEED STRAIGHT ONLY)

DIRECTION TO BE FOLLOWED
(PROCEED RIGHT ONLY)

DIRECTION TO BE FOLLOWED
(PROCEED LEFT ONLY)

STOP (TEMPORARY)

PRIORITY FOR ONCOMING TRAFFIC

END DIVERSION (TEMPORARY)

DIRECTION TO BE FOLLOWED
(PROCEED RIGHT OR LEFT) (TWO WAY TRAFFIC CROSS ROAD)

DIRECTION TO BE FOLLOWED
(TWO WAY TRAFFIC CROSS ROAD)

DIRECTION TO BE FOLLOWED
(TWO WAY TRAFFIC, TWO LANES)

GO (TEMPORARY)

EXPRESSWAY

COMPULSORY MINIMUM SPEED LIMIT

DIRECTION TO BE FOLLOWED
(BEGINNING OF DIVIDED TWO LANE TWO WAY ROAD)

DIRECTION TO BE FOLLOWED
(BEGINNING OF DIVIDED FOUR LANE TWO WAY ROAD)

DIRECTION TO BE FOLLOWED
(END OF DIVIDED FOUR LANE TWO WAY ROAD)

COMPULSORY FOOTPATH

COMPULSORY ROUNDABOUT

TABLE 1: SIZES OF REGULATORY SIGNS

operating speed: km/hr.	100 or more	70 to 90	0- 60	stopping /parking	over sign
circular sign Diameter (mm)	1200	900	600	500	

Road signs

FLOOD AND EROSION CONTROL PLAN (FECF)

Introduction

Across Nigeria, the twin threats of flooding and erosion continue to erode development gains, damaging infrastructure and diminishing agricultural productivity. In recent years, flooding has evolved into a recurrent hazard, with Cross River State facing heightened vulnerability due to its tropical climate, undulating terrain, and proximity to major river systems. Research identifies heavy, prolonged rainfall, fragile tropical soils, unsustainable land-use practices, deforestation, inadequate drainage infrastructure, and development on natural floodplains as key drivers of these hazards. Collectively, these factors intensify the state's exposure to flood and erosion risks, underscoring the urgency of a proactive Flood and Erosion Management Plan tailored to the region's unique environmental conditions.

The Okuku project area, located 350m north of Ogoja Rice mill in Yala Local Government Area of Cross River State, lies within the transitional belt between the southern rainforest and the northern Guinea savanna. The region features moderate elevations and undulating terrain, with elevation approximately 122 meters (400 feet) above sea level. (GeoNames, n.d.)

The topography of Okuku is characterized by undulating terrain and gentle slopes, with elevation ranging between 74 and 80m above sea level. (Refer to **Error! Reference source not found.**: 3D model map) This consistent with the broader geomorphological features of northern Cross River State. Slope gradients are generally mild, falling within the 0–9% range, and exhibit a gradual decline toward adjacent valleys and low-lying floodplains. This landscape configuration influences surface hydrology, with certain areas becoming susceptible to runoff accumulation and localized flooding during periods of high-intensity rainfall. The topographic conditions are particularly relevant for site drainage planning, erosion control, and infrastructure stability within the proposed project footprint.

The soil structure is characterized by highly weathered, iron-rich, and acidic tropical soil predominantly classified as Ferric Acrisol. Soil texture across the area generally ranges from sandy-loamy soils, moderately deep, and strongly acidic due to prolonged weathering and leaching. These soils exhibit low to moderate organic matter content and are often loosely bound at the surface, particularly in cultivated or disturbed areas. While elevated areas tend to be well-drained, low-lying zones near seasonal waterways frequently experience poor drainage. This heterogeneity in soil texture and drainage, combined with the loose topsoil, increases the area's susceptibility to environmental hazards such as sheet erosion, surface runoff, and gully formation.

Vegetation in the Okuku area reflects its transitional ecological position between the southern rainforest belt and the northern Guinea savanna zone. The landscape is characterized by patches of secondary forest, mosaic of grasses, shrubs, and scattered trees, with common species including guinea grass (*Panicum maximum*), elephant grass (*Pennisetum purpureum*), teak (*Tectona grandis*), gmelina (*Gmelina arborea*). Common economic trees include oil palm, cashew, mango, and raffia palm, alongside native species such as locust bean. Undergrowth features grasses, shrubs, and occasional ferns, especially near streams and low-lying areas. Agricultural activities have extensively modified the natural vegetation. Farmlands dominate the terrain, supporting crops like yam, cassava, maize, melon, okra, and vegetables. Traditional land-use practices such as shifting cultivation and bush fallowing are widely observed. Boundary marking is typically done using natural vegetation lines or cleared paths.

Understanding the local soil structure, topography, and vegetation is crucial to designing and implementing an effective flood and erosion management strategy tailored to the environmental realities of Okuku and the proposed project.

The proposed Agricultural Transformation Centre (ATC) at Okuku is a flagship development aimed at strengthening agri-business value chains and driving inclusive economic growth within Yala LGA and beyond. In light of increasing climate variability and site-specific environmental challenges, this Flood and Erosion Management Plan (FEMP) has been developed to guide the planning, design, and operational strategies for managing hydrological and geological risks at the site.

Aims of the FECF

The primary aim of the plan is to: Safeguard infrastructure, farmlands, community asset, and conserve natural ecosystems from hydrological geomorphological hazards.

Objectives of the FECF

The specific objectives of the FECF are to:

Prevent or significantly reduce the occurrence of flooding and erosion within and around the project site and its environs.

Mitigate flood risks associated with seasonal rainfall patterns and rising water tables, and increasing runoff.

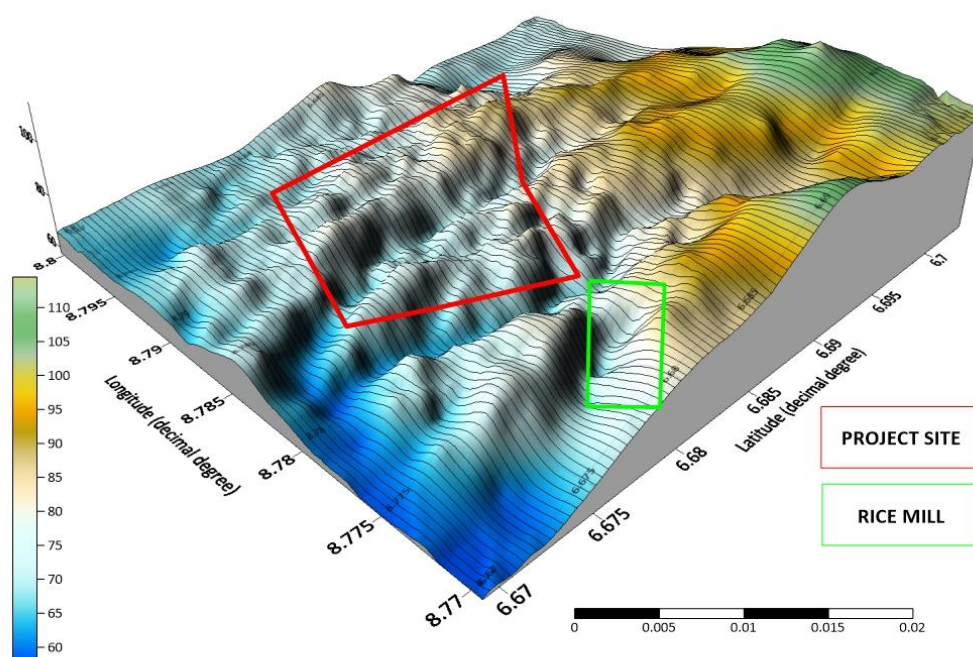
Prevent soil degradation, gully formation and sediment displacement through physical (e.g. proper drainage channels), biological (e.g. revegetation), and structural (culverts, check dams) controls measures.

Strengthen infrastructure resilience through climate-smart planning, design and engineering approaches aligned with vision of the ATC.

Safeguard nearby communities, livelihoods, agricultural lands, and surface water bodies within and around Okuku.

Integrate traditional ecological knowledge with modern engineering, actively engage stakeholders, and align with national and international best practices for coastal resilience flood and erosion control.

Conserve natural floodplains, stream channels, riparian zones and wetland that serve as ecological buffers natural barriers to flooding.



3D SURFACE MODEL OF OKUKU SITE
Projection: Perspective; Rotation: 45°; Tilt: 30°; Field of View: 45°]

Figure 9.7: Digital Elevation Model of ATC site Okuku

Baseline Conditions

Detailed environmental evaluation and field studies conducted within the Okuku Community, Yala LGA of Cross River State, have yielded essential insights into the area's hydro-climatic, soil, and geomorphological characteristics. These findings form the basis for sustainable project planning, risk mitigation, and environmental management strategies for the proposed ATC development in the region. Notable site characteristics include:

The project area is traversed by several seasonal streams and shallow drainage channels that contribute to local surface water flow, these water bodies form part of a regional watershed and influence local flooding dynamics, particularly during peak rainfall.

The terrain is marked by gently undulating landforms interspersed with natural depressions and erosion-prone gullies. Unmanaged gullies, especially in the northern and southwestern zones, are at risk of expansion during the wet season, potentially threatening agricultural fields and planned infrastructure.

Okuku experiences a tropical wet and dry climate, a wet season running from April to October and a dry season from November to March. The average annual rainfall ranging between 1,800 to 2,500 mm. Rainfall is heaviest from July to September. These prolonged rainy periods lead to high runoff, flash flooding, and sustained surface saturation in low-lying areas lacking proper drainage.

The soils in Okuku are primarily sandy-loam to clayey, moderately deep, and variably drained. Certain zones display low infiltration capacity due to surface compaction or fine-textured layers, resulting in runoff accumulation and sheet erosion. Disturbed topsoil in farmlands is particularly vulnerable to rill and gully erosion.

Hydrological patterns and community records suggest a high occurrence of localized flooding during peak rainfall periods, especially in areas near footpaths, natural depressions, and compacted farmlands. The southern perimeter of the site is particularly at risk due to restricted water outflow and inadequate slope drainage. (*Refer to **Error! Reference source not found.***)

Vegetation in the Okuku area consists of a mix of fallow fields, derived savanna grasslands, secondary forest patches, and cultivated lands. While native vegetation offers some protection against erosion, agricultural expansion and land clearing have weakened these buffers, leaving exposed areas more prone to degradation.

As shown in the Flood and Erosion Vulnerability Map (**Error! Reference source not found.**), the proposed ATC site is classified into three categories based on topographic relief:

Highly Vulnerable Zones (Orange): Areas most prone to flooding and erosion, primarily located along drainage channels and within the site's low-lying central corridor. A substantial portion of the ATC site, particularly along the main drainage channel, falls within this category, making it essential to integrate a FECP into the project design.

Moderately Vulnerable Zones (Light Green): Areas with moderate susceptibility to flooding and erosion, typically forming transitional buffers between high- and low-vulnerability zones.

Lowly Vulnerable Zones (Dark Green): Elevated and stable terrain with minimal risk of flooding and erosion.

These baseline conditions for Okuku highlight the urgent need to integrate flood, erosion control plan into the proposed ATC development. With appropriate engineering and environmental safeguards, the project can enhance resilience to climate-induced hazards while supporting local livelihoods and ecological balance.

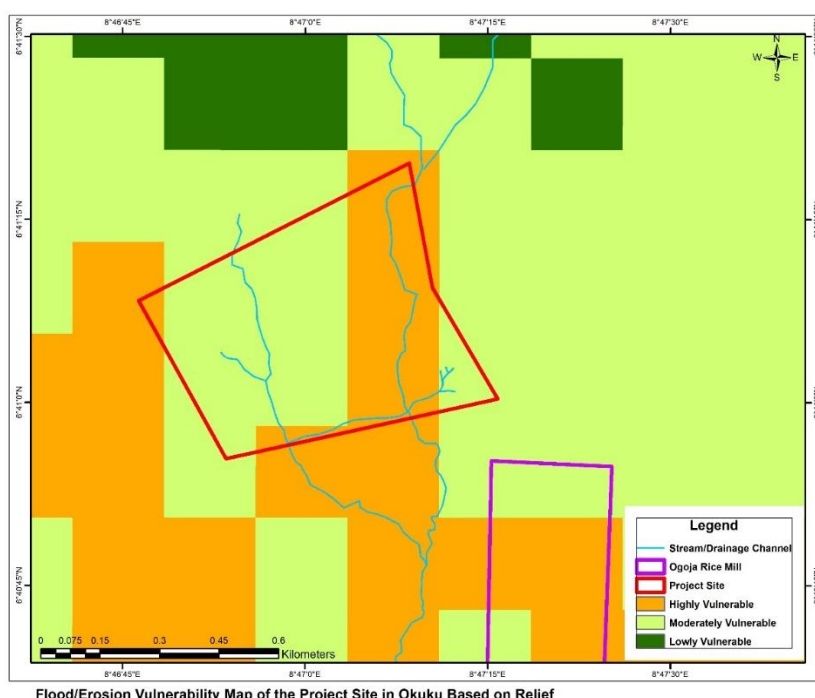


Figure 9.8: Flood & Erosion Vulnerability Map of the ATC site & environs

Flood and Erosion Control Measures for Effective Management of the proposed ATC in Okuku community.

This section outlines the proposed flood and erosion control strategies to mitigate environmental risks and ensure sustainability of the ATC in Okuku Community. a combination of structural,

vegetative and engineering control measures has been considered at the project design level, subject to detailed geotechnical, hydrological data, and community consultations. The proposed measures aim to enhance land stability, safeguard infrastructure, and improve resilience to climate variability.

Site Planning and Engineering Flood Controls

The site layout incorporates deliberate planning and engineering measures to effectively manage flood risks and ensure the long-term resilience of the ATC. These measures include:

- i. Topographic Regrading: Elevate critical structures above the 1-in-25-year flood level using engineered fill and properly compacted construction platforms. This measure will be incorporated into the project's design and construction phases to ensure that low-lying and erosion-prone areas are recontoured, building platforms are raised above anticipated flood levels, and surface runoff is efficiently channelled to designated drainage systems. These interventions will enhance structural stability, improve flood resilience, and prolong foundation integrity.
- ii. Drainage Masterplan: Develop a site stormwater management system including:
 - Primary and secondary channels to efficiently collect and convey surface runoff away from sensitive areas.
 - Concrete-lined trapezoidal drains with a depth of $\geq 0.5\text{m}$, and a slope gradient of 1% designed to manage runoff velocity and prevent scouring.
 - Vegetated swales and bioswales along peripheries to encourage infiltration, filter sediments, and enhance groundwater recharge.
- iii. Retention Pond: A retention pond is proposed in the north western part of the project site, *as shown in **Error! Reference source not found.** and **Error! Reference source not found.***. This location corresponds to a natural low point where surface runoff converges, indicated by the direction and density of flow vectors. Its position captures runoff from higher elevations, helping to slow down flow, reduce erosion, and mitigate flooding. The pond also supports groundwater recharge and protects nearby infrastructure, including the Rice Mill and main development zone.
- iv. Check Dams: Use small rock-fill check dams along identified internal streams and channels to reduce flow velocity and trap sediment transport, thereby enhancing downstream water quality and stabilizing embankments.
- v. Culvert Design Optimization: Existing culverts, along the flow route of storm water from the site to the river, will be evaluated and expanded to accommodate peak flow volumes. This will reduce the risk of blockage and overtopping, which commonly leads to erosion and localized flooding.

- vi. Permeable Pavement Systems: Within pedestrian and parking zones, permeable surfaces will be adopted to enhance stormwater infiltration, reduce surface runoff, and mitigate waterlogging.

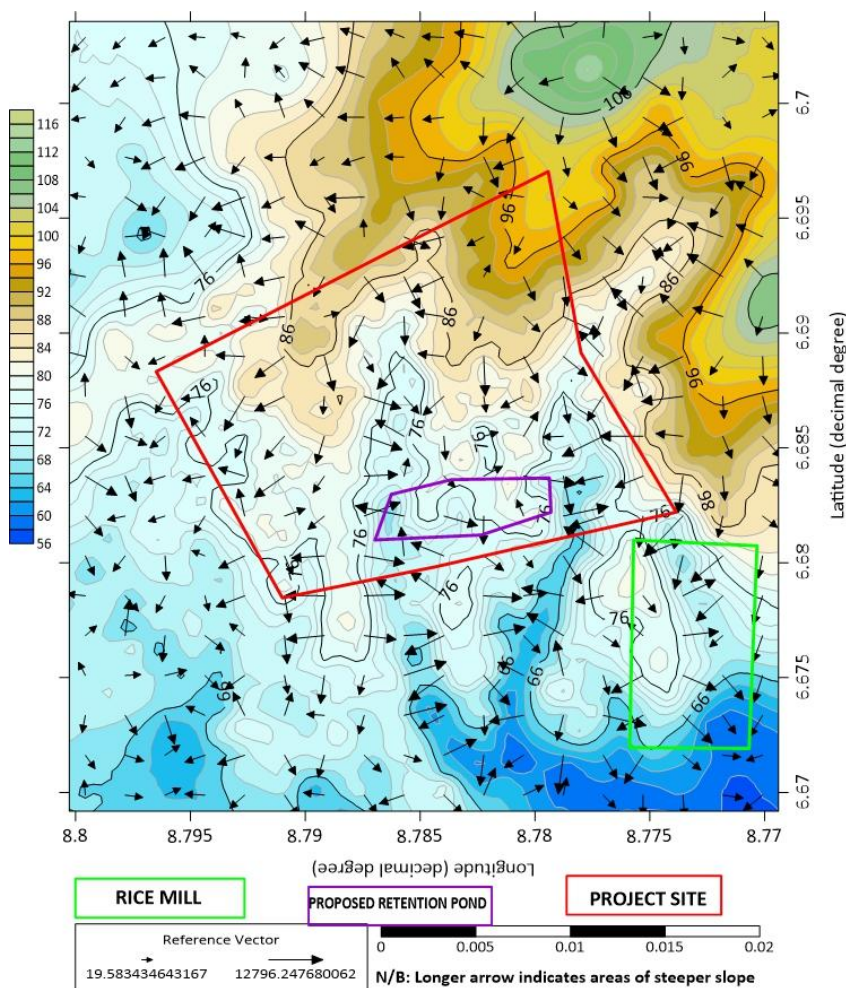


Figure 9.9: Vector flow map showing proposed retention pond

Soil Erosion Prevention Measures in Okuku.

To safeguard the integrity of the landscape and minimize land degradation within the project area in Okuku Community, a strategic mix of structural and vegetative soil erosion control measures has been incorporated into the site design. These measures are aimed at reducing surface runoff, preventing gully formation, and enhancing long-term soil stability.

Structural Measures

Gabion and Rip-raps: Heavy-duty gabion mattresses and riprap to be installed at vulnerable riverbanks, streams edges and culvert outlets to prevent gully initiation and expansion of the gullies. These structures dissipate energy from flowing water and protect embankments from scouring and undercutting.

Terracing and Contour Trenching: Shall be applied along project slopes >6% gradient to slow water movement, increase infiltration and reduce erosion potential, especially around cleared or disturbed project area.

Sediment traps and Barriers: Temporary erosion control devices such as silt fences, sediment traps, and sandbag check dams will be installed at critical locations to capture suspended sediments and prevent sedimentation of downstream watercourses, during construction.

Reinforced Embankments: In flood-prone zones, engineered embankments will be reinforced with stone pitching and geotextile membranes to ensure long-term slope stability.

Conservation of Wetlands: Existing natural wetlands within or adjacent to the project area should be preserved and integrated into the overall flood control strategy.

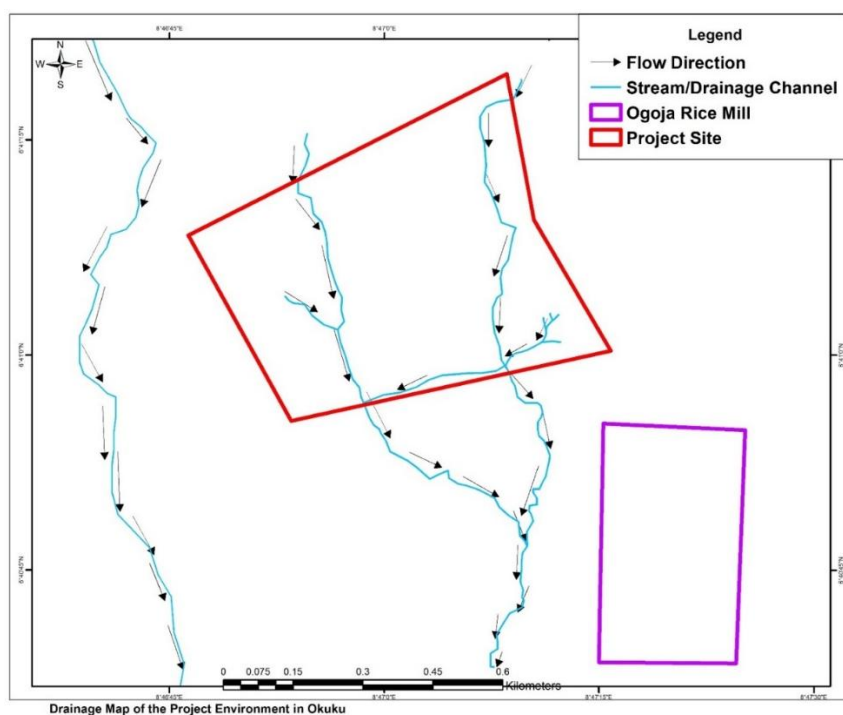


Figure 9.10: Drainage Map of the project site in Okuku showing tributary flow direction

Vegetative Measures

To support long-term flood and erosion control of the project, natural stabilization strategies will be implemented alongside engineering controls. These vegetative measures enhance soil binding, reduce surface runoff, and promote ecological resilience.

Hydro-seeding and Grass Carpeting: Stabilize exposed or soil surfaces with deep-rooted, fast-growing grass species such as Guinea grass and Vetiver grass due to their high soil-binding capacity and effectiveness in reducing surface erosion.

Afforestation of Slopes: Plant native trees such as *Gmelina*, *Acacia (White Teak)*, *Acacia auriculiformis* (Earleaf Acacia), and *Albizia (Siris Tree)*. These species were selected for their canopy coverage, fast growing nature, adaptability to tropical conditions, slope stabilization and erosion control deep roots, and ability to anchor soil, and reduce rainfall impact.

Riparian Buffers: Implement the planting of 868 trees along both sides of the stream channels at 10-meter intervals, in strict accordance with the BMP and the accompanying vegetation map. This intervention is a deliberate measure to ensure long-term protection of stream integrity, enhancement of water quality, and mitigation of climate and biodiversity risks. Additionally, 62 existing trees identified within the project area will be conserved, reinforcing commitment to sustainable land management and ecological preservation.

Agroforestry Integration: On farmlands adjacent to the site, agroforestry practices will be encouraged to promote sustainable land use while providing erosion control through integrated planting of crops and trees.

Community Greenbelts: Designated greenbelts and parklands will be incorporated into the layout to act as flood plains and water sinks, while enhancing environmental aesthetics and community well-being. *Refer to Chapter 4 for the ATC site's vegetation map indicating clearance and conservation (trees) zones.*

Erosion-Control Landscaping

This section outlines a comprehensive erosion-control landscaping and management plan tailored for the proposed ATC. The interventions are designed to sustainably manage runoff, stabilize soil, prevent erosion, and protect the ecological integrity of the project site throughout the construction and operational phases.

Shelterbelts and Windbreaks: Design green belts and shelterbelts using indigenous, low-runoff landscape species such as Vetiver grass, Elephant grass (*Pennisetum purpureum*), and *Acacia auriculiformis* (Earleaf tree) to serve as windbreaks and erosion buffers.

Strategic Afforestation and Tree Preservation: 62 existing trees will be preserved, with additional trees to be planted at 10-meter intervals along the water channel and site perimeter. This strategic intervention plays a vital role in stabilizing soil, reducing surface runoff, enhancing groundwater recharge, and acting as a natural buffer against erosion. The combination of preserved and newly planted trees not only provides critical ecological functions but also enhances the site's visual appeal and reinforces the centre's commitment to environmental sustainability (Figure 3.2).

Mulching and Ground Covers: Mulch or biodegradable ground covers will be applied over exposed soil surfaces in erosion-prone areas to reduce surface runoff velocity, minimize soil displacement, and retain soil moisture. These measures will remain in place until permanent vegetation is established, thereby stabilizing the soil, supporting plant growth, and enhancing overall erosion control effectiveness.

Green Infrastructure. Green infrastructure and landscape design will be integrated in erosion-prone areas, including vegetation buffers, permeable surfaces, and bio-swales, to complement engineered erosion-control measures and enhance site resilience. These interventions will be incorporated into the project's planning, construction, and maintenance phases to strengthen environmental resilience, reduce long-term maintenance costs, and support the ecological integrity of the site.

In order to control erosion and sedimentation during the construction phase, a series of strategically-timed interventions have been planned. **Error! Reference source not found.** presents these site-specific actions, their functions, and the corresponding stages of implementation to uphold environmental standards.

Table 9.15: Construction Phase Measures

Measures	Description	Timeline
Diversion Berms	Create temporary earth bunds to divert runoff away from work zones.	Pre-construction
Stabilized Site Entry	Use rock pads and sediment wash pits to reduce sediment tracking by vehicles.	Ongoing
Slope Protection	Geotextile fabric application and turfing on newly cut embankments to prevent slope failure.	Within 7 days of exposure
Rain Event Protocol	Cease land clearing 24 hrs before heavy rainfall forecasts; inspect all erosion controls post event.	As needed

Operational and Long-term Control Measures

To ensure sustained flood and erosion risk mitigation, CR-SAPZ commits to the following operational and long-term control measures as part of its environmental stewardship obligations:

Routine Cleaning of Drainage Networks: CR-SAPZ shall implement quarterly maintenance program involving the de-silting and debris removal from all site drainage channels, culverts, and retention ponds to ensure unimpeded water flow and prevent localized flooding.

Periodic Vegetation Maintenance: CR-SAPZ will undertake routine rimming of grass cover and replacement of dead plants on slopes and erosion-prone areas to maintain effective ground cover and enhance slope integrity throughout the project lifecycle.

Storm Event Monitoring: CR-SAPZ shall Install automatic rain gauges to monitor precipitation; Any storm event exceeding 50mm/hour will trigger an inspection protocol within 24 hours to assess erosion control systems and initiate immediate corrective actions where needed.

Community Early Warning System: CR-SAPZ in collaboration with Cross River State Emergency Management Agency (SEMA), to deploy flood early-warning mechanisms, including sirens and alert systems, to safeguard vulnerable downstream communities.

Emergency preparedness and Response: CRSAPZ is committed to maintaining a comprehensive emergency preparedness framework and these measures should be well established and effectively maintained. All emergency protocols shall be reviewed bi-annually, updated based on site conditions, and kept fully operational to ensure rapid and effective response to extreme weather events.

Institutional Roles and Responsibilities

Effective implementation of the FECP for the proposed ATC requires the coordinated efforts of multiple institutions. Each stakeholder plays a distinct role in ensuring compliance, monitoring, and sustainability of environmental safeguards (**Error! Reference source not found.**).

Table 9.16: Monitoring and Evaluation Framework

Role	Responsible Entity	Key Functions
FECP Oversight	CR-SAPZ PIU	Oversight, supervision, and review of the flood plan implementation

Execution	DBO Contractor	On-ground implementation of all flood/erosion works.
Monitoring	Environmental Consultant	Routine inspection, performance review, and reporting.
Supervision / Regulation	Cross River State Ministry of Environment / NESREA	Ensure standards and regulatory compliance and enforcement

This monitoring framework establishes clear performance indicators and responsibilities for overseeing flood and erosion control measures. It facilitates early risk identification, ensures compliance with environmental safeguards, and supports data-driven decision-making across all phases of the project lifecycle.

Table 9.17: Proposed Monitoring Plan

Indicator	Method	Frequency	Responsible Unit
Drainage capacity and flow	Flow rate measurement and ponding observations	Quarterly	DBOC
Siltation in retention basins	Sediment depth gauges and visual inspections	Monthly	HSE
Gully formation hotspots	Geotagged photographic surveys	Biannually	Environmental Consultant
Rainfall events above design	Rain gauge logs and hydrological alerts	Event-based	HSE

The estimated budget outlines the financial requirements necessary to implement the flood and erosion control measures detailed for the proposed ATC in Okuku. Adequate budgeting ensures timely execution of mitigation strategies and supports long-term sustainability. **Error! Reference source not found.** and **Error! Reference source not found.** present the proposed FECP implementation monitoring plan and budget respectively.

Table 9.18: FECP Implementation Monitoring Budget

Activity	NGN	USD
Earthworks for drainage, bunds, regrading	DBOC	
Gabions, ripraps, and erosion matting	DBOC	
Vegetation and afforestation	Embedded in BMP	
Sediment control and monitoring systems	DBOC	
Training and early warning system	DBOC	

PIU / ESIC	3,500,000.00	2258.065
Total	3,500,000.00	2258.065

Conclusion

The FECP for the proposed ATC in Okuku, reflects a holistic, evidence-based response to one of the region's most pressing environmental challenges. By integrating scientific data, geospatial analysis, engineering principles, and community inputs, the plan presents a practical and forward-looking framework for reducing the vulnerability of the project site and surrounding communities to flood and erosion-related hazards.

The proposed interventions, ranging from site-level engineering modifications such as topographic regrading and culvert optimization, to ecosystem-based approaches like riparian buffers, agroforestry integration, and vegetative stabilization demonstrate a commitment to climate-smart development. These measures are designed not only to protect the integrity of critical infrastructure but also to improve land productivity, protect water resources, and enhance ecological resilience. The institutional framework outlined in this plan emphasizes shared responsibility, stakeholder coordination, and regulatory oversight. Clearly defined roles for the implementing agency, contractors, environmental consultants, local authorities, and community members ensure that accountability is maintained across all stages of project execution. Furthermore, the monitoring and evaluation framework introduces performance-based indicators and early warning systems that enable adaptive management and timely interventions in response to evolving risks.

Ultimately, successful implementation of the FECP will contribute to the broader goals of climate adaptation, disaster risk reduction, sustainable rural development ensures operational sustainability, and demonstrate compliance with national and global environmental standards. Through strategic design, proactive implementation, and continuous monitoring, the ATC will become a model for climate-resilient agricultural infrastructure in Nigeria.

• CLIMATE CHANGE MANAGEMENT PLAN (CCMP)

Introduction

Climate change has emerged as one of the most pressing global challenges of the 21st century. It refers to significant and lasting changes in the Earth's climate system, including shifts in temperature, rainfall, and weather patterns. This is not just an environmental issue, it has far-reaching consequences for economies, ecosystems, and human well-being. Understanding the root causes of climate change and its wide-ranging impacts, especially on agriculture is essential to developing effective, sustainable solutions.

The community of Okuku, located in Yala Local Government Area of Cross River State, lies within a transitional ecological belt between the Guinea Savanna and the Tropical Rainforest Zone, both increasingly vulnerable to climate-related stressors. It is situated in the humid tropics of south-eastern Nigeria, where climate trends indicate rising mean annual temperatures and increased variability in both rainfall intensity and distribution, driven by global climate change. Relative humidity remains consistently high throughout the year, supporting agricultural productivity but also elevating the risk of moisture-related crop diseases. Seasonal wind patterns significantly influence local weather conditions: south-westerly monsoon winds dominate the wet season, while north-easterly Harmattan winds bring dry, dusty air between December and February. These shifts are governed by the seasonal movement of the Inter-Tropical Convergence Zone (ITCZ). Microclimatic variation is observed across the landscape, with forested areas remaining slightly cooler and low-lying regions prone to temporary flooding during periods of intense rainfall.

(For detailed baseline meteorological data, refer to the ESIA report on Air quality, Noise levels, and Field meteorology).

Topographically, Okuku is predominantly low-lying with gently undulating terrain, interspersed with minor hills and shallow depressions. These features, combined with clay-rich soils and inadequate natural drainage in some areas, contribute to the community's heightened vulnerability to surface runoff, soil erosion, and seasonal flooding. The region's soils are loamy in texture, are acidic and moderately fertile but prone to nutrient leaching and structural degradation, particularly under intensive agricultural use without sustainable land management practices.

is characterized by undulating terrain/gentle slope with its relief ranging between 74-80m above sea level. The environmental and climatic conditions in Okuku present both opportunities and

constraints for the establishment of the proposed ATC. This underscores the need for the deliberate integration of a Climate Change Management Plan (CCMP) across all stages of development, from planning and construction to operation and future scaling. A well-integrated CCMP will enhance local adaptive capacity, promote environmental stewardship, strengthen infrastructure resilience, and ensure the long-term viability of agriculture as a key driver of economic development in Okuku and the wider Yala LGA.

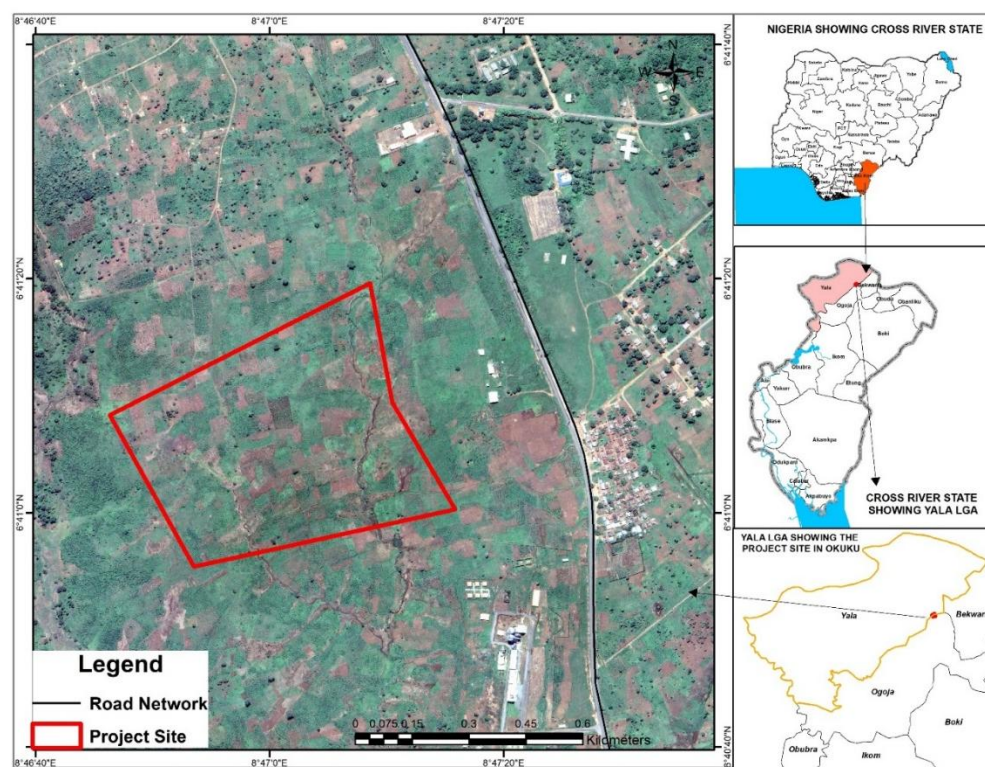


Figure CC 1: Location Map of the Cross-River State Agriculture Transformation Center in Okuku, Yala LGA.

Aim of the CCMP

To ensure that the ATC in Okuku becomes a climate-resilient development model driving agricultural innovation while promoting environmental sustainability, local climate action, and inclusive rural transformation.

Objectives of the CCMP

The CCMP for the ATC in Okuku seeks to:

- To mainstream climate risk analysis and adaptation planning across all stages of project design, development, construction, and operational management, ensuring climate-resilient outcomes.
- To identify, reduce, and monitor greenhouse gas (GHG) emissions associated with construction activities, agro-transformation operations, land-use changes, and energy consumption within the ATC framework.
- To build climate resilience into infrastructure, agricultural inputs, water systems, and supply chains, ensuring service continuity and productivity under a range of future climate scenarios.
- To align project implementation with Nigeria's national climate strategies, including the Nationally Determined Contributions (NDCs), the Climate Change Act (2021), and the Roadmap to Net-Zero (2050–2070), while contributing to broader international climate targets.
- To promote sustainable land management practices, reduce deforestation, and improve air quality through the adoption of low-emission technologies and regenerative environmental interventions.
- To establish robust monitoring and evaluation (M&E) systems for tracking climate risks, adaptation progress, mitigation outcomes, and policy effectiveness over time.
- To strengthen institutional and community capacity for climate action by facilitating stakeholder engagement, awareness campaigns, and technical training on climate-smart agriculture and ecosystem-based adaptation.

Climate Risk Assessment Summary

The ATC project area in Yala LGA is subject to climatic fluctuations typical of a transitional ecological zone, with increasing variability in rainfall and temperature extremes. These evolving conditions present ongoing risks to agriculture, infrastructure, and the long-term resilience of project interventions.

Baseline Condition for Okuku area include:

The following climatic indicators define the environmental baseline for the Okuku area and are critical for understanding potential climate-related impacts on the ATC project:

Climate: The region is influenced by a bimodal rainfall regime, with two distinct seasons. The wet season, extending from April through October, delivering most of the annual 1,800–2,500 mm rainfall, and a dry season from November to March bringing reduced precipitation. Peak rainfall generally occurs in the middle months of the wet season, which can affect site access, drainage, and structural maintenance planning.

Temperature: Average temperatures range from 25 °C to 32 °C, with the hottest period typically between February and April. Cooler conditions are observed during the height of the rainy season, while night-time temperatures remain mild throughout the year.

Humidity: Relative humidity in the Okuku area remains consistently high throughout the year, typically ranging between 70 and 90 percent.

Wind: Prevailing winds are generally light, with speeds from calm (0.00 m/s) to about 1.40 m/s under normal conditions. Stronger gusts occur infrequently, usually during isolated storms, and are not a dominant climatic feature.

Topography and Soils: Gently undulating terrain with elevations ranging from 74–80 meters above sea level; soils are predominantly classified as Ferric Acrisols.

Vegetation and Land Use: Land cover in the Okuku area reflects a transitional forest–savanna mosaic. While natural vegetation remains in some areas, much of the immediate surroundings have been cleared for mixed-use purposes including infrastructure, access roads, and community facilities.

Key Climate-Related Risks and Implications

Given the baseline climatic and environmental conditions of the Okuku area, several climate-related risks have been identified that may affect the planning, construction, and long-term operation of the ATC. The key risks are outlined below:

1. Rainfall Variability and Flood Risk:

The ATC site lies in a region with high annual rainfall (1,800–2,500 mm) and a bimodal wet season. Increasingly erratic and intense rainfall events could lead to:

Seasonal flooding, especially in low-lying or poorly drained areas.

Damage to critical infrastructure such as feeder roads, culverts, storage units, and processing facilities.

Increased surface runoff and soil erosion, particularly on Ferric Acrisol soils with moderate infiltration capacity.

Delays in land preparation, harvesting, and logistics during peak rainfall months.

2. Heat Stress and Elevated Temperatures

With ambient temperatures ranging from 25°C to 32°C and peak heat intensifying between February and April, the ATC structure may face several heat-related challenges:

Crop productivity risks, especially during sensitive growth stages such as flowering and grain filling, which are highly susceptible to thermal stress.

[FAO (2016), IPCC AR6 WGII (2022), NIMET Annual Climate Review]

Water demand is expected to rise, driven by increased evapotranspiration and soil moisture loss under higher temperatures.

Occupational heat risks for workers engaged in outdoor activities may rise, affecting safety and productivity, and elevated risk of heat-related illnesses.

[Source: WHO (2015). Climate Change and Human Health]

3. High Humidity and Disease Pressure:

Relative humidity levels between 70–90% promote favourable conditions for fungal and bacterial outbreaks. Prolonged wetness may lead to:

Contamination risks in processing facilities, as moisture-laden environments encourage mold growth on equipment, surfaces, and raw materials, affecting food safety.

Increased post-harvest spoilage of stored agricultural products, especially grains, tubers, and perishable produce, reducing overall product quality and market value.

Reduced shelf life of processed goods, making it difficult to meet quality standards for regional and export markets.

4. Greenhouse Gas (GHG) Emissions:

The use of diesel generators, agro-transformation equipment, and transport fleets will result in notable CO₂ and NO_x emissions, especially if run on fossil fuels. This can:

- Increase the industrial hub's carbon footprint, contributing to global greenhouse gas accumulation and climate change.

- Elevate operational costs over time due to inefficiencies in fuel combustion, maintenance of aging diesel machinery, and potential future penalties for high-emission practices.

- Reduce air quality, leading to elevated levels of particulate matter and toxic gases, posing health risks such as respiratory illness, fatigue, and decreased worker productivity.

5. Soil Degradation

The site's Ferric Acrisol soils are may degrade further under intensive land use and climate stress. Risks include:

- Erosion and topsoil loss, especially during intense rainfall.

- With increased erosion, the natural drainage of the land may be disrupted. Poor drainage can result in water pooling around buildings or infrastructure, increasing the risk of flooding during heavy rainfall.

- The degradation of the soil can affect any green spaces or landscaping within the transformation centre.

Climate Change Mitigation Measures

To reduce the climate impacts and enhance its long-term sustainability, a range of climate change mitigation measures should be implemented.

1. Energy Efficiency and Low-Carbon Technologies

CR SAPZ/DBOC shall implement the following measures to enhance energy efficiency and transition toward low-carbon operations:

- Deployment of Renewable Energy Systems:** Integrate solar photovoltaic (PV) and hybrid energy systems to power lighting, administrative facilities, and essential infrastructure, thereby reducing dependence on diesel generators and lowering greenhouse gas emissions.

- Off-Grid Energy Solutions for Climate Resilience:** Install decentralized solar systems to ensure uninterrupted power supply during climate-induced grid disruptions and minimize reliance on fossil fuel-based energy sources.

Sustainable Building Design: Construct energy-efficient buildings using high-albedo roofing materials, passive ventilation strategies, and thermal insulation to reduce cooling loads and improve indoor comfort under changing climate conditions.

Smart Energy Management: Implement motion sensors, LED lighting, and smart metering systems to optimize energy consumption, facilitate real-time monitoring, and encourage behavioural changes that support sustainable energy use.

2. Sustainable Transport and Logistics

CR SAPZ/DBOC shall implement the following sustainable mobility strategies:

Low-Emission Fleet Transition: Prioritize the use of low-emission vehicles and motorbikes for haulage, staff transport, and intra-facility movement to reduce carbon intensity.

Climate-Resilient Road Infrastructure: Design and construct internal and access roads using materials and engineering practices tailored for high rainfall, extreme heat, and seasonal variability to minimize infrastructure degradation and ensure all-season accessibility.

Adoption of Clean Mobility Solutions: Promote the use of electric or biofuel-compatible vehicles such as tricycles, forklifts, and mini-vans within the facility to reduce fossil fuel dependence and operational emissions.

Optimized Logistics and Fleet Management: Consolidate transport and delivery schedules to minimize vehicle trips, idle time, and fuel consumption resulting in lower greenhouse gas (GHG) emissions and cost savings.

3. Greenhouse Gas (GHG) Emissions Management

CR SAPZ/DBOC shall implement the following GHG emissions management strategies:

Establishment of Emissions Baseline: The ATC will define its emissions boundaries, collect data on Scope 1 (direct emissions), Scope 2 (indirect emissions from electricity consumption), and Scope 3 (supply chain emissions from upstream activities such as procurement and logistics), and apply the 2006 IPCC Guidelines along with national tools. A baseline year will be set for future performance comparisons.

Emission Intensity Reduction Targets: The ATC will pursue a 10–20% reduction in GHG emissions intensity within the first five years of operation. This will be accomplished through the implementation of energy efficiency upgrades, process optimization, and the use of sustainable construction and operational materials. Staff will be trained in climate-

smart practices, and a robust Monitoring, Reporting, and Verification system will be established to track progress and enable adaptive management.

Residual Emissions Offset Strategy: Unavoidable (residual) emissions will be addressed through nature-based solutions, including agroforestry initiatives and wetland restoration programs within the ATC site. These interventions will support both carbon sequestration and local ecosystem enhancement

Climate Change Adaptation Measures

To ensure long-term sustainability and climate readiness of the ATC, essential resilience strategies will be embedded in all planning, construction, and operational phases. These strategies are designed to protect the proposed infrastructure from climate-related risks. These measures include:

1. Infrastructure Resilience

CR SAPZ/DBOC shall implement the following measures:

Climate-Smart Building Design: All facilities within the ATC area will be constructed using climate-resilient design principles, including structural reinforcements and flood-resistant architectural features.

Elevation and Structural Reinforcement: In flood-prone zones, buildings will be constructed on elevated platforms with reinforced foundations to minimize flood-related damage and maintain operational continuity.

Erosion and Stormwater Management: The site will incorporate oversized drainage channels, culverts, and retention ponds to manage surface runoff during intense rainfall events and prevent waterlogging.

(Refer to figure FE 4, vector flow map showing the proposed retention pond in the Flood and Erosion Management plan).

Stormwater Harvesting: Buildings will be equipped with stormwater harvesting systems to capture and reuse rainwater, reducing pressure on local water resources and drainage systems.

Heat Resilience Measures: Infrastructure will integrate shade structures, weather-resistant materials, passive ventilation systems, and adaptive operational protocols to reduce exposure to extreme temperatures and enhance worker safety.

2. Ecosystem-Based Adaptation

CR SAPZ/DBOC shall integrate the following ecosystem-based initiatives:

Riparian Buffer Zones: Establish 10-meter vegetative buffer zones along waterways to reduce erosion, runoff, and sedimentation. These buffers will be reinforced with deep-rooted native vegetation to stabilize riverbanks and protect freshwater ecosystems. (See Figure 3.2.)

Reforestation of Degraded Areas: Identify and restore ecologically degraded zones within and surrounding the project area using native and climate-resilient species such as *Gmelina*, *Acacia*, *Albizia*, and *Mango*, enhancing microclimatic conditions, promoting carbon sequestration, and supporting habitat restoration.

Green Infrastructure in Buildings and Facilities: Building design and landscaping will incorporate green buffers, bioswales, pollinator gardens, and native plantings around administrative and production areas. These features will reduce stormwater runoff, improve air quality, and lower ambient temperatures through shade and evapotranspiration. Where possible, green roofs and living walls will be introduced to further enhance insulation, biodiversity, and carbon uptake.

Permeable Surfaces and Soil Health Preservation:

Deploy permeable pavements and ground covers to reduce surface runoff, recharge groundwater, and prevent hardscaping-related erosion. Soil compaction will be minimized in construction zones, and organic mulching will be used to maintain soil structure and moisture content.

CAPACITY BUILDING AND POLICY INTEGRATION

Governance Framework

The CR SAZP shall appoint a qualified Climate and Sustainability Officer to oversee the implementation, monitoring, and continuous enhancement of CCMP strategies.

The CCMP shall be fully integrated into the Environmental and Social Management System (ESMS) protocols and embedded within all relevant procurement policies to ensure compliance across the entire project value chain.

Training and Awareness

Bi-annual capacity-building workshops will be conducted for key stakeholders, including project staff, local government officials, and farmer groups (Suppliers and out growers)

focusing on climate risk awareness, adaptation strategies, and Green House Gas (GHG) literacy.

Customized educational toolkits will be developed and disseminated, incorporating infographics, real-time climate alerts, and behavioral guidance materials. These resources will be provided in both English and relevant local dialects to ensure inclusive and culturally appropriate communication

Monitoring and Evaluation

To ensure accountability and track the success of the CCMP, a structured M&E framework will be implemented. This will monitor progress, measure outcomes, and guide adaptive management for the ATC. **Error! Reference source not found.** shows the KPIs.

Table 9.19: Key Performance Indicators (KPIs)

KPI Description	Target	Monitoring Frequency	Responsible Entity
Reduction in greenhouse gas (GHG) emissions (Scope 1,2 & 3)	At least 10% reduction	Annual	HSE
Deployment of renewable energy systems	Minimum of 2 systems	Annual	DBOC
Number of trees to be preserve and planted.	62 stands of trees preserved, 868 riparian buffers at 10-meter intervals	Biannually	HSE
Climate resilience workshops conducted for farmers and staff	Minimum of 2 workshops/year	Annual	HSE
Assessment of critical infrastructure for climate risks	100% of infrastructure assessed	Annual	HSE
External audits of MRE activities	1 audit every 2 years	Every 2 Years	External Audit Consultant

Tools and Mechanisms

GHG Inventory Tool: Adopt standardized African Development Bank (AfDB) and Inter-governmental Panel on Climate Change (IPCC) spreadsheet calculators' tools to track emissions from energy use, waste, and transport

Climate Risk Index: Create a geo-coded local index to assess exposure, sensitivity, and adaptive capacity at the community level, using variables such as elevation, rainfall variability, and land use. and track vulnerability.

Early Warning Systems: Collaborate with the Nigeria Meteorological Agency (NiMet) and National Emergency Management Agency (NEMA) to disseminate location-specific alerts for extreme weather events such as floods, droughts, and other related climate issues.

Annual Climate Scorecard: Publish a performance dashboard showing progress across key indicators, shared with local communities and development partners to promote transparency.

Budget Estimate

Error! Reference source not found. presents the indicative costs for implementing key elements of the CCMP. These values will be validated through detailed cost assessments during project execution.

Table 9.20: CCMP Implementation Monitoring Budget

Component	NGN	USD
Solar systems and smart meters	DBOC	-
Green infrastructure & afforestation	Embedded in BMP	-
GHG inventory and reporting tools	DBOC	
Climate training and toolkits	DBOC	
Water harvesting and CSA systems	DBOC	
Monitoring and audit	DBOC	
PIU / ESIC	3,500,000.00	2258.065
Total Estimate	3,500,000.00	2258.065

Conclusion

The CCMP for the ATC in Okuku offers a strategic, integrated approach to addressing the complex climate challenges facing the region. Grounded in robust environmental data and aligned with national and global climate priorities, the plan outlines a comprehensive framework for mitigation, adaptation, capacity-building, and performance monitoring.

Through targeted actions including the deployment of renewable energy, adoption of climate-smart agriculture, infrastructure resilience measures, and rigorous monitoring protocols, the CCMP is designed to safeguard livelihoods, enhance environmental sustainability, and future-proof the ATC against climate-related disruptions. The inclusion of stakeholder engagement, community training, and policy alignment ensures that the plan is not only technically sound but also socially inclusive and contextually relevant.

By systematically implementing this plan, the proposed ATC in Okuku, can become a model of climate-resilient rural development, advancing Nigeria's net-zero ambitions while improving the adaptive capacity of one of its most climate-sensitive regions.

• CULTURAL HERITAGE MANAGEMENT PLAN (CHMP)

The Agricultural Transformation Centre (ATC) at Okuku, Yala Local Government Area in Cross Rivers State, under the Cross River Special Agricultural Processing Zones (CR-SAPZ) program designed for processing, storing, and packaging agricultural products, linking smallholder farmers to larger markets. However, large-scale land-based projects like this carry the risk of adverse impacts on tangible and intangible cultural heritage resources, which are essential to community identity, spiritual well-being, and social cohesion.

The CHMP provides a structured approach to:

- Identify, evaluate, and document cultural heritage within the Project Area of Influence (PAI).
- Mitigate potential impacts from land acquisition, site clearing, infrastructure construction, and project operations.
- Engage meaningfully with stakeholders, including custodians of cultural knowledge and spiritual leaders.
- Establish operational procedures, particularly for "chance finds" of archaeological, historical, or sacred significance.
- Integrate respect for cultural heritage into project design, workforce conduct, and community relations.

The CHMP complements the ESIA findings and ensures compliance with AfDB Operational Safeguard 8 (Cultural Heritage), Nigerian legal requirements, and global best practices.

OBJECTIVES OF THE CHMP

This CHMP seeks to:

1. **Preserve Tangible Heritage:** Prevent damage, destruction, or loss of physical cultural resources such as shrines, burial sites, sacred groves, artifacts, and monuments within the project area.
2. **Respect Intangible Heritage:** Protect spiritual practices, oral traditions, festivals, traditional knowledge systems, and community rituals integral to local identity.
3. **Promote Informed Consent:** Ensure free, prior, and informed consultations with affected communities regarding cultural heritage risks and mitigation options.

4. **Establish Robust Procedures:** Implement field-ready Chance Finds Protocols to safeguard cultural resources discovered unexpectedly during project activities.
5. **Foster Sustainable Coexistence:** Encourage community participation in heritage management while enabling the project to proceed responsibly.
6. **Comply with Regulatory Standards:** Fulfil obligations under Nigerian law, AfDB safeguards, and international conventions on cultural heritage protection.

LEGAL AND POLICY FRAMEWORK

The CHMP is developed in accordance with:

Nigerian Legal Provisions

National Commission for Museums and Monuments (NCMM) Act, CAP N19 LFN 2004:

Establishes legal protection for antiquities, historical sites, and cultural property. Mandates NCMM oversight for significant cultural resources.

Nigerian Constitution (1999, as amended): Guarantees the protection of cultural rights, including the right to enjoy, develop, and preserve cultural heritage.

Land Use Act (CAP L5, LFN 2004): Regulates land acquisition, acknowledging customary ownership and traditional land uses, which may be linked to cultural heritage.

State and Local Government Regulations: Cross River State and Yala LGA traditional leadership structures play a central role in identifying, protecting, and managing community heritage.

International Standards

AfDB Operational Safeguard 8 (OS8-Cultural Heritage): Requires clients to avoid or minimize impacts on cultural heritage and engage with communities, ensuring respect for spiritual, cultural, and historical values.

UNESCO Convention for the Protection of the World Cultural and Natural Heritage (1972): Promotes safeguarding globally and nationally significant cultural resources.

ILO Convention 169 (Indigenous and Tribal Peoples, where applicable): Provides for cultural rights and protection of indigenous heritage, though Nigeria has not ratified this, its principles guide best practice.

United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP):

Recognizes rights to cultural identity, heritage preservation, and participation in heritage-related decisions.

CULTURAL HERITAGE CONTEXT OF THE PROJECT AREA

Cross River State is renowned for its rich, diverse cultural heritage, including:

Tangible Heritage:

Sacred forests and groves associated with deities or ancestral spirits.

Shrines, altars, and religious structures.

Burial sites and ancestral graveyards.

Historic landmarks, artefacts, and objects of archaeological value.

Intangible Heritage:

Traditional festivals (eg. Yam Festival held every 31st day of August every year), rites of passage, and spiritual ceremonies.

Oral histories and folklore passed through generations.

Indigenous knowledge systems related to agriculture, ecology, and health.

Traditional authority structures, such as councils of elders and cultural custodians.

Preliminary consultations with community leaders and the ESIA scoping process indicate:

Among several cultural groups in Okuku, Ogrinya dance group is restricted to members only who have been initiated into the group. None members are not permitted to come out when Ogrinya group comes out to display.

There are likely undocumented cultural resources within or near the project footprint.

Festivals and religious events can influence project schedules due to community participation.

CULTURAL HERITAGE MANAGEMENT MEASURES

Baseline Identification and Documentation

The assessment of the cultural heritage of the project area shows that:

The cultural heritage of the study communities is linked to language, dress and food, festivals and dances.

The communities have various similarities in the way they dress, foods they eat and ways they conduct their marriages.

Indigenous languages spoken in the communities are some of their cultural heritages.

Among all the communities, land is considered a major socio-cultural asset and a heritage that must be bequeathed to succeeding generations.

Avoidance, Protection, and Buffer Zones

Design project layout to avoid physical disturbance of identified cultural heritage resources.

Where avoidance is impossible, implement protective buffers (e.g., fencing, signage, no-go zones) as agreed with communities.

Respect traditional access routes and practices associated with sacred sites.

Seek NCMM and community approval for any necessary relocation or modification of cultural features (only as a last resort).

Chance Finds Procedure

If unexpected cultural heritage is discovered during excavation, earthworks, or other activities:

1. Immediate Action:

Suspend work in the discovery area.

Secure the site to prevent damage or unauthorized access.

2. Notification:

Inform CR-SAPZ management, cultural monitors, NCMM, and local authorities.

3. Assessment:

Qualified cultural heritage experts assess the find's significance.

4. Decision-Making:

Determine appropriate actions (preservation, relocation, further study) in consultation with stakeholders.

5. Documentation:

Record the find, including photographs, descriptions, GPS coordinates.

6. Work Resumption:

Resume activities only after formal clearance by authorities and cultural leaders.

Community Engagement and Participation

Establish continuous dialogue with host communities regarding cultural heritage management.

Form a Cultural Heritage Committee with representatives from:

Traditional authorities and custodians.

Youth, women, and vulnerable groups.

CR-SAPZ community liaison officers.

Consult on all heritage-related decisions, including avoidance measures, access restrictions, and potential relocation of cultural features.

Provide feedback on project activities and incorporate cultural knowledge into project operations where appropriate.

Intangible Heritage Promotion

Avoid scheduling construction or disruptive activities during key community festivals or spiritual events.

Encourage workers and contractors to respect local customs, attire, language, and spiritual practices.

Explore opportunities to support cultural revitalization, such as documenting oral traditions or sponsoring community heritage initiatives.

ROLES AND RESPONSIBILITIES

Stakeholder	Responsibilities
CR-SAPZ Management	Overall CHMP oversight, resource allocation, regulatory compliance
Contractors/Subcontractors	Implement Chance Finds Protocols, comply with cultural protection measures
Community Relations Team	Facilitate consultations, maintain cultural respect among workforce
NCMM and State Heritage Agencies	Provide technical guidance, legal oversight, and approvals
Community Cultural Leaders	Identify cultural resources, guide protection measures, and mediate decisions

MONITORING, EVALUATION, AND REPORTING

Monitoring Activities

Routine inspections of known heritage sites to ensure protection measures remain effective.

Regular workforce briefings on cultural sensitivity and respect protocols.

Inclusion of cultural heritage indicators in broader environmental and social monitoring frameworks.

Evaluation

Mid-project and end-of-phase audits to assess:

Effectiveness of avoidance and protection measures.

Implementation of Chance Finds Procedures.

Community satisfaction with heritage management efforts.

Reporting

Monthly internal reports detailing:

Heritage incidents or grievances.

Community consultations conducted.

Heritage-related training sessions.

Formal notifications to NCMM and stakeholders in case of significant discoveries or incidents.

GRIEVANCE REDRESS FOR CULTURAL HERITAGE ISSUES

Dedicated grievance channels for cultural heritage concerns, accessible to all community members.

Confidential reporting options to encourage open feedback.

Grievance resolution process:

Acknowledgement of receipt within 3 days.

Investigation and community dialogue within 14 days.

Resolution communicated promptly to complainants.

Escalation mechanisms for unresolved grievances, involving traditional leaders, CR-SAPZ management, and authorities.

CAPACITY BUILDING AND TRAINING

Mandatory cultural sensitivity training for all project staff and contractors.

Specialized sessions for field workers on recognizing cultural resources and respecting community customs.

Inclusion of community representatives in training where relevant.

Continuous learning approach, with refresher courses and updated protocols based on evolving project context.

BUDGET ESTIMATION

The budget below outlines the financial requirements for identifying, preserving, engaging, documenting, and monitoring cultural heritage resources throughout the project lifecycle.

Item	Activities/Description	NGN	USD
Cultural Heritage Baseline Survey	Engagement of archaeologists, anthropologists, local historians, GIS mapping	DBOC	
Community Consultation & Engagement	Traditional leaders' dialogues, town halls, ritual consultations, meeting logistics	DBOC	
Documentation of Cultural Resources	Recording oral histories, festivals, sacred sites, artefacts (video, photos, reports)	DBOC	
Physical Protection of Sites	Fencing, signage, restricted access zones, relocation planning (if needed)	DBOC	
Training and Capacity Building	Local sensitization on cultural heritage importance, staff orientation	DBOC	
Contingency for Chance Finds	Emergency excavation/study in case of unplanned discoveries during earthworks	DBOC	
Monitoring and Reporting	Periodic monitoring, third-party review, reporting tools, community observer stipend	DBOC	
PIU / ESIC		3,500,000.00	2258.065
Cultural Celebration/CSR Activities	Support for traditional festivals, cultural centres, preservation projects	DBOC	
TOTAL		5,000,000.00	3225.806

CONCLUSION

The ATC project acknowledges the fundamental importance of preserving cultural heritage for the well-being of host communities. Through this CHMP, the project commits to:

Safeguarding both tangible and intangible cultural resources.

Promoting respectful engagement with cultural leaders and custodians.

Aligning with legal requirements, AfDB OS8, and global best practice.

Fostering sustainable coexistence between development objectives and cultural heritage preservation.

• LIVELIHOOD RESTORATION AND ENHANCEMENT PLAN (LREP)

The Agricultural Transformation Centre (ATC) project at Okuku, Yala LGA is designed to drive agricultural processing, job creation, and rural economic development under the Special Agro-Industrial Processing Zone (SAPZ) programme. The ATC is expected to generate long-term benefits; however, land acquisition and construction may temporarily or permanently affect the livelihoods of individuals and households in the project area. This Livelihood Restoration and Enhancement Plan (LR&EP) is designed to ensure that project-affected persons (PAPs), particularly those whose livelihoods are adversely impacted by land acquisition and other project activities associated with the development of the ATC, are supported to restore or improve their livelihoods and standards of living.

Objectives of the LREP

This LREP is prepared to meet the following objectives:

- To restore affected livelihoods to pre-project levels or better.
- To enhance income-generation opportunities for host communities.
- To provide targeted support to vulnerable groups.
- To improve the resilience and adaptive capacity of affected households.
- To ensure sustainable livelihood development aligned with the SAPZ's agro-industrial focus.
- To facilitate inclusive economic participation and social cohesion
- To align with lender standards (AfDB ISS) and Nigerian legal framework.
- To integrate sustainable development goals (SDGs 1, 2, 5, and 8).

Project Context and Scope of Impact

Project Location: Okuku, Yala LGA, Cross River State

Land Requirement: Approximately 37.8 ha for ATC infrastructure

Potential Impacts: Displacement of farmlands, economic trees, informal businesses, livestock rearing zones, and temporary employment loss

Primary Livelihoods Affected: Subsistence farming, livestock husbandry, trading, and informal artisanal activities

Legal and Policy Framework

The LR&EP is developed in compliance with:

Nigerian Land Use Act (1978)

AfDB OS5 – Involuntary Resettlement

SAPZ Programme Implementation Manual

Socioeconomic Baseline

Affected Communities:

Ipuole, Okuku

Other contiguous villages

Livelihood Sources:

Rain-fed farming on cassava, yam, maize, vegetables, plantain, bananas, oil palm etc.

Majority of the PAPs are subsistence or small-scale farmers

Some engage in artisanal processing.

Livestock husbandry and aquaculture

Sand mining and sales

Small-scale palm oil processing

Petty trading and local crafts

Artisanal works

Civil/public service employment

High dependence on natural resources, low access to credit, and limited mechanization

Vulnerable Groups:

Female-headed households

Unemployed Youths and elderly without income

Households with no land titles

People living with disabilities

Livelihood Impacts from The ATC Project

Impact Type	Description
Land Take	Loss of farmland and economic crops
Restriction of Access	Disruption to forest resources, and cultural sites
Employment Disruption	Interruption of trading and informal sector employment
Disruption of livestock husbandry activities	Encroachment on livestock husbandry zones near project area
Loss of income	From farming, and micro-enterprises
Loss of access	To forest resources and seasonal harvest areas
Temporary job displacement	During land preparation and civil works

Livelihood Assessment Matrix

Livelihood Type	No. of Affected HHs	Key Vulnerabilities	Restoration Measures	Enhancement Measures
Rainfed Farming	200	Loss of land and produce	Land-for-land, inputs, extension services	Outgrower schemes, Agro-industrial processing clusters
Petty Trading	30	Income shock, market loss	Business kits, financial literacy	Linkages to ATC canteens, retail supply chains
Artisanship	16	Loss of customer base	Toolkits, marketing skills	In-hub service contracts (carpentry, welding, repairs)
Youth (unemployed)	40	Lack of skills, job access	Apprenticeship, vocational training	Digital marketing, e-commerce for agro-products
Women (cross-cutting)	80	Financial exclusion, labor load	Formation of women's groups, access to credit	Gender-responsive agribusiness training

Livelihood Restoration Strategies

Land-Based Livelihood Restoration

- Provision of alternative farmland (where feasible)
- Provision of access to irrigation schemes.
- Soil improvement assistance (organic composting, fertilizers).
- Capacity in climate-smart agriculture and regenerative practices
- Establishment of demonstration farms and cooperative farming models.
- Formation of farmer cooperatives
- Development and integration of farmers into out-grower schemes to provide raw materials to the ATC

Fisheries and Aquaculture Livelihood Support

- Provision of fishponds and fingerlings.
- Training on aquaculture (e.g., catfish farming) fish feed formulation and disease management.
- Training in aquaculture (e.g., catfish farming) aligned with the hub's agro-industrial value chains
- Provision of cold storage and market access support.

Agricultural Input Support

- Subsidized seed distribution (maize, cassava, cocoa, yam, rice, etc.).
- Provision of tools and farming equipment.
- Linkages with agro-dealers and extension officers.

Skills Development and Vocational Training

- Training in agri-business, poultry, piggery, aquaculture, and food processing etc.
- Short-term vocational training in tailoring, welding, carpentry, mechanics, and solar installation.
- Entrepreneurship development for youth and women.

Apprenticeship placement and certification

Employment facilitation in ATC construction and operations

Financial Support and Microcredit

Start-up capital support or revolving loan schemes.

Partnerships with microfinance institutions (MFIs) and cooperatives.

Access to financial literacy programs.

Support for Small and Medium Enterprises (SMEs)

Business advisory services for traders and service providers.

Inclusion in ATC value chain contracts (transport, supply, catering).

Micro-grants and business start-up kits

Training in business management, value addition, and financial literacy

Linkages to ATC markets and supply chains

Gender and Youth Mainstreaming

Targeted training for women on agribusiness and cooperative formation.

Provision of childcare support during capacity building sessions.

Youth incubation programs linked to the ATC.

Employment Opportunities

Prioritization of PAPs in ATC job recruitment

Labour-intensive public works (roadside planting, community sanitation) for transitional support

Special Measures for Vulnerable Groups

Targeted support for women, female-headed households, youth, and persons with disabilities

Tailored livelihood packages (e.g., home-based processing, tailoring, etc.)

Formation of women's cooperatives and youth agribusiness groups

Vulnerable Groups Support Strategy

Tailored Support: Home-based enterprises, flexible training schedules

Dedicated Quotas: In all training and financial programs

Support Services: Childcare provisions, psychosocial counselling

Monitoring: Gender- and vulnerability-sensitive M&E framework

Livelihood Enhancement Initiatives

Community resource centres for information, training, and ICT use.

Agro-industrial processing cooperatives and women-led market linkages.

Out grower schemes and guaranteed off-take arrangements.

Renewable energy support (solar dryers, solar water pumps).

Public-private partnerships for agricultural mechanization.

Table 9.21: Implementation Framework

Stakeholder	Role
Cross River State Government	Policy oversight, land administration, budget support
ATC Project Implementers	Execution, monitoring, and reporting
Community-Based Organizations	Mobilization, grievance redress, feedback loops
NGOs and CSOs	Technical support, capacity building, independent monitoring
Yala LGA	Coordination, local logistics, youth and women engagement

Table 9.22: Monitoring and Evaluation Framework

Indicator	Target	Frequency
% of households with restored farmland	100% of displaced farming households	Quarterly
Number of individuals trained	500+ in Year 1	Biannual
Number of new micro-enterprises supported	At least 200 within first 2 years	Annual
% of income restored (compared to baseline)	100% within 18 months	Biannual
Number of women/youths trained	Minimum 40% of total beneficiaries	Quarterly

Table 9.23: Risks and Mitigation Measures

Risk	Mitigation Measure	Risk Rating
Inadequate funding or delays	Secure lender funds and include LREP in main project budget	High
Lack of community participation	Continuous sensitization and local partnership	Medium
Elite capture of benefits	Transparent selection criteria, independent monitoring	High
Gender-based exclusion	Gender-specific programming and quotas	Medium
Sustainability of enterprises	Mentorship, market linkages, business training	Medium

Grievance Redress Mechanism (GRM)

Multi-tier GRM at village, LGA, and project levels.

Complaints register at community centres and local government offices.

Independent oversight by civil society organizations.

Toll-free line and grievance response team.

LRP Implementation Budget

The estimated budget for the implementation of the LRP is NGN 70 m (USD 45.161, @ NGN1550:1USD). The details and breakdown are in the LRP prepared as a stand-alone for implementation.