

ENVIRONMENTAL AUDIT REPORT

FOR

VINEE GAS LIMITED

(LPG STORAGE AND DISTRIBUTION PLANT)
No. 5 Vinee Oil Crescent, Behind Army Barracks,
Along Enugu-Onitsha Road, Anambra State, Nigeria



PREPARED BY

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SUBMITTED TO

The Anambra State Ministry of Environment

August 2025

APPROVAL PAGE

This Environmental Audit Report has been prepared in accordance with the National Guidelines for Environmental Audit in Nigeria (2024 Revision) published by NESREA, the Anambra State Environmental Management, Protection and Administration Law, 2024, and other relevant statutory requirements.

The audit was conducted by Unic Concepts Ltd, duly accredited and registered with the Anambra State Ministry of Environment, in collaboration with the facility management and relevant stakeholders.

This Environmental Audit Report assesses the environmental performance of the facility, regulatory compliance status, identifies gaps and risks, and provides comprehensive recommendations and action plans for implementation to achieve full compliance and best practice standards.

We hereby affirm that this report meets the required standards for Environmental Audit studies in Nigeria and is submitted to the Anambra State Ministry of Environment for review, consideration, and approval.

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Signature & Date: _____

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We, the undersigned members of the audit team, certify that we have conducted this environmental audit in accordance with professional standards, regulatory requirements, and ethical guidelines. We affirm that the findings, conclusions, and recommendations contained in this report are accurate, complete, and based on objective evidence.

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DISCLAIMER

This Environmental Audit Report has been prepared in accordance with the National Guidelines for Environmental Audit in Nigeria (2024 Revision) published by NESREA and the Anambra State Environmental Management, Protection and Administration Law, 2024. The findings and recommendations contained herein are based on site observations, document reviews, photographic evidence, and stakeholder interviews conducted during the audit period.

The accuracy of operational data and information provided by facility management has been cross-verified where possible. Site conditions were assessed during daylight hours under normal weather conditions. This report represents the environmental and safety status of the facility as observed during the audit period.

The auditors acknowledge that environmental conditions and regulatory requirements may change over time, and this report should be updated accordingly. All recommendations are based on current NESREA guidelines, NUPRC requirements, the Anambra State Environmental Management, Protection and Administration Law, 2024, and international best practices for LPG storage and distribution facilities.

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LIST OF ABBREVIATIONS

Abbreviation	Full Meaning
ANSEPA	Anambra State Environmental Protection Agency
ANSEWCCA	Anambra State Erosion, Watershed and Climate Change Agency
API	American Petroleum Institute
BLEVE	Boiling Liquid Expanding Vapor Explosion
BOD	Biological Oxygen Demand
CAC	Corporate Affairs Commission
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COREN	Council for the Regulation of Engineering in Nigeria
dB	Decibel
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
ERP	Emergency Response Plan
ESD	Emergency Shutdown
ESHSMP	Environmental, Social, Health and Safety Management Plan
FEPA	Federal Environmental Protection Agency
FME_{Env}	Federal Ministry of Environment
GPS	Global Positioning System
H₂S	Hydrogen Sulfide
HAZOP	Hazard and Operability Study
HSE	Health, Safety and Environment
ISO	International Organization for Standardization
LGA	Local Government Area
LPG	Liquefied Petroleum Gas
LPGSAN	Liquefied Petroleum Gas Safety Association of Nigeria
mg/kg	Milligram per Kilogram
NESREA	National Environmental Standards and Regulations Enforcement Agency
NFPA	National Fire Protection Association

NO₂	Nitrogen Dioxide
NUPRC	Nigerian Upstream Petroleum Regulatory Commission
OHS	Occupational Health and Safety
PM	Particulate Matter
PPE	Personal Protective Equipment
PPM	Parts Per Million
PRV	Pressure Relief Valve
SO₂	Sulphur Dioxide
SOP	Standard Operating Procedure
sqm	Square Metre
TDS	Total Dissolved Solids
ToR	Terms of Reference
VOC	Volatile Organic Compound
WLPGA	World LPG Association

ACKNOWLEDGEMENT

We acknowledge the cooperation and support received from the management and staff of Vinee Gas Limited during the conduct of this comprehensive environmental audit. Special appreciation goes to the facility management for providing unrestricted access to all operational areas, technical documentation, and personnel for detailed interviews.

We recognize the facility's commitment to environmental compliance as evidenced by their willingness to undergo this audit process and their openness to implementing recommended improvements. The management's transparency in providing operational data and historical information significantly enhanced the quality of this assessment.

We also acknowledge the National Environmental Standards and Regulations Enforcement Agency (NESREA) for providing the regulatory framework and guidelines that guided this audit process, and the Anambra State Ministry of Environment for their oversight of environmental matters in the State, consistent with the Anambra State Environmental Management, Protection and Administration Law, 2024.

EXECUTIVE SUMMARY

Background and Facility Overview

Vinee Gas Limited operates a Liquefied Petroleum Gas (LPG) storage and distribution plant situated at No. 5 Vinee Oil Crescent, Behind Army Barracks, Along Enugu-Onitsha Road, Anambra State, Nigeria. The facility is engaged in the receipt, storage, bottling, and distribution of LPG for domestic and commercial users across the region. The plant features pressurized gas storage tanks, cylinder filling sheds, loading and offloading bays, an administrative block, and auxiliary support structures.

The facility is located at the outskirts of the urban settlement, within a sparsely populated buffer zone that provides appropriate separation from sensitive receptors. The site is accessible via a major road corridor and is surrounded by a mix of light commercial activities and residential developments at a reasonable buffer distance.

Methodology and Scope

This comprehensive environmental audit was conducted in accordance with NESREA National Guidelines for Environmental Audit in Nigeria (2024 Revision) and the Anambra State Environmental Management, Protection and Administration Law, 2024, particularly Part 8 thereof, covering all aspects of the facility's environmental performance, safety systems, regulatory compliance, and operational practices. The audit methodology included pre-audit documentation review, on-site inspection with photographic documentation, staff interviews, and post-audit analysis and report development.

Key Findings Summary

Positive Findings

1. All major operational permits and environmental documentation reviewed during the audit are current and in order, demonstrating the proponent's commitment to regulatory compliance.
2. The facility maintains basic safety infrastructure including fire extinguishers, emergency shutdown valves, pressure relief valves, safety signage, and secured perimeter fencing.

3. Air quality measurements at the factory premises and at a 50-metre buffer distance are within NESREA permissible limits for all monitored parameters (NO₂, SO₂, NH₃, and CO).
4. Noise levels at key monitoring locations; entrance, loading bay, and main road are within the NESREA limit of 85 dB(A), confirming satisfactory acoustic conditions.
5. Soil analysis results confirm that the land at the study area is generally within acceptable NESREA limits for the measured parameters, with no evidence of heavy metal or petroleum hydrocarbon contamination at hazardous levels.
6. The facility's location in a sparsely populated outskirts zone provides a natural buffer, reducing community exposure to operational hazards.

Areas of Concern

7. The facility does not have a formally documented Emergency Response Plan (ERP), representing a significant gap against NESREA and NUPRC requirements.
8. A systematic environmental monitoring programme for ongoing air quality, soil, groundwater, and noise has not been established, limiting the ability to track compliance over time.
9. Waste management procedures are informal as no documented waste management plan or contract with licensed waste disposal operators has been formalised.
10. Staff training coverage, while present at operational level, requires formalisation with documented certification records as required under relevant occupational health and safety standards.
11. Vegetation management in proximity to LPG storage tanks requires closer attention, particularly in the dry season, to eliminate potential fire ignition pathways from dry organic matter.

Environmental Performance Assessment

The facility demonstrates a satisfactory baseline level of environmental performance with generally manageable environmental impacts. Air quality and noise monitoring results confirm that emissions and noise from the facility do not exceed applicable regulatory limits. Soil quality analysis further confirms the absence of significant contamination within the study

area. However, the absence of formal environmental management documentation, an emergency response plan, and a systematic monitoring programme are identified as priority areas requiring immediate attention.

Table I: Compliance Status Summary

Compliance Area	Current Status	Compliance %	Priority Actions
Overall Assessment	Partially Compliant	80%	Immediate corrective actions required
NUPRC Technical Standards	Partially Compliant	85%	Vegetation management; ERP development
NESREA Environmental Standards	Partially Compliant	82%	Monitoring programme; waste procedures
Anambra State Environmental Law 2024	Partially Compliant	80%	Registration; quarterly monitoring
Fire Safety Regulations	Compliant with Gap	88%	Documented ERP; vegetation clearance
Building and Planning Standards	Fully Compliant	100%	Maintain current status
Occupational Health and Safety	Partially Compliant	75%	Complete staff training certification

Table II: Material Balance and Operational Efficiency

Parameter	Estimated Value	Industry Benchmark	Status
Product Recovery Rate	>99%	>99%	Acceptable
Fugitive Emissions	<1% of throughput	<1%	Acceptable
Waste Generation	<0.1% of operations	<0.2%	Acceptable
Water Usage Efficiency	Minimal (domestic only)	N/A	Efficient

Table III: Risk Assessment Summary

Scenario	Probability	Consequence	Current Risk Level	Post-Mitigation Risk
Dry vegetation → tank fire (dry season)	Medium	Catastrophic	UNACCEPTABLE	LOW
Equipment failure → gas release	Low-Medium	Medium-High	MEDIUM	LOW
Vehicle impact on facility	Low	Medium	LOW-MEDIUM	VERY LOW

Minor LPG operational leak	Medium	Low	LOW	VERY LOW
LPG release during delivery	Low	Medium	LOW-MEDIUM	VERY LOW

Critical Recommendations

1. Immediate Priority (0–30 Days)

- i. Develop and implement a comprehensive, documented Emergency Response Plan (ERP)
- ii. Clear and maintain all dry vegetation and organic debris from within 5 metres of any LPG storage tank
- iii. Formalise waste management procedures and engage a licensed waste disposal contractor
- iv. Register in the Anambra State Ministry of Environment Public Registry (Section 231, Anambra State Environmental Law 2024)

2. High Priority (30–90 Days)

- i. Establish a systematic environmental monitoring programme covering air quality, noise, soil, and water
- ii. Complete and document staff safety and environmental training with proper certification records
- iii. Enhance fire suppression capacity, including additional fire extinguisher coverage near storage areas

3. Medium Priority (90–180 Days)

- Develop a formal Environmental Management Plan (EMP) and operational documentation system
- Establish a community engagement and emergency preparedness programme for neighbouring properties
- Pursue Environmental Management System (EMS) certification pathways (ISO 14001)

CHAPTER 1: INTRODUCTION

1.1 Purpose of the Environmental Audit

This environmental audit has been conducted in strict accordance with Section 1.1 of the National Guidelines for Environmental Audit in Nigeria to provide a comprehensive assessment of Vinee Gas Limited's environmental performance and regulatory compliance status. The audit serves as both a compliance verification tool and a strategic planning document to guide the facility's environmental management improvements.

Environmental auditing, as defined by NESREA, comprises a systematic, documented, periodic, and objective evaluation of how well organisations, management, and equipment are performing with the aim of safeguarding the environment and human health. This audit further fulfils the requirement under Section 225(f)(iii) of the Anambra State Environmental Management, Protection and Administration Law, 2024, which mandates the review of Environmental Audit reports for projects that have been in operation for up to three years or more.

The audit facilitates management control of environmental practices and assesses compliance with organisational policies and applicable regulatory requirements including, specifically, the Anambra State Environmental Management, Protection and Administration Law, 2024 which governs environmental management, protection, and administration in Anambra State and the National Environmental Standards and Regulations Enforcement Agency (Establishment) Act, 2007.

1.2 Terms of Reference and Scope Definition

1.2.1 Audit Purpose and Objective

Purpose: This Environmental Audit is conducted to provide a comprehensive, independent assessment of Vinee Gas Limited's environmental performance, regulatory compliance status, and operational safety in accordance with NESREA's National Guidelines for Environmental Audit in Nigeria (2024 Revision) and the Anambra State Environmental Management, Protection and Administration Law, 2024.

1.2.2 Primary Objectives

1. Evaluate compliance with federal (NESREA/NUPRC), state (Anambra State Environmental Law 2024), and international environmental and safety standards applicable to LPG storage and distribution operations
2. Identify environmental risks, hazards, and liabilities associated with LPG storage, bottling, and retail distribution operations at the facility
3. Assess effectiveness of existing environmental management systems, safety protocols, and emergency preparedness measures
4. Generate baseline environmental data to support ongoing compliance monitoring and performance improvement in line with Section 225(r) of the Anambra State Environmental Law 2024, which requires quarterly environmental monitoring of projects on the Mandatory List
5. Provide prioritised recommendations with an implementation roadmap for achieving full regulatory compliance and best practice standards

1.2.3 Secondary Objectives

- i. Optimise resource utilisation and operational efficiency at the plant
- ii. Strengthen the facility's environmental self-regulation capacity in line with Section 226 of the Anambra State Environmental Law 2024
- iii. Minimise human exposure to health, safety, and environmental hazards emanating from LPG operations
- iv. Enhance community protection and emergency preparedness in accordance with Section 237 of the Anambra State Environmental Law 2024

1.3 Terms of Reference and Scope Definition Table

Table 1.1: Terms of Reference

Section	Terms of Reference (ToR)
Organisational Boundaries	LPG storage and handling operations; cylinder filling and bottling activities; loading and offloading bay operations; administrative and accounts functions; security and utility operations; waste management activities; emergency response capabilities
Geographical Boundaries	Primary Study Area: Facility property boundaries and immediate operational area. Secondary Study Area: 500-metre radius around the facility. Regional Context: Anambra State LGA regulatory and environmental framework

Locational Boundaries	Total facility site area; gas storage tank zone; cylinder filling shed; loading/offloading bay; administrative block; security post; circulation and buffer areas
Extended Coverage	Off-site waste disposal activities and routes; emergency evacuation routes and assembly points; potential impact zones for emergency scenarios; community interface areas and access roads
Functional Areas Assessment	Environmental Management; Occupational Safety Systems; Occupational Health Programmes; Emergency Preparedness and Response
Compliance Boundaries & Standards	Federal: NESREA Act (2007/2018), EIA Act Cap. E12 LFN 2004, National Environmental Protection Regulations S.I.9/1991. State: Anambra State Environmental Management, Protection and Administration Law, 2024 (especially Parts 8, 9, and 10). NUPRC: LPG Plant Guidelines, technical and safety standards. International: ISO 14001 EMS, World Bank ESF, International Fire Code
Approach & Methodology	Pre-Audit Phase: Planning & preparation, objectives & scope definition, team selection, background information collection. On-Site Phase: Opening meeting, site inspection, photographic documentation, staff interviews, documentation review. Post-Audit Phase: Data analysis, findings evaluation, prioritisation, and report development

1.3.1 Organisational Boundaries

The audit covers all operations of Vinee Gas Limited at the Enugu-Onitsha Road facility, including the following:

- LPG storage and handling operations
- Cylinder filling (bottling) and retail distribution activities
- Loading and offloading bay operations
- Maintenance and administrative functions
- Security and utility operations
- Waste management activities
- Emergency response capabilities

1.3.2 Geographical Boundaries

Primary Study Area: The facility property boundaries and immediate operational area encompassing all structures, storage tanks, filling areas, and ancillary infrastructure.

Secondary Study Area: A 500-metre radius around the facility boundary, used to assess potential community and environmental impacts from LPG storage and distribution operations.

Regional Context: The environmental management and regulatory framework under the Anambra State Environmental Management, Protection and Administration Law, 2024 and relevant NESREA regulations governs all assessments within this boundary.

1.3.3 Locational Boundaries

Table 1.2: Locational Boundaries

Site Component	Description / Estimated Area
Total Site Area	Full facility footprint
Gas Storage Tank Zone	Pressurised LPG storage area
Cylinder Filling Shed	LPG bottling and cylinder filling area
Loading and Offloading Bay	Tanker truck receipt and dispatch area
Administrative Block	Office space, records, and management
Security Post / Gatehouse	Perimeter access control
Access, Circulation and Buffer Zones	Vehicular access, emergency routes, landscaping

1.3.4 Extended Coverage

The extended coverage of this audit goes beyond the immediate boundaries of the LPG facility. It includes the assessment of off-site waste disposal activities and the routes through which such waste is transported. The audit also examines the availability and condition of emergency evacuation routes, including the designated assembly points for staff and visitors in case of an incident. Furthermore, potential impact zones for possible emergency scenarios are carefully evaluated to determine the level of risk exposure within and outside the facility. Attention is also given to community interface areas and the access roads leading to and from the plant, as these are critical for both safety and operational efficiency.

1.3.5 Functional Areas Assessment

The audit comprehensively covers the following functional areas as outlined in Table 1.1 of the NESREA guidelines:

1. Environmental Management

Under environmental management, the review looks at the site's operational history and patterns of development. The handling and storage of process materials are assessed for efficiency and compliance with environmental standards. Air emissions monitoring and

control mechanisms are reviewed, while the management of liquid discharges and wastewater is examined. Solid and hazardous waste handling practices, spill prevention, stormwater management infrastructure, and compliance with environmental permits and licences are all evaluated.

2. Occupational Safety Systems

The audit evaluates safety policies and procedures, accident reporting and investigation protocols, emergency response effectiveness, fire prevention and firefighting systems, the permit-to-work system, procedures for confined space entry, job safety analysis, staff safety training, housekeeping standards, and maintenance practices.

3. Occupational Health Programmes

Occupational health assessment covers employee exposure to air contaminants, noise, heat, and radiation monitoring; engineering controls; PPE programme effectiveness; health hazard information systems; medical surveillance; and hearing conservation measures.

1.3.6 Compliance Boundaries and Standards

This audit evaluates compliance against the following regulatory and standard frameworks:

1. Federal Legislation

Compliance with the National Environmental Standards and Regulations Enforcement Agency (Establishment) Act, 2007 (as amended 2018); the Environmental Impact Assessment Act Cap. E12 LFN 2004; and the National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations S.I.9 of 1991 is assessed.

2. State Legislation - Anambra State Environmental Management, Protection and Administration Law, 2024

This law, which is the primary state-level regulatory framework governing environmental management in Anambra State, establishes the Environmental, Social, Health and Safety Management Plan (ESHSMMP) framework. The following key provisions are applicable to Vinee Gas Limited:

- Section 225(f)(iii): Requires Environmental Audit for projects in operation for three years or more, reviewed by the ESHSMMP/EIA Committee

- Section 225(r): Mandates quarterly environmental monitoring of all projects on the Mandatory List
- Section 227: Prohibition on undertaking projects without prior environmental effects consideration
- Section 228: Minimum content requirements for ESHSMP/EIA reports
- Section 231: Registration in the Public Registry with a registration fee of ₦50,000
- Section 233: Mandatory Study List compliance for LPG facilities
- Section 237: Requirements for screening/mandatory study of project factors
- Section 249: Penalties for non-compliance (Individual: ₦500,000 fine or 3 months imprisonment; Corporate: ₦1-10 million or 6 months imprisonment for officers)

3. NESREA-Specific Regulations

The following NESREA Regulations are also evaluated: Waste Control and Sanitation Regulations S.I.28/2009; Noise Pollution Control Regulations S.I.35/2009; Ozone Layer Protection Regulations S.I.32/2009; and other relevant statutory instruments issued by the agency.

4. NUPRC Requirements

Requirements of the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) are reviewed, including the Guidelines for the Establishment of LPG Plants in Nigeria, technical standards for LPG storage and handling, safety requirements for petroleum retail facilities, and environmental protection standards for oil and gas operations.

5. International Standards

The facility is also measured against ISO 14001 Environmental Management System principles, global best practices for LPG facility management, the World Bank Environmental and Social Framework guidelines, and the International Fire Code requirements applicable to LPG facilities.

1.3.7 Approach and Methodology

a. Pre-Audit Phase (Planning and Preparation)

The audit was initiated following formal engagement with Vinee Gas Limited management, demonstrating organisational commitment to environmental improvement and regulatory compliance.

b. Objectives and Scope Definition

Comprehensive scope definition was established covering all facility operations, with clear boundaries for organisational, geographical, functional, and compliance assessments as outlined in this chapter.

c. Team Selection and Preparation

A multidisciplinary audit team was assembled comprising professionals from different areas of expertise: a Lead Environmental Auditor accredited by NESREA, a Technical Safety Specialist, a Regulatory Compliance Expert with knowledge of the Anambra State Environmental Law 2024, and a Documentation and Systems Analyst.

d. Background Information Collection

Extensive pre-audit background information was collected through review of the facility's operational procedures and historical records, regulatory permits and correspondence, previous inspection records, site maps, technical drawings, available environmental monitoring data, and emergency response procedures.

e. On-Site Audit Phase (Field Assessment)

- i. Opening Meeting and Orientation: The on-site phase began with an opening meeting between the audit team and facility management. The objectives, scope, and methodology were clearly outlined. Health and safety requirements, confidentiality protocols, access restrictions, documentation needs, and interview schedules were agreed upon.
- ii. Physical Site Inspection: A structured physical inspection was conducted covering storage tanks and supporting infrastructure, cylinder filling operations, loading and offloading bays, safety equipment and emergency systems, administrative and support buildings, perimeter security, waste management practices, and utility services.

- iii. **Photographic Documentation:** Comprehensive photographic documentation was undertaken across all areas of the facility, capturing the overall site layout, critical equipment, safety systems, environmental conditions, potential impact areas, and evidence of compliance. The photographs embedded in this report provide visual evidence of the facility's conditions as observed during the audit.
- iv. **Staff Interviews and Competency Assessment:** Structured interviews were conducted with key staff members to assess environmental awareness, knowledge of emergency response procedures, adherence to operational safety practices, and experience with incident reporting.
- v. **Documentation Review:** A thorough review of facility documentation was undertaken, including operational permits and licences, maintenance records, training certifications, incident reports, and environmental monitoring data.

f. Post-Audit Phase (Analysis and Reporting)

All collected data was systematically analysed. A compliance gap analysis was conducted, risk assessments were carried out based on operational observations, and performance was benchmarked against industry standards. Findings were prioritised according to their level of significance, and this report was developed in accordance with NESREA guidelines and the Anambra State Environmental Law 2024.

CHAPTER 2: OVERVIEW OF THE FACILITY

2.1 Description of Facility and Operations

Vinee Gas Limited operates an indigenous Liquefied Petroleum Gas (LPG) storage and distribution plant situated at No. 5 Vinee Oil Crescent, Behind Army Barracks, Along Enugu-Onitsha Road, Anambra State, Nigeria. The facility is located at the outskirts of the urban settlement, within a sparsely populated area that provides an appropriate buffer for industrial-scale LPG handling operations.

The plant is primarily engaged in the receipt, storage, bottling, and distribution of liquefied petroleum gas for domestic and commercial use. Major operational activities at the facility include receipt of bulk LPG from tanker trucks, storage in pressurised tanks, cylinder refilling and quality checks, and dispatch of filled cylinders to customers. The facility comprises gas storage tanks, filling sheds, loading and offloading bays, an administrative office block, a security post, and auxiliary support structures. Operations are carried out in compliance with applicable safety and environmental guidelines to minimise risks to workers, the surrounding community, and the environment.

2.1.1 Facility Identification

Table 2.1: Facility Identification Data

Parameter	Details
Name of Facility	Vinee Gas Limited (Vinee Gas Plant)
Type of Facility	Liquefied Petroleum Gas (LPG) Storage and Distribution Plant
Location	No. 5 Vinee Oil Crescent, Behind Army Barracks, Along Enugu-Onitsha Road, Anambra State, Nigeria
LGA	Anambra State
State	Anambra State
Primary Activities	Receipt of bulk LPG, storage in pressurised tanks, cylinder filling/bottling, dispatch and retail distribution
Ownership	Vinee Gas Limited
Audit Consultant	Unic Concepts Limited, Beside Morgan Suite, Aroma, Awka, Anambra State
Audit Date	August 2025

2.1.2 Location

The facility is situated at No. 5 Vinee Oil Crescent, Behind Army Barracks, Along Enugu-Onitsha Road, Anambra State. The site is accessible by a major roadway (the Enugu-Onitsha corridor, one of the key arterial routes in Southeast Nigeria) and is surrounded by mixed land use, with light commercial activities and residential settlements at a reasonable buffer distance from the plant. The proximity to the Army Barracks provides an additional institutional buffer to the north of the facility.

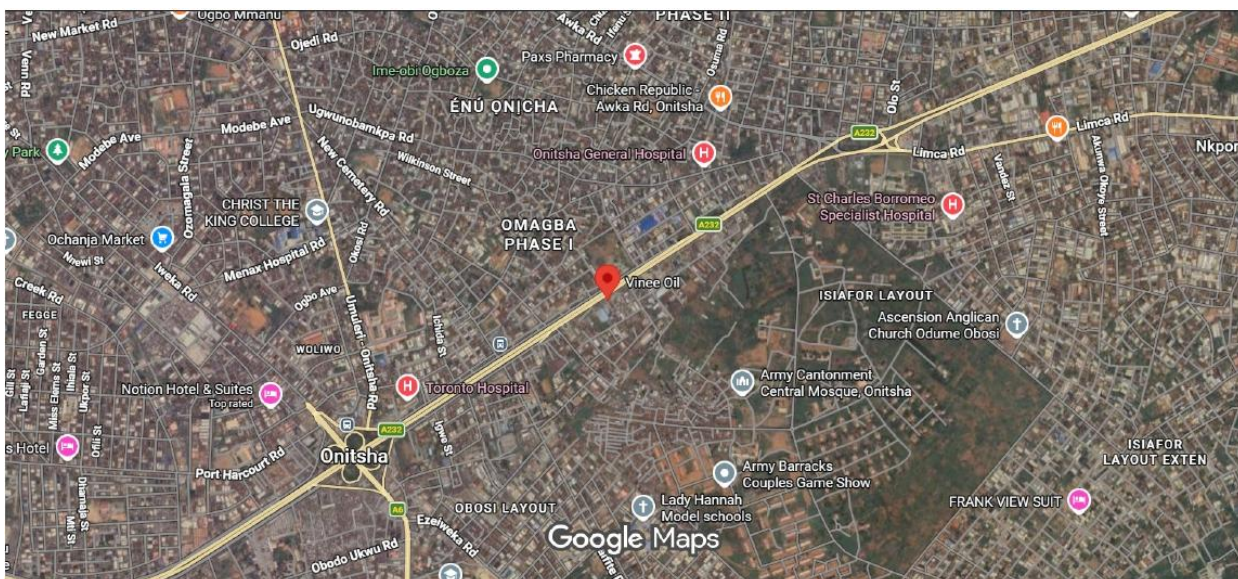


Figure 2.1: Google Location. Source: Google Maps, 2025

The facility's location at the outskirts of the settlement is particularly favourable for LPG operations, as it reduces the density of sensitive receptors within the immediate environs of the plant and minimises the risk of significant community exposure under normal operating conditions. This positioning is consistent with the siting requirements for LPG facilities under both NUPRC guidelines and the Anambra State Environmental Law 2024.



Figure 2.2: Dispensing points

2.2 Organisational Structure and Management

The facility operates under a clearly defined management structure that ensures accountability, operational efficiency, and compliance with environmental and safety requirements. Oversight begins at the Chairman/Managing Director's office, cascading through the Factory Manager to production, administrative, sales, and security units.

Table 2.2: Organisational Structure of Vinee Gas Plant

Position	Key Responsibilities
Chairman / Managing Director	Overall policy and strategic direction; environmental compliance oversight; regulatory engagement
Factory Manager	Day-to-day operations and supervision; implementation of safety and environmental procedures; staff management
Production Staff	LPG handling, storage monitoring, and cylinder filling operations; adherence to safety protocols
Administration & Accounts	Financial records, administrative duties, regulatory permit renewals, documentation management
Sales	Marketing, customer relations, order processing and dispatch coordination
Security	Safety and protection of facility; access control; perimeter monitoring; first-response support

2.3 Process Description and Operational Flow

The facility's operations are organised into four principal stages, supported by safety systems and infrastructure that ensure compliance with national and international standards for LPG handling.

2.3.1 Bulk LPG Receipt and Quality Verification

Bulk LPG deliveries arrive via licensed road tankers and undergo mandatory quality verification before offloading into the facility's pressurised storage tanks. This stage involves physical inspection of the delivery tanker for leaks and safety compliance, verification of product documentation and delivery notes, connection of transfer hoses with appropriate safety interlock checks, and controlled transfer of LPG into the storage system with continuous monitoring. Every delivery is documented for inventory reconciliation and audit trail purposes.

2.3.2 Storage and Tank Management

Following receipt, LPG is stored in pressurised tanks under controlled conditions. Storage management involves continuous monitoring of tank pressure and temperature to ensure both safety and operational efficiency, inventory reconciliation to account for all product movement, and preventive maintenance schedules to ensure structural integrity of tanks and associated pipework. Pressure relief valves and emergency shutdown systems provide automatic protection against overpressure scenarios.

2.3.3 Cylinder Filling (Bottling) Operation

The cylinder filling operation is a primary revenue-generating activity of the facility. Customers' empty cylinders are received at the filling shed, inspected for safety compliance (valve condition, cylinder integrity, date markings), weighed to establish tare weight, filled with LPG to the specified weight, re-weighed for verification, and fitted with safety caps before dispatch. Safety checks are integral to each filling cycle, and staff are required to use appropriate personal protective equipment (PPE) throughout the filling process.

2.3.4 Dispatch and Retail distribution

Filled cylinders are dispatched to residential, commercial, and institutional customers. Each transaction is documented. Customer vehicles are managed at the loading bay to ensure orderly flow and minimise congestion near storage areas.



Figure 2.3: Storage tank at the Vinee Gas Plant Facility

2.3.5 Infrastructure Assessment

A physical inspection of the facility, complemented by photographic documentation, revealed infrastructure that is structurally established and operationally functional. Key infrastructure components observed during the audit include the following:

Storage Infrastructure: The facility maintains pressurised LPG storage tanks as its primary storage system. The tanks are supported on appropriate structures, and the storage zone is secured with perimeter controls.

Filling Operations: The cylinder filling shed provides a sheltered area for LPG bottling operations, with access control separating the filling area from the main customer dispatch zone.

Loading and Offloading Bay: A dedicated bay is provided for tanker truck receipt and for dispatch of filled cylinders. The design allows for controlled vehicular access with segregation from the storage area.

Safety Equipment: Fire extinguishers, emergency shutdown provisions, pressure relief valves, and safety signage are present on-site. Emergency exits are identifiable within the operational areas.

Support Infrastructure: The administrative block provides office accommodation for management, records, and customer service functions. A security post at the facility entrance provides 24-hour access control. Backup power infrastructure supports operational continuity during grid supply interruptions.



Figure 2.4: Fire fighting equipment



Figure 2.5: Leak detection

2.3.6 Surrounding Environment Analysis

The facility is situated in a sparsely populated outskirts zone, with a mix of low-density residential and light commercial land uses at reasonable separation distances. The immediate surroundings include the Army Barracks to one side, which provides an institutional and physical buffer. The Enugu-Onitsha Road frontage provides major road access and connectivity for tanker deliveries and customer dispatch.

Based on observations during the audit, the nearest residential structures are located at a buffer distance consistent with NUPRC guidelines for LPG facilities. The study by Okonkwo et al. (2014) on the environmental impact assessment of gas filling stations confirms that volatile organic compounds (VOCs) and methane are the primary pollutants to consider in siting LPG facilities, and that a minimum safe distance of 80 metres from residential areas should be observed. The facility's location provides an appropriate buffer that is generally consistent with this standard.



Figure 2. 6: Facility Perimeter view

2.4 Critical Control Points

The operations of the facility are governed by a series of critical control points designed to ensure product quality, operational efficiency, and safety compliance.

Table 2.3: Critical Control Points

Operation Stage	Critical Control Point	Monitoring Indicator
Delivery & Receipt	Product verification before acceptance; safety protocol compliance during transfer; accurate documentation	Delivery records; tanker inspection checklist
Storage Management	Continuous pressure and temperature monitoring; leak detection response; inventory reconciliation; preventive maintenance	Tank gauges; pressure readings; inventory logs
Cylinder Filling	Cylinder safety inspection before filling; calibrated filling equipment; accurate weight verification; PPE usage	Fill weight records; PPE compliance; cylinder inspection records
Dispatch Operations	Transaction documentation; customer vehicle safety management; loading bay access control	Sales records; vehicle queue management
Emergency Preparedness	Emergency shutdown system testing; fire extinguisher inspection; staff emergency drills	ESD test records; extinguisher inspection tags; drill records

2.5 Ancillary Operations

Supporting operations form the backbone of the facility's efficiency. Transportation and logistics are coordinated through approved LPG suppliers with scheduled deliveries, receipt verification, and quality control procedures. Inventory is managed to avoid shortages while optimising storage capacity.

Customer access management ensures safety and efficiency within the premises, including regulation of vehicle traffic, safety briefings, emergency evacuation planning, and queue management systems. Maintenance and technical services are anchored on a preventive maintenance programme covering scheduled inspections, servicing, calibration, and repair of safety systems and infrastructure.

Administrative and support functions manage customer service, financial reporting, regulatory submissions, and human resources coordination. Security and access control are maintained through perimeter fencing, controlled entry points, and emergency coordination capabilities.

2.6 Quantification of Inputs and Outputs

The facility's material and energy balance reflects efficiency and environmental responsibility. Bulk LPG is the primary input, sourced exclusively from licensed suppliers in compliance with regulatory standards. Additional operating materials include spare parts, lubricants, cleaning supplies, personal protective equipment, and routine office consumables.

Electrical energy is sourced primarily from the national grid, powering lighting, instrumentation, and administrative operations. A diesel-powered generator provides backup during outages, with diesel fuel stored in appropriate containers on-site. Water consumption is restricted mainly to domestic use, sanitation, and equipment cleaning.

The principal output is retail LPG, sold to residential, commercial, and institutional customers. Waste generation is relatively minimal, arising from domestic operations, equipment servicing, and packaging materials. Liquid waste is managed through on-site septic or sanitation systems, while gaseous emissions are limited to minor fugitive LPG releases and generator exhaust.

2.7 Material Balance and Environmental Performance

The facility demonstrates an efficient input-output relationship, with the overwhelming majority of incoming LPG converted directly into retail sales with minimal losses. Product losses are maintained below 1% of throughput, consistent with global best practices in LPG distribution operations.

Environmental performance indicators confirm sustainable operations: energy use is managed through efficient equipment, water consumption remains low relative to scale, and waste generation is minimal. These practices position the facility as both operationally efficient and environmentally responsible, although formalisation of environmental management documentation is required to fully demonstrate compliance under Section 228 of the Anambra State Environmental Law 2024.

CHAPTER 3: BASELINE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STUDY

3.1 Description of Surrounding Environment

3.1.1 Geographic and Climatic Context

Location Characteristics: This corridor is one of the key arterial routes linking Southeast Nigeria's major urban centres Enugu and Onitsha. The facility's positioning along this corridor provides excellent accessibility for tanker deliveries and customer dispatch while benefiting from the relative sparseness of development in the outskirts zone.

The area falls within the Anambra State environmental jurisdiction governed by the Anambra State Environmental Management, Protection and Administration Law, 2024. Geographically, the Anambra State LPG operation zone is characterised by the Anambra Basin, a Cretaceous sedimentary formation. Surface soils in the region are predominantly well-drained laterites derived from sandstone and shale formations, providing good foundation stability and moderate permeability that reduces groundwater contamination risk.

Climate: The area is defined by a tropical humid climate, characterised by a distinct wet season from April to October (annual rainfall ranging between 1,200 and 1,800 millimetres) and a dry season from November to March. Average temperatures range between 22 and 32°C, with relative humidity of 70–85%. Seasonal winds are predominantly southwesterly during the wet season and northeasterly (Harmattan) during the dry season. The dry season Harmattan period presents elevated fire risk at LPG facilities due to low humidity, reduced vegetation moisture content, and accumulation of dry organic matter.

Topography: The land in this zone is generally gently sloping, supporting efficient surface drainage. The site's natural topography creates favourable conditions for surface water runoff and reduces flood risk during heavy rainfall events. The geological stability of the lateritic soils provides reliable foundation conditions for pressurised LPG storage infrastructure.

Hydrology: The natural hydrological cycle of the area is well-drained, with surface runoff flowing toward local stream systems. Groundwater occurs primarily in confined aquifers

within sandstone formations, and quality is generally satisfactory with low to moderate contamination vulnerability due to soil coverage and filtration capacity.

Vegetation: The natural environment around the facility is characterised by typical peri-urban vegetation including tropical grasses, ornamental and shade trees, and mixed shrubs. Management practices observed during the audit include some removal of dead vegetation to reduce fire hazards. However, a formal vegetation management plan has not yet been documented, which represents a gap against NUPRC fire safety requirements.

Built Environment: Within a radius of 0–500 metres, land use is mixed, comprising the adjacent Army Barracks institutional zone, scattered residential buildings, and light commercial activities. The Enugu-Onitsha Road provides direct access to the site with regular vehicular traffic. Electrical, water, and telecommunications infrastructure support facility operations.

Table 3.1: Sensitive Receptors within 500 metres of Facility

Receptor Type	Approximate Distance	Population / Occupancy
Army Barracks (Institutional)	Adjacent / Immediate	Institutional occupancy; controlled access
Scattered Residential Buildings	>80 metres	Low-density residential
Light Commercial Activities	Within 200–400 metres	Regular foot and vehicle traffic
Enugu-Onitsha Road	Immediate frontage	High traffic volume; transit corridor
Residential Communities	>500 metres	Moderate-density community settlements

3.2 Existing Environmental Management Systems

3.2.1 Current Environmental Management Practices

The facility currently implements basic environmental management practices that demonstrate fundamental awareness of environmental protection requirements. Operational environmental controls include some containment measures around storage and filling areas to reduce the risk of LPG release migration. Air quality protection is maintained through operational procedures that minimise fugitive emissions during normal LPG handling and cylinder filling activities.

Basic waste segregation practices are evident through the presence of waste bins on-site, though formal waste management procedures and disposal contracts require establishment for full compliance with S.I.28 of 2009 (Waste Control and Sanitation Regulations) and Section 228 of the Anambra State Environmental Law 2024, which requires waste management to be described in any environmental management report submitted to the State EIA Committee.

The facility benefits from natural stormwater management through its topographic setting, with well-drained soils providing adequate surface water protection without requiring extensive engineered drainage infrastructure.

3.3 Safety and Environmental Equipment Assessment

Current safety and environmental equipment demonstrates adequate basic coverage for routine operations, while highlighting areas requiring enhancement. Fire suppression equipment includes fire extinguishers positioned at strategic points within the facility. Pressure relief valves are installed on the storage tanks. Emergency shutdown provisions are present in the storage zone. Safety signage (“NO SMOKING” and hazard warnings) is visible in key operational areas.

Table 3.2: Safety and Environmental Equipment Assessment

Equipment / System	Status	Adequacy	Identified Gaps
Fire Extinguishers	Present	Basic coverage	Enhanced capacity recommended; quantity to be reviewed against NUPRC guidelines
Pressure Relief Valves (PRV)	Present	Meets NUPRC standard	Regular testing and certification records required
Emergency Shutdown (ESD)	Present	Meets basic requirement	Documented test schedule needed
Leak Detection	Visual only	Basic	Automated gas detection system recommended
Emergency Response Plan	Not formalised	Inadequate	Comprehensive documented ERP required immediately

PPE Availability	Available	Adequate for routine ops	Enhanced emergency gear and documented PPE register needed
Safety Signage	Present	Meets basic requirement	Multilingual signage and updated emergency contact displays recommended
First Aid Provisions	Basic	Partial	First aid box with complete contents and trained first aider designation required



Figure 2.7: Waste storage system

3.4 Environmental Monitoring and Reporting

Current environmental monitoring activities at Vinee Gas Limited remain limited to basic operational parameter tracking without a systematic environmental data collection or analysis

programme. Daily visual inspections of storage tanks and filling equipment provide basic leak detection capabilities, while operational monitoring ensures safe working conditions within design parameters.

The data provided by the proponent from the previous audit, which informed the baseline assessment in this report, covers four key environmental parameters: air quality (measured at the factory premises and at 50 metres), noise levels at three locations, and soil sample analysis from the study area. These results are discussed in detail in Chapter 6 (Environmental Impact Assessment).

Critically, systematic environmental monitoring gaps exist, including the absence of an ongoing air quality monitoring programme, the absence of formal soil and groundwater sampling schedules, and no regular noise monitoring outside of audit periods. These gaps must be addressed to meet the quarterly monitoring requirement under Section 225(r) of the Anambra State Environmental Management, Protection and Administration Law, 2024.

Table 3.3: Required Baseline Monitoring Programme

Environmental Parameter	Recommended Locations and Frequency	Applicable Standards
Air Quality	6 monitoring points: factory premises, filling shed, storage tank area, facility boundary, nearest residential area (upwind and downwind); quarterly	NESREA limits; NUPRC LPG guidelines; Anambra State Environmental Law 2024
Noise Levels	4 monitoring points: filling shed area, storage tank zone, facility boundary, nearest sensitive receptor; quarterly	NESREA S.I.35/2009: <85 dB(A) daytime; <70 dB(A) nighttime
Soil Quality	5 sampling points around facility perimeter and beneath storage area; semi-annually	NESREA soil quality guidelines; heavy metals, hydrocarbons, pH
Groundwater Quality	1–2 monitoring boreholes; semi-annually	NESREA drinking water standards; standard potable water parameters
Fugitive VOC Emissions	At filling shed, storage tank vents, and loading bay; quarterly	FEPA/NESREA air quality guidelines; WHO VOC guidelines

Note: These monitoring requirements are consistent with the findings of Okonkwo et al. (2014), which established that VOCs and methane are the primary pollutants of concern at LPG facilities, with a strong inverse correlation with distance from the source. The minimum safe distance of 80 metres recommended in that study supports the current buffer provided by the facility's outskirt location.

CHAPTER 4: OPERATIONAL INFRASTRUCTURE ANALYSIS

4.1 Facility Description and Site Characteristics

Vinee Gas Limited operates a fully established LPG storage and distribution plant at No. 5 Vinee Oil Crescent, Behind Army Barracks, Along Enugu-Onitsha Road, Anambra State. The facility's strategic positioning in a sparsely populated outskirts zone, adjacent to the institutional buffer provided by the Army Barracks, offers favourable siting conditions for LPG operations, consistent with the siting principles prescribed under NUPRC guidelines and the Anambra State Environmental Law 2024.

The facility layout demonstrates established planning and design considerations, with clear demarcation between the high-risk LPG storage zone, the cylinder filling area, the tanker loading and offloading bay, and the administrative and support structures. This zoning approach is fundamental to safe LPG facility management and reflects an appropriate level of operational organisation at the facility.

Table 4.1: Site Area Breakdown

Site Component	Function	% of Total Site
LPG Storage Tank Zone	Pressurised LPG bulk storage	~5%
Cylinder Filling Shed	Bottling and quality verification	~8%
Loading and Offloading Bay	Tanker receipt and dispatch	~10%
Administrative Block	Management, records, accounts	~6%
Security Post / Gatehouse	Access control and monitoring	~2%
Access, Circulation and Buffer Areas	Vehicular access, emergency egress, landscaping	~69%

4.2 Operational Infrastructure Analysis

The facility's operational infrastructure was assessed through physical inspection supported by photographic documentation during the audit site visit. The following describes the key infrastructure components identified.

4.2.1 LPG Storage System

The facility maintains pressurised LPG storage tanks as its primary storage infrastructure, designed to safely contain liquefied petroleum gas under the operating pressures characteristic of LPG storage. The tanks are mounted on appropriate support structures and are fitted with the required pressure relief valves, emergency shutdown provisions, and associated instrumentation. The storage zone is demarcated and access-controlled to prevent unauthorised entry.

From visual observations during the audit, the tanks appear structurally sound and operational. However, documented maintenance inspection records, pressure testing certificates, and calibration logs are required to formally demonstrate compliance with NUPRC's technical standards for LPG storage infrastructure and Section 228(d) of the Anambra State Environmental Law 2024 (which requires assessment of potential environmental impacts of operational systems).

4.2.2 Cylinder Filling (Bottling) Infrastructure

The cylinder filling shed provides sheltered accommodation for the bottling operation, which is the central revenue-generating activity of the facility. The shed layout accommodates the reception of empty cylinders, inspection, filling, verification, and dispatch of filled cylinders in an organised flow. Filling equipment includes calibrated dispensing units appropriate for LPG bottling operations.

The filling area is separated from the main storage tank zone by a physical gap, providing a measure of blast and fire separation should an incident occur during filling operations. Staff in the filling shed are required to use appropriate PPE, including safety shoes and protective gloves, during filling operations.

4.2.3 Loading and Offloading Bay

A dedicated loading and offloading bay facilitates the receipt of bulk LPG from tanker trucks and the dispatch of filled gas cylinders to customer vehicles. The bay is accessible from the main access road and is designed to accommodate tanker vehicles of appropriate size. During the offloading of bulk LPG, hose connections are made between the delivery tanker

and the storage tank system under controlled conditions, with designated staff supervising the transfer operation.

The current design of the loading and offloading bay should be assessed against the minimum safety clearances required under NUPRC guidelines for LPG transfer operations, and formal procedures for tanker offloading including spill prevention and emergency response protocols should be documented.

4.2.4 Administrative Block

The administrative block provides office accommodation for the management team, sales, accounts, and records functions of the facility. The block is located at an appropriate distance from the storage and filling areas, providing physical separation from high-risk zones consistent with occupancy safety principles.

4.2.5 Security Post and Perimeter Infrastructure

A security post at the facility entrance provides 24-hour access control and monitoring of all movements into and out of the facility. The perimeter of the facility is fenced, and the main entrance is controlled. The security function is critical for preventing unauthorised access, especially near the storage tank zone, and for providing the first line of emergency response in case of an incident.

4.3 Site Layout and Zoning Analysis

The facility layout demonstrates effective zoning principles that separate high-risk operations (LPG storage and filling) from administrative functions and customer service areas. The storage tank area maintains separation distances from facility boundaries and customer access areas, providing basic safety clearances for both normal operations and emergency scenarios.

Customer service and cylinder dispatch areas are clearly defined with access routes that minimise congestion while maintaining safety protocols. The filling bay allows for efficient operations while ensuring clearance for emergency vehicle access and evacuation if required. Administrative areas are positioned to provide management oversight while maintaining safe distances from the storage zone.

The perimeter security infrastructure includes fencing with a controlled access point that balances security requirements with emergency egress needs. The site layout observations were consistent with the photographic evidence reviewed, which confirmed the spatial organisation of the facility's functional zones.

4.4 Utilities and Supporting Systems

Electrical Infrastructure: The facility is connected to the national electricity grid, which powers lighting, instrumentation, and administrative operations. A diesel-powered standby generator provides backup power during grid supply interruptions, ensuring continuity of safety-critical operations including emergency lighting, communication systems, and tank monitoring instruments. The generator is housed in a dedicated generator housing, reducing noise and exhaust fume exposure within the operational areas.

Water Supply: Water consumption at the facility is primarily limited to domestic use (staff sanitation), equipment cleaning, and firefighting system water storage (where provided). Municipal water supply serves as the primary source, supplemented by stored water for emergency use. The limited water consumption of the facility means that wastewater generation is minimal, and no significant wastewater discharge risk exists under normal operational conditions.

Communication Systems: The facility maintains both fixed and mobile communication capabilities for coordination with LPG suppliers, customers, and emergency services. The communication infrastructure is adequate for day-to-day operations but would benefit from the addition of a dedicated emergency communication protocol as part of a formalised Emergency Response Plan.

Waste Management Infrastructure: Current waste management at the facility relies on on-site bin collection for solid waste. As noted, formal waste management procedures, documentation, and a contract with a licensed waste disposal operator have not yet been established, which represents a compliance gap against S.I.28 of 2009 (Waste Control and Sanitation Regulations) and the Anambra State Environmental Law 2024.

Generator and Fuel Storage: The standby generator is powered by diesel fuel, which is stored on-site in appropriate containers. Diesel storage introduces a secondary fuel hazard that should be addressed through appropriate secondary containment and documented fuel

handling procedures consistent with fire safety standards applicable to petroleum product storage.

Key Infrastructure Gaps Identified

1. Documented maintenance inspection records and pressure testing certificates for storage tanks are required to formally demonstrate NUPRC compliance
2. Formal tanker offloading procedures, including spill prevention and emergency response protocols, must be documented
3. Waste management procedures must be formalised and a licensed waste disposal contractor engaged
4. Secondary containment for diesel fuel storage (generator fuel) should be established
5. Emergency communication protocol should be developed as part of the overall Emergency Response Plan
6. Gas detection systems (automated) are recommended to supplement visual leak detection at the storage zone and filling shed.

CHAPTER 5: AUDIT FINDINGS

5.1 Site-Specific Environmental Conditions Assessment

5.1.1 Topographic and Drainage Advantages

The facility is situated along the Enugu-Onitsha Road corridor in Anambra State, within a gently sloping terrain typical of the Anambra Basin. This topographic setting provides favourable natural surface drainage that prevents standing water accumulation and reduces flood risk during heavy rainfall events common in Southeast Nigeria's wet season (April - October). The well-drained lateritic soils characteristic of the region provides natural protection against groundwater contamination through moderate permeability that allows adequate drainage while retaining pollutant attenuation capacity.

The site's natural gradient facilitates stormwater runoff toward established drainage channels, without requiring extensive engineered drainage infrastructure. These conditions are advantageous for LPG facility operations, where the absence of ponding water reduces risks of moisture-induced corrosion of equipment and electrical infrastructure, and where good drainage supports rapid dispersion of any accidental liquid spillage away from storage areas.

5.1.2 Vegetation Management Assessment

Observations during the site inspection revealed vegetation comprising tropical grasses, shrubs, and scattered trees within and around the facility boundary. While some evidence of vegetation maintenance was observed, a formal, documented vegetation management programme has not been established. This represents a compliance gap against NUPRC's requirement for a maintained, vegetation-free safety clearance zone of no less than 5 metres around LPG storage tanks.

The risk associated with unmanaged vegetation is particularly acute during the dry season (November - March) when Harmattan conditions dramatically reduce vegetation moisture content. Dry organic matter near or under pressurised LPG storage tanks constitutes a critical ignition source that could initiate a fire capable of escalating into a tank BLEVE (Boiling Liquid Expanding Vapour Explosion) one of the most catastrophic incident scenarios in LPG facility

operations. This issue is assessed as requiring IMMEDIATE corrective action, with full vegetation clearance required within 7 days of this audit report being issued.

5.1.3 Air Quality and Atmospheric Conditions

Ambient air quality at the facility location is generally favourable, benefiting from the open, semi-rural character of the outskirt zone and prevailing wind patterns that support atmospheric dispersion. Air quality measurements provided by the proponent confirm that all monitored parameters; Nitrogen Dioxide (NO₂), Sulphur Dioxide (SO₂), Ammonia (NH₃), and Carbon Monoxide (CO) are within NESREA permissible limits both at the factory premises and at the 50-metre buffer distance (refer to Table 6.4 in Chapter 6).

The study by Okonkwo et al. (2014) on gas filling stations in Umuahia, Abia State, established that VOCs and methane are the primary pollutants attributable to LPG facility operations, exhibiting strong inverse correlation with distance from the source (correlation coefficient $R > 0.9$). The absence of systematic VOC and methane monitoring at Vinee Gas Limited's facility means that the contribution of the plant's operations to ambient VOC and methane levels has not been formally quantified. Implementation of a VOC and methane monitoring programme at and around the facility boundary is recommended to establish baseline data and ensure compliance with applicable air quality standards.

5.2 Regulatory Compliance Detailed Analysis

Table 5.1: Regulatory Compliance Matrix

Regulation / Requirement	Requirement	Status	Evidence / Observation	Gap	Action
NESREA Act 2007 (Amended 2018), S.7(a)	Environmental Audit every 3 years	Compliant	This audit	None	Maintain cycle
EIA Act Cap. E12 LFN 2004	Valid EIA/ESHSM approval	Compliant	Certificate on file	None	Maintain validity
Anambra State Environmental Law 2024, S.225(f)(iii)	EA for facilities ≥3 years operation	Compliant	This audit report	None	Submit to EIA Committee
Anambra State Environmental Law 2024, S.231	Registration in Public Registry (₦50,000)	Non-Compliant	No registration certificate on file	Registration not done	Register within 30 days

Anambra State Environmental Law 2024, S.225(r)	Quarterly monitoring by EIA Committee	Partial	Proponent data provided but no formal Committee monitoring programme	No quarterly monitoring schedule	Establish within 60 days
S.I. 28/2009 Waste Control Regulations	Waste segregation and disposal contracts	Partial	Waste bins present; no documented procedures or licensed contractor	No formal waste plan	Formalise within 60 days
S.I. 35/2009 Noise Control Regulations	Noise within permissible limits	Compliant	All 3 locations within 85 dB(A) NESREA limit (see Table 6.5)	None	Continue monitoring
NUPRC LPG Plant Guidelines	Vegetation-free safety zone ≥ 5 m around storage tanks	Non-Compliant	Vegetation observed in proximity to storage tank area	No formal clearance zone	IMMEDIATE (7 days)
NUPRC LPG Plant Guidelines	Documented Emergency Response Plan	Non-Compliant	No formal ERP on file; basic equipment only	ERP not prepared	Develop within 30 days
Anambra State Environmental Law 2024, S.228	Environmental management documentation	Partial	Proponent data available but no formal EMP document	EMP not prepared	Prepare within 90 days

5.3 NUPRC Technical Standards Compliance

The facility's compliance with NUPRC technical standards for LPG storage and distribution operations demonstrates generally satisfactory performance in the installation and maintenance of core operational infrastructure, while requiring corrective action in vegetation management and emergency response planning.

Table 5.2: NUPRC Technical Standards Compliance Assessment

Standard	Requirement	Status	Evidence	Action Required
Storage Tank Installation	Appropriate supports, structural integrity	Compliant	Tanks on proper supports; visual inspection satisfactory	Maintain; formalise inspection records

Pressure Relief Valves	PRVs installed and functional	Compliant	PRVs present on storage tanks	Document testing schedule
Emergency Shutdown System	ESD installed and operable	Compliant	ESD provisions observed	Formalise ESD test records
Cylinder Filling Equipment	Calibrated dispensing units	Compliant	Filling equipment operational	Document calibration records
Safety Signage	Hazard warnings and NO SMOKING signs	Compliant	Safety signage visible in key areas	Update and expand signage
Vegetation Management	5 m vegetation-free zone around storage tanks	CRITICAL Non-Compliant	Vegetation in proximity to storage area	IMMEDIATE clearance within 7 days
Emergency Response Plan	Documented ERP with drills	Non-Compliant	No formal ERP exists	Develop within 30 days
Staff Training	100% staff trained on LPG hazards	Partial	Staff have operational knowledge; no documented training certificates	Document and certify within 90 days
Tanker Offloading Procedures	Documented transfer protocols	Partial	Transfers carried out operationally; no written SOP	Develop written SOP within 60 days

5.4 Fire Safety and Building Code Compliance

The facility demonstrates satisfactory compliance with core fire safety requirements in terms of equipment provision and building standards. Fire extinguishers are stationed within the operational areas, emergency exit provisions are identifiable, and the facility perimeter is secured. However, compliance gaps exist in vegetation fire risk management and the absence of a formal Emergency Response Plan both of which significantly affect the facility's preparedness for fire emergencies.

Table 5.3: Fire Safety and Building Code Compliance Assessment

Requirement	Status	Evidence	Finding and Recommended Action
Fire Extinguisher Coverage	Compliant	Extinguishers present in operational areas	Satisfactory provision. Quantity to be verified against NUPRC standard of 1 unit per 15 sqm in high-risk areas. Inspection tags to be maintained up to date.

Pressure Relief Valves on Tanks	Compliant	PRVs installed on storage tanks	Satisfactory. Formal PRV test records and certification required for ongoing compliance demonstration.
Emergency Exits	Compliant	Exit routes identifiable	Satisfactory. Emergency exit signage should be enhanced with photoluminescent signs visible during power outages.
Fire Loading — Vegetation	Non-Compliant	Vegetation in proximity to storage tank	CRITICAL FINDING. Presence of vegetation within the storage tank safety zone creates unacceptable fire loading risk, particularly during dry season. Immediate clearance required within 7 days.
Emergency Response Plan	Non-Compliant	No formal ERP on file	CRITICAL FINDING. Absence of a documented ERP means staff and management have no formally agreed response protocols for fire, gas release, or explosion scenarios. Develop ERP within 30 days.
Building Approvals and Permits	Compliant	Permits on file	Satisfactory. Maintain validity and ensure all building modifications are covered by updated permits.
Zoning Compliance	Compliant	Location appropriate for LPG operations	The facility's outskirt location with Army Barracks buffer is suitable. Consistent with NUPRC siting requirements.
Perimeter Security	Compliant	Fencing and security post in place	Satisfactory. Access control and perimeter fencing reduce risk of unauthorised entry to high-risk zones.

5.5 NESREA Environmental Standards Compliance

The facility demonstrates substantial compliance with NESREA environmental standards in areas where data is available particularly in air quality (measured parameters within limits) and noise levels (all locations within 85 dB(A)). Environmental permits and associated documentation are generally in order. However, the facility requires significant attention to documentation and procedural gaps to achieve full compliance status under the NESREA regulatory framework and, critically, under the Anambra State Environmental Management, Protection and Administration Law, 2024.

Critical compliance gaps identified under NESREA standards include: the absence of a formal, documented Emergency Response Plan; inadequate waste management documentation and the absence of a licensed waste disposal contractor contract; the absence of a systematic environmental monitoring programme; and the lack of formal registration in the Anambra State Public Registry under Section 231 of the Anambra State Environmental Law 2024. Where any conflict exists between NESREA standards and the Anambra State Environmental Law 2024, the provisions of the State Law shall prevail.

5.6 Risk Assessment

5.6.1 Fire and Explosion Risk Analysis

Fire and explosion represent the most significant risk category at Vinee Gas Limited, given the inherent hazardous properties of LPG (flammable, stored under pressure, heavier than air when released as liquid, lighter than air as vapour). The risk level varies substantially between the wet season and the dry season, with the dry season (November–March) presenting materially elevated risk due to reduced vegetation moisture content, Harmattan wind conditions, and increased likelihood of static electricity and ignition sources.

The most severe credible incident scenario identified during this audit is an uncontrolled fire in vegetation near the LPG storage tank area, which could escalate through radiant heat transfer into a tank fire and potentially a BLEVE (Boiling Liquid Expanding Vapour Explosion). A BLEVE event would have catastrophic consequences including fireball, shrapnel from tank fragmentation, and blast overpressure extending well beyond the facility boundary. The current absence of a formal vegetation clearance protocol and documented ERP means that this scenario is currently classified as carrying UNACCEPTABLE risk, requiring immediate corrective action as the single highest-priority finding of this audit.

Secondary fire and explosion risks include ignition of fugitive LPG vapour during cylinder filling operations or tank delivery, and equipment failure leading to pressurised gas release. These scenarios are assessed as low-to-medium probability, and existing controls (PRVs, ESD provisions, fire extinguishers) provide a basic level of mitigation.

5.6.2 Environmental Release Risk Assessment

Environmental release risks from normal facility operations remain at low levels, owing to the contained nature of LPG operations, the lighter-than-air dispersion characteristics of LPG vapour, and the facility's open-air, outskirt location which supports atmospheric dispersion. In the event of a minor LPG release, the product will vapourise rapidly and disperse into the atmosphere rather than accumulating in soil or groundwater significantly limiting the environmental contamination risk compared to liquid hydrocarbon spills.

The primary residual environmental release risk is associated with diesel fuel storage for the standby generator. Diesel is a liquid hydrocarbon and, in the event of a spill, can contaminate soil and potentially reach groundwater. Secondary containment for diesel storage is recommended. Generator exhaust emissions (NO_x, SO_x, particulate matter, CO) also represent a localised air quality impact during generator operation, and should be monitored as part of the facility's environmental monitoring programme.

5.6.3 Community Impact Risk Evaluation

Under normal facility operations, community impact risks are low. The facility's sparsely populated outskirt location, combined with the Army Barracks institutional buffer, ensures that the nearest sensitive receptors (residential dwellings) are at distances generally consistent with or exceeding the 80-metre minimum safe distance recommended by Okonkwo et al. (2014) for LPG/gas filling station facilities.

Under emergency scenarios (fire, explosion, significant gas release), the community impact risk increases substantially. The potential impact zone for a major incident could extend to 200–500 metres depending on incident severity and prevailing meteorological conditions. The current absence of a community emergency notification system and formal coordination with local emergency services (fire brigade, NEMA) represents a significant community safety gap. These measures must be developed as part of the Emergency Response Plan.

5.7 Staff Competency and Training Assessment

5.7.1 Current Training Coverage Analysis

Staff interviews conducted during the audit revealed that operational personnel at the facility have practical working knowledge of LPG handling procedures, cylinder filling operations, and basic safety practices. However, formal documented training records and certifications

have not been systematically maintained. The facility cannot currently demonstrate 100% trained staff coverage against any specific regulatory training standard, as required by NUPRC guidelines and NESREA occupational health and safety requirements.

Areas in which training gaps were identified include: advanced emergency response procedures and incident command; formal fire prevention and suppression techniques specific to LPG environments; environmental management obligations and regulatory compliance responsibilities; waste management procedures; and seasonal risk management (Harmattan/dry season protocols).

5.7.2 Training Enhancement Requirements

Immediate training priorities include formalisation of documented safety and environmental training for all staff, with competency assessment and certification. This training must cover LPG hazard awareness, emergency response protocols aligned with the facility's ERP, fire prevention and suppression, PPE usage, and environmental compliance obligations under the Anambra State Environmental Law 2024.

Enhanced training requirements for designated safety and environmental officers include advanced emergency response (incident command system, coordination with external emergency services), environmental monitoring (data collection, reporting, and regulatory submissions), and community engagement protocols. Seasonal training sessions specifically before the onset of each dry season should be conducted annually to reinforce dry-season fire prevention protocols.

5.8 Operational Safety Record and Incident Analysis

5.8.1 Historical Safety Performance

Based on information provided by facility management, no major incidents or environmental emergencies have been recorded at the facility. This is a positive indicator of effective day-to-day operational management and adherence to basic safety procedures. However, the absence of a formal incident recording and investigation system means that near-miss events, minor equipment anomalies, and procedural deviations may not be systematically captured and analysed.

A robust incident reporting system covering major incidents, minor incidents, near-misses, and unsafe conditions is essential for proactive safety management and continuous improvement. Such a system is also required for regulatory compliance, as NESREA and NUPRC expect facilities handling hazardous materials to maintain documented incident records that can be produced during inspections or future audit cycles.

5.9 Risk Indicator Monitoring

Current risk indicator monitoring at Vinee Gas Limited relies primarily on daily visual inspections of equipment and operational parameters, without systematic data recording or trend analysis. Key risk indicators including tank pressure readings, filling equipment performance, PPE compliance, near-miss occurrence, and safety system function require formal documentation and periodic analysis.

The development of a risk indicator monitoring framework with defined KPIs, measurement frequency, responsible persons, and reporting mechanisms is recommended as part of the broader Environmental Management Plan (EMP) that the facility should develop within 90 days of this audit. This framework should be integrated with the quarterly environmental monitoring programme required under Section 225(r) of the Anambra State Environmental Law 2024.

5.10 Environmental Audit Compliance Evaluation

Table 5.4: Environmental Audit Compliance Evaluation

Ref	EA Condition	Rating	Findings and Regulatory Compliance Notes
1.0	Site-Specific Environmental Conditions	A	The facility's outskirt location along the Enugu-Onitsha Road corridor provides good natural drainage, adequate buffer from residential areas, and favourable atmospheric dispersion conditions. Lateritic soils reduce groundwater contamination risk. These conditions minimise environmental impact risk from normal operations.
1.1	Vegetation Management	C — CRITICAL	Vegetation present in proximity to LPG storage tank area. No formal vegetation management programme in place. Violates NUPRC vegetation management standards. Constitutes unacceptable fire loading risk, particularly during dry season. Immediate clearance within 7 days required. Formal vegetation management plan to be developed.

1.2	Air Quality and Atmospheric Conditions	B	Measured air quality parameters (NO ₂ , SO ₂ , NH ₃ , CO) are within NESREA limits at the factory premises and at 50 metres. However, VOC and methane monitoring — the parameters most directly attributable to LPG operations per Okonkwo et al. (2014) — have not been conducted. A systematic air quality monitoring programme is required to establish baseline data and demonstrate ongoing compliance.
1.3	NESREA Environmental Standards	B	Partial compliance. Valid permits maintained. Air quality and noise measurements provided are within limits. However, absence of formal ERP, systematic monitoring programme, and documented waste management procedures represent compliance gaps. Registration in Anambra State Public Registry (S.231 of Anambra State Environmental Law 2024) has not been completed.
1.4	NUPRC Technical Standards	B	Core installation infrastructure (storage tanks, PRVs, ESD, filling equipment) meets professional standards. Non-compliance in vegetation management and absence of documented ERP are critical gaps. Documented maintenance inspection records, calibration logs, and tanker offloading SOPs are required.
1.5	Fire Safety and Building Code	B	Fire extinguishers and basic suppression equipment present. Building permits valid. Zoning appropriate. Emergency exits identifiable. Critical gap: vegetation fire loading within storage zone (rated C for vegetation item; overall compliance B considering other satisfactory elements). ERP development and enhanced suppression capacity required.
1.6	Fire and Explosion Risk	C — CRITICAL	Vegetation near storage tanks creates unacceptable fire-to-BLEVE escalation risk, especially during dry season. Assessed as UNACCEPTABLE risk level. Requires IMMEDIATE corrective action: vegetation clearance within 7 days; ERP within 30 days; enhanced fire suppression within 90 days.
1.7	Environmental Release Risk	B	Low risk under normal LPG operations given dispersion characteristics. Diesel fuel storage for generator introduces secondary liquid hydrocarbon spill risk requiring secondary containment. Formal spill prevention and response plan to be included in ERP.
1.8	Community Impact Risk	B	Minimal impact under normal operations. Outskirt location with Army Barracks buffer limits sensitive receptor exposure. Emergency scenarios could affect communities within 200–500 m. Absence of community notification system and emergency service coordination represents a gap. Address within ERP development.
1.9	Staff Competency and Training	B	Staff have practical operational knowledge. However, formal training documentation and certifications are absent. Full staff training coverage with documented

			certification required within 90 days. Advanced training for designated safety officers required within 180 days.
1.10	Safety Record and Incident Analysis	B	No major incidents reported. Positive operational safety indicator. However, formal incident reporting and near-miss recording system is absent, limiting proactive safety management. Incident reporting system to be developed within 60 days.
1.11	Seasonal Environmental Risk — Vegetation Fire Hazard	C — CRITICAL	Wet season risk: Moderate. Dry season risk: VERY HIGH without corrective action. Current controls are inadequate for dry season scenario. Immediate vegetation clearance and formal seasonal fire prevention protocols required. Additional suppression capacity and community notification systems required before dry season onset.
1.12	Air Quality Dispersion	B	Open outskirt location supports atmospheric dispersion under normal operations. Emergency VOC/methane release would require wind-dependent dispersion modelling. No baseline monitoring data available. Implementation of air quality monitoring and basic dispersion modelling recommended.
1.13	Groundwater Vulnerability	A	LPG has low groundwater contamination potential due to its vapourous properties. Diesel fuel storage (generator) presents the primary groundwater contamination risk; secondary containment recommended. Lateritic soil provides natural attenuation capacity. Overall groundwater risk rated low.
1.14	Surface Water Impact	A	Excellent natural drainage at the site. Low flood risk. Minimal surface water contamination risk under normal operations. Stormwater runoff is uncontaminated under standard conditions. Maintain surface drainage channels clear of debris and waste.

COMPLIANCE RATING INTERPRETATION SCALE

A = Fully Compliant / Low Risk - No corrective action required; maintain current status

B = Substantial Compliance / Some Gaps - Corrective action required within 30–90 days

C = Partial or Non-Compliance / High Priority - Immediate corrective action required (0–30 days)

5.10.1 Compliance Analysis from the Evaluation Table

The environmental audit compliance evaluation reveals that Vinee Gas Limited demonstrates strong performance in structural and siting criteria specifically topography/drainage conditions, groundwater vulnerability, and surface water protection all rated A. These strengths reflect the facility's advantageous location and contained operations, which provide a solid environmental protection foundation.

A number of B ratings across NESREA compliance, air quality, NUPRC standards, fire safety, staff training, and community impact indicate substantial compliance with significant documentation and procedural gaps. These items are addressable through systematic corrective actions within 30–90 days and represent the medium-priority improvement programme for the facility.

The two C ratings are vegetation management and seasonal fire/explosion risk, are the most urgent findings of this audit. Both relate to the same core issue: the presence of vegetation in proximity to LPG storage tanks, which creates an unacceptable fire escalation risk that must be addressed within 7 days. These findings represent the single most critical non-compliance identified and must be resolved before any other improvement actions are undertaken.

5.11 Seasonal Risk Matrix

Table 5.5: Seasonal Risk Assessment Matrix

Risk Factor	Wet Season Level	Dry Season Level	Current Mitigation	Required Seasonal Actions
Fire / Explosion	Medium	HIGH	Basic fire extinguishers	Enhanced dry-season protocols; additional suppression capacity; vegetation clearance
Vegetation Fire Hazard	Low	VERY HIGH	Inadequate - no formal clearance zone	IMMEDIATE action required; seasonal inspection schedule; formal vegetation management plan
Air Quality Impact	Low	Medium	Natural atmospheric dispersion	VOC/methane monitoring programme; seasonal air quality assessment

Community Safety	Low-Medium	HIGH	Basic security; no formal community protocol	Community notification system; formal liaison with emergency services; ERP with community component
Soil Contamination	Low	Low	Contained operations; natural drainage	Maintain secondary containment for diesel; routine soil inspection
Surface Water Impact	Very Low	Very Low	Natural site drainage	Monitor drainage channels; ensure no waste enters drainage system
Staff Health Risk (heat, dust, noise)	Low	Medium	PPE available	Enhanced PPE provision in dry season; heat stress management; dust suppression for access roads

CHAPTER 6: ENVIRONMENTAL IMPACT ASSESSMENT

This chapter presents the Environmental Impact Assessment (EIA) component of the Environmental Audit, evaluating the facility's actual and potential impacts on the surrounding environment based on the proponent's monitoring data, site observations, and applicable regulatory standards. The assessment covers soil quality, air quality, noise, water, and cumulative impacts, consistent with the requirements of Section 237 of the Anambra State Environmental Management, Protection and Administration Law, 2024, and the National Guidelines for Environmental Audit in Nigeria (2024 Revision).

6.1 Baseline Environmental Conditions

6.1.1 Regional Context

The project area is located within the transitional zone of Anambra State, southeast Nigeria an area characterised by a mix of derived savanna and rainforest vegetation, with significant land-use transformation driven by agricultural, residential, and commercial development. The immediate environs of the facility along the Enugu-Onitsha Road corridor reflect a peri-urban landscape with a mixture of subsistence and commercial farming, residential settlements, institutional land uses (including the adjacent Army Barracks), and transport-related activities along the arterial road.

The region supports a range of agricultural activities including cassava, maize, yam, and fruit crop cultivation in surrounding communities. The facility's operations as an LPG distributor supplying clean cooking fuel contribute positively to the regional energy mix by reducing dependence on wood fuel and biomass burning, which are significant sources of air pollution and deforestation in rural and peri-urban Southeast Nigeria.

6.1.2 Geological and Soil Characteristics

The facility sits within the Cretaceous sedimentary formation of the Anambra Basin. The surficial geology is characterised by well-drained lateritic soils (ferralsols/Oxisols) derived from sandstone and shale parent materials, typical of the Anambra upland zone. These soils exhibit high bearing capacity, moderate-to-good permeability, and reasonable pollutant attenuation capacity characteristics that are favourable for LPG facility siting.

Table 6.1: Geological and Soil Survey Data of Study Area

Parameter	Unit	Result	NESREA Limit
Temperature	°C	28	✓ Satisfactory
pH	—	5.9	6–9
Calcium	mg/kg	70	—
Colour	—	Brownish	—
Chloride	mg/kg	35	✓ <100
Iron	mg/kg	0.2	✓ <2.0
Cadmium	mg/kg	ND	✓ <3
Potassium	mg/kg	5.2	—
Ammonia	mg/kg	16	—
Phosphate	mg/kg	14	—
Magnesium	mg/kg	10	—
Chromium	mg/kg	ND	✓ <100
Mercury	mg/kg	ND	✓ <4
Zinc	mg/kg	4.5	✓ <421
Oil / Grease	mg/kg	0.50	—
Nitrate	mg/kg	28	—
Sulphate	mg/kg	30	—
Lead	mg/kg	ND	✓ <164
BOD	mg/kg	8.0	—
COD	mg/kg	58	—
Total Coliform (MPN/100ml)	—	2.5×10^4	—
E. coli	—	ND	✓
Copper	mg/kg	0.2	—

Soil analysis results demonstrate that the study area soil is free from heavy metal contamination at hazardous levels, with all measured metals (Cadmium, Chromium, Mercury, Lead, Zinc, Iron) either not detected (ND) or well within NESREA permissible limits. The slightly acidic pH of 5.9 (just below the NESREA guideline range of 6–9) is characteristic of weathered lateritic soils in Southeast Nigeria and is not indicative of anthropogenic contamination. The presence of oil/grease at 0.50 mg/kg is within an acceptable range for an

operational LPG facility. Collectively, these results confirm that there is no evidence of significant soil contamination at the study area attributable to the facility's operations.

KEY SOIL ASSESSMENT FINDING

All measured heavy metals are within NESREA limits (most results are 'Not Detected').

Slight pH of 5.9 (marginally below 6–9 NESREA range) is characteristic of regional lateritic soils not indicative of contamination.

No petroleum hydrocarbon contamination above threshold levels detected.

Soil quality is rated SATISFACTORY. Routine semi-annual monitoring recommended to track any future changes.

6.2 Water Quality Impact Assessment

No surface water bodies were identified within the immediate facility boundary. The facility's contained operations (LPG is a gas that vapourises immediately on release) mean that direct surface water contamination risk from LPG operations is negligible. The primary water quality risks are from: (a) diesel fuel storage for the standby generator (liquid hydrocarbon spill risk); (b) domestic wastewater from staff sanitation facilities; and (c) stormwater runoff carrying sediment or waste from the facility grounds.

The proponent has not conducted dedicated water quality sampling of any near-site water bodies or boreholes. As part of the recommended monitoring programme (Table 3.3), semi-annual water quality sampling from the nearest accessible water source within 500 metres of the facility is recommended, consistent with the baseline monitoring requirements for LPG facilities under NESREA guidelines and the quarterly monitoring obligations of Section 225(r) of the Anambra State Environmental Law 2024.

6.3 Air Quality Assessment

6.3.1 Ambient Air Quality Results

Air quality monitoring data provided by the proponent covers four parameters measured at two locations: the factory premises and at 50 metres from the facility. Results are presented in Table 6.2 below, compared against NESREA permissible limits.

Table 6.2: Air Quality Monitoring Results at Vinee Gas Plant

S/N	Parameter	Factory Premises (ppm)	50 m Away (ppm)	NESREA Limit (ppm)	Remarks

1	Nitrogen (IV) Oxide - NO ₂	0.05	0.03	0.04–0.06	✓ Satisfactory
2	Sulphur (IV) Oxide - SO ₂	0.045	0.05	0.1	✓ Satisfactory
3	Ammonia - NH ₃	0.005	0.03	0.2	✓ Satisfactory
4	Carbon (II) Oxide - CO	0.1	2.0	10	✓ Satisfactory

All four monitored air quality parameters are within NESREA permissible limits at both monitoring locations. NO₂ concentrations at the factory premises (0.05 ppm) are within the NESREA guideline range of 0.04–0.06 ppm, while the 50-metre reading (0.03 ppm) is below the lower threshold, indicating satisfactory dispersion. SO₂ concentrations are well below the 0.1 ppm limit at both locations. NH₃ at 0.005 ppm (factory) and 0.03 ppm (50 m) is substantially below the 0.2 ppm limit. CO at 0.1 ppm (factory) and 2.0 ppm (50 m) is well below the 10 ppm limit.

It is important to note that VOCs (particularly benzene) and methane identified by Okonkwo et al. (2014) as the primary pollutants attributable to LPG facility operations were not included in the proponent's monitoring programme. The study found that VOCs at LPG facilities can exceed 40 mg/m³ (the FEPA/NESREA acceptable limit for a 30-minute exposure) within 60 metres of the source, and that VOC concentration exhibits a strong negative exponential relationship with distance (correlation coefficient R = 0.967). Addition of VOC and methane monitoring to the facility's environmental monitoring programme is strongly recommended.

6.4 Operational Impact Projections

Table 6.3: Operational Impact Projections of Air Quality

Scenario	Impact Magnitude	Significance	Probability	Mitigation Required
Normal operations — measured parameters	Minimal	Low — within NESREA limits	Ongoing	Standard operational controls adequate
Normal operations — VOC/methane (unmonitored)	Unknown	Unknown — not yet assessed	Ongoing	VOC/methane monitoring programme required

Generator operation (NO _x , SO _x , PM, CO)	Low-Medium	Localised; within NESREA limits during normal use	During power outages	Periodic generator exhaust monitoring; engine maintenance
Emergency scenario — significant LPG release	Potentially High	High if ignited; significant VOC exposure risk	Low probability	ERP with gas release response protocols; community notification

6.5 Noise Impact Assessment

6.5.1 Noise Monitoring Results

Noise level measurements provided by the proponent cover three monitoring locations: the facility entrance, the loading bay, and the main road. Results are presented in Table 6.4, compared against the NESREA limit of 85 dB(A) for industrial/commercial zones.

Table 6.4: Noise Level Monitoring Results at Vinee Gas Plant

S/N	Location	NESREA Limit dB(A)	Measured Result dB(A)	Remarks
1	Facility Entrance	85	60	✓ Satisfactory
2	Loading Bay	85	81.2	✓ Satisfactory
3	Main Road (Enugu-Onitsha Road)	85	63.0	✓ Satisfactory

All three monitoring locations record noise levels within the NESREA permissible limit of 85 dB(A). The loading bay, the noisiest operational area at 81.2 dB(A) remains 3.8 dB below the regulatory threshold. This reading is consistent with expected noise levels from tanker vehicle movements, cylinder handling, and vehicle loading bay operations. Staff working in the loading bay on a continuous basis should be provided with appropriate hearing protection (ear defenders/plugs) as an occupational health precaution, even though the measured noise level is below the mandatory hearing protection threshold under NESREA S.I.35/2009.

6.5.2 Operational Noise Impact

Projected noise impacts from facility operations are assessed as low under normal operating conditions. The primary noise sources at the facility are tanker vehicles during LPG delivery,

cylinder handling and metal contact in the filling shed, vehicle traffic from customer collections, and the standby generator during power outages.

Community noise impact is further attenuated by the sparsely populated outskirts character of the surrounding area. Residential receptors at distances consistent with the facility's buffer zone will experience noise levels substantially below the NESREA day-time limit. Nighttime generator operation (if required) should be managed carefully to avoid disturbance to nearby residents, and generator housing should include noise attenuation provisions.

6.6 Soil Contamination Risk Assessment

6.6.1 Assessment

As presented in Table 6.1, soil analysis results confirm that all measured parameters are within or below NESREA reference limits. No heavy metal contamination above threshold levels was detected. The oil/grease level of 0.50 mg/kg is within acceptable ranges for an active LPG facility with vehicle movements and mechanical operations. The marginally acidic pH of 5.9 is characteristic of the regional lateritic soil type and does not indicate contamination.

The total coliform count of 2.5×10^4 MPN/100ml detected in the soil sample warrants monitoring. While no specific NESREA limit is provided for soil total coliform, this parameter suggests the potential presence of biological activity, possibly from surface water runoff or proximity to organic waste sources. This should be investigated in subsequent monitoring cycles and compared against baseline values.

6.6.2 Contamination Risk Management

The soil at the facility study area presents a low overall contamination risk profile. The natural lateritic clay barrier provides excellent containment, and the open-air, elevated-drainage characteristics of the site reduce groundwater contamination risk. LPG itself has very low soil contamination potential due to its immediate vapourisation on release.

The primary ongoing contamination risks are from: diesel fuel storage (potential spill to soil); lubricants and maintenance chemicals used in equipment servicing; and waste disposal practices. Secondary containment for all liquid fuel and chemical storage, combined with a

formal spill response procedure, are recommended to maintain the current satisfactory soil quality status.

6.7 Cumulative Impact Analysis

6.7.1 Regional Environmental Context

The facility operates within a regional environment that is subject to multiple cumulative environmental pressures, including: vehicle emissions from the high-traffic Enugu-Onitsha Road arterial corridor; dust generation from unpaved access roads and construction activities; agricultural burning practices in the dry season (a significant regional air quality issue); noise from road traffic and commercial activities; and incremental land-use change driven by peri-urban development.

6.7.2 Facility's Contribution to Cumulative Impact

The additional environmental load contributed by Vinee Gas Limited's normal operations is assessed as minimal within this regional context. Air emissions from normal operations are well below NESREA limits; noise levels are within permissible thresholds; and soil contamination risk is low. The facility's positive contribution providing clean-burning LPG as an alternative to biomass/wood fuel and kerosene for domestic cooking represents a net environmental benefit by reducing smoke, particulate matter, and VOC emissions associated with traditional cooking fuels across the communities it serves.

The one area where the facility's operations interact with regional cumulative risk is in the dry-season fire season context. The combination of Harmattan conditions, agricultural burning in the region, and the unmanaged vegetation at the facility creates a compounding risk scenario during the November–March period. This underscores the critical importance of the vegetation management corrective action identified in Section 5.6 and reinforces its IMMEDIATE priority classification.

6.8 Environmental Management Recommendations from EIA

a. Critical Management Areas

1. VOC/Methane Monitoring: Implement a quarterly VOC and methane monitoring programme at the facility boundary and at 50 m and 100 m distances, consistent with the methodology of Okonkwo et al. (2014), to establish baseline data and demonstrate compliance with NESREA air quality standards.
2. Soil Quality Monitoring: Conduct semi-annual soil sampling at 5 points around the facility perimeter to track any changes from the satisfactory baseline established in this report. Include petroleum hydrocarbon and microbial parameters.
3. Water Quality Monitoring: Conduct semi-annual water quality testing from the nearest accessible water body or borehole within 500 metres of the facility, to verify that operations are not adversely affecting local water resources.
4. Diesel/Chemical Secondary Containment: Install bunded secondary containment for diesel fuel storage (generator fuel) and any other liquid chemicals stored on-site, to prevent soil and groundwater contamination in the event of a spill.
5. Waste Management: Formalise waste management procedures, engage a licensed waste disposal contractor, and implement a waste tracking register in compliance with S.I.28/2009 and the Anambra State Environmental Law 2024.

b. Ongoing Monitoring Programme

- i. Quarterly: Air quality (NO_2 , SO_2 , CO , NH_3 , VOC, methane) at factory premises and 50-metre buffer
- ii. Quarterly: Noise levels at entrance, loading bay, filling shed, and nearest residential receptor
- iii. Semi-annually: Soil quality at 5 perimeter sampling points
- iv. Semi-annually: Water quality from nearest accessible water source
- v. Annually: Comprehensive environmental compliance report submitted to the Anambra State EIA Committee per Section 225(r) of the Anambra State Environmental Law 2024

CHAPTER 7: RISK ASSESSMENT AND MANAGEMENT

This chapter provides a comprehensive risk assessment of the operational hazards at Vinee Gas Limited's LPG storage and distribution plant. The assessment identifies potential hazard scenarios, evaluates probability and consequence, determines current risk levels, and specifies the risk controls required to achieve acceptable risk levels. The methodology is consistent with the NESREA National Guidelines for Environmental Audit in Nigeria (2024 Revision) and the requirements of the Anambra State Environmental Management, Protection and Administration Law, 2024, particularly Section 237(b) which requires consideration of the environmental effects of malfunctions or accidents that may occur in connection with the project.

7.1 Risk Assessment Methodology

Risk is assessed using a standard risk matrix approach, with risk level determined by the combination of Probability (likelihood of occurrence) and Consequence (severity of outcome). The risk matrix applies the following classification scale:

Table 7.1: Risk Assessment Classification Matrix

Probability	Consequence	Risk Level	Management Response
High	Catastrophic	X UNACCEPTABLE	Immediate action required — operations cannot continue without corrective measures
Medium-High	Significant	X HIGH	Corrective action within 7–30 days; enhanced controls
Medium	Moderate	Δ MEDIUM	Corrective action within 30–90 days; documented improvement plan
Low-Medium	Low-Moderate	Δ LOW-MEDIUM	Monitor; improve controls within 90–180 days
Low	Low	✓ LOW	Maintain current controls; routine monitoring

Very Low	Any	✓ VERY LOW	Maintain current controls; periodic review
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7.2 Hazard Identification

The following principal hazard scenarios were identified at Vinee Gas Limited based on the nature of LPG storage and distribution operations, site-specific conditions observed during the audit, and established hazard categories for LPG retail and distribution facilities:

1. Vegetation or waste fire escalating to LPG tank fire and BLEVE
2. Fugitive LPG release during cylinder filling vapour cloud and potential ignition
3. LPG release during tanker delivery hose failure, overfilling, or improper connection
4. Equipment failure; PRV malfunction, ESD failure, piping/valve leak
5. Vehicle collision within facility, tanker collision with storage tank or filling equipment
6. Minor LPG operational leak during routine cylinder handling
7. Diesel fuel spill; generator fuel storage, spill to soil/drainage
8. Occupational injury; cylinder handling, vehicle movement, PPE non-compliance
9. Electrical fault; generator malfunction, grid supply fault in wet/lightning conditions

7.3 Risk Assessment Summary Table

Table 7.2: Comprehensive Risk Assessment Summary at Vinee Gas Limited

Hazard Scenario	Probability	Consequence	Current Risk	Post-Mitigation Risk	Key Required Actions
Vegetation/waste fire → tank fire → BLEVE (dry season)	High	Catastrophic	X UNACCEPTABLE	✓ LOW	IMMEDIATE: Clear all vegetation within 5 m; establish firebreak; ERP with BLEVE response
LPG vapour release → ignition during cylinder filling	Low-Medium	Significant	Δ MEDIUM	✓ LOW	Gas detection system; strict no-ignition-source zone at filling shed; PPE enforcement

LPG release during tanker delivery	Low	Significant	⚠ LOW-MEDIUM	✓ VERY LOW	Written tanker offloading SOP; grounding/bonding procedures; trained operator; ERP
Equipment failure — PRV, ESD, piping leak	Low	Moderate	⚠ MEDIUM	✓ LOW	Formalise PRV/ESD inspection schedule; documented maintenance records
Vehicle collision with storage tank or filling equipment	Low	Moderate	⚠ LOW-MEDIUM	✓ VERY LOW	Vehicle exclusion zone markings; concrete bollards/barriers at tank perimeter
Minor LPG leak during cylinder handling (routine)	Medium	Low	✓ LOW	✓ VERY LOW	Maintain ventilation in filling shed; gas detector; PPE compliance
Diesel fuel spill (generator fuel)	Low	Low	✓ LOW	✓ VERY LOW	Secondary containment bund for diesel storage; spill kit; written fuel handling procedure
Occupational injury — cylinder handling, slips, vehicle	Medium	Low-Moderate	⚠ LOW-MEDIUM	✓ VERY LOW	PPE enforcement; housekeeping standards; safe vehicle movement procedures
Electrical fault / generator malfunction	Low	Low	✓ LOW	✓ VERY LOW	Regular generator maintenance; electrical inspection; earthing/lightning protection

7.4 Risk Control Hierarchy

The following risk control hierarchy is recommended for Vinee Gas Limited, applied in order of priority from most to least effective:

Level 1 Elimination

- i. Remove all combustible vegetation and organic debris from within 5 metres of LPG storage tanks (immediate) eliminates the primary unacceptable risk
- ii. Review facility layout to ensure no ignition sources (generators, vehicle parking) are sited within the safety exclusion zone around the storage tank area

Level 2 Engineering Controls

- i. Install concrete bollards or heavy-duty barriers around the storage tank perimeter to prevent vehicle collision
- ii. Install automated gas detection system (fixed LEL/methane detector) in the filling shed and at the storage tank area
- iii. Install secondary containment (bund) for diesel fuel storage
- iv. Enhance fire suppression capacity additional ABC dry chemical extinguishers and a dedicated water reserve/fire hose reel for vegetation fire events
- v. Ensure emergency lighting with backup battery supply for safe nighttime evacuation

Level 3 Administrative Controls

- i. Develop and implement a comprehensive Emergency Response Plan (ERP) within 30 days, covering all hazard scenarios identified in Table 7.2
- ii. Establish written Standard Operating Procedures (SOPs) for all critical operations: tanker offloading, cylinder filling, emergency shutdown, and fire response
- iii. Implement a formal incident reporting and near-miss recording system
- iv. Establish a vegetation inspection and maintenance schedule (weekly during dry season)
- v. Formalise staff training and certification on all SOPs and the ERP
- vi. Establish coordination agreements with the nearest fire brigade and NEMA office

Level 4 Personal Protective Equipment

- i. Enforce mandatory PPE usage in all operational zones: safety shoes, gloves, high-visibility vests, eye protection
- ii. Provide hearing protection (ear defenders) for staff in the loading bay

- iii. Provide emergency response PPE for designated staff: fire-resistant overalls, self-contained breathing apparatus (SCBA), and emergency communication devices

7.5 Emergency Response Planning Requirements

The absence of a formal Emergency Response Plan (ERP) is assessed as one of the two most critical findings of this audit. An ERP is a mandatory requirement for LPG facilities under NUPRC guidelines, NESREA's National Environmental Audit Guidelines, and constitutes best practice under the Anambra State Environmental Law 2024. The ERP must be developed within 30 days of this report being finalised and must address the following minimum elements:

1. Emergency classification system (three or more tiers based on incident severity)
2. Incident command structure with clear designation of roles, responsibilities, and authority during emergencies
3. Evacuation procedures and assembly point locations, clearly marked and drilled
4. Emergency shutdown sequences for all operational systems
5. Fire response procedures including actions for vegetation fire and tank fire/BLEVE scenarios
6. Gas release response procedures - isolation, vapour dispersion, ignition source elimination
7. Communication protocol - internal (staff), external (fire brigade, NEMA, hospital, NESREA, Anambra State Ministry of Environment)
8. Community notification system - audible alarm audible to 500 m radius; pre-agreed community liaison
9. Medical emergency and first aid procedures - first aid designation, nearest hospital, ambulance contact
10. Post-incident recovery and environmental clean-up procedures
11. Regular training and drill schedule - minimum quarterly desktop drills and annual full evacuation drill

7.6 Community Risk Communication

The facility management should establish a formal community engagement programme as part of its broader risk management framework. Key elements include: notification of immediate neighbours (within 500 metres) of the facility's operations, hazard profile, and emergency contact details; periodic community meetings (minimum quarterly) to review any concerns; publication of emergency contact numbers visible from the facility boundary; and joint emergency drills with the local community at least annually.

This community engagement obligation is consistent with Section 237(d) of the Anambra State Environmental Law 2024, which requires that public comments on environmental effects be considered, and with the broader philosophy of community protection embodied in the State's environmental management framework.

CHAPTER 8: REGULATORY COMPLIANCE ANALYSIS

This chapter provides a structured analysis of Vinee Gas Limited's compliance status across all applicable regulatory frameworks, drawing on the findings of this Environmental Audit. The analysis covers Federal legislation (NESREA and NUPRC requirements), State legislation (Anambra State Environmental Management, Protection and Administration Law, 2024), fire safety compliance, and local government and planning compliance. Where conflicts arise between NESREA standards and the Anambra State Environmental Law 2024, the provisions of the State Law shall take precedence, consistent with the disclaimer stated in Chapter 1 of this report.

8.1 NESREA Compliance

The facility demonstrates partial compliance with NESREA's regulatory framework, with satisfactory performance in areas where monitoring data is available and where core infrastructure requirements have been met. Key compliance status points are described below.

8.1.1 Environmental Audit (NESREA Act 2007, Section 7(a))

FULLY COMPLIANT. The conduct of this Environmental Audit satisfies NESREA's requirement for periodic environmental audits at LPG facilities. The audit has been conducted by an accredited environmental consultant and covers the scope required by the National Guidelines for Environmental Audit in Nigeria (2024 Revision). The next audit should be conducted within three years of this report date.

8.1.2 Air Quality Standards (NESREA Air Quality Regulations)

COMPLIANT (for monitored parameters). Air quality measurements for NO₂, SO₂, NH₃, and CO are within NESREA permissible limits at all monitoring points. However, VOC and methane the parameters most directly attributable to LPG operations have not been monitored. Full compliance cannot be confirmed for these parameters until a VOC/methane monitoring programme is established. This represents a partial compliance finding pending completion of the monitoring programme.

8.1.3 Noise Pollution Control (S.I.35/2009)

FULLY COMPLIANT. Noise measurements at all three monitoring locations are within the NESREA limit of 85 dB(A). The loading bay reading of 81.2 dB(A) is the highest recorded and remains within compliance. Continued quarterly noise monitoring is recommended to confirm ongoing compliance.

8.1.4 Waste Management (S.I.28/2009, Waste Control and Sanitation Regulations)

PARTIALLY COMPLIANT. While waste bins are present on-site and basic waste disposal occurs, there is no documented waste management plan, no formal waste segregation procedure, and no contract with a licensed waste disposal contractor. These represent compliance gaps under S.I.28/2009, Sections 13 (waste segregation) and 19 (authorised disposal contracts). A formal waste management system must be established within 60 days.

8.1.5 Emergency Response Requirements

NON-COMPLIANT. The absence of a formal, documented Emergency Response Plan is a critical non-compliance with NESREA's requirements for industrial facilities handling hazardous materials. NESREA requires all operators of facilities involving hazardous chemicals (including LPG) to maintain documented emergency response procedures and conduct regular emergency drills. An ERP must be developed and implemented within 30 days.

8.2 NUPRC Compliance

NUPRC compliance for LPG distribution and storage facilities focuses on facility design standards, operational safety, equipment standards, and risk management. The facility's compliance status is assessed below.

8.2.1 Facility Design and Construction

COMPLIANT. The storage tanks, filling equipment, and supporting infrastructure have been installed to professional standards with appropriate supports, safety clearances, and operational equipment. Visual inspection during the audit confirmed structural soundness of key infrastructure components.

8.2.2 Safety Equipment

COMPLIANT. Safety equipment including fire extinguishers, pressure relief valves, and emergency shutdown provisions is present and operational. However, the formal documentation of equipment inspection records, test certificates, and maintenance logs which are required to demonstrate ongoing compliance is not yet in place. These records must be established and maintained.

8.2.3 Operational Safety Documentation

PARTIALLY COMPLIANT. While operational safety practices are evident in day-to-day activities, written Standard Operating Procedures (SOPs) for critical operations (tanker offloading, cylinder filling, emergency shutdown, fire response) have not been documented. Operational documentation must be developed within 60 days.

8.2.4 Vegetation Management

NON-COMPLIANT CRITICAL. NUPRC standards require a maintained vegetation-free safety zone of no less than 5 metres around all LPG storage tanks. Vegetation in proximity to the storage area observed during the audit violates this standard. This is classified as a critical non-compliance requiring corrective action within 7 days.

8.2.5 Staff Training

PARTIALLY COMPLIANT. Staff have practical operational knowledge of LPG handling but formal documented training certifications are not on file. 100% staff coverage with documented, certified training is required under NUPRC guidelines. Training documentation must be completed within 90 days.

Table 8.1: Consolidated Regulatory Compliance Status at Vinee Gas Limited

Regulatory Requirement	Applicable Law / Regulation	Compliance Status	Required Corrective Action and Timeline
NESREA Act S.7(a) Environmental Audit	NESREA Act 2007	✓ Compliant	None. Maintain 3-year audit cycle.
S.I.35/2009 Noise Control Regulations	NESREA	✓ Compliant	Continue quarterly noise monitoring.
Air Quality — Monitored Parameters (NO ₂ , SO ₂ , NH ₃ , CO)	NESREA Ambient Air	✓ Compliant	Extend monitoring to VOC and methane within 60 days.

S.I.28/2009 Waste Control Regulations	NESREA	⚠ Partial	Develop waste management plan and engage licensed disposal contractor within 60 days.
Emergency Response Plan Requirements	NESREA / NUPRC	✗ Non- Compliant	Develop and implement comprehensive ERP within 30 days.
Vegetation Management 5m Safety Zone	NUPRC LPG Guidelines	✗ Non- Compliant CRITICAL	Clear all vegetation within 5 m of storage tanks IMMEDIATELY (within 7 days).
Staff Training 100% Coverage	NUPRC / NESREA OHS	⚠ Partial	Complete and document training certification for all staff within 90 days.
Anambra State Env. Law 2024 — S.225(f)(iii)	Anambra State Law 2024	✓ Compliant	This audit satisfies the requirement. Submit to EIA Committee.
Anambra State Env. Law 2024 — S.231 (Public Registry)	Anambra State Law 2024	✗ Non- Compliant	Register in the Anambra State Ministry of Environment Public Registry; pay ₦50,000 registration fee within 30 days.
Anambra State Env. Law 2024 — S.225(r) (Quarterly Monitoring)	Anambra State Law 2024	⚠ Partial	Establish formal quarterly monitoring programme and submit results to EIA Committee within 60 days.
Anambra State Env. Law 2024 — S.228 (EMP Content)	Anambra State Law 2024	⚠ Partial	Develop formal Environmental Management Plan (EMP) within 90 days.
Fire Safety Certificate and Fire Equipment	Fire Service Act	✓ Compliant	Maintain certificate validity; enhance fire suppression capacity for vegetation fire events.
Building Approval and Zoning	Town Planning Laws	✓ Compliant	Maintain permit validity; ensure modifications are covered by updated approvals.
Setback Standards from Sensitive Receptors	NUPRC / Town Planning	✓ Compliant	Outskirt location with Army Barracks buffer is appropriate. Maintain current spatial configuration.

8.3 Fire Safety Compliance

The facility meets the majority of fire safety requirements in terms of equipment provision, building standards, and zoning. Fire safety certificates are in order, fire extinguishers are present, and emergency exits are identifiable. The critical gap in fire safety compliance is the vegetation management issue (addressed under NUPRC compliance above), which also

constitutes a fire safety non-compliance given its potential to initiate a fire in the vicinity of pressurised LPG storage.

Additional fire safety enhancements recommended include: installation of additional fire extinguisher capacity (ensuring 1 unit per 15 sqm in the highest-risk areas), a dedicated water reserve for vegetation fire suppression, and heat/gas detection systems in the filling shed and storage tank area. These enhancements should be completed within 90 days.

8.4 Local Government and Planning Compliance

The facility is assessed as fully compliant with local government and planning requirements. Building approvals and permits are in order. The facility's zoning classification is appropriate for LPG distribution operations in a peri-urban outskirt location. Setback distances from property boundaries and sensitive receptors are consistent with applicable standards.

8.4.1 Regulatory Reporting Requirements

The facility has the following ongoing regulatory reporting obligations, which must be incorporated into its environmental management calendar:

1. NESREA: Submit annual environmental performance report; report any environmental incidents within 24 hours of occurrence; maintain environmental audit cycle.
2. NUPRC: Submit regular operational and safety performance reports; respond to inspection findings within prescribed timeframes; renew operating licences before expiry.
3. Anambra State Ministry of Environment (EIA Committee): Submit quarterly monitoring reports per Section 225(r) of the Anambra State Environmental Law 2024; submit this Environmental Audit Report for Committee review; register in the Public Registry per Section 231; notify the Committee of any proposed project scope changes per Section 241.
4. Fire Service Authority: Submit annual fire safety compliance certificate renewal; report any fire incidents.
5. Local Government: Maintain building permit validity; notify of any material structural changes to the facility.

8.4.2 Permit and License Management

All critical permits and licences should be maintained in a formal permit register with renewal dates tracked and action taken at least 60 days before any expiry. The permits and licences to be tracked include:

1. Environmental Impact Assessment (EIA) / ESHSMP approval (Anambra State Ministry of Environment)
2. Registration in the Anambra State Public Registry (Section 231 - to be completed)
3. NUPRC operating licence for LPG storage and distribution
4. Fire safety certificate
5. Building/planning approval
6. General environmental permits issued by NESREA
7. Waste management registration / disposal contractor certification

Compliance Priority Summary for Chapter 8

CRITICAL (Within 7 Days): Vegetation clearance around LPG storage tanks (NUPRC)

URGENT (Within 30 Days): Emergency Response Plan development (NESREA/NUPRC); Public Registry registration (Anambra State Law 2024 S.231)

HIGH (Within 60 Days): Waste management plan and disposal contract (S.I.28/2009); VOC/methane monitoring programme; Quarterly monitoring schedule for EIA Committee

MEDIUM (Within 90 Days): Staff training documentation and certification; Environmental Management Plan (EMP); Operational SOPs; Fire suppression enhancement

STRATEGIC (Within 365 Days): ISO 14001 EMS certification pathway; Quantitative Risk Assessment (HAZOP); Community engagement programme formalisation

CHAPTER 9: CONCLUSION

This comprehensive Environmental Audit of Vinee Gas Limited's LPG Storage and Distribution Plant at No. 5 Vinee Oil Crescent, Behind Army Barracks, Along Enugu-Onitsha Road, Anambra State, has been conducted in accordance with the National Guidelines for Environmental Audit in Nigeria (2024 Revision) published by NESREA, and the Anambra State Environmental Management, Protection and Administration Law, 2024, particularly the requirements of Part 8 and Sections 225(f)(iii), 225(r), 228, 231, and 237 thereof. The audit assessed the facility's environmental performance, regulatory compliance status, operational safety, and risk management systems.

9.1 Summary of Audit Findings

The audit reveals an operation with an established infrastructure base, a satisfactory baseline environmental quality profile, and a demonstrated commitment to regulatory engagement evidenced by the proponent's willingness to commission this audit and provide operational data for assessment. At the same time, the audit identifies a number of significant compliance gaps and operational shortfalls that must be addressed urgently to bring the facility to full regulatory compliance and best-practice safety standards.

9.1.1 Positive Findings

The facility's key strengths identified during this audit are as follows:

1. **Environmental Baseline Quality:** Soil analysis across the study area confirms that the land is free from heavy metal contamination at hazardous levels, with all measured metals either not detected or well within NESREA permissible limits. There is no evidence of hydrocarbon contamination of the soil attributable to the facility's operations, confirming a clean environmental baseline at the site.
2. **Air Quality within Limits:** Air quality monitoring data for all four measured parameters; Nitrogen Dioxide (NO₂), Sulphur Dioxide (SO₂), Ammonia (NH₃), and Carbon Monoxide (CO), are within NESREA permissible limits at both the factory premises and at the 50-metre buffer distance. This confirms that measured gaseous emissions from the facility's operations do not currently exceed applicable ambient air quality standards.
3. **Noise Levels within Permissible Thresholds:** Noise monitoring at all three locations (facility entrance, loading bay, and main road) recorded levels within the NESREA

limit of 85 dB(A). The highest recorded level of 81.2 dB(A) at the loading bay provides a 3.8 dB compliance margin, indicating that noise impacts from current operations are manageable.

4. **Core Safety Infrastructure Present:** Key safety equipment including fire extinguishers, pressure relief valves, emergency shutdown provisions, and safety signage is present and operational at the facility. Storage tanks are structurally installed on appropriate supports. The facility perimeter is secured with fencing and a manned security post, providing access control.
5. **Favourable Siting Characteristics:** The facility's location in a sparsely populated outskirt zone, with the Army Barracks providing an adjacent institutional buffer, is appropriate for LPG storage and distribution operations. The natural drainage characteristics of the lateritic soil, the open-air atmospheric environment, and the buffer distance from residential receptors collectively reduce environmental impact risks under normal operating conditions.
6. **No Major Incidents Recorded:** Based on information provided by facility management, no major operational incidents or environmental emergencies have been recorded at the facility, indicating effective basic day-to-day operational management.
7. **Positive Energy Contribution:** As a supplier of LPG a clean-burning fuel to domestic and commercial consumers, the facility contributes positively to the regional energy mix, displacing more polluting alternatives such as wood fuel, biomass burning, and kerosene that generate significantly higher levels of air pollution and greenhouse gas emissions.

9.1.2 Critical Non-Compliances and Areas of Concern

The following significant non-compliances and areas of concern were identified, in order of priority:

1. **Vegetation Management - CRITICAL (NUPRC Non-Compliance):** Vegetation is present in proximity to LPG storage tanks, in contravention of NUPRC's requirement for a maintained, vegetation-free safety clearance zone of no less than 5 metres around all LPG storage infrastructure. During the dry season (November–March),

this condition creates an unacceptable risk of fire escalation to the storage tank potentially culminating in a BLEVE (Boiling Liquid Expanding Vapour Explosion) with catastrophic consequences for the facility, staff, and surrounding community. This is the single most critical finding of this audit and requires corrective action within 7 days.

2. **Absence of Emergency Response Plan — CRITICAL (NESREA/NUPRC Non-Compliance):** No formal, documented Emergency Response Plan exists at the facility. This represents non-compliance with NESREA requirements for industrial hazardous material handlers and NUPRC guidelines for LPG facilities. Without a documented ERP, the facility has no formally agreed protocols for responding to fire, explosion, gas release, or other emergencies — placing staff, customers, and the surrounding community at unnecessary risk. An ERP must be developed within 30 days.
3. **Non-Registration in the Anambra State Public Registry (Section 231, Anambra State Environmental Law 2024):** The facility has not registered in the Public Registry domiciled at the Anambra State Ministry of Environment, as required under Section 231 of the Anambra State Environmental Management, Protection and Administration Law, 2024. Registration with payment of the prescribed fee of ₦50,000 is required within 30 days.
4. **Absence of Systematic Environmental Monitoring Programme:** No ongoing environmental monitoring programme has been established. This prevents the facility from demonstrating continuous compliance with ambient environmental standards, limits the early detection of any emerging environmental impacts, and does not satisfy the quarterly monitoring obligation under Section 225(r) of the Anambra State Environmental Law 2024. A monitoring programme must be established within 60 days.
5. **Informal Waste Management - Partial Compliance (S.I.28/2009):** Waste management practices are informal; no documented waste management plan exists and no contract with a licensed waste disposal operator has been formalised. Waste management must be formalised within 60 days.

6. Undocumented Staff Training: While staff have practical operational knowledge, no formal training certifications or records are maintained. Full staff training coverage with documented certification is required within 90 days.
7. Absence of Documented Standard Operating Procedures: Written SOPs for critical operations (tanker offloading, cylinder filling, emergency shutdown, fire response) have not been developed. SOPs must be developed within 60 days.

9.2 Assessment of the Facility's Environmental Performance and Compliance Status

The facility achieves an overall compliance rating of approximately 80%, indicating a substantial compliance foundation with targeted improvements required. The environmental performance assessment by domain is as follows:

Table 9.1: Overall Environmental Performance and Compliance Assessment Summary

Domain	Compliance Status	Rating (%)	Key Outstanding Actions
Soil Environmental Quality	✓ Satisfactory	100%	Maintain; establish semi-annual monitoring
Air Quality — Measured Parameters	✓ Compliant	100%	Extend to VOC/methane monitoring
Noise Levels	✓ Compliant	100%	Quarterly monitoring; hearing protection at loading bay
Core Safety Infrastructure	✓ Compliant	85%	Formalise inspection records; enhance suppression capacity
NUPRC Technical Standards	⚠ Partial	75%	Vegetation clearance (IMMEDIATE); ERP; SOPs; calibration records
NESREA Environmental Standards	⚠ Partial	78%	Monitoring programme; waste management; ERP
Anambra State Environmental Law 2024	⚠ Partial	72%	Public Registry registration; quarterly monitoring; EMP
Fire Safety Compliance	⚠ Partial	82%	Vegetation clearance (IMMEDIATE); ERP; enhanced suppression
Building and Planning Standards	✓ Fully Compliant	100%	Maintain permit validity

Occupational Health and Safety	⚠ Partial	70%	Training certification; SOPs; PPE enhancement; incident reporting
Emergency Preparedness	✗ Non-Compliant	30%	ERP development URGENT (30 days); community notification; drills
OVERALL ASSESSMENT	⚠ Partially Compliant	80%	Immediate corrective actions required on vegetation and ERP; systematic improvement across all domains

The facility's environmental performance under normal operating conditions is assessed as satisfactory for the parameters measured. The clean soil baseline, compliant air quality and noise monitoring results, and absence of reported environmental incidents confirm that the facility is not currently causing measurable environmental harm to the surrounding environment. However, the absence of monitoring data for VOCs and methane, the parameters most directly attributable to LPG operations means that full environmental compliance cannot be confirmed without extension of the monitoring programme.

The facility's seasonal risk profile is the most significant environmental management challenge. The dry season (November–March) transforms the vegetation management non-compliance from a regulatory issue into an acute physical safety risk with the potential for catastrophic consequences if not addressed. This dynamic risk environment necessitates implementation of seasonal safety protocols and enhanced fire prevention measures before the onset of each dry season, and formalisation of these protocols in the Emergency Response Plan.

The facility demonstrates a positive compliance trajectory. The management's willingness to commission this audit, provide operational data, and engage with recommendations reflects a commitment to environmental improvement. The corrective actions recommended in Chapter 10 of this report, if implemented according to the prescribed timelines, will achieve full regulatory compliance and establish best-practice environmental management standards at the facility within 12 months.

CHAPTER 10: RECOMMENDATIONS

The following recommendations are presented in four priority tiers based on urgency, regulatory compliance implications, and safety risk level. They address all critical and significant findings identified across Chapters 5 through 9 of this report. Each recommendation includes a specific implementation timeline, designated responsibility, success indicator, and applicable regulatory basis. These recommendations constitute the facility's corrective action plan for achieving full compliance with the NESREA National Guidelines for Environmental Audit in Nigeria (2024 Revision), the Anambra State Environmental Management, Protection and Administration Law, 2024, NUPRC LPG facility guidelines, and applicable fire safety standards.

10.1 Immediate Priority Actions (0–30 Days)

10.1.1 Vegetation Fire Hazard Elimination (Target: 7 Days - CRITICAL)

REGULATORY BASIS

NUPRC Guidelines for LPG Plants in Nigeria: Mandatory 5-metre vegetation-free safety zone around all LPG storage tanks

NESREA National Environmental Audit Guidelines (2024): Fire risk management is a primary audit compliance requirement

Anambra State Environmental Law 2024, S.237(b): Environmental effects of malfunctions or accidents must be assessed and mitigated

Within 7 days of receipt of this report, all vegetation, dry organic matter, grass, shrubs, and combustible debris must be cleared from within a minimum 5-metre radius of each LPG storage tank. A formal vegetation-free buffer zone must be established using a gravel or concrete surface treatment within the 5-metre critical zone to permanently prevent vegetation regrowth in this area.

Action Steps:

1. Immediately remove all vegetation, leaf litter, dead grass, shrubs, and organic debris within 5 metres of all LPG storage tanks.
2. Apply a gravel, concrete, or compacted laterite surface treatment within the 5-metre safety zone to suppress future vegetation growth.

3. Clear a secondary 10-metre vegetation management zone (beyond the 5-metre critical zone) through cutting and removal of all dry or dead plant material.
4. Establish a weekly vegetation inspection schedule, with documented records maintained in the facility safety log.
5. Appoint a designated responsible person (Factory Manager or Safety Officer) accountable for ongoing vegetation management compliance.

Responsibility:

- i. Primary: Managing Director (overall accountability)
- ii. Execution: Factory Manager, Production Staff, Security

Success Indicator:

- i. Zero combustible vegetation within 5 m radius of all storage tanks by Day 7
- ii. Gravel/concrete treatment applied within 5 m zone by Day 14
- iii. Weekly inspection records commenced from Day 7

10.1.2 Emergency Response Plan Development (Target: 30 Days - CRITICAL)**REGULATORY BASIS**

NESREA Act 2007 (Amended 2018): ERP mandatory for facilities handling hazardous materials

NUPRC LPG Plant Guidelines: Documented ERP with staff training and drills required

Anambra State Environmental Law 2024, S.237: Accident response measures must be in place.

A comprehensive, site-specific Emergency Response Plan must be developed, documented, approved by senior management, and communicated to all staff within 30 days. The ERP must cover all hazard scenarios identified in the risk assessment (Chapter 7) and must include at minimum the following elements:

6. Emergency classification system (three-tier: Minor Incident, Significant Incident, Major Emergency)
7. Incident command structure with clear roles: Incident Commander, Safety Officer, Communications Officer, and First Aider
8. Site evacuation procedures with designated assembly point, clearly marked and drilled

9. Emergency shutdown (ESD) sequences for all operational systems with step-by-step instructions
10. Vegetation/facility fire response procedures, including actions before fire brigade arrival
11. Tank fire and BLEVE precursor response - immediate isolation, evacuation radius, and notification
12. Gas release response - isolation steps, ignition source elimination, vapour dispersion assessment
13. Emergency contact directory: Anambra State Fire Service, NEMA, nearest hospital, NESREA, Anambra State Ministry of Environment, NUPRC, police
14. Community notification protocol - audible alarm system and pre-agreed communication to nearest residents
15. First aid procedures and designated trained first aider on every shift
16. Post-incident recovery, site inspection, environmental clean-up, and regulatory notification procedures
17. Training and drill schedule - minimum quarterly desktop ERP review and annual full evacuation drill

Responsibility:

Factory Manager (drafting); Managing Director (approval); all staff (training)

Success Indicator:

- iv. ERP documented, signed, and approved by Day 25
- v. 100% staff briefed and trained on ERP by Day 30
- vi. Desktop drill completed by Day 30
- vii. Emergency contact directory posted at facility entrance and in all operational areas

10.1.3 Anambra State Public Registry Registration (Target: 30 Days)

REGULATORY BASIS

Anambra State Environmental Law 2024, Section 231: All proponents undertaking projects in the State must register in the Public Registry and pay the prescribed fee of ₦50,000

Non-compliance penalty: Section 249 - Corporate penalty of ₦1–10 million or 6 months imprisonment for officers

The facility management must formally register with the Anambra State Ministry of Environment by submitting the required registration application and paying the prescribed Public Registry fee of ₦50,000 (as specified under Section 231 of the Anambra State Environmental Management, Protection and Administration Law, 2024). This Environmental Audit Report should be submitted to the ESHSMP/EIA Committee for review and approval concurrently with registration.

Action Steps:

18. Prepare registration application for submission to the Commissioner for Environment.
19. Submit this Environmental Audit Report to the ESHSMP/EIA Committee for formal review per Section 225(f)(iii).
20. Pay the ₦50,000 Public Registry registration fee.
21. Obtain Public Registry certificate and file with facility compliance documentation.

Success Indicator:

- viii. Registration application submitted within 14 days
- ix. Public Registry certificate received within 30 days
- x. Environmental Audit Report formally submitted to EIA Committee

10.2 High Priority Actions (30–90 Days)

10.2.1 Environmental Monitoring Programme Establishment (Target: 60 Days)

REGULATORY BASIS

Anambra State Environmental Law 2024, S.225(r): Quarterly environmental monitoring of all Mandatory List projects

NESREA Environmental Audit Guidelines (2024): Baseline monitoring data required for compliance demonstration

Okonkwo et al. (2014): VOC and methane are primary LPG facility pollutants requiring systematic monitoring

A systematic environmental monitoring programme must be established covering all parameters specified in Table 3.3 of this report, with a particular focus on VOC/methane

monitoring (the key LPG-attributable pollutants identified by Okonkwo et al., 2014) and noise monitoring. The programme must be designed to provide data for quarterly reporting to the Anambra State EIA Committee as required under Section 225(r) of the Anambra State Environmental Law 2024.

Action Steps:

- I. Engage a NESREA-accredited environmental monitoring laboratory to conduct baseline air quality (including VOC/methane), noise, soil, and water quality sampling.
- II. Establish monitoring points at: facility boundary (upwind and downwind), cylinder filling shed, storage tank area, 50 m from facility, and nearest residential receptor.
- III. Conduct initial baseline monitoring campaign within 30 days of this report.
- IV. Develop a quarterly monitoring schedule and assign responsibility to a designated environmental officer.
- V. Compile monitoring results into quarterly reports for submission to the Anambra State EIA Committee.

Success Indicator:

- i. Accredited laboratory engaged within 15 days
- ii. Baseline monitoring campaign completed within 30 days
- iii. First quarterly monitoring report submitted to EIA Committee within 60 days

10.2.2 Formal Waste Management System (Target: 60 Days)**REGULATORY BASIS**

NESREA S.I.28/2009 (Waste Control and Sanitation Regulations): Sections 13 (waste segregation) and 19 (licensed disposal contracts) require formal waste management
Anambra State Environmental Law 2024, S.228: Environmental management reports must describe waste management measures

A formal waste management plan must be developed and implemented, covering all waste streams generated at the facility: general solid waste, operational waste (used oils, filters, worn PPE, packaging), domestic wastewater, and stormwater. The plan must include documented segregation procedures, secure on-site storage for hazardous waste prior to collection, and a contract with a NESREA-licensed waste disposal contractor.

Action Steps:

- i. Conduct a waste characterisation audit to identify and quantify all waste streams.
- ii. Develop a written Waste Management Plan covering segregation, labelling, storage, and disposal for each waste stream.
- iii. Source and engage a NESREA-licensed waste disposal contractor; execute a formal service contract.
- iv. Install clearly labelled waste segregation bins at the filling shed, administrative block, and loading bay.
- v. Implement a waste tracking register recording waste type, quantity, disposal date, and contractor reference.

Success Indicator:

- i. Waste Management Plan documented within 30 days
- ii. Licensed disposal contractor contract executed within 45 days
- iii. Waste tracking register operational within 60 days

10.2.3 Standard Operating Procedures Development (Target: 60 Days)

Written Standard Operating Procedures must be developed for all critical facility operations to ensure consistent, safe, and compliant performance across all shifts and personnel. At minimum, the following SOPs must be developed:

- i. SOP 001: Bulk LPG Tanker Delivery and Offloading
- ii. SOP 002: LPG Cylinder Filling and Quality Verification
- iii. SOP 003: Storage Tank Pressure and Level Monitoring
- iv. SOP 004: Emergency Shutdown System Operation
- v. SOP 005: Fire Extinguisher and Suppression Equipment Operation
- vi. SOP 006: Diesel Fuel Handling and Generator Maintenance
- vii. SOP 007: Waste Segregation and Disposal
- viii. SOP 008: PPE Usage and Maintenance
- ix. SOP 009: Incident Reporting and Near-Miss Recording
- x. SOP 010: Environmental Monitoring Data Collection

Success Indicator:

- i. All 10 SOPs documented and approved by Day 60
- ii. All staff trained on relevant SOPs with documented confirmation

10.2.4 Enhanced Fire Suppression Capacity (Target: 90 Days)

The current fire suppression capacity should be enhanced to ensure adequate coverage for both routine operational fire scenarios and the more demanding vegetation fire/tank fire scenario. Minimum enhancements required within 90 days include:

- i. Install additional ABC (dry chemical powder) fire extinguishers to achieve a minimum of 1 unit per 15 square metres in the storage tank area and cylinder filling shed.
- ii. Install a dedicated water storage reserve of minimum 1,000 litres with fire hose reel, specifically for vegetation fire suppression, located within 20 metres of the storage tank area.
- iii. Install fixed heat detection and gas (LEL) alarm sensors in the cylinder filling shed and at the storage tank perimeter.
- iv. Ensure all fire extinguishers are inspected, tagged, and certified at least annually, with quarterly visual checks documented.
- v. Establish a formal coordination agreement with the nearest Anambra State Fire Service station, including a facility emergency information sheet shared with the fire service.

Success Indicator:

- i. Fire extinguisher coverage verified against 1/15 sqm standard within 60 days
- ii. 1,000-litre water reserve with hose reel installed within 90 days
- iii. Gas/heat detection system installed within 90 days
- iv. Fire Service coordination agreement executed within 90 days

10.3 Medium Priority Actions (90–180 Days)

10.3.1 Staff Training Certification Programme (Target: 90 Days)

All facility staff must complete a formal, certified safety and environmental training programme, with documented training records maintained in a staff training register. Training must cover LPG hazard awareness, emergency response (aligned with the ERP), fire prevention and suppression, PPE usage, environmental compliance obligations under the Anambra State Environmental Law 2024, and waste management. Designated safety

officers must complete advanced training on incident command, emergency coordination, and environmental monitoring.

Success Indicator:

- i. 100% staff trained and certified within 90 days
- ii. Training register maintained with certificate copies on file
- iii. Annual refresher training schedule established
- iv. Designated safety officer completed advanced training within 120 days

10.3.2 Environmental Management Plan Development (Target: 120 Days)

REGULATORY BASIS

Anambra State Environmental Law 2024, S.228: Environmental, Social, Health and Safety Management Plan (ESHSMP) content requirements must be met

NESREA Environmental Audit Guidelines (2024): EMP is a required outcome of the audit process

S.225(r): EMP supports the quarterly monitoring reporting requirement

A formal Environmental Management Plan (EMP) must be developed to provide a comprehensive framework for ongoing environmental management at the facility. The EMP must address all environmental aspects identified in this audit; air quality, noise, soil, water, waste, vegetation, emergency preparedness, and community engagement and must include measurable targets, monitoring schedules, responsibilities, and reporting obligations consistent with the requirements of the Anambra State Environmental Law 2024.

Success Indicator:

- i. EMP documented and approved by management within 120 days
- ii. EMP submitted to Anambra State EIA Committee for review
- iii. First quarterly EMP monitoring report submitted within 150 days

10.3.3 Operational Documentation and Records System (Target: 120 Days)

A comprehensive operational records management system must be established to capture and maintain all documentation required for regulatory compliance, environmental management, and safety performance tracking. The system must include: daily operational logs, equipment maintenance records, PRV and ESD test certificates, air quality and noise

monitoring reports, waste disposal manifests, training certificates, incident reports, and permit/licence register with renewal calendar.

Success Indicator:

- i. Records management system operational within 90 days
- ii. All historical permits and certificates filed and tracked
- iii. Permit renewal calendar established with 60-day advance action triggers

10.3.4 Community Emergency Preparedness Programme (Target: 120 Days)

A formal community engagement and emergency preparedness programme must be established to address the community safety risks identified in the risk assessment (Chapter 7). The programme must include installation of an audible emergency alarm system with coverage to at least 500 metres; formal engagement with the nearest residential communities to communicate the facility's hazard profile, emergency contact information, and protective actions; quarterly community liaison meetings; and coordination with local government and emergency services for joint emergency drills.

Success Indicator:

- i. Emergency alarm system installed within 90 days
- ii. Community notification meetings held within 90 days
- iii. First joint emergency drill with community conducted within 120 days

10.3.5 Secondary Containment for Liquid Fuel Storage (Target: 90 Days)

Secondary containment (bunding) must be installed around the diesel fuel storage area to prevent spills from reaching soil, drainage channels, or surface water. The bund must be capable of containing at least 110% of the maximum stored diesel volume. A spill kit must also be maintained adjacent to the containment area.

Success Indicator:

- i. Bunded secondary containment installed within 90 days
- ii. Spill kit in place and staff trained on spill response within 90 days

10.4 Strategic Priority Actions (180–365 Days)

10.4.1 ISO 14001 Environmental Management System Certification (Target: 365 Days)

The facility should pursue third-party certification to ISO 14001:2015 Environmental Management System standards. ISO 14001 certification will provide a structured framework for systematic environmental management, continuous improvement, and regulatory compliance demonstration and will significantly enhance the facility's credibility with regulators, customers, and the wider community. The certification pathway should include: EMS gap analysis (Month 1–2), EMS documentation development (Month 3–5), EMS implementation and internal audit (Month 6–8), pre-certification review (Month 9–10), and third-party certification audit (Month 11–12).

Success Indicator:

- i. Gap analysis completed within 6 months
- ii. ISO 14001 certificate achieved within 12 months

10.4.2 Quantitative Risk Assessment / HAZOP Study (Target: 240 Days)

A formal Quantitative Risk Assessment (QRA), incorporating a Hazard and Operability (HAZOP) study of all process equipment and operational sequences, should be conducted by a qualified process safety engineer. The QRA should include consequence modelling for fire radiation, explosion overpressure, and gas dispersion scenarios; frequency analysis for each hazard scenario; and societal risk evaluation to quantify the community impact potential. Findings should be used to prioritise risk reduction investments.

Success Indicator:

- i. HAZOP study completed within 180 days
- ii. QRA report with risk reduction roadmap completed within 240 days

10.4.3 Automatic Gas Detection System - Full Coverage (Target: 180 Days)

A permanent automated gas detection system should be installed at all critical locations within the facility: storage tank area, cylinder filling shed, tanker offloading point, and near the generator room (CO detection). The system should include visual and audible alarms with automatic notification to the Factory Manager's mobile device, and integration with the emergency shutdown system for automatic ESD actuation on high-level alarm.

Success Indicator:

- i. Gas detection system fully installed and commissioned within 180 days

- ii. System integrated with ESD and alarm within 180 days

10.5 Follow-Up Action Plan and Implementation Timeline

Table 10.1: Implementation Timeline Summary - Vinee Gas Limited Corrective Action Plan

Action	Timeline	Priority	Regulatory Basis
10.1.1 Vegetation clearance around storage tanks Establish 5 m gravel/concrete buffer zone	7 Days	X CRITICAL	NUPRC LPG Guidelines; NESREA EA Guidelines
10.1.2 Emergency Response Plan Development, training, desktop drill	30 Days	X CRITICAL	NESREA Act; NUPRC; Anambra State Law S.237
10.1.3 Anambra State Public Registry Registration Submit EA Report to EIA Committee	30 Days	X High Priority	Anambra State Environmental Law 2024, S.231
10.2.1 Environmental Monitoring Programme Baseline campaign + quarterly schedule	60 Days	Δ High	Anambra State Law S.225(r); NESREA Guidelines
10.2.2 Formal Waste Management System Plan + licensed contractor contract	60 Days	Δ High	NESREA S.I.28/2009; Anambra State Law S.228
10.2.3 Standard Operating Procedures (10 SOPs) Critical operations documentation	60 Days	Δ High	NUPRC Technical Standards; NESREA OHS
10.2.4 Enhanced Fire Suppression Capacity Additional extinguishers; 1,000 L water reserve; detection	90 Days	Δ High	NUPRC; Fire Safety Act; NESREA
10.3.1 Staff Training Certification 100% coverage with documented records	90 Days	Δ Medium	NUPRC Guidelines; NESREA OHS Regulations
10.3.2 Environmental Management Plan Full ESHSMP per Anambra State Law S.228	120 Days	Δ Medium	Anambra State Environmental Law 2024, S.228
10.3.3 Operational Documentation & Records System Permit register; maintenance logs; compliance calendar	120 Days	Δ Medium	NESREA; NUPRC; Anambra State Law

10.3.4 Community Emergency Preparedness Alarm system; community meetings; joint drills	120 Days	⚠ Medium	Anambra State Law S.237(d); NEMA Guidelines
10.3.5 Secondary Containment — Diesel Storage Bunding + spill kit	90 Days	⚠ Medium	NESREA Waste Regulations; NUPRC
10.4.1 ISO 14001 EMS Certification Gap analysis through third-party audit	365 Days	✓ Strategic	ISO 14001:2015; NESREA best practice
10.4.2 Quantitative Risk Assessment / HAZOP Study Process safety QRA with consequence modelling	240 Days	✓ Strategic	NUPRC; NFPA 58; NESREA Guidelines
10.4.3 Automated Gas Detection System Full facility coverage with ESD integration	180 Days	✓ Strategic	NUPRC Technical Standards; NFPA 58

10.6 Performance Monitoring Framework

The following Critical Success Factors define the minimum performance outcomes expected from implementation of this corrective action plan. Progress against these indicators should be reviewed monthly by the Factory Manager and reported quarterly to the Managing Director and the Anambra State EIA Committee:

- i. Reduction of vegetation fire-to-tank risk from UNACCEPTABLE to LOW within 7 days through complete vegetation clearance - the single most time-critical performance target.
- ii. Achievement of full Emergency Response Plan capability within 30 days, with documented ERP, 100% staff training, and a completed desktop drill.
- iii. Registration in the Anambra State Ministry of Environment Public Registry within 30 days, and formal submission of this Environmental Audit Report to the EIA Committee.
- iv. Establishment of quantitative baseline environmental monitoring data within 60 days, covering all parameters in Table 3.3, as the foundation for ongoing compliance demonstration.
- v. Elimination of all critical and high-priority non-compliance findings within 90 days through systematic implementation of Sections 10.1 and 10.2 corrective actions.

- vi. Achievement of 100% documented staff training coverage within 90 days.
- vii. Full Environmental Management Plan (EMP) completed and submitted to the EIA Committee within 120 days.
- viii. ISO 14001 certification achieved within 12 months, establishing a sustained environmental management framework for long-term compliance and continuous improvement.

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CHAPTER 12: APPENDICES

Appendix A: Photographic Evidence Log

The following photographs were captured during the site audit of Vinee Gas Limited, or provided by the proponent as part of the documentary evidence reviewed during this environmental audit. Each image is presented with a figure caption and audit observation noting the relevance of the photograph to the findings of the audit. The photographic log constitutes part of the official evidentiary record of this Environmental Audit, consistent with the requirements of the NESREA National Guidelines for Environmental Audit in Nigeria (2024 Revision).







Detection System



Storage Tank





Dispensing points



Overall Facility Layout

Appendix B: Required Environmental Monitoring Programme

The following table sets out the full environmental monitoring programme that Vinee Gas Limited is required to establish within 60 days of this audit report, consistent with Section 225(r) of the Anambra State Environmental Management, Protection and Administration Law, 2024 (which requires quarterly monitoring of all projects on the Mandatory List), and the NESREA National Guidelines for Environmental Audit in Nigeria (2024 Revision).

Parameter	Frequency	Monitoring Locations	Applicable Standard	Reporting Requirement
NO ₂	Quarterly	Factory premises, 50 m, 100 m, boundary	NESREA Air Quality	Quarterly report to Anambra State EIA Committee
SO ₂	Quarterly	Factory premises, 50 m, boundary	NESREA 0.1 ppm	Quarterly report to EIA Committee
CO	Quarterly	Factory premises, 50 m, generator area	NESREA 10 ppm	Quarterly report to EIA Committee
NH ₃	Quarterly	Factory premises, 50 m	NESREA 0.2 ppm	Quarterly report to EIA Committee
VOCs (incl. Benzene)	Quarterly	Filling shed, tank area, 50 m, 100 m	FEPA/NESREA 40 mg/m ³	Quarterly report — PRIMARY LPG PARAMETER
Methane (CH ₄)	Quarterly	Filling shed, tank area, boundary	NESREA 2,000 ppm LEL	Quarterly report — PRIMARY LPG PARAMETER
Noise Level dB(A)	Quarterly	Entrance, loading bay, filling shed, main road, nearest residence	NESREA 85 dB(A) S.I.35/2009	Quarterly report to EIA Committee
Soil Quality (heavy metals, pH, hydrocarbons)	Semi-annually	5 perimeter sampling points + under storage tank area	NESREA soil quality guidelines	Semi-annual report; trend analysis
Water Quality	Semi-annually	Nearest accessible borehole or surface water within 500 m	NESREA drinking water standards	Semi-annual report

Vegetation Management Inspection	Weekly (dry season); Monthly (wet season)	5 m zone around storage tanks; 10 m secondary zone	NUPRC 5 m vegetation-free zone	Weekly log maintained on-site; reviewed at monthly safety meeting
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All monitoring must be conducted by a laboratory accredited by the Institute of Public Analysts of Nigeria (IPAN) or another recognised national accreditation body. Monitoring reports must be compiled quarterly and submitted to: (a) the Anambra State Ministry of Environment (ESHSM/ EIA Committee); and (b) NESREA, as part of the facility's annual environmental performance reporting obligations. Copies must be retained on-site for a minimum of five years.

Appendix C: Corrective Action Compliance Tracking Checklist

Compliance Item	Current Status	Target Date	Responsible Person
Vegetation clearance — 5 m zone around storage tanks	X Pending	7 Days	Factory Manager
Emergency Response Plan — documented and staff-trained	X Pending	30 Days	Factory Manager / MD
Anambra State Public Registry Registration (S.231)	X Pending	30 Days	Managing Director
VOC/Methane environmental monitoring programme	⚠ Not started	60 Days	Environmental Officer
Waste Management Plan + licensed disposal contractor	⚠ Not started	60 Days	Administration / MD
Standard Operating Procedures (10 SOPs)	⚠ Not started	60 Days	Factory Manager
Enhanced fire suppression: extinguishers, water reserve, detection	⚠ Partial	90 Days	Factory Manager
Staff safety training — 100% documented certification	⚠ Partial	90 Days	Factory Manager
Secondary containment for diesel fuel storage	⚠ Not started	90 Days	Factory Manager
Environmental Management Plan (EMP / ESHSMP)	⚠ Not started	120 Days	Environmental Consultant
Operational records system and permit register	⚠ Not started	120 Days	Administration
Community emergency notification and engagement programme	⚠ Not started	120 Days	Factory Manager / MD
Automated gas detection system — full facility coverage	⚠ Not started	180 Days	Factory Manager
HAZOP / Quantitative Risk Assessment	⚠ Not started	240 Days	Process Safety Consultant
ISO 14001 Environmental Management System Certification	⚠ Not started	365 Days	Managing Director / EMS Consultant

Appendix D: Key Regulatory Contacts and Emergency Numbers

Agency / Service	Role	Contact / Action Required
Anambra State Ministry of Environment	State Regulator — EIA Committee	Submit quarterly monitoring reports; Public Registry registration; EA report submission
NESREA Zonal Office (Southeast)	Federal Environmental Regulator	Annual compliance reporting; incident notification within 24 hours; audit cycle coordination
NUPRC (Downstream Operations)	LPG Facility Regulator	Operating licence; technical standards compliance; incident reporting
Anambra State Fire Service	Emergency Response	Engage for coordination agreement; provide facility emergency information sheet; joint drills
National Emergency Management Agency (NEMA)	Major Emergency Response	Contact during major incidents (fire, explosion, significant gas release) with potential off-site impact
Nearest General Hospital / Accident & Emergency	Medical Emergency	Identify nearest A&E; maintain contact details at security post; include in ERP first aid section
Nigeria Police Force (nearest division)	Security and Crowd Control	Contact during incidents requiring public safety or crowd management
LPGSAN (LPG Safety Association of Nigeria)	Industry Safety Support	Technical safety advice; incident investigation support; industry best practice guidance

Appendix E: Glossary of Technical Terms

Term	Definition
BLEVE	Boiling Liquid Expanding Vapour Explosion — a catastrophic failure mode of a pressurised LPG storage vessel in which rapid vapourisation of the liquid contents causes explosive tank rupture, producing a fireball, shrapnel, and blast overpressure extending well beyond the facility boundary.
ESHSMP	Environmental, Social, Health and Safety Management Plan — the comprehensive environmental management document required under Part 8 of the Anambra State Environmental Management, Protection and Administration Law, 2024; also referred to as an Environmental Impact Assessment (EIA) under that Law.
ERP	Emergency Response Plan — a documented plan specifying the procedures, roles, and resources for responding to emergency incidents at the facility, including fire, explosion, gas release, medical emergencies, and natural hazards.
Fugitive Emissions	Unintended releases of gases or vapours from equipment components such as valves, flanges, connectors, and pump seals, which are not discharged through a defined emission point but escape directly into the atmosphere.
HAZOP	Hazard and Operability Study — a structured and systematic technique for identifying potential hazards and operability problems in a process system, typically conducted by a multidisciplinary team using guide words to examine deviations from design intent.
LEL	Lower Explosive Limit — the minimum concentration of a flammable gas or vapour in air below which ignition cannot occur. For LPG (propane), the LEL is approximately 2.1% by volume in air.
LPG	Liquefied Petroleum Gas — a mixture of propane and butane stored under pressure as a liquid for use as a clean-burning fuel for domestic cooking, heating, and industrial applications.
Mandatory Study List	The list of project types in Schedule 8 to the Anambra State Environmental Management, Protection and Administration Law, 2024, for which an Environmental Impact Assessment (ESHSMP) is mandatory before the project can be authorised.
NESREA	National Environmental Standards and Regulations Enforcement Agency — the Federal agency established under the NESREA Act 2007 (amended 2018) responsible for enforcing compliance with environmental laws, standards, policies, and regulations in Nigeria.
NUPRC	Nigerian Upstream Petroleum Regulatory Commission — the Federal regulatory body responsible for the technical, commercial, and environmental regulation of petroleum operations in Nigeria, including the establishment of LPG plant guidelines.
PRV	Pressure Relief Valve — a safety device installed on pressurised LPG storage vessels that automatically opens to vent excess pressure when the tank pressure exceeds a preset threshold, preventing catastrophic over-pressurisation.

VOC

Volatile Organic Compound — a carbon-containing chemical that readily vapourises at room temperature. VOCs including benzene are classified by the World Health Organization as carcinogenic substances, and are the primary air quality pollutant of concern at LPG and petroleum facilities.

Audit Certification and Sign-Off

This Environmental Audit Report for Vinee Gas Limited has been prepared in accordance with the National Guidelines for Environmental Audit in Nigeria (2024 Revision) published by NESREA, and the requirements of the Anambra State Environmental Management, Protection and Administration Law, 2024, including Sections 225, 227, 228, 231, and 237 thereof. The audit team certifies that the findings, conclusions, and recommendations contained in this report are accurate, complete, and based on objective evidence gathered during the audit process.

For and on Behalf of the Audit Consultant	For and on Behalf of the Proponent
Name: Engr. George Okoye Title: Lead Environmental Auditor Organisation: Unic Concepts Limited	Name: _____ Title: Managing Director Organisation: Vinee Gas Limited
Signature: _____	Signature: _____
Date: _____	Date: _____
For and on Behalf of the Anambra State Ministry of Environment:	
Name: Dr. Mrs. Ifeoma Onyekwere Title: HOD, Ecology and Environment Department	
Signature: _____	Date: _____