ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED GRANITE QUARRY (34082QL) IN HUGUNGUMAI VILLAGE, KUNCHI LGA KANO STATE

BY

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LIST OF ABBREVIATIONS AND ACRONYMS

BOD	Biochemical Oxygen Demand
BP	Bank Policy
CBO	Community-Based Organization
CDA	Community Development Agreement
CDD	Community-Driven Development
CSO	Community Support Organizations
CITES	Convention on International Trade in Endangered Species of Wild fauna & flora
DO	Dissolved Oxygen
DS	Dissolved Solids
DSS	Department of State Security
DPO	Divisional Police Officer
EA	Environmental Assessment
EAR	Environmental Audit Report
ESA	Environmentally Sensitive Areas
ESIA	Environmental & Social Impact Assessment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ESMF	Environmental and Social Management Framework
FRDP	Federal Roads Development Project
FGN	Federal Government of Nigeria
GIS	Geographic Information System
HC	Hydrocarbon
HSE	Health Safety and Environment
IEE	Initial Environmental Examination
HIV/AIDS	Human Immuno-deficiency Virus/Acquired Immune Deficiency Syndrome
IDA	International Development Association
LB	Land Bureau
LGA	Local Government Area
LVO	Land Valuation Office
LFN	Laws of the Federation of Nigeria
MDAs	Ministries, Departments & Agencies
MDG	Millennium Development Goals
MIGA	Multilateral Guarantee Agency
MOE	State Ministry of Environment
MoH	State Ministry of Housing
NGO	Non-Governmental Organization
NS	Not Specified
OD	Operational Directives (of the World Bank)
NGO	Non-governmental Organization
OP	Operational Policy
PPE	Personal Protective Equipment
KASEPPA	Kano State Environmental Planning and Protection Agency

SMEnv	State Ministry of Environment
SPM	Suspended Particulate Matter
TDS	Total Dissolved Solids
TOR	Terms of Reference
TSP	Total Suspended Particulate

UNITS OF MEASUREMENT

cfu/ml	Colony forming unit per millilitre
cm	Centimetre
dBA	Decibel
ft	Feet
g	Gramme
k	Kilogramme
g/cm	Gramme per Centimetre
Km	Kilometre
m	Meter
m^3	Meter Cube
meq	Milliequivalent
mg	Milligramme
mg/Kg	Milligramme per Kilogramme
mg/l	Milligramme per Litre
ml	Millilitre
mm	Millimetre
m/s	Meter per Second
NTU	Turbidity Unit
o/oo	Parts per thousand
oN	Degree North
Ph	Hydrogen ion concentration
ppb	parts per billion
ppm	parts per million
ToC	Temperature in degrees Celsius
µg	Microgramme
µS	micro-Siemens
µm	micrometre
%	Percentage

CHEMICAL ELEMENTS AND COMPOUNDS

Al	Aluminium
C	Carbon
Ca	Calcium
$CaCO_3$	Calcium Carbonate
CCl_4	Carbon Tetrachloride
Cd	Cadmium
Cl	Chloride
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Cr	Chromium
Cu	Copper
Fe	Iron
H	Hydrogen
H_2O	Water
H_2S	Hydrogen Sulphide
Hg	Mercury
K	Potassium
Mg	Magnesium
Mn	Manganese
N	Nitrogen
Na	Sodium
Na_2PO_4	Sodium phosphate
NaOH	Sodium hydroxide
NH_3	Ammonia
NH_4+	Ammonium ion
NH_4F	Ammonium fluoride
Ni	Nickel
NO_2 -	Nitrite ion
NO_3-	Nitrate ion
NOX	Nitrogen Oxides
O_2	Oxygen
P	Phosphorus
Pb	Lead
PO4	Phosphate
SiO_2	Silicate
SO_2	Sulphur dioxide
SO_4	Sulphate ion
V	Vanadium
Zn	Zinc

ORGANISATIONS

APHA	America Public Health Association
FEPA	Federal Environmental Protection Agency
FMEnv	Federal Ministry of Environment
FMW	Federal Ministry of Works
UNEP	United Nations Environmental Programme
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
WB	World Bank
WHO	World Health Organization
KNSG	Kano State Government
MSMD	Ministry of Solid Minerals Development

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EXECUTIVE SUMMARY

General/Overview of the Project

This report presents the Environmental and Social Impact Assessment (ESIA) forthe proposed Granite Quarry Plant by Eso Terra Investment Limited. Eso Terra Investment Limited provides raw materials such as granite aggregates to construct the Kano Maradi railway tracks. The proposed granite quarry covers an area of about 83,500 m^2. The ESIA of the proposed project was conducted following the statutory requirements for environmental management in Nigeria, which include the EIA Act CAP E12 LFN 2004, the Federal Ministry of Environment (FMEnv) Sectoral Guidelines for quarry/mining projects (1995), the Nigerian Minerals and Mining Act, (2007), and the Nigerian Minerals and Mining Regulations, 2011. Though the proposed site has already been exposed to active mining by the previous site owner (Dantata & Sawoe Construction Limited) and currently artisanal mining is ongoing however, the process to acquire relevant environmental permits is initiated by Eso Terra to examine both the positive and negative effects that the proposed project is likely to have onboth the physical and socioeconomic environment to allow sound decision making to promote human activities that align synergistically with the natural world within a sustainable development framework. The project was to provide essential raw materials such as gravel, granite and other products needed to construct the Kano-Maradi Rail project. The new "standard gauge" Kano-Maradi railway line has an approximate length of 393km. The railway line connects the three Federal States of Kano, Jigawa and Katsina with the city of Maradi in (Republic of the Niger).

Objectives of the ESIA

The objectives of the ESIA for the proposed project are to:

- Provide information on the quarry's environment's current ecology (ambient air quality, soil, fauna, flora, microorganisms, biological diversity, surface water, groundwater, geology, hydrogeology).
- Determine the project's environmental impacts, including its effect on the community's socio-economic and socio-cultural activities.
- Examine the health situation of the human population around the project site

- Examine and assess the significant potential and associated impacts of all activities and auxiliary facilities in all project phases (mobilisation, site preparation, construction, operation, abandonment) on the natural, social and health environments.
- Provide recommendations for mitigating identified adverse impacts and enhancing beneficial impacts of the project.
- Develop an environmental management plan for implementing mitigation measures and an environmental monitoring plan for monitoring efficiency.

Specific Project Objectives

The main objective of this project is to extract granite materials by drilling and blasting the body of rocks into smaller units of specific sizes through quarrying. These units of rocks are further crushed into materials and aggregates to feed the construction activities of the Kano-Maradi Rail project. The project's economic sustainability depends on the Kano-Maradi rail project, although the quarry can source and service other markets beyond it.

Project Location

The proposed granite quarry project is located within the Hugungumai community in Kunchi Local Government Area (LGA) of Kano State, Nigeria. The host community (Hugungumai) is about 2.5km southwest of Kunchi LGA Headquarters. The Granite Quarry project is located within the acquired property by Eso Terra Investment Limited, with a central geographical coordinate of 12°25’45” N and 8°13’45"E and an elevation of 510m above sea level.

Need for the Project

Eso Terra Investment intends to efficiently participate in converting rocks into usable materials for society by converting rock deposits into sand, gravel, granite, and other products that would be used for the Kano—Maradi railway project and different construction purposes within and around Kano state. This will, in turn, help convert our natural resources into something useful to man.

Benefits of the Project

During operation, the benefits of the quarry are numerous and cannot be over-

emphasized. Some of the benefits of the project include:

- Provision of granite to support the construction and operation of Kano-Maradi Rail Line
- Convert natural resources into material usable by man.
- Production of sand, stones, gravel, granite, and other products.
- Provide employment opportunities for many skilled and unskilledNigerians, especially those from the host communities.
- Enhancement of the provision of basic social amenities to the host communities.
- Poverty alleviation through increased derivation of funds to local and state governments.
- Promote a good relationship between Eso Terra and the host community through increased socioeconomic assistance.

Legal and Institutional Regulatory Framework

The ESIA of the proposed project was conducted in compliance with a comprehensive legal and regulatory framework. This framework, which encompasses national, international, and Kano State laws and regulations, includes: The EIA Act CAP E12 LFN 2004 and the Federal Ministry of Environment (FMEnv), The National Effluent Limitation Regulation, S.I.8 of (1991), Pollution Abatement in Industries, Industries Generating Wastes Regulation, (1991, (No. 42, Vol. 78, August, (1991), The management of hazardous and solid waste regulation, S.I.15 of (1991) (No. 102, Vol. 78, August, (1991), Land Use Act (CAP L202 LFN) (2004), The Penal Code Act. The Federal Republic of Nigeria, CAP 53 LFN, (2004), National Effluent Limitation Regulation, S.1.8 (1991), National Pollution Abatement in Industries and Facilities Generating Wastes Regulation, S.I.9 (1991), National Environmental Protection (Management of Solid and Hazardous Waste) Regulation, S.I.15 (1991), National Environmental Standards and Regulation Enforcement Agency (NESREA) Act (2007), The Nigerian Minerals & Mining Act (2007), Nigerian Minerals and Mining Regulations (2011), The Labour Act, CAP L1 LFN (2004), The Nigerian Urban and Regional Planning Act CAP N138 LFN 2004, Public Health Law CAP 103 LFN 1990, Kano State Environmental Planning and Protection Agency (KASEPPA), Edict No. 15 of 1990.

Project Description/Components

The quarry project's key components are divided into two zones: the blasting zone (drilling and blasting) and the production zone (admin, crushing, stockpiling, material, and explosive stores).

The critical activities for the proposed development of the Quarry are:

- Mobilize the site for bush clearing and water extraction from the quarry pit.
- Site preparation with earth-moving equipment and vibrators: stumping,levelling, and site consolidation.
- Erection of foundation support for the quarry.
- Construction of office buildings
- Installation of quarry accessories
- Demobilization

Table ES1: Waste Types & Management– Operational Stage

WASTE TYPE	MANAGEMENT METHOD
(Regulated Waste)	
Oily sludge, absorbent, degreaser, grease, oily rags, and oil filters	Collected on-site, then transported off-site
(Regulated Waste)	To a designated waste dump facility for recycling or treatment and disposal.
Waste oil and containers	Drained on-site with collection drums transported off-site by the waste contractor for off-site re-use, recycling, or disposal.
Scrap metal	Segregation and storage on-site in open storage bins. Transportation off-site by a waste contractor for off-site recycling
General wastes - putrescible and organic	To minimise the attraction of vermin and pests, putrescible waste will be stored in a sealed and covered bin and disposed of off-site weekly.
General wastes - plastics	Collection on site and stored in a segregated area. Transportation from the site to a government-approved waste facility.
Explosives	No waste explosive produced on site.
Recyclable waste - paper, cardboard, plastics, glass, and aluminium cans	Collect recyclable products segregated according to Eso Terra Limited recyclable material collection arrangements in appropriate containers.
Diesel & solvents	Recycle through an approved licensed waste collection agency.
Hazardous waste paints and resins	Collection on site and stored in a segregated area.

	Transported off-site by a licensed, regulated waste transporter to a licensed facility for treatment and disposal
Tyres	Truck tyres can sometimes be re-treaded, and Earthmover tyres can be re-used as bunding around the site. Light vehicle tyres will be stored on-site and transported from the site by the original supplier or a licensed, regulated waste transporter to a licensed facility for recycling or disposal.
Vehicle batteries	Dead batteries shall be removed from the site by the battery supplier. Batteries not removed by the supplier shall be stored on-site for collection and disposed of as regulated waste by a certified regulated waste contractor.
Sewage waste and sludge	Wastes will be collected on-site into a septic tank and evacuated for disposal at a landfill facility approved by KNSG.
Crusher lubricants	Collected on-site and transported off-site by a licensed, regulated waste transporter to a licensed facility for recycling, treatment, and disposal.
Heavy Mobile Equipment (HME) Lubricants	Collected on-site, then transported off-site to a designated waste dump facility for recycling, treatment, and disposal.
Crusher wear liners (cast manganese steel)	Collected on-site, then transported off-site to a designated waste dump facility for recycling, treatment, and disposal.

Study Approach

The approach was to obtain ecological and social baseline data from desktop, field and laboratory studies, interviews and consultations with the relevant stakeholders, individuals, etc. It is hoped that this approach provides adequate information for establishing the baseline status of the environment of the project area. Therefore, the project's potential environmental impacts are measured, mitigative measures are proposed, and an environmental management plan (EMP) is rightfully developed. Field assessments included but were not limited to the following: air, water, and soil quality assessment, vegetation mapping and characterisation (including health status), animal resources, socio-economic/social assessment, and health impact assessment, which were adequately addressed.

Flora and fauna were identified through visual observations, hearing animal calls, and examining footprints, remains, etc. These are followed by interpretations and discussions of results and a report on the flora and fauna species in the area. The field

assessment/data gathering runs from 7th November 2022 to 20th November 2022 for a single season, covering only a spatial boundary of 600m and 2km for environmental media and socioeconomic assessment. The sampling collations are as follows:

Air quality assessment in 11 locations plus a control location in and around the project site.

- Noise level assessment in 11 locations plus control in and around the project site.
- Soil sample collection from 11 locations plus control in and around the project site (encompassing Topsoil and Subsoil).
- Surface water sample collection from 2 different quarry pits located within the project area
- Underground water sample collection from a well in Hugungumai Community. Samples were transferred into proper preservation containers and transported tothe Kano State Ministry of Environment Pollution Control laboratory, where they were placed in freezers for analysis.

Description of the Environment

Regional Climate/Meteorology

The study area is in the semi-arid climatic zone of Nigeria and is characterised by two distinct seasons: the hot, dry season and a cool, rainy season. Nigeria's climate is characterised by the hot and wet conditions associated with the Inter-Tropical Convergence Zone (ITCZ) movement north and south of the equator. This Inter-Tropical Convergence Zone (ITCZ) appears as a band of clouds, usually thunderstorms, that circle the globe near the equator, and Nigeria is located just north of the equator.

The project area is within the tropics, dominated by two contrasting seasons,the dry and wet (rainy) seasons. The two season regimes depend on the twoprevailing air masses blowing across the country at various times of the year, the south-westerly humid maritime air mass blowing from across the Atlantic and the north-easterly air mass of Saharan origin, i.e., Harmattan. Kunchi's wet season is oppressive and mostly cloudy; the dry season is partly cloudy and hot year-round. Over the course of the year, the temperature typically varies from 13.89°C to 38.89°C and is rarely below 11.67°C or above 41.11°C.

Ambient Air Quality Assessment

The pollutants monitored concerning air quality are nitrogen dioxide (NO_2),sulphur dioxide (SO_2), suspended particulate matter (SPM), ammonia (NH_3), hydrogen sulphide (H_2S), carbon monoxide (CO), and methane (C_2H_4), carbon- dioxide (CO_2) Chlorine (Cl2), Phosphine (PH_3), Total volatile organic compounds (TVOC), formaldehyde (HCHO), hydrogen cyanide (HCN). Ambient SPM levels in the study area ranged from 001 to 004 mg/m³. These recorded values were above the FMEnv daily average maximum limit permitted of 0.25 mg/m³ (FMEnv, 1995). Ambient NO_2 levels in the study area were 0.2 ppm-1.1 ppm across all sampling stations. The concentration falls above the regulatory limit of 0.06 ppm. The high concentration may be because of the bean plants within the project area. Other parameters fall within the regulatory limit.

Noise

In all the sampling points, noise levels measured ranged between 48.4 and 63.9 (dBA) and were below the tolerable limit or noise level zone that could cause annoyance or pollution. The values were within 90dBA stipulated by the FMEnv and WHO.

Surface and Groundwater Physio Chemistry

Water samples were collected from two quarry pits (KQW1 and KQW2) within the site representing surface or open water sources and a well in Hugungumai community (KQW3) for the groundwater source. The Groundwater sample was colourless and transparent, while the quarry pits water samples were cloudy and light greyish.

The pH of the water samples from the quarry pits was slightly alkaline; the value was inconsistent with the underground water sample, whose pH was slightly acidic. The electrical conductivity of the water samples (KQW1, KQW2 and KQW3) was 152 µS/cm, 235 µS/cm, and 1062 µS/cm, respectively. These values were consistent with the corresponding TDS value of the water samples. Most underground water contains more dissolving solids than surface water, leading to high conductivity levels. The permissible EC level by FMEnv was set for 1000 µS/cm. The concentrations of the heavy metals fall within the regulatory limit except for the concentration of Zinc in the two open water sources from the quarry pits (KQW1 and KQW2), with values above the regulatory limit.

The microbial analysis of the water samples shows the presence of E. coli in two samples,

KQW1 and KQW2, while E. coli was absent in KQW3. The total coliform count was 0 Cfu/ml for KQW1 and KQW3, while KQW2 recorded 1 Cfu/ml.

Soil Physio-Chemistry

The soils of the study area varied from moderately alkaline to slightly alkaline, with a pH ranging from 7.9 to 9.0. The alkalinity could be attributed to the leaching loss of exchangeable anions. The textural distribution of the soil samples of the site area ranged from clay soil to sandy loam soil, while the colour ranged from grey, brown, to deep brown. The sandy and clayed nature of the soil is associated with the soil grain size. The salinity level raged from 6.3-19.1mg/kg with a conductivity level ranging from 801-4001. The moisture content of the soil samples was low. This is associated with the period the samples were collected (Dry Season). The concentration of Nitrite, Nitrate, Sulphate, Nitrogen and Chlorine ranged from SO42- (0.00- 0.1 mg/kg), NO3 2- (10.7-23.7 mg/kg), N2 (1.9-8.1 mg/kg) and Cl2 (0.6-3.0 mg/kg). Meanwhile, NO22- (0.00 mg/kg) was found across all three samples.

The concentrations of copper, cadmium, nickel, mercury, zinc, and iron were low except for the zinc concentration, which ranged from 0.3 to 3 mg/kg. The soil samples' organic content (TPH, benzene, xylene, toluene, PAH, and Oil and Grease) was 0.0 mg/kg across the board.

Geology

The study area falls within the Pre-Cambrian crystalline basement complex of the central part of Nigeria, consisting of a migmatite-gneiss-granite sequence, which forms a distinctive unit of granitic intrusion within the Basement. The area is underlain by granites of various degrees of crystallisation, ranging from fine grains to porphyritic. The Lithology of the rock in the proposed quarry is biotite granite. The texture of the rocks is fine to coarse grain size to porphyritic; physical mineral composition includes quartz, feldspars, and biotite/muscovite mica. Field observation and measurements reveal structural interplay in the area, and observed structural elements appear co-axial with NE-SE and NW-SE trends. The prominence of micro faults will make the blasting work easier and provide a good prospect for aggregate production. Laboratory Analysis and Geotechnical Tests were conducted for the rock sample. The laboratory test is comprised of an analysis to determine the composition of the rock within the Eso Terra site.

Biodiversity

The biodiversity study was carried out to assess the area's vegetation and wildlife composition.

Vegetation studies were carried out within the project site and the neighbouring community of the project site to determine the species composition, diversity, and population of plant species. The plant community structure was observed, and the species within each quadrant were identified. Unidentified plant species' floral and vegetative parts were collected, pressed in the field with herbarium press, and taken to the laboratory for herbarium. A total of 9 plant species were encountered in the area as the predominant vegetation of these areas is characterised by a continuous scanty tree (66.7%), shrubs (11.1%) and grass/herb (22.2%) cover that is characteristic of Sudan Savanna and an occasional collectionof dense tree/shrub strata. The average height of the trees across the area is between 8m-13m. *Balanites aegyptiaca*, *Bauhinia thonningii* and *Parkia biglobosa* dominate the project site, while in residential areas, non-indigenous species, specifically Azadirachta indica, are the most dominant species. The presence of Eichhornia crassipes and Zannichellia palustris characterised the ponds in the sites. Trees are used to create shelter belts around farms, while tree branches are used to fuel wood. Interviews with hunters also provided further information on the wildlife diversity abundance and use in the area. The conservation status of the wildlife species was also considered to determine whether this species needs any form of conservation or is on the International Union for Conservation of Nature (IUCN) red list. The common wildlife around the site were white egrets, agama lizards and frogs.

Socioeconomics

The study was designed to obtainall relevant socio-economic and health data on the community from primary and secondary sources. The questionnaire was administered to 40 households in the study area, and 32 were retrieved. The questionnaires were administered to willing households selected randomly from the community. Focused Group Discussions (FGDs) and interviews were also held in the study area. Respondents to the questionnaire and participants in the FGDs and interviews were all 18 years and above. The FGDs and consultations took place at the Hakimi palace in Hugungumai alongside his subjects and at the office of the Chairman Kunchi LGA with the chairman in attendance and other interested groups from the community. The consultation with

the security agents (Nigerian Police) also took place at the police command; all these consultations were held on the 7th and 8th November 2022.

The study revealed that about 22% of the sample population were females, while about 78% were males. The study also projects the diverse nature of the respondents in the area whereby 32% engaged in trading activities while other forms of occupation such as farming 43%, artisans 17%, civil servants 6% and others 2%. The study also looked at the monthly income of respondents within the proposed project area ranging from < ₦5, 000-₦10,000 (8.4%); ₦10,000-₦15,000 (13.1%); ₦15, 000-₦20,000 (15%) ₦20, 000-₦ 30,000 (21.7%) and above ₦ 30,000 (41.8%); and the prevalence disease in the area is fever, malaria, and rheumatism among aged groups. Members of these communities expressed their concerns about the proposed project.

These concerns bordered on perceived effects ontheir environment, livelihood, and health. They also acknowledged that the project would bring development to the area.

Potential and Associated Impacts

The proposed quarry had significant positive (beneficial) and adverse (negative) impacts on the area's ecology, society, and health. The associated and potential significant beneficial impacts are included.

- Improvement of the economic status of landlords and traditional rulers through payment of adequate compensation.
- Mining and producing chippings of assorted sizes will generate revenue for the government and support the Kano-Maradi rail line.
- Contribute to the country's general economic growth as it would positively or indirectly affect some sectors of our country directly or indirectly.
- Creation of employment opportunities for both skilled and unskilled labour that will be employed at distinct phases of the project.
- Increase in socioeconomic activities in the host community due to purchasing chippings and other associated activities.
- Chippings of assorted sizes will be available to construct theKano-Maradi rail line.
- There will be a transfer of technical knowledge in the mining industry to Quarryworkers.

The associated and potentially significant adverse impacts of the proposed project include but are not limited to the following:

- Increase in the ambient noise level in the area above baseline values due to noise generated during the drilling of holes.
- Vegetation cover removal destroys the natural habitat of soil flora and fauna and hinders wildlife migration.
- Security problems due to community interference and conflicts.
- Injury to personnel (surveyors) due to exposure to wild bushes and animals.
- Injury/death/assets damage due to accidents during dumping of materialsfrom the point of generation to the feed hopper.
- Increased traffic volume/delays due to the daily movement of work trucks and personnel to the site.
- Negative effects on air quality due to emission of atmospheric pollutants (COX, NOX, etc.) from internal combustion engines/exhausts during personnel movement.
- Changes in drainage and hydrological patterns may result in erosion and flooding in the area.
- Soil compaction due to heavy vehicle movement and excavated material will affect the diversity of soil fauna within the area and alter drainage patterns.
- Increase in population leading to transmission of infectious diseases, especially sexual transmission infections.
- Pollution of soil and groundwater sources around the facility.

Mitigation of Potential and Associated Impacts

Appropriate mitigation measures have been proposed to reduce this potential and associated impacts to As Low as Reasonably Practicable (ALARP), as presented in Table ES2. All the impacts related to the proposed project were reduced to Low after mitigation. This is based on the following:

- The area proposed for the quarry is a secondary forest with very sparse vegetation and wildlife. Thus, the impact on biodiversity is minimal.
- Design, firefighting, and ancillaries, which will be installed within the facility yard, will adequately address issues associated with fire outbreaks and safety

risks.

- Eso Terra Investment Limited management shall ensure adequate and continuous consultation and interaction with the property owners and the entire community to prevent crises arising from the acquisition of the quarry site.

Table ES2. Summary of Mitigation of the Potential and Associated Impacts

	Project Phase	Project Activity	Environmental Component	Potential and Associated Impact	
Planning & Pre-Operation	Site Acquisition	Land take	Flora and Fauna, Land use	Restriction of access by the proposed quarry to Hugungumai inhabitants and neighbouring communities	
			Socioeconomic	Improvement of the economic status of landowners in the Hugungumai community, such as farmers, artisans and traditional rulers, through payment of compensation & livelihood restoration program	
				Security challenges are due to the influx of workers to Hugungumai and other areas in Kunchi LGA, including the possibility of kidnapping and community disputes.	
				Conflicts due to the displacement of Hugungumai artisanal miners from their source of livelihood.	
				Conflict due to an unsatisfactory compensation process	
		Site Survey	Personnel Health & Safety	Risk of injury to personnel due to exposure in the bushes	
	Mobilisation to site	Transportation of equipment/materials/personnel to worksite		Increased traffic volume on the road linking Kunchi, Bichi and Kazaure LGAs	
				Risk of injury, death, asset damage due to road traffic accidents and incidents	
			Air quality and personnel Safety	Adverse effects on the air quality of Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	
	Quarry Development	Site Clearance	Flora and Fauna, Land use	De-vegetation of the 34082 QL area and loss of local flora and economic trees	
		Stripping of topsoil and compaction of same with	Soil and Water	Changes in drainage and hydrological patterns may result in erosion and flooding in and surrounding the 34082 QLS quarry area.	

		earth-moving equipment within the proposed project location	Air Quality and Personnel Safety	Adverse effects on air quality in Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	
		Construction of Quarry (Quarry Plant Offices, Base camps)	Soil	Soil compaction caused by heavy vehicle movement and excavated material will affect the diversity of soil fauna within the area and alter the drainage pattern.	
			Health (Radiation and Heat) of workers	Welders exposed to heat and light radiation, heat rashes, welding flashes leading to eye diseases	
			Socioeconomic and Health Impact	An increase in population leads to the transmission of infectious diseases, especially sexual transmission infections.	
				Community conflicts resulting from labour and recruitment issues and compensation leading to security problems	
				Creation of job opportunities for locals in Kunchi LGA and neighbouring areas	
			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_X, NO_X, etc.) from earth-moving equipment and localised increase in background noise level	
Quarry Operation	Rock Operation (Extraction)	Overburden removal to expose rock, pit development, and hole drilling with the use of drill wagons	Soil and Water	Pollution of soil and groundwater sources around 34082QL quarry from improper management of wastes	
		Blasting and loading broken or disintegrated rock with excavators into dump trucks and conveyed to the crushing machine.	Socioeconomic (Health and Safety, Assets, Security)	Risk of injury, death, and asset damage due to accident associated with quarry operation	
				Increased demand for existing community health and sanitation infrastructure due to the influx of mine workers and camp followers.	
				Threats to community health and safety, including the risk of infectious diseases such as STDs, including HIV/AIDS, from the influx of mine workers	
				Indiscriminate disposal of sanitary and domestic wastes during drilling and other operations.	
				Management of explosives to ensure no leakages of material.	
				Damage to community assets as a result of blasting (crack in the building)	

			Air Quality & Noice	Localised increase (above baseline values stated in sections 4.7 and 4.6) in ambient concentrations of air pollutants (NO_2, SOx, COx, C_xH_y, H_2S, & SPM)—noise and vibration from machines and blasting.	
			Soil, Flora/Fauna and Water	Damage to ecological resources and environmental degradation by spillages during fuelling of drilling Machines.	
				Wildlife migration due to noise and vibration, exposure of soil to weather conditions, fauna habitat loss and injury to wild animals	
			Geology and Hazard	Risk of geological hazards such as ground quivering, land subsidence	
		Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening. Stockpiling		Structural damage to nearby buildings.	
	Rock Crushing Stage	Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening. Stockpiling	Socioeconomic (Health and Safety)	Injury/death/assets damage due to accidents during dumping of materials from the point of the quarry to the feed hopper. Reduction in cases of dumping of materials within and around crushing locations.	
		Haulage of granite aggregates to the required area along the railway alignment		Increased traffic volume/delays due to the daily movement of work trucks and personnel to the site	
				Risk of injury, death, and asset damage due to road traffic accidents and incidents	
			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, PM2.5, PM10, NO_X, etc.) from internal combustion engines/exhausts during personnel movement	
		Maintenance and general operations of the facility	Soil and Water	Pollution of soil and groundwater sources around the facility from improper management of wastes meant for incineration and ash residue.	
				Risk of the improperly abandoned quarry site, e.g. drowning of humans and animals, particularly children, in mining pits, environmental degradation, etc	

			Socioeconomic (Health and Safety)	Fire outbreak, destruction of facility, loss of life of personnel due to malfunctioning of facility or operators' fault	
				Health-related hazards on operational staff due to constant inhalation of crushing materials	
				Kidnap/forceful abduction of operation staff	
Post Quarry Operation	Demobilisation (Movement of vehicles and personnel)	Transportation of equipment, materials, and personnel to worksite	Socioeconomic (Health and Safety)	Increased traffic volume and delays due to daily movement of trucks and personnel along the Hugungumai road and major roads connecting the area	
				Risk of injury, death, and asset damage due to road traffic accidents and incidents	
			Air Quality & Noise	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from earth moving Equipment and localised Increase in background noise level	
	Decommissioning/Abandonment	Decommissioning /abandonment and ancillary facilities	Soil and Water	Soil and groundwater contamination from wastes abandoned at the site	
			Socioeconomic (Health and Asset)	Risk of poor management of decommissioned facilities	
				Availability of land for alternative uses	

Environmental and Social Management Plan

Cost-effective Environmental Management and Monitoring plans were developed to ensure that the adverse (negative) environmental impacts identified in this impact assessment are effectively remediated and continuously monitored. The plans included Action Party, Timing of Mitigation, Parameters to be Monitored, Responsible Party, and Monitoring Frequency and Cost Implications of the plans, presented in Table ES3.

Table ES3. Summary of the Cost-Effective ESMP

Item	Responsibility	Cost Estimate	Cost Estimate
		NGN (₦)	USD ($)
Mitigation	Eso Terra	₦10,000,000.00	$6,666.67
Monitoring	FMEnv, MSMD, Kano State Departments/Ministries, Consultancy for Compliances	₦64,500,000.00	$43,000.00
Capacity Building	Eso Terra Management, Community Leaders/CBOs /NGOs	₦10,250,000.00	$6,833.33
Grievance Redress	Eso Terra Management,	₦7,527,500.00	$5,018.33

Mechanism	Grievance Redress Committee		
Community Development Agreement/CSR	Eso Terra, FMEnv, Kunchi LGA	₦85,000,000.00	$56,666.67
Environmental Protection & Rehabilitation Plan	Eso Terra, MSMD, FMEnv	₦120,000,000.00	$80,000.00
Sub- Total		**₦297,277,500.00**	**$198,185.00**
Contingency (Add 5% of Sub Total)		**₦14,863,875.00**	**$9,909.25**
Total		**₦312,141,375.00**	**$208,094.25**

Conclusion

This project's social and economic rating is highly positive compared to the preceding analysis. Evaluation of alternatives has already shown that options are limited and not productive. Already, the proponent has sunk a substantial amount of time and commitment to the project. A further delay of the project is denying all stakeholders the anticipated benefits. Redesigning or relocation will lead to a loss of time and money that is already tied to the preliminary costs of the project. The project does not pose any severe and negative environmental impacts. Adequate mitigation measures have been proposed to address any of the adverse effects arising from the project. It is observed and established that most negative impacts on the environmentare rated low and short-term with no significant effect. The positive impacts are highly rated and will benefit all stakeholders and residents. The project proponents have proposed to adhere to prudent implementation of the environmental management plan as advised by the expert. They are obtaining all necessary permits and licenses from the relevant authorities and have qualified and adequate personnel to do the project as proposed.

CHAPTER ONE

INTRODUCTION & BACKGROUND INFORMATION

1.1 General/Overview of the Project

Quarrying activities in Nigeria are a significant sector that contributes positively to supporting local construction. However, the quarrying process has some safety, environmental, and socio-economic concerns that must be addressed.

To comply with the Federal Ministry of Environment (FMEnv) and Ministryof Mines and Steel Development statutory provisions, Eso Terra Investment Limited commissioned Snafhcore Limited to conduct an Environmental and Social Impact Assessment (ESIA) of the proposed stone quarry operations at Hugungumai, KunchiLocal Government Area (LGA) of Kano state. The proposed quarry covers a total land cadastral of about 83,500m^2 and has a Quarry Lease Number of 34082QL in the Hugungumai Community.

Environmental and Social Impact Assessment (ESIA) is considered part of environmental planning. ESIAs are undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority. This report presents the Environmental Social Impact Assessment (ESIA) for the proposed Granite Quarry plant by Eso Terra Investment Limited. Though the proposed site has already been exposed to active mining by the previous site owner (Dantata & Sawoe Construction Limited) and currently artisanal mining is ongoing however, the process to acquire relevant environmental permits, which Eso Terra initiates to examine both the positive and negative effects that the proposed project is likely to have on. To obtain adequate environmental permits, Eso Terra seeks to investigate the positive and negative impact the proposed project is expected to have on both the physical and socioeconomic environment to allow sound decision-making to promote human activities thatalign synergistically with the natural world within a sustainable development framework. The project was to provide essential raw materials such as gravel, granite and other products needed to construct the Kano-Maradi Rail project. The new "standard gauge" Kano-Maradi railway line has an approximate length

of 393km. The railway line connects the Three Federal States of Kano, Jigawa and Katsina with the city of Maradi in (Republic of the Niger). Thus, this study conducted broad stakeholder participation. It is an important planning tool for the project proponent as it will outline any significant project impacts and clearly define mitigation measures to avoid or curb any adversities. The proposed mitigations have taken into consideration the concerns of various stakeholders.

The proposed project's ESIA was conducted following the statutory requirements for environmental management in Nigeria, which include the EIA Act CAP E12 LFN 2004, the Federal Ministry of Environment (FMEnv) Sectoral Guidelines for quarry/mining projects (1995), the Nigerian Minerals and Mining Act (2007), and the Nigerian Minerals and Mining Regulations, 2011, the World Bank guideline, and AfDB's Integrated Safeguards Systems (ISS).

1.2 Project Objectives

The main objective of this project is to extract granite materials within the project site, which will be done by drilling and blasting the body of rocks into smaller units of specific sizes. These unit's rocks are further into aggregates and by loading and conveyed to another crusher within the project area. This activity will be followed by the transportation of the crushed materials to feed the construction activities of the Kano-Maradi Railway project track. The Kano-Maradi railway project is the new "standard gauge" Kano-Maradi railway line with an approximate length of 393 km. The railway line connects the Three Federal States of Kano, Jigawa and Katsina with the city of Maradi in (Republic of the Niger). The economic sustainability of the project is dependent on the Kano-Maradi rail project. However, the quarry can source and service other markets beyond the Kano–Maradi railway project.

1.3 Project Location

The proposed Granite Quarry project shall be located within the acquired propertyby Eso Terra Investment Limited with geographical coordinates of the entire perimeter CB1: 12°25'30" N and 8°13'45"E, CB2: 12°26'00"N 8°13'45"E, CB3: 12°26'00"N 8°13'15"E, CB4: 12°25'30"N 8°14'15"E in Hugungumai community, Kunchi Local Government Area, Kano State (Figures 1.2 and 1.3), Nigeria (Figure 1.1). The community within which the quarry is located is about 2.5km southwest of Kunchi LGA headquarters. The quarry site is located at the Northeastern Part of Hugungumai

community with about 1km distance to human dwelling. The Federal Republic of Nigeria, the host nation, covers an area of 923,768 km^2 in Africa. It lies in the tropics between latitudes 4^{o}N and 14^{o}N and longitudes 3^{o}E and 14^{o}E. Kano State – where this project's study area is located, is in the inland region, specifically in the Northwestern part of Nigeria. Kano State borders Katsina State to the northwest, Jigawa State to the northeast, and Bauchi and Kaduna State to the south.

Figure 1.1. Map of Africa Showing Nigeria.

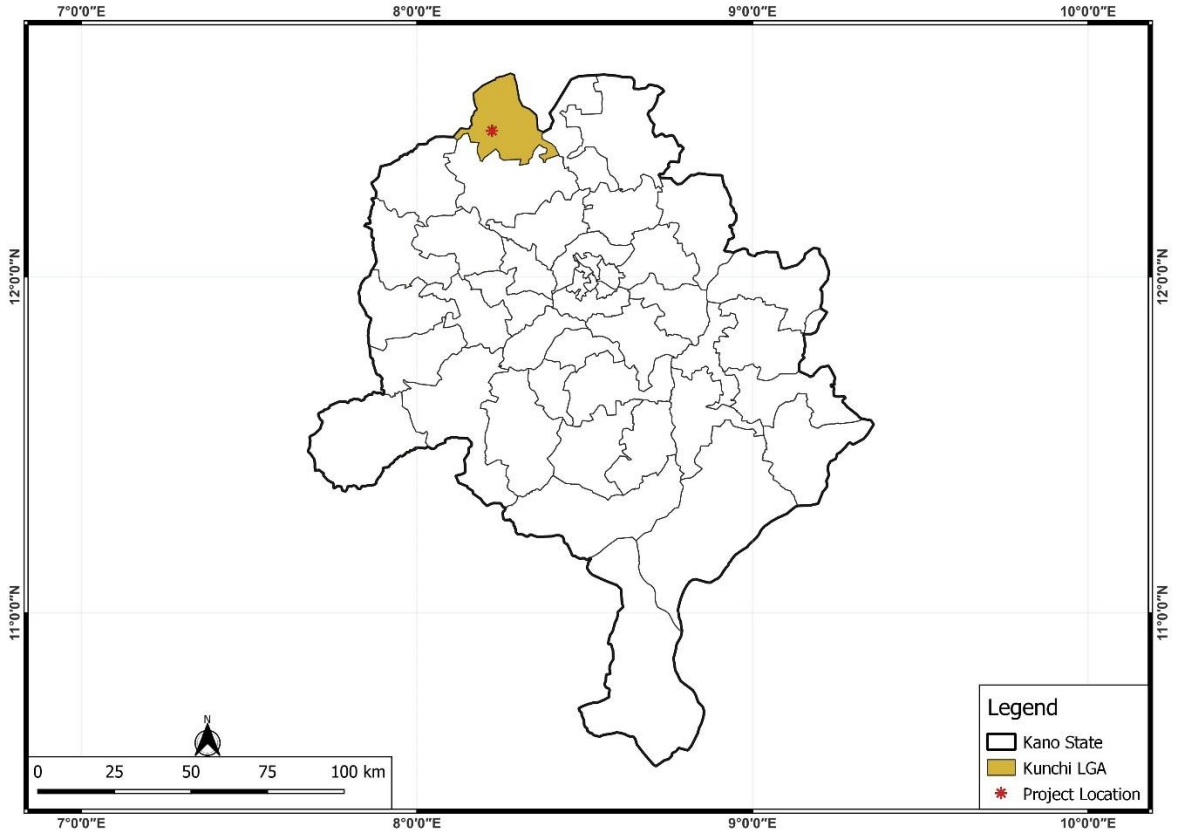

Figure 1.2. Map of Nigeria with Kano State Showing Kunchi LGA

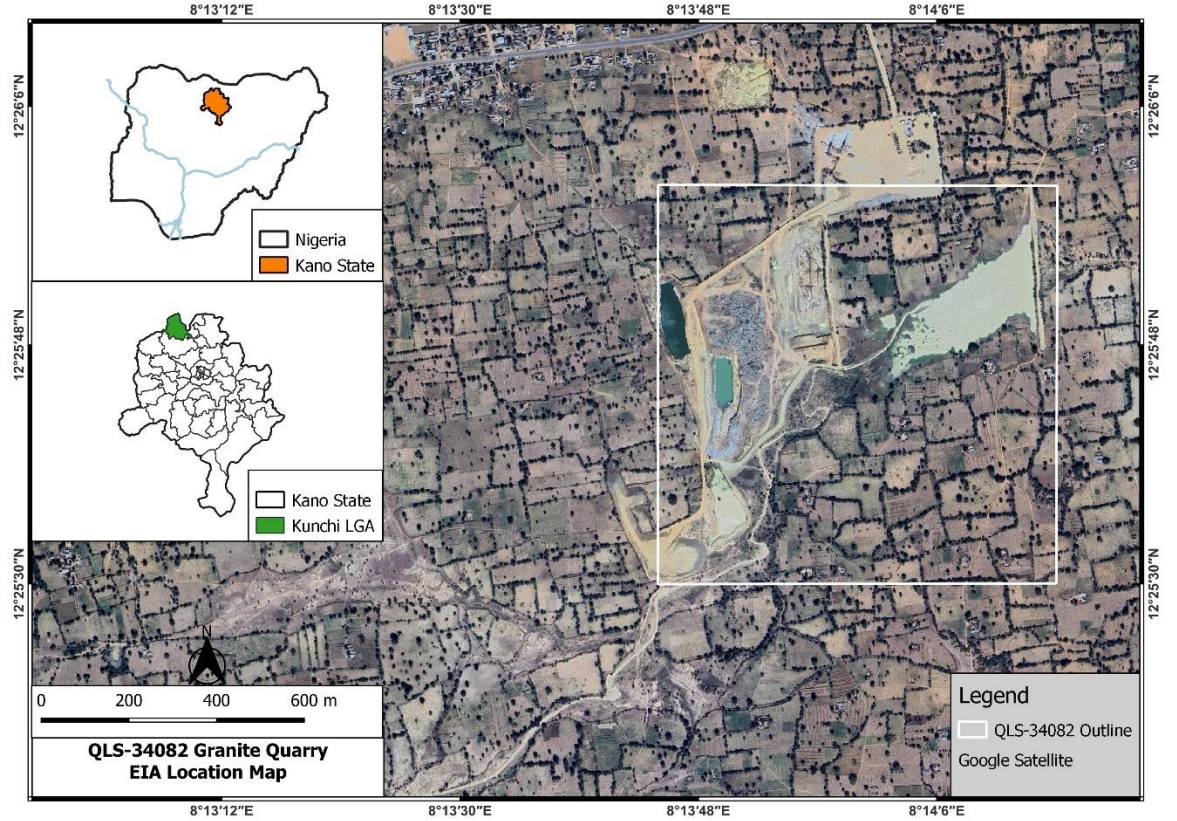

Figure 1.3. Map Showing the Exact Project Location

1.4 The Proponent

Eso Terra Investment Limited, the Proponent, is incorporated in Nigeria with RC: 1248634. It was registered on 13th March 2015 with a registered office address of No. 2 Waziri Ibrahim Crescent, Abakpa GRA, Kaduna, Kaduna State. The company's business focus on the mining sector is to become one of the leading mining companies in Nigeria within a short time through effective workforce, technology, and resources management while contributing to Nigeria's economic and technological development. The mission is to engage in these activities profitably and responsibly to benefit all stakeholders within the best class of Health, Safety and Environmental Practices in the industry. This mission underscores our unwavering commitment to responsible and sustainable mining practices.

Nigerian Mining Cadastre Office granted Quarry Lease-34082 to Mr Mujtaba Yusuf Rabiu for five (5) years. The quarry lease is renewable under the Mineral and Mining Act of 2007. However, Eso Terra Investment Limited subsequently renewed the quarry lease based on the terms agreed upon with Mr Mujtaba Yusuf under a new license or lease no. 58315QL to develop and operate the quarry throughout the railway project. The quarry formerly operated by Dantata and Sawoe Nigeria Limited still possesses a good quantity and quality of granite to be extracted to support the Kano-Maradi rail line. The proposed quarry has granite resources of over 7 million tonnes (surface and underground), as contained in the feasibility studies, Appendix 5. ESIA Terms of Reference

1.5 Project Terms of Reference

The Terms of Reference (ToR) for the ESIA of the proposed project and scope were defined at the initial stages of the project. The ToR is contained in the matrix table 1.1 below and approved by the FMEnv:

Table 1.1. Data Sampling Framework

Environmental and Social Component	Data
Air quality	• Emissions (NOX, SOx, H2S, CO, CO2, NH3, HCHO, TVOC, SPM2.5 & 10) within and around the project site
Meteorology data	• Temperature • Rainfall • Sunshine • Cloudiness • Wind speed • Wind direction

	• Seasonal variation and extreme microclimates and determining factors.
Water Quality (Surface and Quarry Pit)	• Biochemistry of water samples for Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) where applicable. • Chemistry: total nitrogen, sulphates, chlorides, phosphate, exchangeable cations (Ca++K +, Mg2+, Mn 2+), heavy metals (Fe, Zn, Cr, Pb, Cu, V, Ni, Ba, Bo). This also includes the study of phenols, cyanide, and sulphide. • Physio-chemical characteristics - Salinity, Total Dissolved Solid (TDS), Turbidity, Oil and grease content, dissolved Oxygen (DO), electrical conductivity, pH etc
Noise	• Vibration level at random locations within and around the site
Land and soil	• Satellite imagery supplemented by a land use map of the area shall be used to assess land use. • Representative bulked samples (15cm& 30cm) shall be collected at designated distances along transects. • Topographical survey to determine natural phenomena like drainage/channel patterns, identify geomorphic features, and establish flood controls. • History of flooding and sediment transport studies involving field measurement and • Laboratory analysis (Physical, Chemical, microbiology components
Archaeology	• Social anthropological considerations will be examined, including the identification of shrines, burial sites and archaeological sites affected by the project. • Parks, designated areas of environmental/amenity value, and nature reserves will be identified and described. • Various aspects of the local culture, customs, religious beliefs, social taboos, sacred places etc will be identified and described
Geology and hydrogeology	• Identification of rock sequence and description of principal rock types of the area. • Physio-chemistry, dissolved oxygen (OD), salinity (as chlorides), total suspended solids (TSS), total dissolved solids (TDS), turbidity, total hydrocarbon content, etc. Water chemistry (exchangeable cations (Ca2+, K+, Mg2+, Mn 2+). Heavy metals (Fe, Zn, Cr, Cu) and water microbiology of the underground water.
Biodiversity	• Assessment of the general and specific characteristics of the vegetation and wildlife by determining the florist composition, life form and biological spectrum.
Waste Management Studies	• Waste inventory of the project area • Type of waste generated in the area and

	disposal/management methods.
Human health and safety	• Assessment of Common diseases in the area • An inventory of diseases prevalent in the area.
Socioeconomic	The essential information includes the following: • Type of occupation • Educational level of people in the area • Kind of disease in the area • The feelings/opinions of the affected communities on the power project • The operations of people in the affected Community • Type of Culture • Level of income • Assess on environmental/safety risk Also, physical observation and professional judgment shall be used to identify the following: • Historical sites • Settlements pattern • Land requirement • Infrastructure Development • Industrial activities vis-à-vis women • Cost of living and income level
Community engagement	Consultation to intimate the stakeholders of the project includes the following: • Federal Ministry of Environment • States Environmental Protection Board (Kano State Ministry of Environment) • Local Government Council (Kunchi LGA) • Neighbouring Community (Hugungumai)
Traffic and transport	Traffic data, transport route, traffic assessment, accidents, proposed car parking Lots and traffic congestion

1.6 The ESIA Objectives

The objectives of the ESIA for the proposed project are to:

- To provide information on the current ecology (ambient air quality, soil, fauna, flora, microorganisms, biological diversity, surface water, groundwater) and socioeconomic conditions of the environment within the proposed Quarry project.
- To determine the project's impacts on the environment, including effectson socioeconomic and sociocultural activities of the community.
- Examine the health situation of the human population around the project site
- Examine and assess the significant potential impacts of all activities and auxiliary facilities in all phases of the project (construction, operation, abandonment) on the natural, social and health environments.
- Provide recommendations for the mitigation of identified adverse impacts.

- Develop an Environmental Management Plan for implementing the mitigation measures and an Environmental Monitoring Plan for monitoringthe efficiency of the mitigation measures.

1.7 ESIA Work Scope

The proposed study work scope includes the following:

- Review national and international environmental regulations, standards, codes, and conventions relevant to the proposed project activities.
- Review existing literature on the study area, including study reports (ESIA,EA PIA, etc.) to characterise the baseline conditions.
- Comprehensive field sampling/testing at the proposed project area for a single season.
- Consultation with all stakeholders and regulatory agencies.
- Impact identification, prediction, interpretation, and evaluation.
- Development of cost-effective mitigation/ameliorative measures, monitoring programmes and an Environmental Management Plan covering the project life cycle.
- Prepare draft and final ESIA reports that meet regulatory requirements.

1.8 ESIA Methodology

This study combined multidisciplinary standard methods from pure science, engineering, and social sciences to obtain primary data for impact identification and evaluation and to establish ameliorative measures. It involved site identification, characterisation of the existing environment, review of the proposed project, and development of an environmental management plan.

Site Identification

The geography and relevant environmental and socio-economic information on the proposed project area were identified using maps, charts, articles, previous study reports on the location and similar environments, photographs, and a reconnaissance visit to the site on October 11, 2022. The information generated enabled the definition of the limits of the area to be surveyed/assessed.

Data Collection

Using the information gathered from site identification and consultation, the significant

habitats in the area were categorised, and their respective sampling requirements were defined. This enabled the effective collection of qualitative and quantitative data on the flora and fauna of the project area. The fieldwork, conducted from November 7th to November 20th, 2022, covered all relevant ecological, socio-economic, and health environments to complement information from the literature.

Consultation with Stakeholders and Experts

This involved the dissemination of information and interactions/dialogues with the various stakeholders in the proposed project, including professionals in engineering, science, health, and environmental issues.

Impact Assessment and Mitigation

The potential and associated impacts of the proposed project were systematically assessed using the (FMEnv) EIA Sectorial Guidelines (1995), the World Bank **ESS3 Resource Efficiency and Pollution Prevention and Management** (2016), AfDB's ISS (2023) as well as the ecological and socio-economic status data collected from the project were used to identify and evaluate the potential and associated impacts of the proposed project and to proffer appropriate mitigation measures.

In addition, professional judgement, knowledge of the ecosystem in which the proposed project is to be located, and consensus of opinions based on similar projects were essential for determining appropriate impact mitigation measures.

Furthermore, auditing or monitoring has been designed into the proposed project's Environmental and Social Management Plan (ESMP) to allow for ongoing improvement of operational practices if those initially established proveinadequate. The ESMP shall also enable a rapid rescue/response if an unforeseen environmental impact occurs.

Reporting and Review

Subsequently, the proposed project's ESIA findings were documented in this report. The definitive version of this report will be issued after the regulators'/stakeholders' review. This version shall incorporate all pertinent issues and comments from the review as directed by the FMEnv.

1.9 Legal and Institutional Framework for Environmental Protection and Conduct of ESIA

1.9.1 National Frameworks and Regulatory Requirement for Environmental Protection/ESIA

Existing statutes on environmental protection in Nigeria contain specific provisions designed to prohibit or control environmental pollution/degradation and to prescribe sanctions or damages to be enforced against persons or corporate entities who contravene the provisions.

The principal bodies responsible for environmental matters are the Federal and State Ministries of Environment. These bodies are charged with enforcing existing statutes and regulations in Nigeria. The following subsections outline the guiding policies and regulations of the FMEnv and the Kano State Ministry of Environment that are relevant to the proposed Quarry development.

The Federal Ministry of Environment (Revised 2016)

The goal of the National Policy on the Environment is to ensure environmental protection and the conservation of natural resources for sustainable development. The goal will be achieved by the following strategic objectives:

- Securing all Nigerians a quality of environment adequate for their health and well-being.
- Conserving and using natural resources for the benefit of present and future generations.
- Restoring, maintaining, and enhancing the ecosystem and ecological processes are essential for preserving biological diversity.
- Raising public awareness and promoting understanding of the essentiallinkages between the environment, resources, and development; and
- Cooperate with other countries, international organisations, and agencies to optimise the use of transboundary transport and prevent environmental recourse.

National Guidelines and Standards for Environmental Pollution Control in Nigeria

In line with the strategic thrust of the National Policy on the Environment, the National

Guidelines and Standards for Environmental Pollution Control in Nigeriawas published in March 1991 to serve as a primary instrument for monitoring and controlling industrial and urban pollution. The main thrusts of these guidelines are:

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

National Effluent Limitation Regulation

The National Effluent Limitation Regulation, S.I.8 of 1991 (No. 42, Vol. 78, August 1991), is a mandatory regulation that requires industries as waste-generating facilities to install anti-pollution and pollution abatement equipment on-site based on the best available technology (BAT) for detoxification of effluent and chemical discharges. The regulation is specific to each category of waste-generating facility, and it concerns the limitations of solid and liquid discharges or gaseous emissions into the ecosystem. Appropriate penalties for infringement are also specified in the regulation.

Pollution Abatement in Industries, Industries Generating Wastes Regulation

The pollution abatement regulation, S.I.9 of 1991 (No. 42, Vol. 78, August 1991) imposes restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency plans by industries; submission of lists and details of chemicals used by industries to FMEnv; requirement of permit by sectors for the storage and transportation of harmful or toxic waste; the generator's liability; strategies for waste reduction; permissible limits of discharge into public drains; protection of workers and safety requirements; for environmental audit (or environmental impact assessment fornew industries) and penalty for contravention.

Management of Hazardous and Solid Wastes Regulation

The management of hazardous and solid waste regulation, S.I.15 of 1991 (No. 102,Vol. 78, August 1991) defines the requirements for groundwater protection, surface impoundment, land treatment, waste piles, landfills, incinerators, etc. It also describes

the hazardous substances tracking programme with a comprehensive list of acutely hazardous chemical products and dangerous waste constituents. It also states the requirements and procedures for inspection, enforcement, and penalty.

Environmental Impact Assessment Act

EIA Act CAP E12 LFN 2004 makes ESIA mandatory for all new major public and private projects in Nigeria. The EIA Act sets out to:

- Consider the impacts and the extent of these impacts on theenvironment before embarking on any project or activity.
- Promote the implementation of appropriate policy in all Federal Lands consistent with all laws and decision-making processes through which the goal of this Act may be realised.
- Encourage the development of procedures for information exchange, notification and consultation between organisations and persons when the proposed activities are likely to have significant environmental effects on boundary or trans-state or on the environment of bordering towns and villages.
- The Act gives specific powers to the FMEnv to regulate the environmental assessment of projects.

National Environmental Standards and Regulation Enforcement Agency (NESREA) Act 2007

The act was the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources with the following provisions:

- Provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution, prevention, and control through monetary measures
- Empower the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation
- Prohibits, without lawful authority, the discharge of hazardous substances to the environment.

This offence is punishable with a fine not exceeding N1,000,000 (one million Naira) and an imprisonment term of five years. In the case of a company, there is an additional fee of N50,000 for every day the offence persists.

Endangered Species Act (Cap 108), 1990

This Act prohibits hunting, capture, and trade of some endangered species like crocodiles, alligators, turtles, parrots, etc. The Federal Republic of Nigeria has enacted the Endangered Species (Control of International Trade and Traffic) Act (No. 11of 1985) specifically to implement CITES. It is broader than CITES because it also covers domestic taking of listed species. Two schedules are included: Schedule I (Endangered Species – Animals in relation to which International Trade is Prohibited) and Schedule 2 (Animals in relation to which International Trade may only be conducted under License). The Act prohibits taking Schedule 1 species and requires taking Schedule 2 species following a license issued under the decree.

1.9.2Other National Laws and Regulations

Other relevant national regulations on environmental protection relevant to the proposed project are:

Land Use Act of (1978)

The Land Use Act of 1978, the Constitution of 1999 and the Public Lands Acquisition Laws of the relevant states constitute Nigeria's governing policy for land acquisition. The law is subsumed into the new Land Use Act (CAP L202) LFN 2004. As with most national and state laws on compulsory land acquisition in the public interest or for a public purpose, the legislation enables the State to acquire land (more precisely, to abrogate leases andother authorisations to occupy land). The Act also specifies the procedures thestate must follow to clear the land and defines the compensatory measures the State must implement to compensate the people affected. Under the Land Use Act, there are two types of land rights:

- Statutory occupancy rights: Individuals and entities can obtain a statutory right of occupancy for urban and non-urban land. Certificate of occupancy recipients are obligated to pay the state for any unexhausted improvements (i.e., improvements with continuing value, such as a building or irrigation system) on

the land when the recipient takes possession and must pay rent fixed by the state. Rights are transferable with the authorisation of the state governor.

- Customary right of occupancy: Local governments may grant customary rights of occupancy to land in any non-urban area to any person or organisation for agricultural, residential, and other purposes, including grazing and other customary purposes ancillary to agricultural use. The term for customary rights (contained in the application form and not the legislation) is 50 years and may be renewed for a second 50-year term. Recipients of customary occupancy rights must pay an annual tax on the land. They cannot transfer any portion of the rights without the governor's approval (for sales of rights) or the local government(other transfers).

The Act puts all land in the urban areas of each state under the governor's control and management. The governor holds the land in trust for the state's people. He is solely responsible for allocating landin all urban areas to individuals who reside in the state and to organisations for residential, agricultural, and commercial purposes. All other land in the state subject to Land Use Act conditions is under the local government's control and management.

The act divests traditional owners of land and vests such land in the state governor for the benefit and use of all Nigerians. It provides the processes through which the federal government may acquire land. In rural land, where there are no formal title deeds and any land rights are customarily held, compensation for land acquisition is only provided for buildings, crops and other 'improvements' to the land and rent for the year the land wasoccupied. Payment is not paid for land since the government does not recognise customary ownership.

The governor will determine who receives the compensation for community-owned land where no individual or family claims ownership. This might be the community, the chief, or a community leader who can use the money according to customary law.

Alternatively, money can be put into a community fund. The governor has the power to cancel the right that any person must live on or use any piece of land if the land is required for use in the public interest. This includes road construction, seaport, mining, and oil pipelines. Land rights cease immediately upon receipt of notice from the

governor.

There are some differences between the Nigerian laws for resettlement and the IFC requirements. These differences are related to the requirements for seeking alternative sites, preparation of a Resettlement Plan and Restoration Plan, timing, and formal consultation requirements (with resettled and host communities). Emphasis on vulnerable groups and Indigenous people; definitions of a cut-off date;the criteria to aid; grievance mechanisms and monitoring; andevaluation requirements. Eso Terra will be undertaking the project in alignment with the National Nigerian law, the international best practice of the IFC Standards, and the guideline of AfDB's ISS on projects involving 200 or more persons as defined by the involuntary resettlement policy.

Penal Code Act 1960

An Act to supplement the Penal Code of the Northern States in respect of matters within the exclusive legislative competence of the National Assembly and for ancillary purposes.

The Nigerian penal code was enacted in 1959 and is based on the British criminal code of the colonial era. The code under chapter XXXVI makes it an offence, punishable under the law, for anybody to Violet the atmosphere in place as to make it harmful to the health of persons in their dwelling place, neighbouring business, or public ways, do any act which is and which they know or have reason to believe to be likely fraudulent dealings with minerals and mines.

The Nigerian Minerals and Mining Act (2007)

The Nigerian Minerals and Mining Act 2007 ("the Act") was passed into law on March 16, 2007, to repeal the Minerals and Mining Act, No. 34 of 1999 and regulate the exploration and exploitation of solid materials in Nigeria.

The Act vests control of all properties and minerals in Nigeria in the State and prohibits unauthorised exploration or exploitation of minerals. From the commencement of the Act, all lands in which minerals have been found in commercial quantities shall be acquired by the Federal Government following the Land Use Act. Property in mineral resources shall pass from the Government to the person by whom the mineral resources are lawfully won upon their recovery following the provisions of the Act.

The Act further provides that the use of land for mining operations shall have priority over other uses of land and be considered (for access, use and occupation of land for mining operations) as constituting an overriding public interest within the meaning of the Land Use Act. Suppose a mining lease, a small-scale mining lease or a quarry lease is granted over land subject to an existing and valid statutory or customary right of occupancy. In that case, the state governor within which such rights are granted shall revoke such right of occupancy within sixty days of such grant or declaration following the provisions of section 28 of the Land Use Act.

The Act empowers the Ministry of Solid Mineral Development to make regulations for the operation of the mining sector.

The Nigerian Minerals & Mining Regulation (2011)

The Ministry of Solid Minerals Development 2011 launched the Nigerian Minerals and Mining Regulations 2011 to establish a more coordinated and accountable solid minerals sector in the country. The Regulations were issued to set out the rules, procedures, and processes for acquiring mineral titles and to give effect to the Minerals and Mining Act 2007. The regulation has a specific section that guides sustainable management of the environment:

Section 30: Deductibility of Environmental Costs

Companies exploiting mineral resources shall establish a tax-deductible reserve for environmental protection, mine rehabilitation, reclamation, and mine closure costs.

Section 114: Restoration of Mines Land

The Minister shall, by order, require the guarantee of a mining lease to restore any area in which mining operations have been carried out or are to be carried out.

Section 115: Reclamation

Where land subject to a mining lease has been exploited, the reclamation mined-out area shall be restored by the applicant under the condition.

Section 118: Environmental Obligation

Every holder of a mineral title under this Act shall, as far as it is reasonably practicable, Minimize, manage and mitigate any environmental impact resulting fromactivities carried

out under this Act and Rehabilitate and reclaim, where applicable, the land disturbed, excavated, explored, mined or covered with tailings arising frommining operations to its natural or predetermined state or such as may be specified in this Act, its regulations and other pertinent laws in force and following established best practices.

Section 118: Environmental Impact Assessment

Every holder of an exploration license, small-scale mining lease, mining lease, quarry lease, and water use permit shall

- Before the commencement of mining operations, or upon application for an extension of the term; or
- Upon an application for the conversion of a mineral title, submit to the Mines Environmental Compliance Department an Environmental Impact Assessment approved by the Federal Ministry of the Environmental in respect of the Exploration or Mining Operations to be conducted within the Mineral title Area and Environmental Protection and Rehabilitation Program containing such details as may be provided for in the environmental regulation issued according to this Act.

Section 120: Contents of the Environmental Protection and RehabilitationProgramme

The Environmental Protection and Rehabilitation Programme required under the Provisions of Minerals and Mining Act 2007 shall:

- Provide specific rehabilitation and reclamation actions, inspections, and annual reports.
- A reasonable estimate of the total cost of rehabilitation
- Cost estimates for each specific rehabilitation and reclamation action and
- A timetable for the orderly and efficient rehabilitation and reclamation of the Mineral title area to a safe and environmentally sound condition suitable for future economic development or recreational use.

The Mines Environmental Compliance Department shall exercise all its powers concerning the Environmental Protection and Rehabilitation Programmes provided in section 119 in consultation with the State Mineral Resources and Environmental Management Committee established according to Section 19 of this Act.

The Mines Environmental Compliance Department may approve or reject an Environmental Protection and Rehabilitation Programme submitted by the Mineral title of its decision thereon within sixty days of the submission of the Environmental Protection and Rehabilitation Programme.

Suppose the Mines Environmental Compliance Department does not notify the Holder of a Mineral title within the period specified under subsection (3) of this section. In that case, the Environmental Protection and RehabilitationProgramme shall be approved as submitted.

In the case of rejection of the Environmental Protection and Rehabilitation Programme by the Mines Environmental Compliance Department, the Mineral title holder may. Submit such other number of Environmental Protection and Rehabilitation Programme as may be necessary to obtain the approval of the Mines Environmental Compliance Department, or if its application is rejected twice, the Holder may submit the matter to arbitration within thirty days of notification of the decision under subsection of this section. In the case of its approval, the Mines Environmental Protection and Rehabilitation Programme.

Section 121: Establishment of the Environmental Protection andRehabilitation Fund.

The Minister shall establish an Environmental Protection and Rehabilitation Fund to guarantee the environmental obligations of Holders of Mineral titles as provided under this Act.

The Minister shall appoint a reputable institution customarily engaged in business as a trustee or fund manager to administer the Environmental Protection and Rehabilitation Fund. The trustee appointed under 10 subsection (2) of this section shall operate the fund following the provisions of the Trustees Investments Act, cap T2i laws of the Federation of Nigeria, 2004 or amendment thereof.

Every mineral title holder shall contribute to the Environmental Protection and Rehabilitation Fund per the amounts specified in the approved Environmental Protection and Rehabilitation Programme no later than one year from such approval.

If the Mines Environmental Compliance Department determines that the estimated cost of implementing the approved Environmental Protection and Rehabilitation Programme

is less than the amount already deposited in the Environmental Protection and Rehabilitation Fund, it may refund any excess amount in the Fund to the Holder of the Mineral title; or reviews the number of future contributions or modify the contributions schedule as the circumstances may require.

Where a mineral title is reviewed, the Holder shall pay into the Environmental Protection and Rehabilitation Fund such annual amounts as may be specified in an amended Environmental Protection and Rehabilitation Programme approved under section 120 of the regulation.

The trustee shall keep proper records regarding the operation of theFund and shall have them prepared by an independent firm of chartered accountants for the fiscal year.

- The trustee shall, not later than three months after the end of each fiscal year, send a copy of the audited statement of accounts referred to in subsection (6) of this section to be sent to the Minister and each member of the State Mineral Resources and Environmental Management Committee

- The Environmental Protection and Rehabilitation Fund and any sum accruing, therefore, shall be applied only to the implementation of the Environmental Protection and Rehabilitation Programme to which they relate following the timetable of payments established in the Environmental Protection and Rehabilitation Programme

- The Holder of a mining lease shall implement and meet all obligations described in the Environmental Protection and Rehabilitation Programme during the term of the mining lease
- When the Environmental Protection and Rehabilitation Programme hasbeen fully implemented and completed further to certification by an independent external audit has confirmed that the implementation of the Environmental Protection and Rehabilitation Programme has been satisfactorily completed, the Head of Mines Environment Compliance Department shall authorise the refund of any remaining in the EnvironmentalProtection and Rehabilitation Fund to the title holder within thirty days of thereceipt of the certification.

Labour Act Cap L1, LFN 2004

The Labour Act Cap L1, LFN (2004), is the primary law protecting the employment rights of individual workers. The act protects wages, contracts, employment terms and conditions, and recruitment. It also classifies workers and particular worker types. Union membership is governed by the Trade Union Amendment Act (1995). 1999 constitution includes a stipulation of "equal pay for equal work without discrimination on account of sex or any other ground whatsoever".

While Nigeria has ratified all eight core International Labour Organisation Conventions and enacted laws to enforce the provisions, there are indications of restrictions on the trade union rights of workers in Nigeria, discrimination, child labour and forced labour.

Employee's Compensation Act, 2010

The Employee Compensation Act, of 2010, is a social security/welfare scheme that provides comprehensive compensation to employees who suffer from occupational diseases or sustain injuries arising from accidents at the workplace or in the course of employment. The basis or justification for 'compensation' is the employer's duty of care. The Employee Compensation Act of 2010 specifically addresses compensation for work-related injuries, disabilities, or death, establishing a framework for employer liability in such cases. The Employees' Compensation Act, 2010, was signed into law on 17th December 2010. This Act repeals the Workmen's Compensation Act Cap.

Child's Right Act (2003

The law guarantees the rights of all children in Nigeria. So far 24 out of 36 states of Nigeria have adopted the CRA as a state law. There are therefore twelve (12) states in Nigeria that are yet to adopt the CRA in their laws of the 36 states of the federation. Children as defined by Child's Right Act (2003) is any person under the age of 18. National Human Rights Commission as parts of its mandates to promote, protect and enforce the rights of all citizens as well as foreign nationals in Nigeria undertakes several procedures of promoting and protecting the rights of children under this age because they are vulnerable.

Violence Against Persons (Prohibition) Act, 2015

The Violence Against Persons (Prohibition) Act (VAPP) was enacted in May 2015. The Act resulted from agitations to protect persons against the different forms of violence.

Violence, both at the home front and in the larger society, is fast becoming a trend in recent days in Nigeria. Daily, we hear of someone killing or maiming their spouse, a scorned lover pouring acid on an ex-lover, or someone being forcefully taken away from their family and loved ones. The need to protect citizens from violence such as these led to enacting the VAPP Act in 2015. The Violence Against Persons (Prohibition) Act is an improvement on the penal and criminal code concerning violence; it also compensates victims and protects their rights.

National Gender Policy, 2006

The goal of the National Gender Policy is to "build a just society devoid of discrimination, harness the full potentials of all social groups regardless of sex or circumstance, promote the enjoyment of fundamental human rights and protect the health, social, economic and political wellbeing of all citizens to address the inequalities that exist in the socio-economic sphere', and combat all forms of violence against women and girls, among other things. It further draws from regional and international instruments to Nigeria as a party. The persistence of gender inequalities and underrepresentation of women in decision-making positions at all levels continue to provide the need for a gender policy to provide the policy framework for addressing them. The overall goal of the policy is "to build a just society devoid of discrimination, where the needs and concerns of women, men, girls, and boys are mainstreamed equitably into all sectors of national development

1.9.3 Kano State Ministry of Environment

The Ministry of Environment is responsible for providing a decent, orderly, and reasonably conducive environment for a habitable society, as contained in the assignments of Ministerial responsibilities.

The States have an environmental protection board that is empowered to monitor and control pollution and the disposal of solid, gaseous, and liquid wastes generated by various facilities in the states. This board protects public health and safety, restores and enhances environmental quality, and sustains economic vitality through effective and efficient implementation of environmental programmes.

Some of the functions of the state Ministry of Environment include:

- Consulting with the Federal Ministry of Environment to achieve a healthy or better management of the environment via the development of a National Policyon the Environment
- Co-operating with FMEnv and other National Directorates/Agencies in the performance of environmental functions, including environmental education/awareness to the citizenry
- Responsibility for monitoring waste management standards,
- Responsibility for general environmental matters in the State, and
- Monitor the implementation of ESIA studies and other environmental studies for all development projects in the state.

Generally, state laws on the environment are still evolving. Specifically,for EA, the States rely on that of the Federal Government, the EIA Act CAP E12 LFN 2004, International Guidelines and Conventions

1.9.4International Laws and Guidelines

In addition to the national laws/regulations, Nigeria is a signatory or party to several international conventions and treaties that support ESIA as the key tool for achieving sustainable development. Some of these include:

World Bank Guidelines on Environmental Assessment {EA} ESS (2016)

The World Bank requires the execution of an ESIA on a proposed industrial activity by a borrower as a pre-requisite for granting any financial assistance in the form of loans. Details of the World Bank's ESIA procedures and guidelines are published in the Bank's Guidance Note for Borrowers. The Guidance Notes guide the Borrower on applying the Environmental and Social Standards (ESSs), which form part of the World Bank's 2016 Environmental and Social Framework (ESF). The Guidance Notes help explain the requirements of the ESSs; they are neither Bank policy nor mandatory. The Guidance Notes do not substitute for the need to exercise sound judgment in project decisions. In case of any inconsistency or conflict between the Guidance Notes and the ESSs, the provisions of the ESSs prevail.

Paris (France) Good Practice for Environmental Impact Assessment of

Development Projects 1991

This is an endorsement by the OECD Ministers of the importance of ESIA for developmental Projects.

World Heritage Convention 1978

The World Heritage Convention (1978) seeks to set aside cultural and natural heritage; the latter is defined as areas with outstanding universal value from the aesthetic, scientific, and conservation points of view.

Convention on International Trade in Endangered Species of Wild Fauna and Flora 1975

This convention was signed into law in 1973 during the Washington Summit, but it was enacted in 1975 and restricted the trade of fauna and flora species termed endangered organisms. It establishes a list of endangered species for which international commercial trade is prohibited or regulated via a permit system to combat illegal trade and over-exploitation.

Vienna Convention for the Protection of the Ozone Layer 1985

The convention, instituted in 1985, places general obligations on countries to act appropriately to protect human health and the environment against adverse effects resulting from human activities that tend to modify the ozone layer.

Protocol on Substances that deplete the Ozone layer 1987

The protocol was amended for the first time on 29 June 1990 in London. A second set of amendments was adopted in Copenhagen in November 1992; these entered into force in 1994.

United Nations Guiding Principles on the Human Environment 1972

These guiding principles are formal declarations that express the basis on which an environmental policy can be built and provide a foundation for action. The United Nations has been concerned about harmful environmental trends since theywere formed. As a result of this, they published two significant concept documents, the United Nations Guiding Principles on the Human Environment in 1972 and the Rio Declaration on Environment and Development. The principles applicable to this project include:

Principle 2

The earth's natural resources, including the air, water, land, flora and fauna, and especially representative samples of natural ecosystems, must be safeguarded through careful planning or management to benefit present and future generations.

Principle 4

Man has a special responsibility to safeguard and wisely manage the heritage of wildlife and its habitat, which are now gravely imperilled by a combination of adverse factors. Therefore, nature conservation, including wildlife, must be an essential part of economic development planning.

Rio Declaration on Environment and Development 1992

The Rio Earth Summit (1992) emphasised the need for the preservation of biological diversity, the sustainable use of its components and the fair and equitablesharing of benefits arising out of the utilisation of genetic resources, including access to genetic resources and appropriate transfer of relevant technologies, considering all rights over those resources and to technologies. The principles adopted include:

Principle 1

Human beings are at the centre of concern for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 17

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

UN Convention on Biological Diversity 1994

The Convention's objectives include conserving biological diversity, sustainable use of its components, and fair and equitable sharing of benefits from genetic resources.

Convention Concerning the Protection of the World Cultural and Natural Heritage Sites (or World Heritage Convention) 1972

The convention sets aside areas of cultural and natural heritage for protection. The latter

is defined as areas with outstanding universal value from the aesthetic, scientific and conservation points of view.

United Nations Framework Convention on Climate Change (1992)

To achieve sustainable social and economic development, energy consumption for developing countries needs to grow, considering the possibilities of achieving greater energy efficiency and controlling greenhouse gas emissions. This also includes the application of modern technologies on terms that make such an application economically and socially beneficial and determined to protect the climate system for present and future generations.

African Convention on the Conservation of Nature and Natural Resources 1968

It emphasises the conservation of nature and natural resources in AfricanCountries.

Jakarta Mandate on Biodiversity 1995

Given the worldwide concern for coastal biodiversity and recognising the significant differences between marine and terrestrial biodiversity, policies and Conventions on Biological Diversity (CBD) were developed at the Jakarta conferencein 1995. This is also called the Institute of Integrated Coastal Area Management (ICAM).

Articles 5

Establish and maintain Marine Protected Areas (MAPAs) for conservation and sustainable use of threatened species, habitats, living marine resources and ecological processes.

Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and Their Disposal 1989

The convention focuses on the hazards of generating and disposing of hazardous wastes. It defines waste as regulated and controls its transboundary movement to protect human and environmental health against its adverse effects.

Montreal, Canada- Cartagena Protocol on Biosafety Convention on Biological Diversity 2000

This protocol, signed in Montreal (Canada), emphasises biosafety and biological diversity.

Paris (France) UNESCO Convention 1972

This emphasises the protection of the World's Culture and Natural Heritage

Stockholm (Sweden) Declaration on Human Environment 1972

This declaration demands that nations cooperate to develop further international law regarding liability and compensation for victims of pollution and other environmental damage caused by activities within their authority.

Bonn Convention on Conservation of Endangered Species 1979

This emphasises the promotion of measures for conservation and management of migratory species.

Bern, Switzerland Convention of Protection of Workers againstOccupational Hazards 1979

This emphasises the protection of workers against occupational Hazards in their working environment due to Air Pollution, Noise and Vibration (ILO No. 148)

International Labour Organisation (ILO) Convention on Indigenous and Tribal People in Independent Countries 1989

The article requires that Governments must ensure that studies are conducted to assess the Environmental Impact of planned development activities and take measures, in cooperation with the people concerned, to preserve the environment ofthe territories they inhabit

Protocol on Cooperation in Combating Pollution 1981

This emphasises the need to combat pollution in cases of emergencies in the West and Central African Region

International Best Practice Standards and Guidelines

CRSG may seek financing from financial institutions with specific environmental and social performance requirements. As such, the Project design and recommended mitigation will endeavour to uphold international best practices and maintain or reduce impacts to ALARP (as low as reasonably practical) levels. This ESIA report may be updated later should specific standards or requirements, such as those of the IFC and AfDB's ISS, be determined necessary.

The African Development Bank's Integrated Safeguards System, 2023

The African Development Bank's 2023 Integrated Safeguards System (ISS) incorporates ten Operational Safeguards (OSs) to manage and mitigate environmental and social risks. These E&S operational safeguards collectively aim to ensure that projects funded by the AfDB are environmentally and socially responsible, with a strong emphasis on protecting vulnerable communities and ecosystems.

1.10 The ESIA Process

The procedure laid down by the FMEnv for undertaking an ESIA to satisfy the EIA Act CAP E12 LFN 2004 is presented in Figure 1.4 below. In summary, the process involves submitting a project proposal to the FMEnv by the project proponent. An initial evaluation of the proposed project is done by FMEnv, screening and scopingof the proposal by FMEnv, ESIA draft preparation by an accredited consultant,panel review exercise and the preparation of the Final Draft ESIA Report and approval by the technical committee.

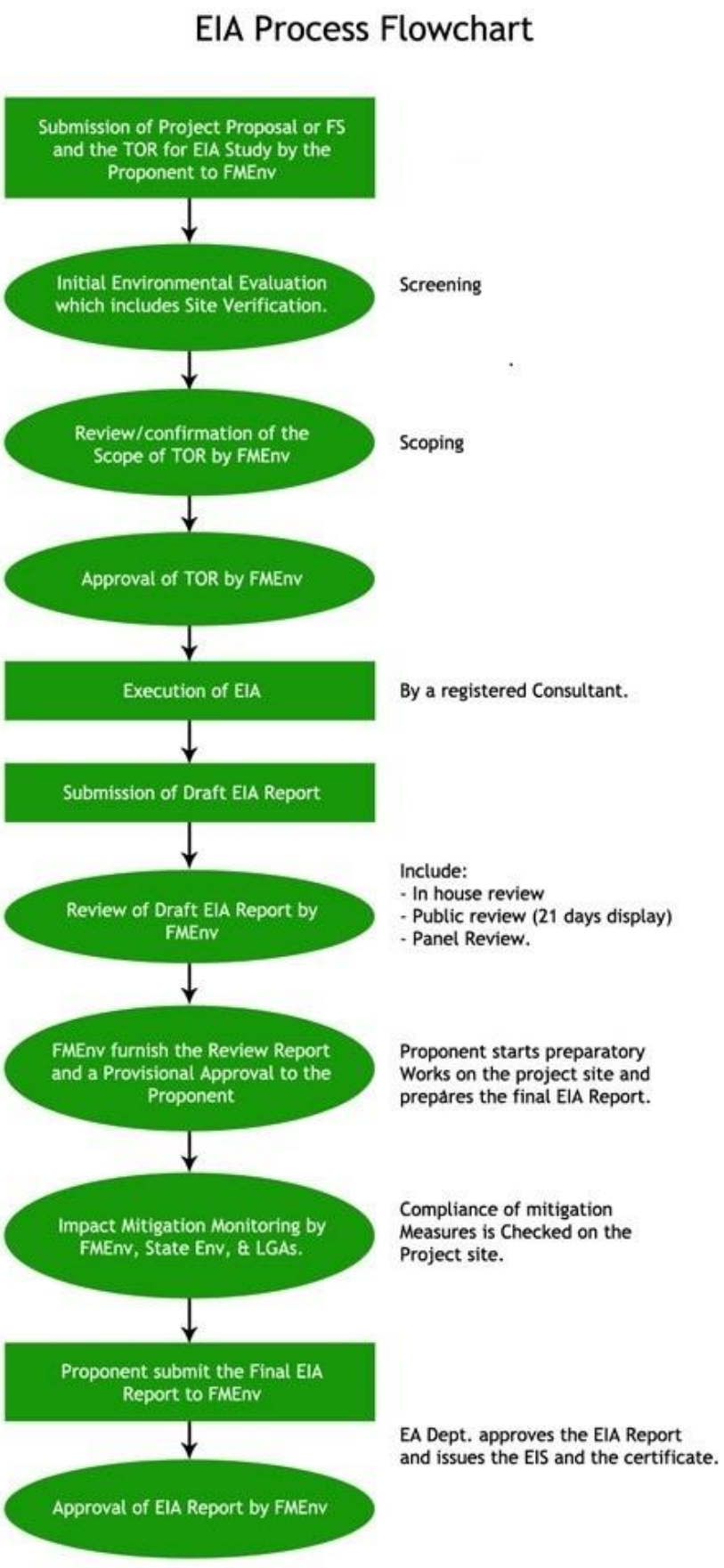

Figure 1.4: Federal Ministry of Environment's ESIA Procedure

1.11 Structure of the Report

This report is presented in nine chapters, viz.

Chapter one is an introduction with background information on the proponent, an outline of the ESIA terms of reference, objectives, work scope, and methodology,and a review of the legal and administrative framework for ESIA in Nigeria as applicable to the proposed project.

Chapter two discusses the project justification, the need/value, and the envisaged sustainability of the project.

Chapter three discusses the technical details of the proposed project.

Chapter four describes the baseline data acquisition method and the study area's ecological, socio-economic and health baseline status.

Chapter five discusses the impact assessment approach and presents the associated and potential impacts of the proposed project.

Chapter six presents mitigation measures for the proposed project's identified medium and high significant impacts.

Chapter seven presents the Environmental and Social Management Plan (ESMP) to be adopted throughout the project cycle. This includes an environmental monitoring programme.

Chapter eight presents the project decommission phase.

Chapter Nine highlights the key findings of the study in conclusion.

CHAPTER TWO

PROJECT JUSTIFICATION

2.1 General

The proposed Quarry project is integrated to extract and crush large pieces of rock into smaller fragments such as sand, granite, and stone. When functional, the plant shall crush large pieces of rocks using different heavy equipment like Drill machines, Excavators, Bulldozers, Crushers, etc., to achieve its final products, which include sand, granite, gravel, stone, and other related products. This will significantly benefit the Kano-Maradi Rail line and the country in general.

2.2 Need for the Project

Eso Terra intends to participate efficiently in the society's conversion of rocks into usable materials by converting these heavy rocks into usable materials like sand, gravel, granite, and other products that would be used for the Kano—Maradi rail line and construction and erecting structures within and around Kano state. This will, in turn, help convert our natural resources into something useful to man.

2.3 Benefits of the Project

During operation, the benefits of the quarry are numerous and cannot be over-emphasized. Some of the benefits of the project include:

- Provision of granite to support the construction and operation of the Kano-Maradi Rail Line
- Convert natural resources into material usable by man.
- Production of sand, stones, gravel, granite, and other products.
- Provide employment opportunities for many skilled and unskilled Nigerians, especially those from the host communities.
- Enhancement of the provision of basic social amenities to the hostcommunities. Poverty alleviation through increased derivation funds to local and state governments.

- Promote a good relationship between Eso Terra and the host community through increased socioeconomic assistance.

2.4 Envisaged Sustainability of the Proposed Quarry

Economic and Commercial Sustainability

The sustainability of the quarry is dependent on the quantity of material to be mined and the extent of its support to the Kano-Maradi rail project. Generally, quarry activities are a core area of Nigeria's economy, as the country is still developing. The need for quarry products is in high demand for constructing roads and rails, erecting structures, and maintaining existing ones, conferring economic sustainability on the facility. The project may employ directly over 36 persons during the operation phases **(Table 5 of Appendix 5)**. Priority will be given to qualified people from the host community, followed by the nearby communities before the others.

Eso Terra has already incorporated plans to absorb the artisanal miners (female Majority) into the quarry project. This will help manage any future public disturbance issues caused by the quarry acquisition by Eso Terra. The mining activities will create avenues for many business and employment opportunities, thus greatly enrichingthe financial capacity of the project host communities. This will be achieved through the involvement of contractors, suppliers, employment, provision of public facilities and services, increased social capital in the host communities, provision of microcredit schemes, etc. The project will contribute economically to the Kunchi LGA, Kano State and Nigeria.

Technical Sustainability

Eso Terra has a team of professionals with vast knowledge in the area. Moreover, the best technology in the modern quarry industry will be used. This shall ensure optimum maintenance and servicing of the machinery, hence ensuring the technical sustainability of this project. The quarry facility has dust control mechanisms and high-grade accessories that require less maintenance.

Fortunately, a fresh perspective on operations management and advancements in quarry technologies is transforming the aggregates industry. A combination of automated data capture using network-connected devices and web-based reporting and analytics tools will help support the quarry.

Environmental Sustainability

The project shall be environmentally sustainable because of the adoption of FMEnv ESIA processes followed by the development and implementation of an adequate Environmental and Social Management Plan (ESMP) throughout the project's life span. Strict adherence to occupational health and safety and good housekeeping practices will be strictly followed. The choice of equipment within the perimeter of acquired land will reduce to the barest minimum environmental impacts on biodiversity, soil, and agricultural resources; this increases the project's environmental sustainability.

2.5 Project Alternatives

There are several alternatives usually to any project that comes to bear when weighing the best options for a project. Though the quarrying of the granite is being proposed, selecting alternatives is premised on several considerations, which include the desirability or acceptability of the project, the potential environmental and social impacts of the project, the government's and people's inclination to the project and economic viability of the project.

One other alternative to quarrying the project location is considered, namely, the farming Alternative.

The Farming Alternatives

Farming the land, compared to the quarrying of the location for which the licenses were obtained, was weighed based on economic viability and vis –-vis the site has already been exposed to artisanal mining activities for a long time. Farming the land may require soil replacement because the soil has undergone deterioration and is prone to flooding and erosion; it would require massive investment for it to be used for farming options, which is not feasible or economically viable simply because some sections of the area have already been exposed to mining activities. Only a tiny portion of the land has viable soil conducive to farming. As indicated in the inspection carried out by a team of experts, which includes soil scientists, few mammals and Aves survive in the area. Even if crops could be planted, they would be restricted to only a tiny portion of the land area, where the soil is still conducive to growing such crops. Such restriction makes it economically impossible to have productive agriculture activities in the region, and the

land's topography may not also allow efficient agricultural production. Therefore, the farming alternatives are not recommended and, hence, rejected.

2.6 Project Development Options

During the Project planning phase, which was a significant component of the ESIA process, three project development options were considered:

Option 1 (Do Nothing or No Development Option)

The non-implementation of the construction of the proposed quarry project. In this case, no impact associated with the project will occur. The disadvantages of adopting this option include.

- Without the granite quarry, the railway project would not succeed.
- The rock deposits will not be mined; thus, economic value cannot be assessed and utilised profitably.
- Loss of revenue paid to the Government to obtain the mining license lease and other logistic expenses.
- There is a risk of forfeiting the right to the minefields after the stipulated years ofnon-development.
- Loss of revenue to the local, state, and federal governments and the host community.
- Loss of job opportunities that the project execution would have afforded some Indigenous inhabitants of Hugungumai and other neighbouring communities.
- Loss of commercial and economic benefits to Kunchi Local Government Area
- Continuation of artisanal mining with no recourse to the environment.
- Exposure of animals and humans to the risk of falling on existing quarry pits

This option was rejected.

Option 2: Delayed Option

This means the manifest and associated benefits of the project will be delayed, so this option was also rejected. Delaying the project may also slow down the rail construction.

Option 3: Project Execution

This option involves going ahead and implementing the project. This will make the Government and Eso terra achieve their goal of harnessing the rock deposits, thus

contributing to the company's national economy and revenue profile. The option would also benefit the project host community members, Kano State and Nigeria. This was the recommended option, given its importance in providing rock aggregates for the Kano-Maradi rail and other aspects of the Nigerian economy's construction and building industry. This option was accepted.

CHAPTER THREE

PROJECT DESCRIPTION

3.1 Project Area Description

Topographically, a more significant part of the project land lies on a naturally flat terrain, while the rest is on artificial mini hills resulting from the stockpile of spoil from past mining activities. There are visible pockets of artisanal mining and quarry pits, which show evidence of abandoned quarrying (Plates 3.1 and 3.2). However, the mining activity was minimal and restricted to artisanal activities at the assessment time. The approximate area for the granite license is about 83,500 m^2. The desired ores are covered with overburden material, whose thickness varies with location. However, some portions of the project area have been exposed due to artisanal mining within theproject area.

Geographical coordinates defining outline area of QL-34082 quarry are presented in table 3.1 and Figure 1.3 present the outline of the tenement on a satellite map of the area.

Table 3.1: Outline Coordinates of Quarry Lease

BEACONS	LATITUDE				LONGITUDE		
CB1	8	13	45		12	25	30
CB2	8	13	45		12	26	0
CB3	8	14	15		12	26	0
CB4	8	14	15		12	25	30

Plate 3.1. Quarry Pit & Evidence of Artisanal Mining Activities (Field Work, 2022)

Plate 2.2. Large boulders within the Site (Field Work, 2022)

3.2 Geological Consideration

Rock aggregates have diverse applications in infrastructural products such as concrete, stone masonry, drainage construction, and road building. Depending on the size of the aggregate material, aggregates are classified as coarse, fine, dust, or powder, resulting from crushing rock materials (Table 3.2). More coarse aggregates will be produced from the quarry to meet the project's needs.

Table 3.2: Rock Texture

SN	AGGREGATES (mm)	TEXTURE	USES
1	0– 5	Coarse	Mixed material used for road sub-base.
2	15–22	Coarse	Concrete works
3	22–30	Coarse	Concrete works
4	5– 10	Fine	Asphalting of road
5	0– 1	Powder	Fillers for asphalts
6	100 – 300	Hard Core	Stone pinching and soil stabilisation jobs

Basement complex rocks of Precambrian origin underlie the Kano state. Prolonged weathering of the rocks produced deep clay-rich regolith. The reserve estimation method used was the random drilling of pilot holes across the stretch of the rock deposit. Drilling information was used to ascertain the average overburden thickness and rock volume.

The surface-proven reserve of the granite is about 206,250 tonnes. The planned crushing capacity of 600tph for stone aggregate; the daily output of 5000 tons on a full operation based on eight (8) hours. Total output per annum (250 working days, i.e., considering weekends and public holidays) will be 1, 250,000 tonnes/yr. The average estimated reserve of the sub-surface granite is 7 million tonnes. Therefore, the sub-surface and surface granite resource of the proposed aggregate granite quarry will have a life span of about five years. Waste rocks shall be stockpiled away from the quarry pits.

3.3 Project Components

The quarry project is divided into two zones: the blasting zone and the production zone {Admin, Crushing, stockpiling, material}. **(Chapter 3 of Appendix 3 contains details of the project design)**

The critical activities for the proposed development of the Quarry Plant are:

- Planning Phase: Including exploration, mobilisation to the site, and site preparation.
- Quarry Development: (construction) Phase, including erection of foundations, installation of equipment/machinery, construction of office buildings, rehabilitation of access roads, and construction of other facilities required for quarry operation.
- The quarry operation phase includes the extraction of materials, processing, rock blasting, etc.
- Decommissioning phase: includes removal of equipment, recontouring, revegetation, etc.

3.3.1 Planning Phase

In the proposed quarrying project, spatial consideration and planning will be done to reflect National mining regulations, aesthetics, and overall efficiency. Distance and location chosen within the quarry site for the explosive storage facility construction shall conform to the Ministry of Solid Minerals Development (MSMD) Regulations stipulations. The rock processing facility shall be situated at a reasonable distance of about 200m, which guarantees efficient workflow from the extraction pit to the crushing plant. Other structural units like the office building, workshop, main entrance gate, diesel dump, weighing bridge, roads (12m width + 1.1km Long from the entrance of the quarry to the main area) and walkways (3m width running the length of the road) within the premises shall be positioned in a well-organized manner to make the site have an appealing look.

The speed of construction of the Kano-Maradi rail line will define the timing and rate of progression through the stages associated with the quarry development. Still, as established from available resources (Feasibility Report), the quarry will have an operational life of at least five years.

3.3.2 Quarry Development

The Quarry Plant shall be sited within the confines of the 34082-quarry lease by Eso Terra Investment Limited. The shelter will be big enough to accommodate the heavy

machinery and other supporting facilities. The detailed site preparation activities are presented below:

Removal of Overburden

This involves removing the waste material that often overlies a pit or quarry site using sizeable earth-moving equipment such as excavators, bucket loaders, dozers, and dump trucks. Granite resources within the waste (Spoils) are removed before excavation of the construction materials beneath it.

The Drilling & Blasting Zone

The Blasting Zone is the area where the granite is blasted. It is set a great distance from the production zone. Equipment used at the blasting zone includes drilling materials, compressors, excavators, and dump trucks.

The process begins with a detailed three-dimensional survey of the quarry surface. This allows the mining engineer with expertise in blasting to design the blast and to plot where the holes should be drilled so that the blast can be carried out safely and efficiently. The survey will show if there are any bulges or hollows on the surface. A bulge will need more explosive than usual to ensure that it is completely fragmented and not left in place on the surface. Hollow areas require less explosive than normal. The placement of explosives is professionally planned to ensure that the necessary fragmentation of the rock is achieved with minimum environmental impact.

Approval for blasting shall be obtained from the MSMD before quarrying activities, and there will be strict adherence to the specified principles detailed in the national laws and regulations as well as international best practices with reasonable precautions taken to ensure workers' and public safety as well as protection of properties. The explosives to be used for blasting shall be those specified by MSMD and will be securely stored in the magazines (away from the blasting area).

The rock mass shall be drilled with a pneumatic crawler drill machine and pneumatic jackhammers capable of producing a drill hole diameter of at least 3 inches depending on the desired explosive consumption and a drill depth of at least 10 m and then charged with high and low explosives in the most efficient method that will create a good fragmentation. Drilling cores will be carried out at the desired burden to facilitate the

insertion of explosive (dynamite), which will be detonated to blast the rock material into large boulders. **Figure 3.1** shows the blasting process. After developing a work programme, the quarry engineer shall fully ascertain the blast pattern, drilling diameter, depth, number, quantity of explosives, and spacing of blast holes**.** Blasted rocks from the project shall be gathered and loaded into the dumper trucks of at least 8-10 tons of boulders size by loaders.

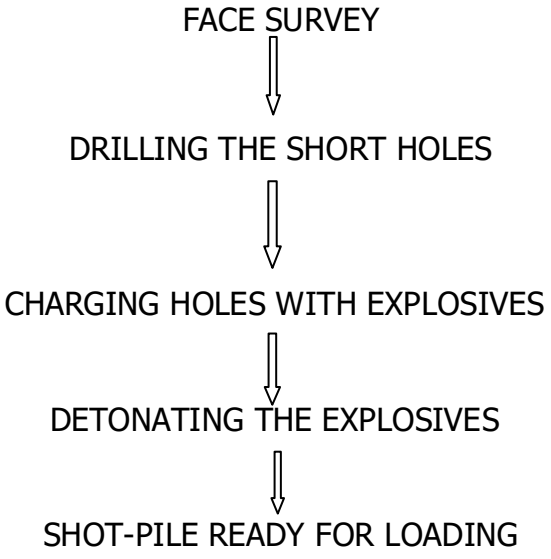

Figure 3.1 Blasting Process

Production

In this area, the boulders derived from the quarry are broken down into rocks and chippings of varying sizes using sets of mechanical crushers. A network of conveyor belts transports the crushed and ground stones to a stacking area, segregated according to the dimensions of the chippings. The finished product is then transported offsite by bucket loaders and trucks. **Figure 3.2** shows the crushing process.

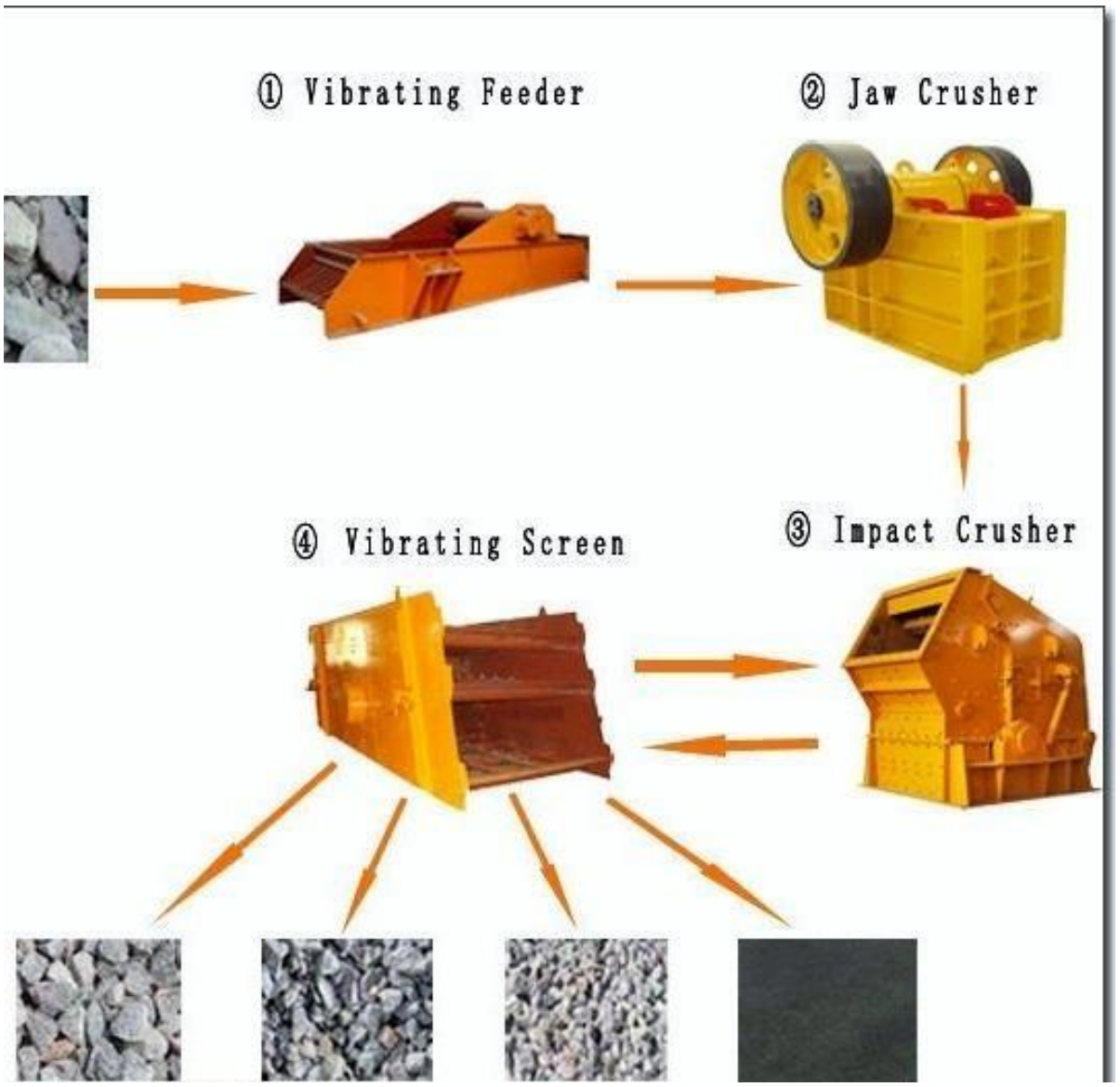

Figure 3.2 Crushing Process

CONSTRUCTION OF ANCILLARY FACILITIES

Table 3.3 describes the Proposed Infrastructure to be provided within the site.

Earthworks

This will involve stripping topsoil, sinking foundational materials to support the plant, and filling with appropriate materials to the recommended level, which shall be carried out using excavators, bulldozers, tipper trucks, etc.

Plant House

This shall involve building the plant house with approved materials. The house shall be constructed to allow for proper ventilation. There shall be an emergency exit, and the floors shall be sufficiently concreted to support the quarry and the vibrations from the

plant operations.

Plant Shelter Entrance

This shall be constructed using foldable steel doors sufficiently raised for easy access by vehicles transporting the plant's materials. All site preparation and related activities shall be carried out within the limits of the acquired land, per Eso Terra Investment Limited Facility contractor specifications, and in line with regulatory requirements.

Vehicle Parking Area

This is where vehicles will be parked for usage as required, such as Tippers/Trucks and Cars. The vehicle park area is designed to accommodate about 25-30 vehicles with an approximate space of about 5 m by 7 m each.

Other Structures

Borehole: To meet the site's water requirements, a borehole will be drilled, a 10,000-litre water storage overhead tank will be installed, and a 500 kVa generator will be stationed to pump water to the overhead tank.

Mini Canteen: This is to serve as a food outlet for the quarry workers.

Measuring Scale: This is where trucks will be measured to ascertain their appropriate tonnage capacity and weight material in the truck.

3.3.3 Quarry Operation Phase

The quarrying operations proposed will include both Machine and Manual Operations. The quarry production/excavation activities and spatial arrangements will consist of drilling, blasting, a crushing unit, a haulage road within the quarry pit, a workshop, an administrative office, and other structural units. **Table 3.4** shows the equipment to be used to achieve the quarry operation.

The rock excavation approach envisaged in this project shall be the conventional quarrying process where rock breakage is achieved through the mechanical action of explosives on rock using the most efficient methods.

Table 3.3 Proposed Infrastructure

SN	INFRASTRUCTURE	PURPOSE
1	Explosive Magazines	Explosive material storage
2	Rock crushing facility	Process of rock crushing to standard aggregate sizes
3	Workshop	For maintenance and repairs of quarry machines
4	Offices	For administration of the site
5	Stores	Safekeeping of spare parts and other items
6	Weighing bridge	For determination of weights of crushed materials
7	Ground level fuel dump and bond wall	For storage of diesel and Petrol (22,000 Litres)
8	Entrance gate	To control the movement of persons and material as well as security concerns.

Table 3.4 Equipment Selection

SN	EQUIPMENT	USES
1	Air drill machine	For drilling of blast holes into rock
2	Air compressor	To power the air drill machine
3	Excavators	This is for loading blasted rocks into trucks, digging earth, etc.
4	Front-loaders	This is for loading crushed rock into trucks and cleaning the yard.
5	Dump trucks	For conveying blasted and crushed rock to crushing plants and material stockyards, respectively
6	Hydraulic Hammer	For breaking of boulder rock to crushable sizes
7	Bulldozer	For clearing site
8	Crushers	Disintegration of rock boulders into desired aggregates

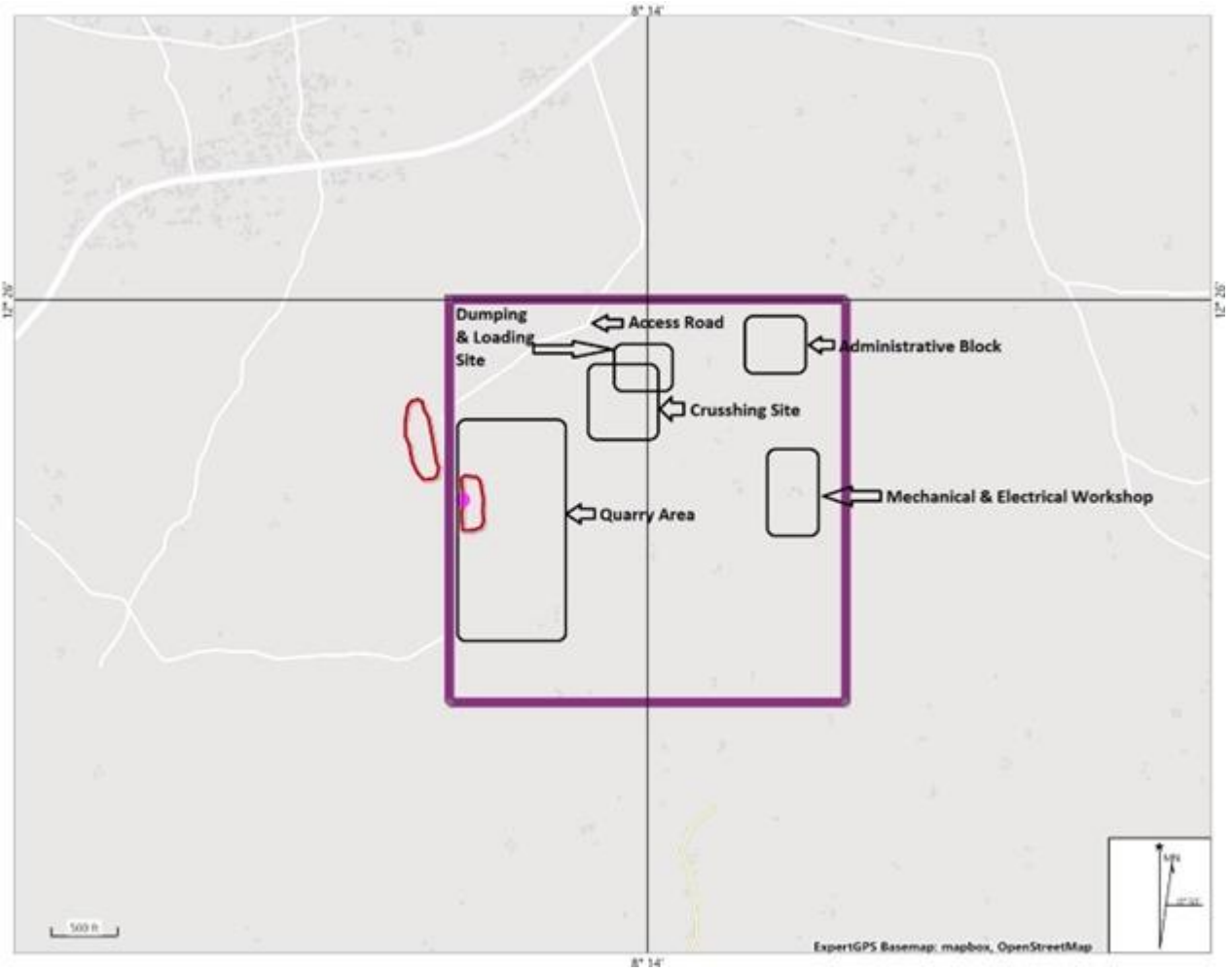

Figure 3.3 Layout of the Proposed Quarry Facility

3.4 Proposed Crushing and Power Machinery

A crushing plant capable of producing between 200-250 tph is considered.
The primary section of the plant will be made of:

- 200-250 tons per hour
- Primary feeder of 60 m^3
- Waste and discharge conveyors
- Secondary section of plants will be made of:
- 48" cone crusher
- 36" cone crusher
- Screening Machines
- Assorted sizes of conveyors.

The 500 kVa power generating plant is considered to power the entire crushing plant. Internal zoning shall provide a buffer to conditioned spaces for unfavourable orientations. Externally, trees shall be planted to provide good scenery, improve the land

scarping, and serve as a buffer for dust particles and wind.

3.5 Commissioning Plan

Commissioning comprises a series of checks and tests of equipment. The various tests are highlighted below:

- Completion check - The technician responsible for inspecting the plant for Completion of Plant Construction will ensure that all parts are installed.
- Finishing off the work - Confirm that all installation works have been finished
- Safety aspects - Confirm that all protection equipment has been installed.
- Site preparedness - Confirm the site is clean of debris and safe for work
- Mechanical test - All mechanical parts of the plant will be started, and the responsible personnel will inspect the plant for the smooth operation of each piece of equipment, the function of logical circuits and the function of safety circuits
- The quarry shall be started, and the responsible personnel shall inspect the quarry for the proper function of the quarry and smooth throughput of materials through the various machinery.

The Quarry commissioning process will extend over many days as individual components, subsystems, and systems are checked for correct functionality. The quarry plants shall be maintained periodically, including a structural integrity test for the crushing plants. The mechanical devices shall be maintained based on the manufacturer's specifications.

3.6 Plant Closure / Decommissioning

The FMEnv Guidelines and MSMD for decommissioning quarry plants shall be employed to decommission the Quarry Plant. All mechanical, electrical, and civil works shall be effectively demobilised, and the unit shall be adequately uninstalled and securely sealed. All supporting infrastructure shall be demobilised from the site.

Appropriate warning signs shall be implemented to prevent people from tampering with the sealed Unit and its infrastructure. The necessary areas shall be re-vegetated with indigenous plant species. The abandoned plant shall be regularly inspected to ensure compliance with the decommissioning and abandonment plan.

Decommissioning planning will starts at least three years before the end of quarry operations.

- The decommissioning process shall be done following local regulations and international best practices.
- The quarry operator shall engage with local communities and stakeholders throughout the decommissioning process
- The decommissioning plan shall include provisions for ongoing environmental monitoring and maintenance.
- The quarry operator shall ensure the site is safe and secure during and after decommissioning.

The timeline for the decommissioning of the quarry project includes the following:

Stage 1:

- ❖ Quarry operations cease
- ❖ Equipment and machinery removal
- ❖ Initial site clearing and remediation

Stage 2:

- ❖ Environmental monitoring and reporting
- ❖ Rehabilitation and reclamation of quarry pits and haul roads
- ❖ Revegetation and reforestation of disturbed areas

Stage 3:

- ❖ Continued environmental monitoring and reporting
- ❖ Completion of final rehabilitation and reclamation works
- ❖ Site inspections and audits

Stage 4:

- ❖ Long-term environmental monitoring and maintenance
- ❖ Ongoing rehabilitation and reclamation as needed
- ❖ Final closure and handover to local authorities or landowners

Stage 5 - Post-closure:

- ❖ Ongoing environmental monitoring and maintenance
- ❖ Periodic site inspections and audits
- ❖ Implementation of post-closure management and monitoring plan

3.7 Project Schedule

Quarry development activities require adequate resources in workforce, machinery, and capital. Careful planning and timely deployment of sufficient funds to acquire needed resources are paramount for successful project implementation. The proposed quarry will be operated as a construction project quarry as was nurtured to support the Kano-Maradi Rail Line. This quarry operation is scheduled to commence immediately after the quarry lease is issued by the Ministry of Solid Mineral Development (MSMD) Abuja and subsequently approval of environmental clearance by the FMEnv and the EPRP, CDA by MSMD. Quarry development schedules are presented in **Table 3.5**.

Table 3.5 Project Schedule

Timing	Project Phases	Months													
		1	2	4	3	5	6	7	8	9	10	11	12	10 Years	2 Month
December 2022-Jan-23	Mobilisation														
December 2023-June 2023	Site Preparation														
June 2023- Dec 2023	Quarry Plant Construction														
2023-2030	Operation and Maintenance														
January- March 2031	Decommissioning and abandonment														

3.8 Quarry Waste and Proposed Management Method

Tables 3.6 and 3.7 show the type of waste that will be generated in the Eso Terra Quarry sin Hugungumai 34082QLS in Kunchi LGA and the proposed management methods.

Table 3.6 Waste Types & Quantities - Pre-Operational Stage

WASTE TYPE	SOURCE(S)	MANAGEMENT METHOD	ESTIMATED QUANTITY
Cleared vegetation	Clearing site for quarry access roads and site infrastructure	• Reusing vegetation waste on site for rehabilitation, landscaping, and erosion control was possible.	• About 50m^3
Excavated waste (soil and overburden)	Excavation for quarry, roads, and site infrastructure	• Excessive material is used to reclamation deep gully areas within the Hugungumai area.	• 2000m^3
Concrete	Site infrastructure area	• Minimize waste by producing or procuring only the amount required. • All excess concrete will be returned to the point of supply.	• Less than 50m^3
Scrap metal	Site infrastructure area	• Segregation and collection on site. • Transportation off-site by a waste contractor for off-site recycling.	• Variable.
Paints and resins	Site infrastructure area and workshop	• Minimise waste by procuring only the amount required. • Collect on-site and store in a segregated covered area. • Transport from the site by a Licensed, regulated waste transporter for disposal at a licensed facility.	• Variable
Waste oil and containers **(Regulated waste)**	Workshop	• Collected, labelled, and stored separately on-site in a bunded tank. • Transported from the site by a licensed waste transporter to a licensed facility for recycling.	• Variable
General wastes putrescible and organic	Workshop and offices	• Putrescible waste will be stored in a sealed and covered bin and disposed of off-site weekly to minimise the attraction of vermin and pests.	• Less than 30m^3 bin per week
General waste, including plastics, packaging, and materials	All site operations	• General waste will be taken off-site for disposal at a government-approved waste facility. • Collection and segregation of recyclable waste on site. • Transportation from the site by a licensed waste	• Approximately One 5m^3 bin per week

		transporter to a licensed facility for recycling.	
Sewage treatment sludge **(Regulated waste)**	All site operations	• Wastes will be collected in septic tanks, treated in an on-site Package Treatment Plant with the produced waste sludge and disposed of at a landfill facility approved by the Kano state government. • Portable toilets are proposed before construction of the Package Treatment Plant. • Waste removed from the site by a licensed contractor.	Variable depending on the workforce

Table 3.7 Waste Types & Quantities – Operational Stage

WASTE TYPE	SOURCE(S)	MANAGEMENT METHOD	ESTIMATED QUANTITY
Oily sludge, absorbent, degreaser, grease, oily rags, and oilfilters **(Regulated waste)**	Workshop	• Collected on-site and transported off-site by a licensed, regulated waste transporter to a licensed facility for recycling, treatment, and disposal.	Variable
Waste oil and Containers	Workshop	• Drained on-site with collection drums transported off-site by the waste contractor for off-site re-use, recycling, or disposal.	Approx. 5,000 litres per year
Scrap metal	Site infrastructure areas	• Segregation and storage on-site in open storage bins. • Transportation off-site by a waste contractor for off-site recycling.	Variable
General wastes – Putrescence and organic	Workshop and offices	• To minimise the attraction of vermin and pests, putrescence waste will be stored in a sealed and covered bin and disposed of off-site weekly.	Approx. one $3m^3$ bin per week
General wastes - plastics	Workshop and offices	• Collection on-site and stored in a segregated area. • Transportation from the site to a government-approved waste facility.	Less than 1 m^3 per week
Explosives	Quarry Pit	• No waste explosives produced on site.	Nil (all used on site)
Recyclable waste - paper, cardboard, plastics, glass, and aluminium cans	Workshop and offices	• Collect recyclable products segregated according to Eso Terra Quarry Limited recyclable material collection arrangements in appropriate containers.	Variable
Diesel & solvents **(Regulated waste)**	Workshop	• Recycle through an approved licensed waste collection agency.	Variable

WASTE TYPE	SOURCE(S)	MANAGEMENT METHOD	ESTIMATED QUANTITY
Hazardous waste paints and resins **(Regulated waste)**	Workshop	• Collection on-site and stored in a segregated area. • Transported off-site by a licensed, regulated waste transporter to a licensed facility fortreatment and disposal	Variable
Tyres **(Regulated waste)**	Workshop.	• But not always; truck tyres can be re-trodden. Earthmover tyres can be re-used as bunding around the site. • Light vehicle tyres will be stored on-site and transported from the site by the supplier or a licensed, regulated waste transporter to a licensed facility for recycling or disposal.	Variable
Vehicle batteries **(Regulated waste)**	Workshop	• Dead batteries shall be removed from the site by the battery supplier. Batteries not removed by the supplier shall be stored on-site for collection and disposed of as regulated waste by a certified regulated waste contractor.	Approx. 50 per Year
Sewage waste and sludge **(Regulated waste)**	Workshop and offices	• Wastes will be treated in an on-site septictank, pre-treated, and disposed of at a landfill facility approved by KNSG.	Approx. 1,500 litres per annum
Crusher lubricants **(Regulated waste)**	Crusher	• Collected on-site and transported off-site by a licensed, regulated waste transporter to a licensed facility for recycling, treatment, and disposal.	Approx.2,750 litres perannum
Heavy Mobile Equipment (HME) Lubricants **(Regulated waste)**	Heavy Mobile Equipment	• Collected on-site and transported off-site by a licensed, regulated waste transporter to a licensed facility for recycling, treatment, and disposal.	Approx. 3, 000 litres per annum
Crusher wear liners (Cast manganese steel) **(Regulated waste)**	Crusher	• Collected on-site and transported off-site by a licensed, regulated waste transporter to a licensed facility for recycling, treatment, and disposal.	Approx. 15 tonnes per annum

CHAPTER FOUR

DESCRIPTION OF THE ENVIRONMENT

4.1 General

This chapter provides a comprehensive overview of the study approach and field methodology for the Environmental Status Report studies. It also details the current environmental conditions of the project site, Hugungumai, in Kunchi Local Government Area of Kano State. The results presented here are the culmination of meticulous field and laboratory work conducted with the approval of FMEnv, covering a single-season (Dry season) sample for the environment's physical and biological components. This thorough approach ensures the accuracy and reliability of the data.

The human and health issues discussed are based on analysing responses and occurrences from literature, checklists, and Focus Group Discussions.

4.2 Baseline Study Methodology and Chain of Custody

The approach was to gather ecological baseline data from desktop, field and laboratory studies, interviews and consultations with the relevant stakeholders, individuals, and communities. This inclusive approach ensures that the baseline status of the environment of the project area is accurately established, considering all perspectives. The project's potential environmental impacts are measured, mitigative measures are proposed, and an Environmental and Social Management Plan (ESMP) is rightfully developed. Field assessments included but were not limited to thefollowing: air, water, and soil quality assessment, vegetation mapping and characterisation (including health status), animal resources, socio-economic/social assessment, and health impact assessment, which were adequately addressed.

Flora and fauna were identified through visual observations, hearing animal calls, and examining footprints, remains, etc. These are followed by interpretations and discussions of results and a report on the flora and fauna species in the area.

The socio-economic studies were carried out with great care and consideration, ensuring that the concerns of the communities were heard and addressed. This involved interviews, consultations, and the issuance of questionnaires to the people of the communities, as well as visits to public places such as markets, schools, and other sensitive receptors in and around the project area. The field assessment/Data gathering runs from 7 November 2022 to 20 November 2022 for only one season.

Details of the methodology are as follows:

4.2.1 Methodology Used for the Socioeconomic Study

Field survey to identify all stakeholders that are directly or indirectly impacted bythe proposed project; Focus Group Discussion (FGD) with proposed project affected communities; Personal observations; In-depth interview with community leaders of the identified communities (women leaders, religious leaders and youth leaders) the artisanal miners; this provides a vertical depth knowledge on the likely socio-economic impacts of the proposed project; Structured questionnaire to collect the baseline information and community members perceptions of the proposed project (Crewell, 2003; Bernard, 2011; Akpabio, 2013).

A simple random sampling technique was used to administer the questionnaire and enumerate the combination of socio-economiccharacteristics. Population estimation was based on a questionnaire survey and projection from 2006 census figures by the National Population Commission (NPC). The sample size for this study will be extracted from the sample size table developed by Dillman (2007) and Salant and Dillman (1994). An estimated forty (40) people of indigenes, residents, women, men, and youths were randomly interviewed. Thirty (32) questionnaires were distributed, filled, and retrieved. This was done to validate and complement the information given by the general respondents.

4.2.2 Literature review

Literature relevant to the study area was reviewed, including relevant literature on water, air, soil, noise, climate temperature, humidity, rainfall, topography, geology, hydrogeology, ecology, and the socioeconomics of the communities. The aim was to identify the composition of the flora and fauna and understand features peculiar to the

project area.

4.2.3 Field Survey

The field data and sample collection involved are presented on which was aimed at:

- Identification of sensitive receptors around the project site.
- Reconnaissance visits to understand the peculiarity of the project site.
- Identification of ecologically sensitive areas and important species of flora and fauna present.
- Identification and marking of sampling points.
- Analysis of project activities and their interactions with environmental components such as soil, water, flora, and fauna.
- Collection of relevant samples in and around the project site.

4.2.4 Methods of Sample Data Collection

Water and soil samples were collected on the 8^{th} – 10^{th} of November 2022 from different points in the study area and taken to the laboratory for analysis. The geographic coordinates of the sampling points were taken accordingly. Air quality and noise level assessment was done in 11 locations plus acontrol. Soil samples were from 11 locations plus control. Surface water sample collection from 2 different quarry pits located withinthe project area. Underground water sample collection from a well in the Hugungumai community.

The samples were taken to the Kano State Ministry of Environment laboratory for analysis. On-site assessment of the physical, chemical, geological, topographical as well asgeophysical conditions and positions of the study area were conducted as follows:

Noise levels

Noise levels were measured using the Dosimeter. The noise levels were measuredat various points and elevations in the study area.

Decibel (Sound Level Meter): This instrument has three measuring ranges (30-80, 50-100, 80-130). After powering on the unit, a proper measuring range is selected by pressing the Range Button. The instrument is held at a height of about 3m above ground level so that the microphone sensor measures the noise level, and the sound level value

(dB (A)) will be displayed on the LCD (Light Crystal Diode).

Noise, vibration detection, and air sampling were done using their meters. These detection meters are powered and handheld. A steady digital reading display on the screen marks the specific parameter value. Soil and water samples were collected in specified well-labelled containers and stored under proper conditions before being transported to the lab for analysis. Colorimetric and titrimetric techniques were used to test for the concentrations of various metals and inorganic and organic elements while adopting the American Public Health Association (APHA) standard method.

Air quality

Air quality analysis was carried out at various locations in the study area using a hand-held Crowcon multi-gas air quality meter.

Gasman (Crowcon Detection Instrument) is an intrinsically safe personal gas detector designed to warn the user of dangerous conditions in the immediate vicinity. It monitors flammable gases, oxygen enrichment, and other toxic gases. With the unit placed in normal air (site of visit), the switch is turned on to the GAS position and ready for use. The reading is in ppm (parts per million) for all the gases measured.

Haz-Dust Particulate Monitor: This potable direct-reading particulate monitor uses infrared electromagnetic radiation to sense airborne particles.The sensing method is traditionally referred to as near-forward light scattering. The mass concentration

readout is expressed in milligrams per cubic meter (mg/m^3).The unit is held in the palm, so the display faces up. **Plate 4.1**

Plate 4.1. Onsite Air Quality and Noise Level Assessment (Field, 2022)

Water Samples

Water samples were collected from 2 quarry pits within the site (Surface) and one borehole from Hugungumai Community using sterilised bottles. pH values were measured on-site with a pH meter. Temperature and Total Dissolved Solids (TDS) were also measured on-site using their respective meters. The sulphates, nitrates and phosphorus analyses were carried out using appropriate test kits, while an Ion Meter was used to detect and analyse compounds such as ammonia. **Plates 4.2 and 4.3**

Plate 4.2 *In situ* Water Quality Test for The Surface Water Sample Within theSite (Field Work, 2022)

Plate 4.3 *In situ* Water Quality Test for the Well Water Sample within Hugungumai Community (Field, 2022)

Soil Samples

Soil samples in the study area were collected and analysed using suitable laboratory instruments for pH, temperature, TDS, etc. **Plate 4.4**

Plate 4.4. Soil Sampling and Labelling Within the Site (Field, 2022)

4.2.5 Preservation and Transfer of Samples

The DPR-recommended methods of sample preservation shown in Table 4.1 below were adopted. Samples were transferred into proper preservation containers and transported

to the Kano State Ministry of Environment Pollution Control laboratory, where they were placed in freezers for analysis. These freezers were set to recommended temperature levels and in the refrigerator for microbiological analysis. Table 4.2 presents the Summary of Analytical Methods and Equipment Used in Laboratory Analysis of Soil and Water Analysis.

Table 4.1: DPR Recommended Preservatives for Various Constituents Used by the Laboratory.

SN	PARAMETER	REQUIRED VOLUME (ml)	CONTAINER	PRESERVATION	MAXIMUM HOLDING PERIOD
1	PH	35	P, G	Cool 4^{o}C Detect On-site	6 Hours
2	Electrical Conductivity	100	P, G	Cool 4^{o}C	24 Hours
3	Colour	50	P, G	Cool 4^{o}C	24 Hours
4	Odour	200	P, G	Cool 4^{o}C	24 Hours
5	Turbidity	100	P, G	Cool 4^{o}C	7 Days
6	Total Dissolved Solids (TDS)	50	P, G	Filter on site Cool 4^{o}C	24 Hours
7	Total Suspende Solids (TSS) d	50	P, G	Filter on site	6 Months
8	Total Hardness	100	P, G	Cool 4^{o}C HNO^{3} to PH<2	7 Days
9	Acidity and Alkalinity	100	P, G	Cool 4^{o}C	24 Hours
10	Salinity as CI	50	P, G	None Required	7 Days
11	Chemical Oxygen Demand(COD)	50	P, G	2ml H_2SO_4 per litre	7 Days
12	Biological Oxygen Demand(BOD)	1000	P, G	Refrigeration at 4^{o}C	6 Hours
13	Surfactants as (MB AS)	250	P, G	Cool 4^{o}C	24 Hours
14	Dissolved Oxygen (DO)	300	G only	Detect on site	No Holding
15	Ammonia	400	P, G	Cool 4^{o}C H_2SO_4 to PH<2	24 Hours
16	Oil & Grease	1000	G only	Cool 4^{o}C H_2SO_4 or HCL to PH<2	24 Hours
17	Nitrate (NO_3)	100	P, G	Cool 4^{o}C H_2SO_4 to PH<2	24 Hours
18	Sulphate (SO_4)	50	P, G	Cool 4^{o}C	7 Days
19	Carbonate (CO_3) free CO_2 & HCO_3	-	P, G	-	-
20	Cyanides	500	P, G	Cool 4^{o}C NaOH to pH 12	24 Hours
21	Phosphorus	-	-	40mg, $HgCl_2$ per litre 4^{o}C	7 Days
22	Phenolics	500	G only	Cool, 4^{o}C, H_2PO_4 to pH<4.1g$CuSO_4$/litre	24 Hours
23	Chromium	100	P, G	HNO_3 to pH<2	-
24	Arsenic	100	P, G	-	6 Months
25	Cadmium	100	P, G	-	6 Months
26	Cobalt	-	P, G	-	6 Months
27	Copper	-	P, G	-	6 Months
28	Iron	-	P, G	-	6 Months

29	Mercury	100	P, G	Filter, HNO_3 to pH<2	38 Days (Glass)
30	Lead	100	P, G	HNO_3 to pH<2	6 Months
31	Nickel	100	P, G	-	6 Months
32	Zinc	100	P, G	-	6 Months
33	Vanadium	100	P, G	-	6 Months
34	Calcium	100	P, G	None Required	7 Days
35	Magnesium	100	P, G	-	6 Months

Where P = Plastic and G = Glass

Table 4.2: Summary of Analytical Methods and Equipment Used in Laboratory Analysis of Soil and Water Analysis

SN	Parameters Determined	Equipment/Technique
1	pH	Jenco UC meter 6100
2	Temperature	Jenco UC meter 6100
3	Conductivity, µS/cm	Hanna H1
4	Salinity % or ppt	Salinometer
5	Dissolved Oxygen, mg/l	DO meter, wrinkler's
6	Transparency (m)	Secchi disc
7	Grain size	Granulometry and sedimentation
8	BOD5 mg/l	Hach BOD track
9	NH4 mg/l	Nessler's reagent
10	NO3 mg/l	Phenol disulphuric acid
11	PO4 mg/l	Colorimetry with molybdenum blue solution
12	SO4 mg/l	Turbidometry and photometry
13	THC mg/l	Capillary GL
14	Aliphatic and Aromatic mg/l	GC-MS
15	TOC %	Graphite furnace and gravity
16	N%	Graphite furnace and gravity
17	TDS mg/l	Gravimetry after drying to constant weight
18	TSS mg/l	Gravimetry after drying to constant weight
19	Heavy Metal mg/l or ppm	AAS, UNICAM 939, after digestion
20	Soil Moisture Content %	Gravimetry after drying to constant weight
21	Soil permeability	Falling head permeability test
22	Exchangeable cations mg/l	AAS, after digestion

4.2.6Sampling Points

The sampling was designed to comprehensively capture all the environmental/ecological components peculiar to the project site. The spatial boundaries for the field study and sampling were a 600m radius, while that of the socioeconomic survey was a 2km radius. The description is highlighted below. Figure 4.1 shows the sample location distribution within the quarry lease area for air quality and noise level obtained at the exact locations except for water, which has distinct sampling points. **Tables 4.10, 4.11, and 4.12**

show sampling coordinates and the sample analysis results carried out in the laboratory.

Below is the summary of the samples collected:

- Air quality assessment in 11 locations plus a control location in and around the project site.
- Noise level assessment in 11 locations plus control in and around the project site.
- Soil sample collection from 11 locations plus control in and around the project site {encompassing Topsoil and Subsoil}.
- Surface water sample collection from 2 different quarry pits located within the project area
- Underground water sample collection from a well in Hugungumai community.

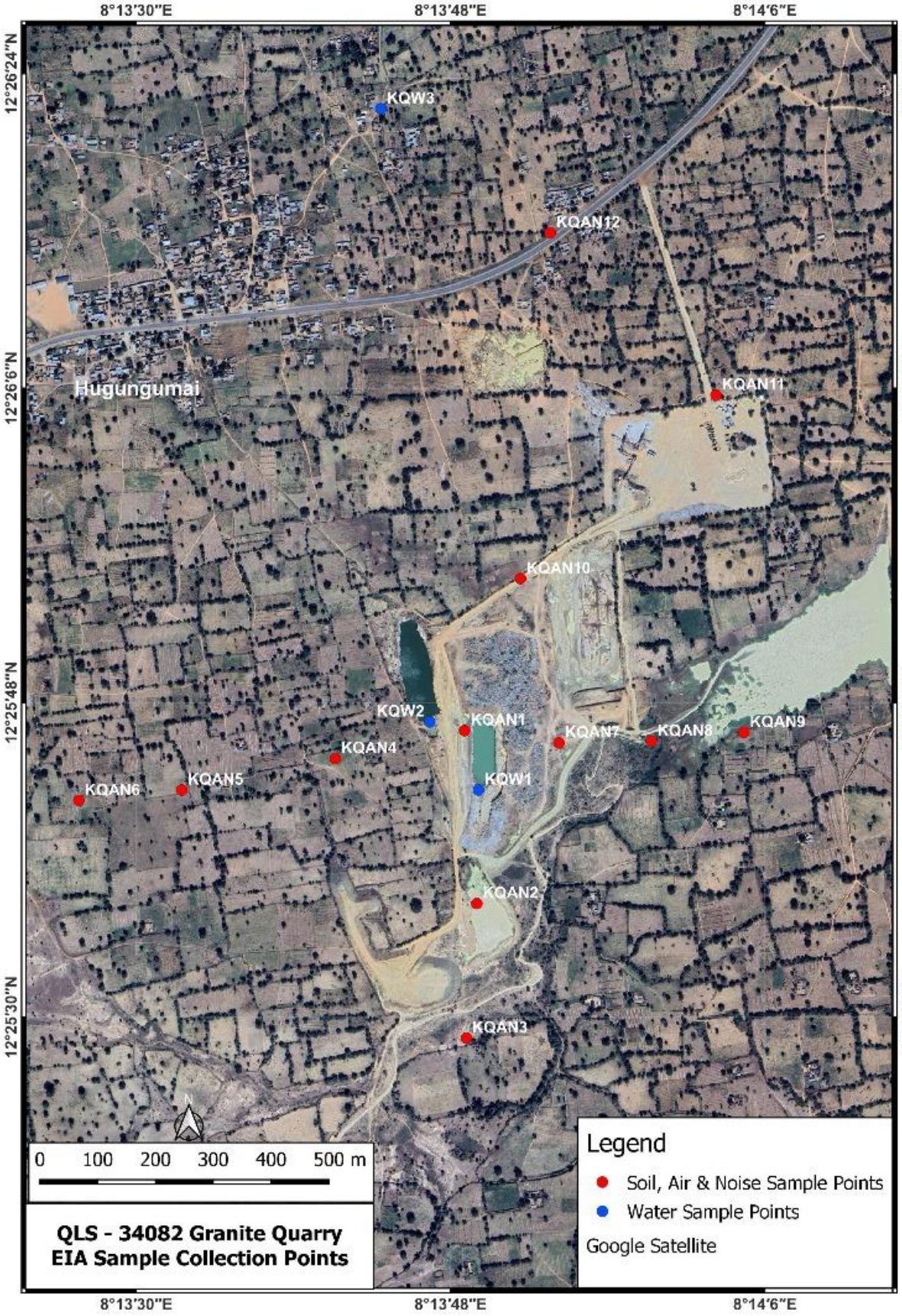

Figure 4.1 Map Showing the Location of Sampling Points within the Project Area

4.3 Regional Climate/Meteorology

The study area is in the semi-arid climatic zone of Nigeria and is characterised by two distinct seasons: the hot, dry season and a cool, rainy season. Nigeria's climate is characterised by the hot and wet conditions associated with the movement of the Inter-Tropical Convergence Zone (ITCZ) north and south of the equator. This Inter-Tropical Convergence Zone (ITCZ) appears as a band of clouds, usually thunderstorms, that circle the globe near the equator. Nigeria is located just north of the equator.

The project area is within the tropics, dominated by two contrasting seasons: dry and wet (rainy) seasons. The two-season regimes depend on the two prevailing air masses blowing across the country at various times of the year: the south-westerly humid maritime air mass blowing from across the Atlantic and the north-easterly air mass of Saharan origin, i.e., Harmattan.

Kunchi's wet season is oppressive and mostly cloudy; the dry season is partly cloudy and hot year-round. Over the year, the temperature typically varies from 13.89°C to 38.89°C and is rarely below 11.67°C or above 41.11°C.

Sunshine

The general pattern of sunshine hours in Nigeria is lowest in the coastal areas and highest in the extreme northeast. The lower sunshine hours in the south are due to the more significant cloudiness and rainfall characteristic of the southern part of the country.

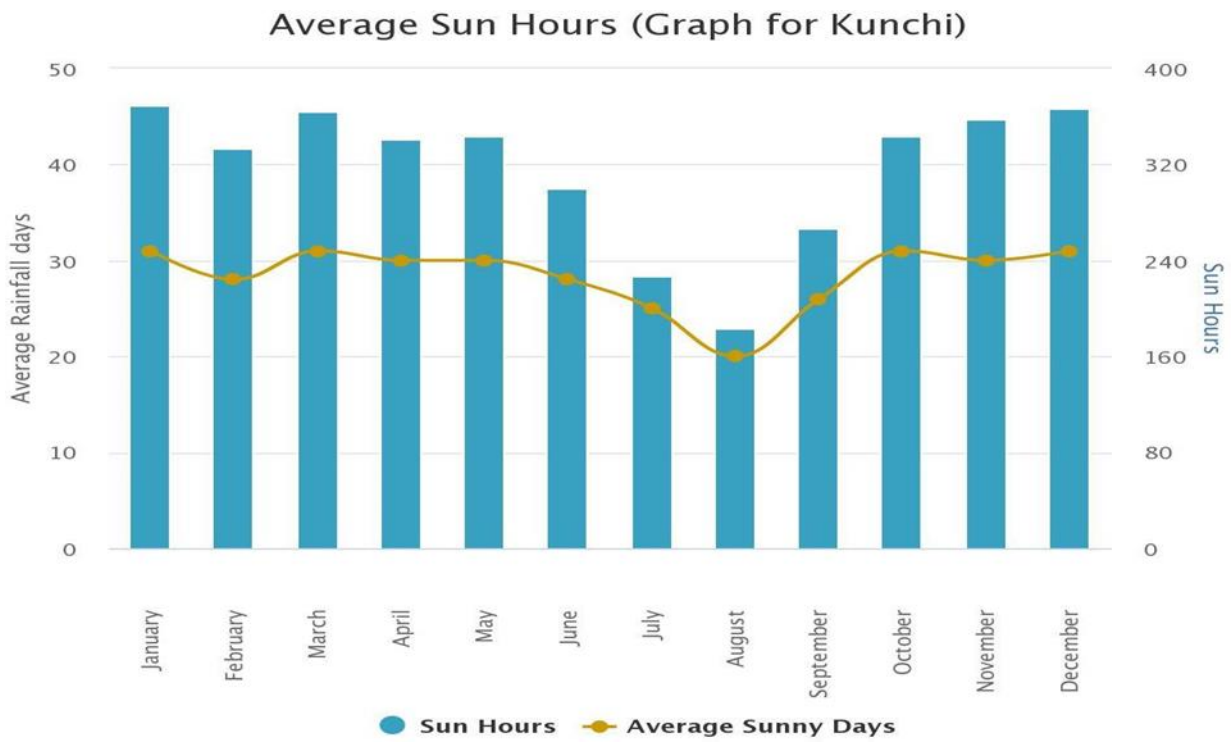

Figure 4.2: Average Annual Sunshine within the Project Region (World Meteorological Organization (WMO) 2022)

The length of the day in Kunchi does not vary over the year, staying within 51 minutes of 12 hours throughout. In 2022, the shortest dayis December 21, with 11 hours and 24 minutes of daylight; the longest is June 21, with 12 hours and 52 minutes of daylight. The earliest sunrise is at 6:00 AM on May 31,and the latest sunrise is 53 minutes later at 6:53 AM on January 25. The earliest sunset is at 5:57 PM on November 19, and the latest sunset is 59 minutes later at 6:56 PM on July 10. average annual sun hour ranges from less than 200-over 300 hours, while the average annual Sundays fall below 100 hours. Figures 4.2 and 4.3

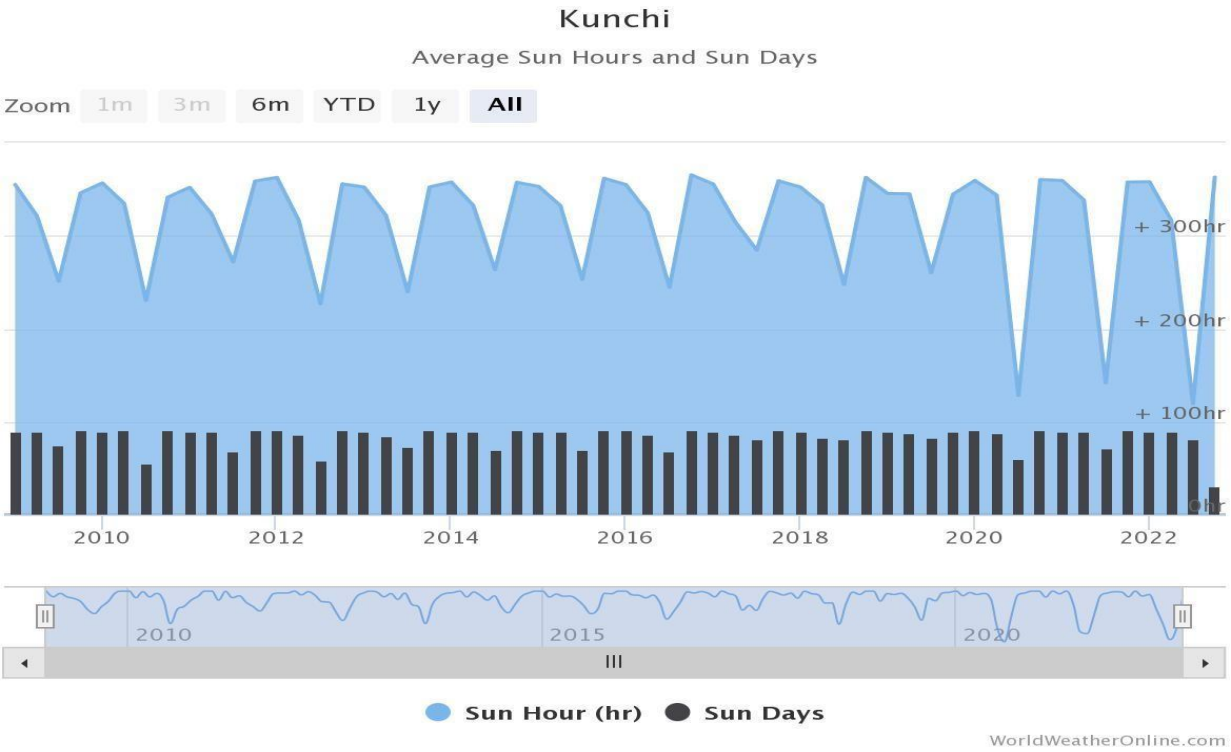

Figure 4.3 Average monthly sun hours and sun day (WMO, 2022)

Temperature

The hot season lasts 2.5 months, between March and June, with an average daily elevated temperature above 98°F. The hottest month of the year in Kunchi is May, with an average high of 37.78°C and a low of 25.56°C. The cool season lasts 1.6 months, from December to January, with an average daily elevated temperature below 30.56°C. The coldest month of the year in Kunchi is January. The average temperature in Kunchi ranged from 25^0C-35^oC. Figures 4.4 and 4.5

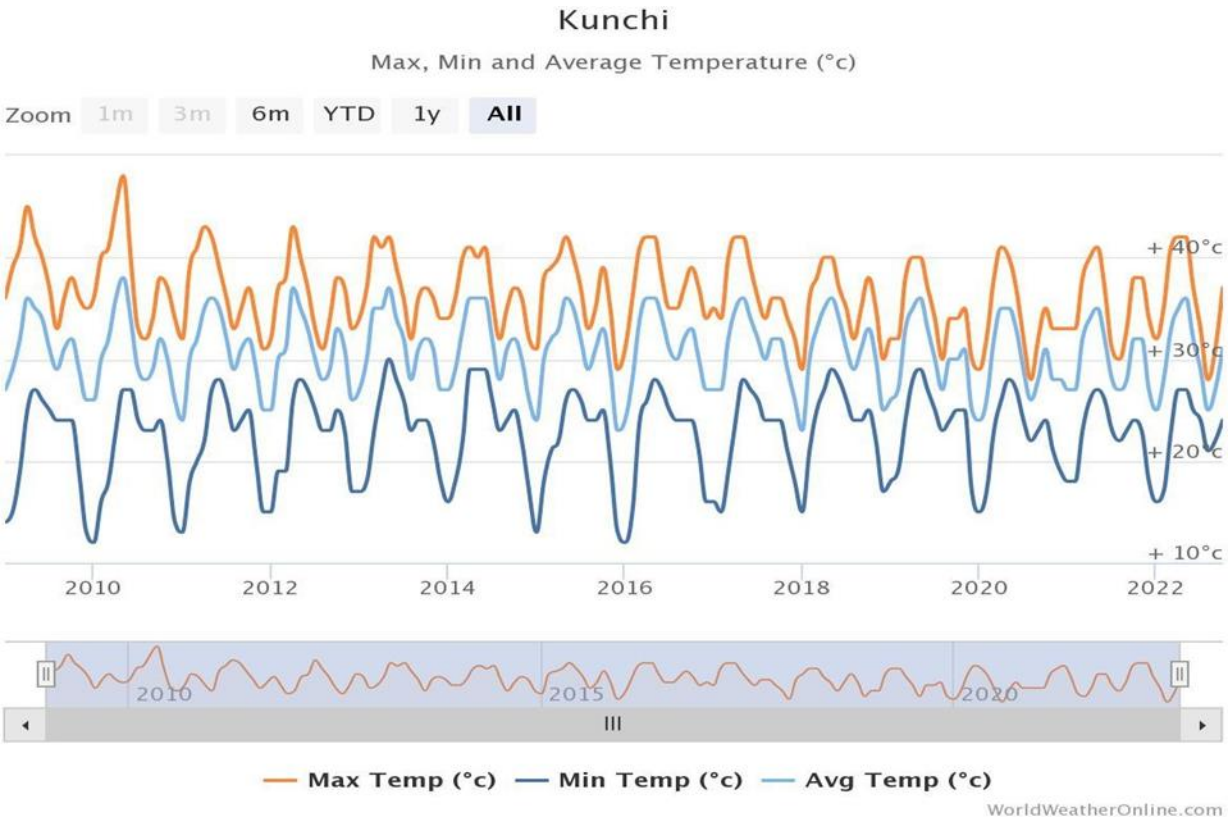

Figure 4.4: Temperature of the Project Area (WMO, 2022)

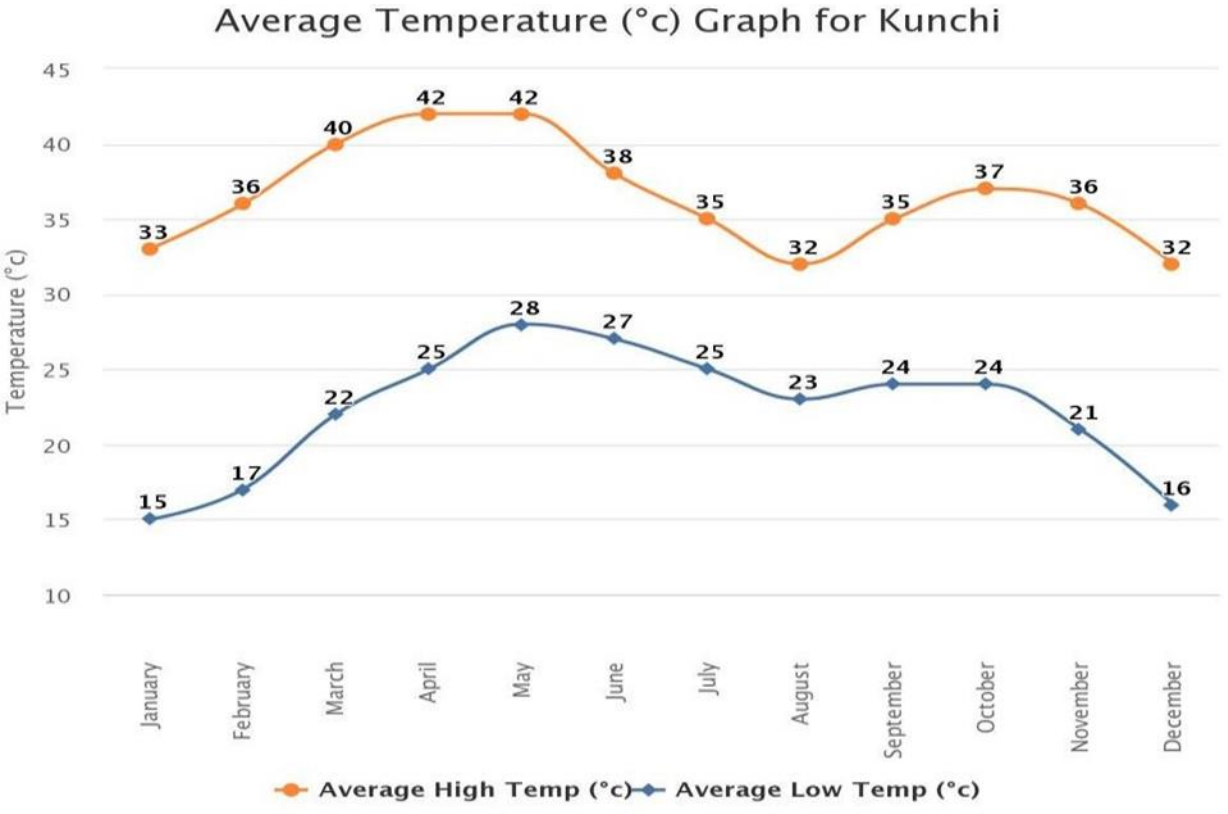

Figure 4.5. Average monthly temperature (WMO, 2022)

Atmospheric Pressure

Pressure is the weight of air on the ground. Variations in atmospheric pressure are closely related to air temperature, water vapour content and vertical and horizontal air movements. Cool or chilly air subsides, increasing its pressure on the air and theearth beneath it, but warm air expands and rises relative to its surroundings, thus decreasing pressure locally. May through August witnessed a rise in atmospheric pressure, with a gradual decline in September. The lowest recorded values occur from October to April. This corresponds to the rainfall pattern for those months. The atmospheric pressure fluctuates between 1010mb to 1015mb. The highest average pressure was recorded in the year 2016, and the lowest recorded in2010

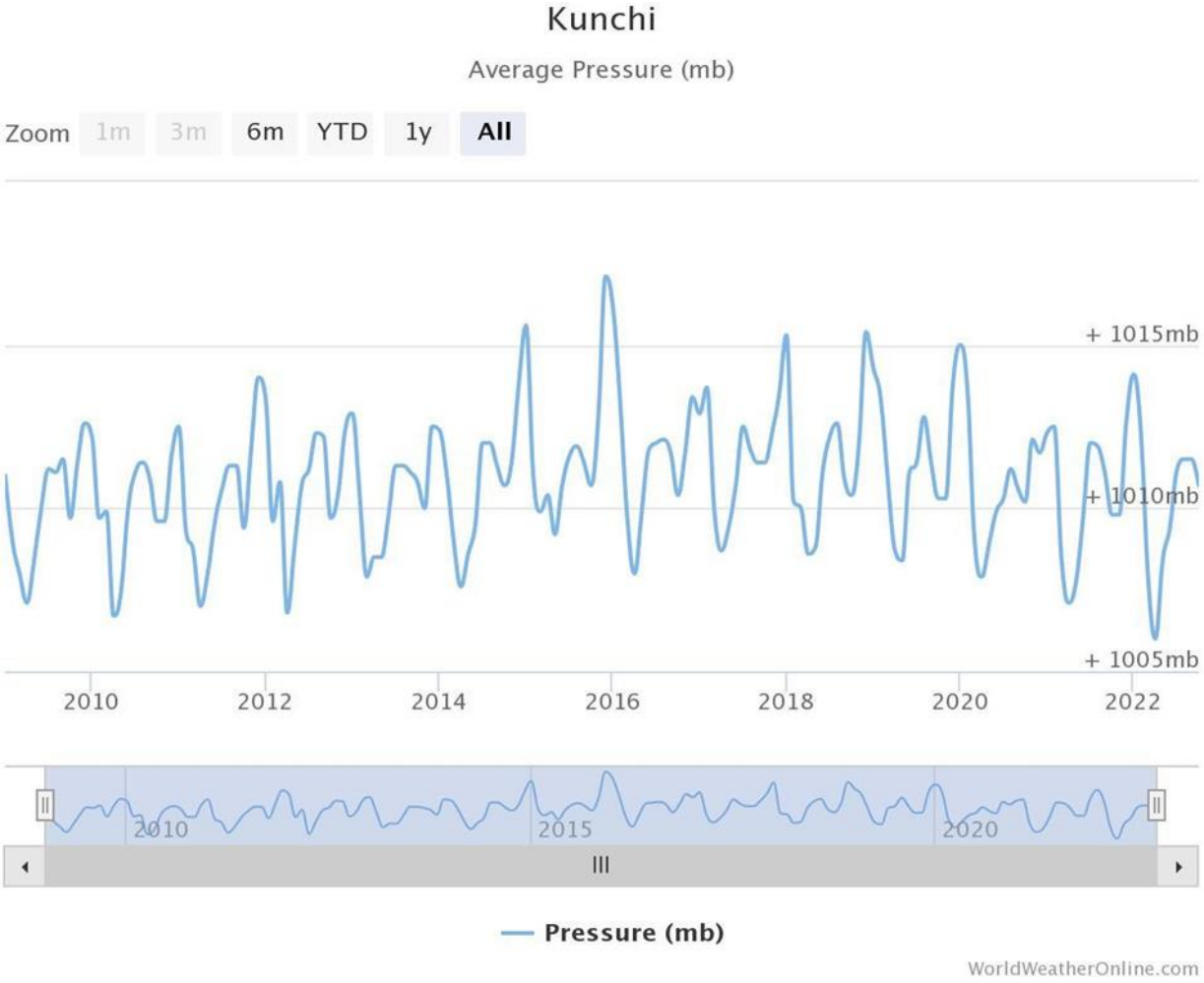

Figure 4.6. Atmospheric Pressure within the Project Region (WMO, 2022)

Relative Humidity and Cloud Cover

Relative humidity is the ratio of water vapour in the air at a specific temperature to the maximum amount the air can hold, expressed as a percentage. For example, a reading of 100 per cent relative humidity means that the air is saturated with water vapour and cannot hold any more, creating the possibility of rain.

We base the humidity comfort level on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. Lower dew points feel drier, and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically followed by a muggy night. Kunchi experiences extreme seasonal variation in the perceived humidity.

The muggier period of the year lasts for 5.9 months, from April to October, during which time the comfort level is muggy, oppressive, or miserable at least 25% of thetime. The month with the muggiest days in Kunchi is August, with 30.7 days that are muggy or worse. The month with the fewest muggy days in Kunchi is December, with 0.0 days that are muggy or worse.

In Kunchi, the average percentage of the sky covered by clouds experiences significant seasonal variation over the year. The more straightforward part of the year begins around November and lasts for 3.8 months, ending around March. The clearest month of the year in Kunchi is January, during which, on average, the sky is clear, mostly clear, or partly cloudy 66% of the time. The cloudier part of the year begins around March and lasts for 8.2 months, ending around November.

The cloudiest month of the year in Kunchi is May, during which the sky is overcast or mostly cloudy 67% of the time. The average cloud cover is below 50%, while the average annual humidity level runs between 50% and 200% (Figure 4.7).

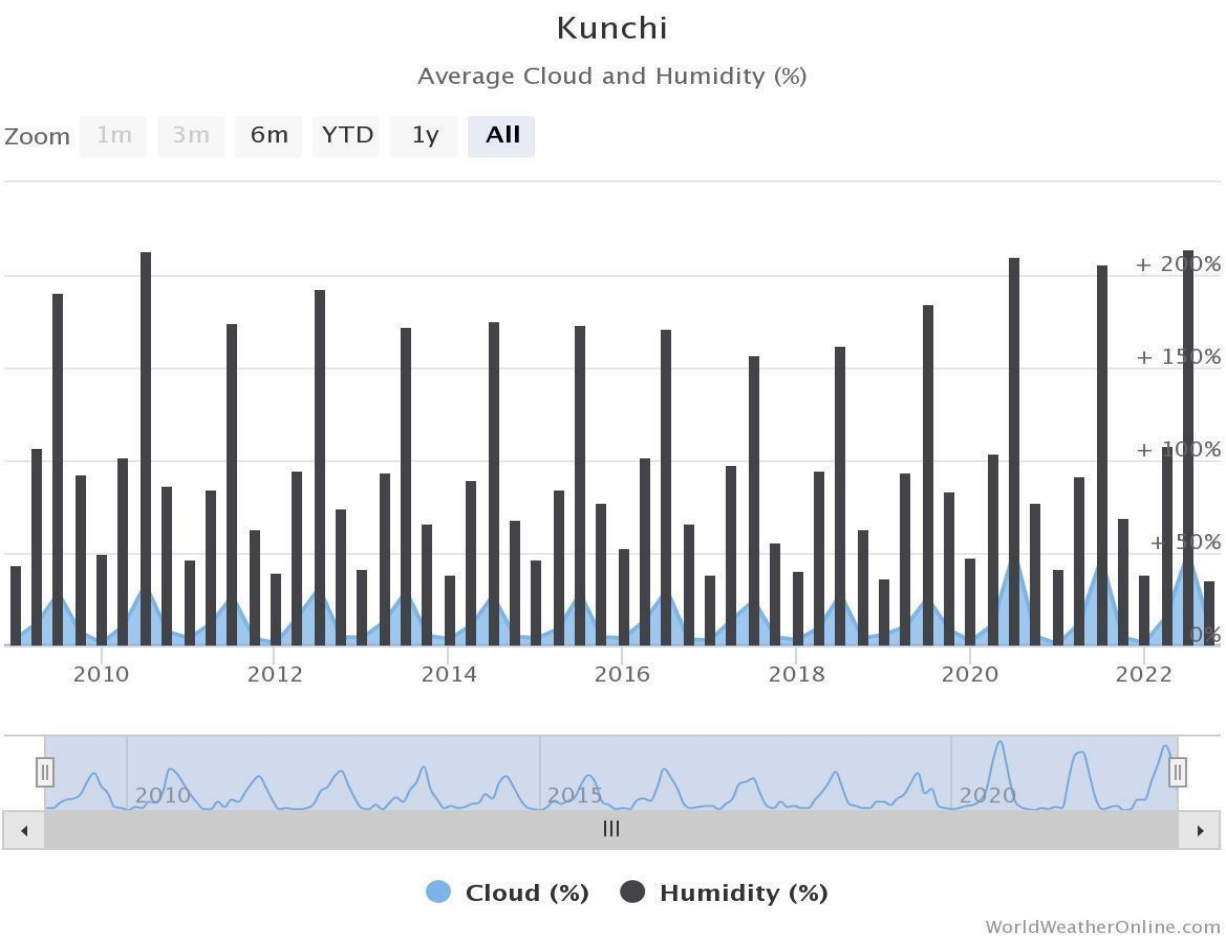

Figure 4.7. Relative Humidity and Cloud Cover (WMO, 2022)

Precipitation and Rainfall

The study area is characterised by a short-wet season, with most rainfall between May and September. During this period, rainfall is a daily occurrence even though it rarely lasts long and is quite different from the regular torrential rain known in wet tropical regions of the south. The average annual rainfall ranges from 100mm to 300mm in the study area. Historically, rainfall in the region usually peaks in August with little or no rain between October and April, during which the climate is dominated by the harmattan wind blowing Sahara dust over the land. The dust dims the sunlight, lowering temperatures significantly and leading to dust disturbance, especially in rural regions with unpaved road surfaces.

A wet day has at least 0.04 inches of liquid or liquid-equivalent precipitation.The chance of wet days in Kunchi varies very significantly throughout the year. The wetter season lasts 3.6 months, from June to September, with a greater than 39% chance of a given day being a wet day. The month with the most wet days in Kunchi is August, with an average of 23.2 days with at least 0.04 inches of precipitation. The drier season lasts six

months, from November to April. The month with the fewest wet days in Kunchi is September, with an average of 0.0 days with at least 0.04 inches of precipitation.

Among wet days, we distinguish between those that experience rain alone, snow alone, or a mixture of the two. The month with the most days of rain alone in Kunchi is August, with an average of 23.2 days. Based on this categorisation, rain alone is the most generic form of precipitation throughout the year, with a peak probability of 77% in August. Kunchi experiences extreme seasonal variation in monthly rainfall. The rainy period of the year lasts for 5.6 months, from April to October, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Kunchi is August, with an average rainfall of 6.3 inches.

The year's dry period lasts six months, from November to April. The month with the least rain in Kunchi is January, with an average rainfall of 0.0 inches. The average annual rainfall ranges from below 100mm in 2022 to over 300mm in 2021 - figures 4.8 and 4.9

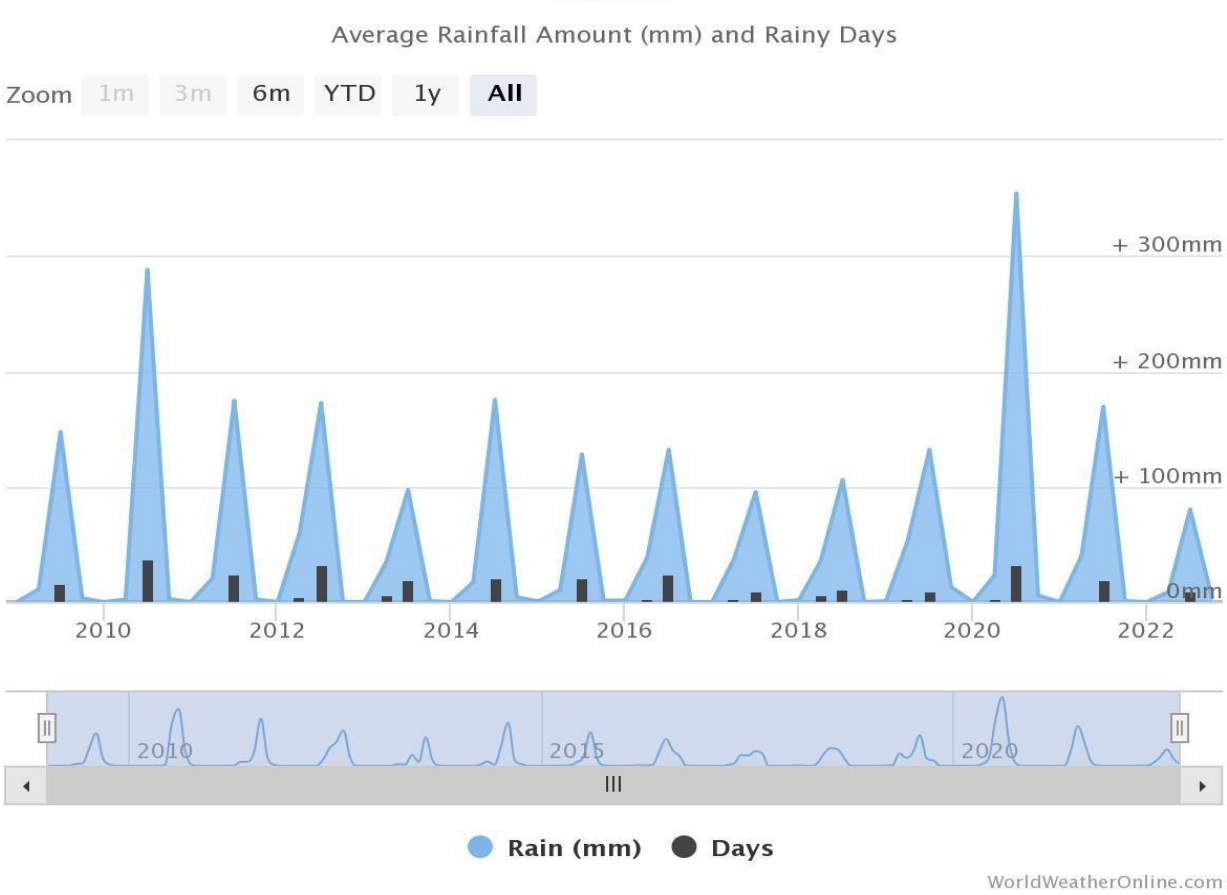

Figure 4.8. Rainfalls in the Project Area

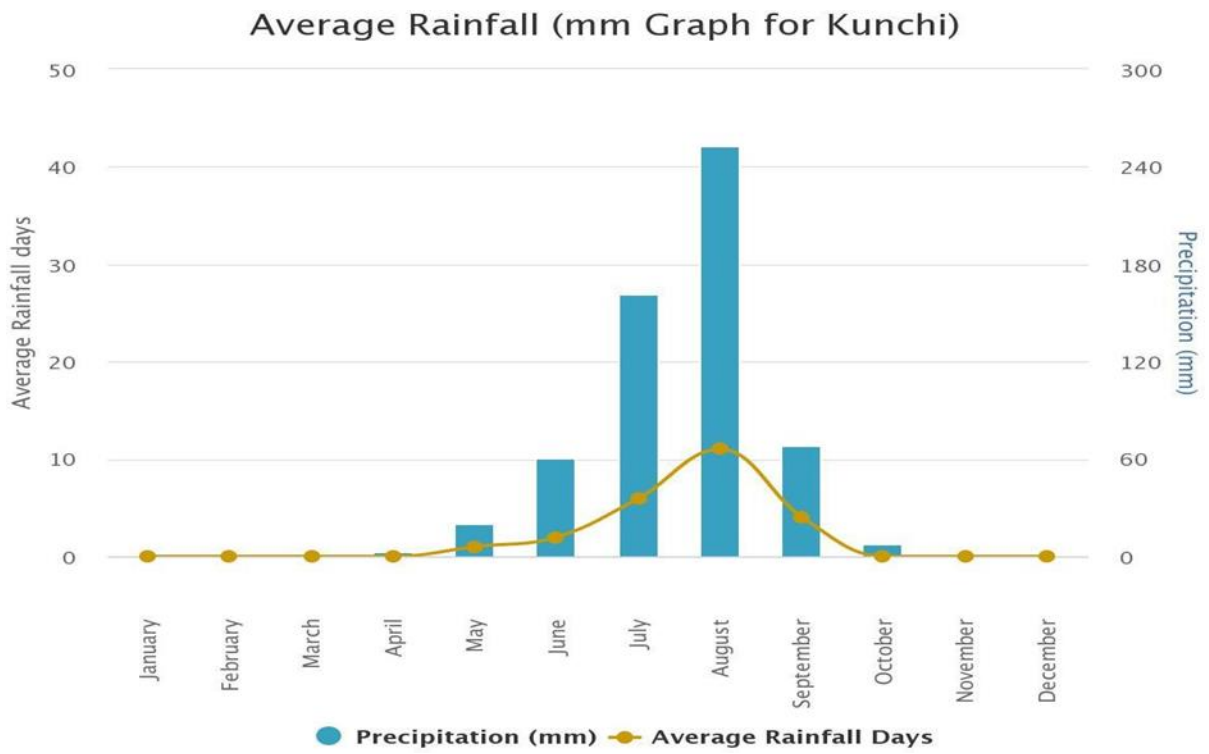

Figure 4.9. Average Monthly Precipitation (WMO, 2022)

Visibility

Fogs form in the morning, impairing visibility to less than 10km. In November and through February, the harmattan period, morning mist is usually prominent, with visibility as low as 4 miles and remaining below 6 miles for several days, thus constituting a severe hazard to land and air transport. Visibility, especially in the dry season, is foggy in the early hours and improves as the day progresses - figure 4.10

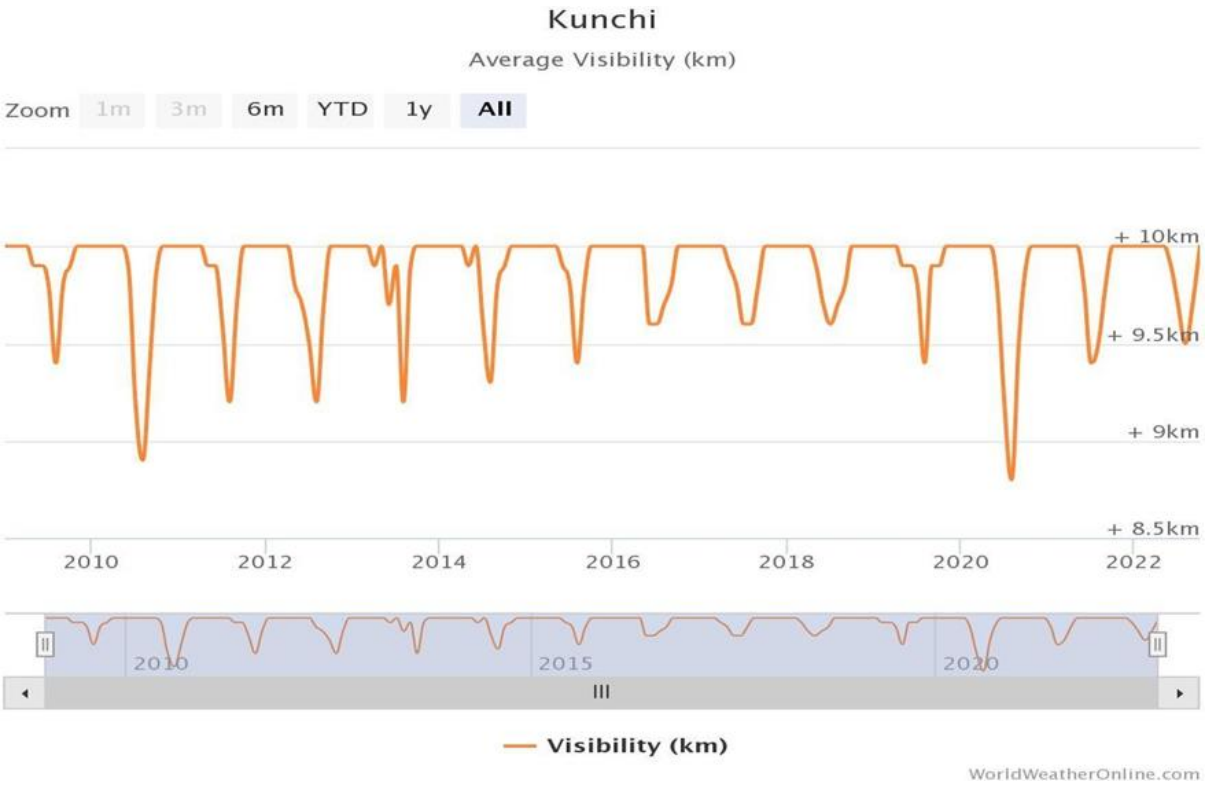

Figure 4.10. Average Visibilities in the Project (WMO, 2022)

Ultraviolet Index

The ultraviolet index, or UV Index, is an international standard measurement of the strength of sunburn-producing ultraviolet (UV) radiation at a particular place and time. Canadian scientists developed the scale in 1992, and the UN's World Health Organization and World Meteorological Organization adopted and standardised it in 1994. It is primarily used in daily forecasts aimed at the public and is increasingly available as an hourly forecast.

The UV Index is designed as an open-ended linear scale directly proportional to the intensity of UV radiation that causes sunburn on human skin. For example, if a light-skinned individual (without sunscreen) begins to sunburn in 30 minutes at UV Index 6, then that individual should expect to sunburn in about 15 minutes at UV Index 12 – twice the UV, twice as fast (Table 4.3). The average annual UV index for the project area ranged from +8-+20 (Figures 4.11 and 4.12).

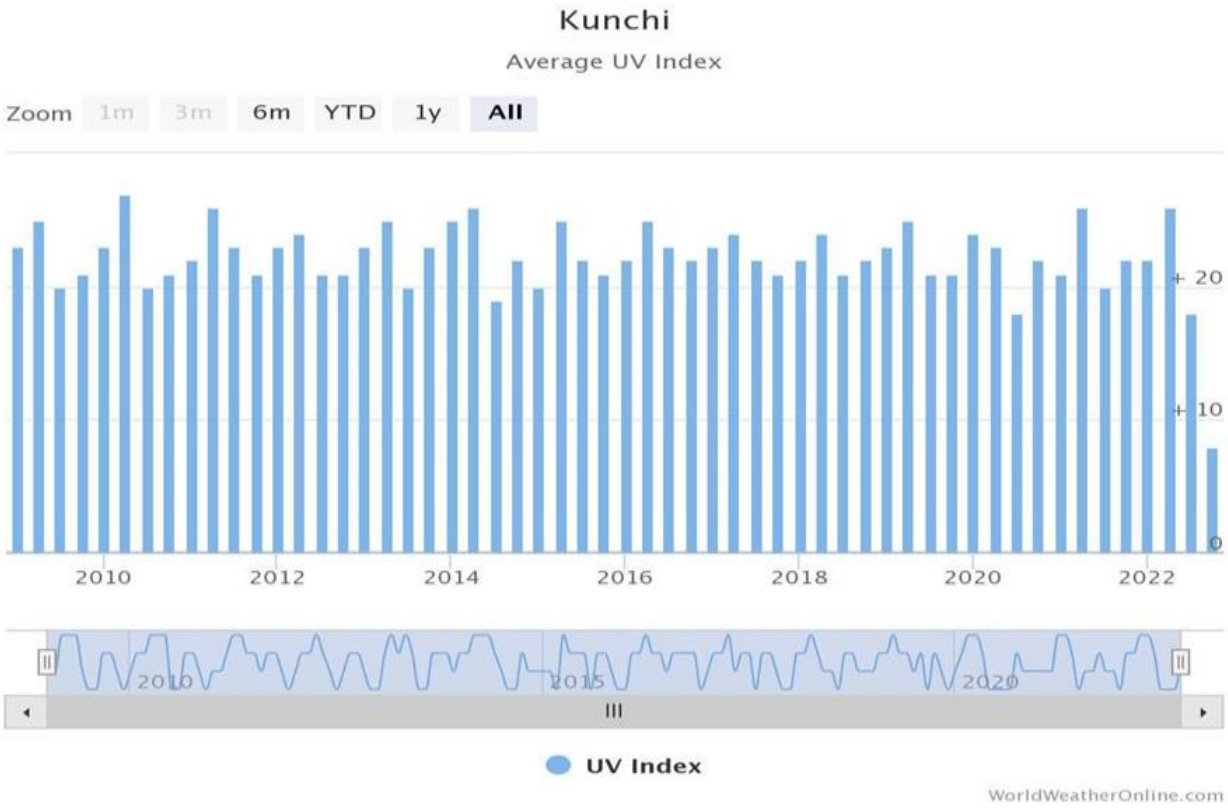

Figure 4.11. Average UV index of the Project area (WMO, 2022)

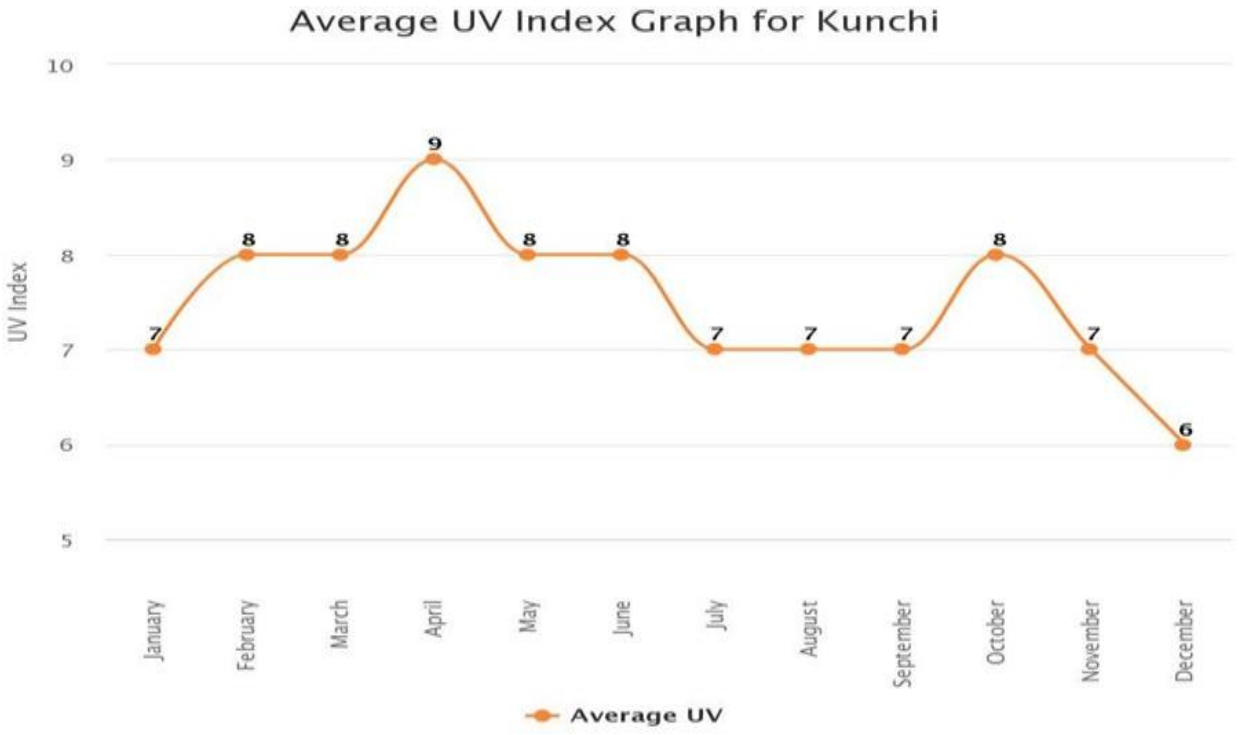

Figure 4.12. Monthly UV Index (WMO, 2022)

Table 4.3. UV Index Scale

UV Index	Media graphic colour	Risk of harm from unprotected sun exposure forthe average adult	Recommended protection
0.0–2.9	Green	"Low"	A UV Index reading of 0 to 2 means low danger from the sun's UV rays for the average person. Wear sunglasses on bright days. If you burn easily, cover up and use broad-spectrum SPF 30+ sunscreen. Bright surfaces like sand, water, and snow will increase UV exposure.
3.0–5.9	Yellow	"Moderate"	A UV Index reading of 3 to 5 means a moderate risk of harm from unprotected sun exposure. Stay in the shade near midday when the sun is strongest. Wear sun-protective clothing, a wide-brimmed hat, and UV-blocking sunglasses outdoors. Use broad-spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days and after swimming or sweating. Bright surfaces like sand, water, and snow will increase UV exposure.
6.0–7.9	Orange	"High"	A UV Index reading of 6 to 7 means an elevated risk of harm from unprotected sun exposure. Protection against skin and eye damage is needed. Reduce time in the sun between 10 a.m. and 4 p.m. If outdoors, seek shade and wear sun-protective clothing, a wide-brimmed hat, and UV-blocking sunglasses. Use broad-spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days and after swimming or sweating. Bright surfaces like sand, water, and snowwill increase UV exposure.
8.0–10.9	Red	"Very high"	A UV Index reading of 8 to 10 means a remarkably elevated risk of harm from unprotected sun exposure. Take extra precautions because unprotected skin and eyes will be damaged and can burn quickly.
			Minimise sun exposure between 10 a.m. and 4 p.m. If outdoors, seek shade and wear sun-protective clothing, a wide-brimmed hat, and UV-blocking sunglasses. Use broad-spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days and after swimming or sweating. Bright surfaces like sand, water, and snow will increase UV exposure.

11.0+	Violet	"Extreme"	A UV Index reading of 11 or more means an extreme risk of harm from unprotected sun exposure. Take all precautions because unprotected skin and eyes can burn in minutes. Try to avoid sun exposure between 10 a.m. and 4 p.m. If outdoors, seek shade and wear sun-protective clothing, a wide-brimmed hat, and UV-blocking sunglasses. Use broad spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days and after swimming or sweating. Bright surfaces like sand, water and snow will increase UV exposure.

Wind Speed

Wind speed describes how fast the air is moving past a certain point. This may be averaged over a given unit of time, such as miles per hour or an instantaneous speed, reported as a peak wind speed, wind gust or squall. Wind direction describes the direction on a compass from which the wind emanates, for instance, from the North or the West. Wind speed and direction are essential for monitoring and predicting weather patterns and global climate. Wind speed and direction have numerous impacts on surface water. These parameters affect ratesof evaporation, mixing of surface waters, and the development of seiches andstorm surges. Each of these processes has dramatic effects on water quality and water level.

Wind speed is affected by several factors and situations, operating on varying scales (from micro to macro scales). These include the pressure gradient, Rossby waves and jet streams, and local weather conditions. There are links between wind speed and wind direction, notably with the pressure gradient and terrain conditions. Pressure gradient is a term that describes the difference in air pressure between two points in the atmosphere or on the surface of the Earth. It is vital to wind speed because the more significant the pressure difference, the faster the wind flows (from the high to low pressure) to balance out the variation. The pressure gradient influences wind direction when combined with the Coriolis Effect and friction. The wind experienced at any given location depends highly on local topography andother factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The average hourly wind speed in Kunchi experiences significant seasonal variation over the year. The windier part of the year lasts 7.8 months, from November to July, with

average wind speeds of more than 6.3 miles per hour. The windiest month of the year in Kunchi is January, with an average hourly wind speedof 8.4 miles per hour. The calmer time of year lasts for 4.2 months, from July to November. The calmest month of the year in Kunchi is September, with an average hourly wind speed of 4.3 miles per hour. The average wind speed runs from 7kmphto over 25kmph. Figures 4.13 and 4.14

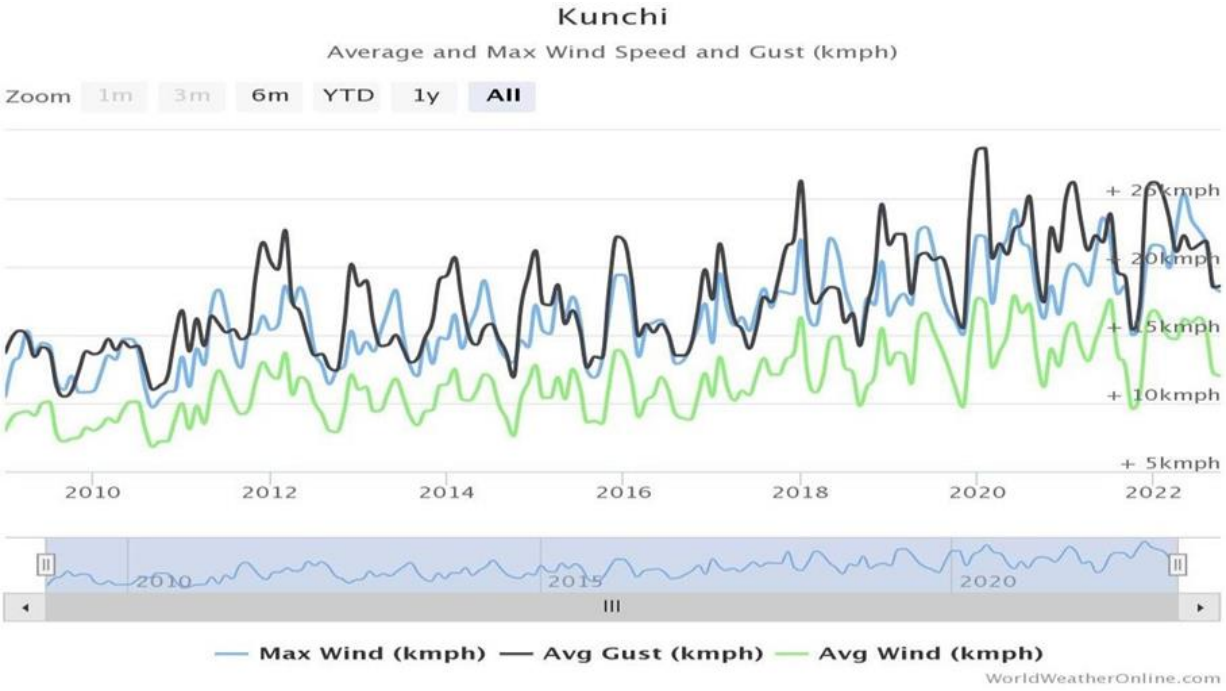

Figure 4.13 Wind Speed in the Project Area {Source: (WMO, 2022)

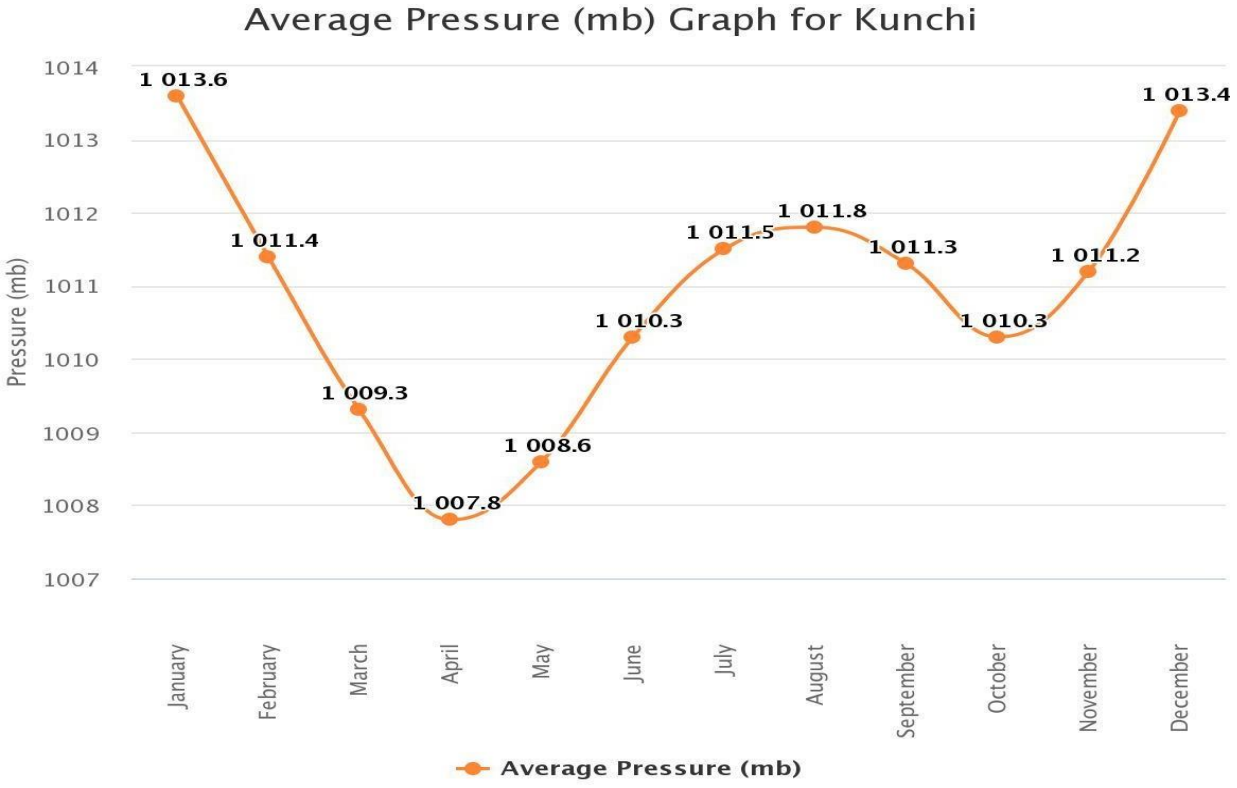

Figure 4.14 Monthly Pressure in Kunchi (WMO, 2022)

4.4 Topography

Topography describes the configuration of a surface, including its relief and the position of its natural and man-made features. In a broader sense, topography is concerned with general local detail, including relief, vegetative and human-made features, and even local history and culture. For this study, topography specifically involves recording relief or terrain, the surface's three-dimensional quality, and identifying specific landforms.

The topography of the northern terrain of the project area is higher than that of the southern part, and the ground elevation could be up to 519m. It crosses the geomorphic units of fluctuating hilly regions, erosion plains, and denudation areas from south to north. The elevation in the southern part gradually increases towards northern Kano.

The terrain fluctuates wildly, and areas of the upland plain serve as caps for regolith hills, e.g., Gwauron Dutse and Dala hills. A narrow strip of the Chad Formation occurs to the east. In height, the relief ranges from lower plains (500m) to highlands of more than 1,000m above sea level.

The topography within 2 miles of Kunchi is flat, with a maximumelevation change of 85 feet and an average above-sea level of 1,365 feet. Within 10 miles is a flat (358 feet). Within 50 miles, it contains only modest variations in elevation (1,791 feet). The area within 2 miles of Kunchi is covered by cropland (78%), within 10 miles by cropland (76%), and within 50 miles by cropland (71%) and grassland (14%).

The relief of Kano State is undulating and flat in some parts; it is about 400 to 550 meters above sea level.

Several manmade lakes such as Tiga, Challawa Gorge, Gari, Jakara, Watari, Guzuguzu, Kafin Chiri, Dudurun Gaya, Hugungumai and Bagauda have been constructed to improve portable water supply to towns and villages and to provide water for irrigation. Dam construction has resulted in the drying out of downstream fadama lands. Overgrazing of fadamas "results in soil compaction and reduces vegetation cover, leading to increased surface runoff in the wet season and reduced water holding capacity of the soils." Wind erosion of surface soil is common. The topography of the project area ranges from 470m-514m above sea level (Figures 4.15 and 4.16). The topography of

the project area is flat with few dots of granitic outcrops. Rocks in the area are poorly exposed and are as high as 389m above sea level in some places, especially in the central area where the main quarry is proposed. The drainage system in the area is usually marked by the proliferation of smaller streams that dry for many months, especially from October to May. A significant water collection point is the Kunchi Dam, built by the Kano State government in the 1970s for irrigation and animal feeding.

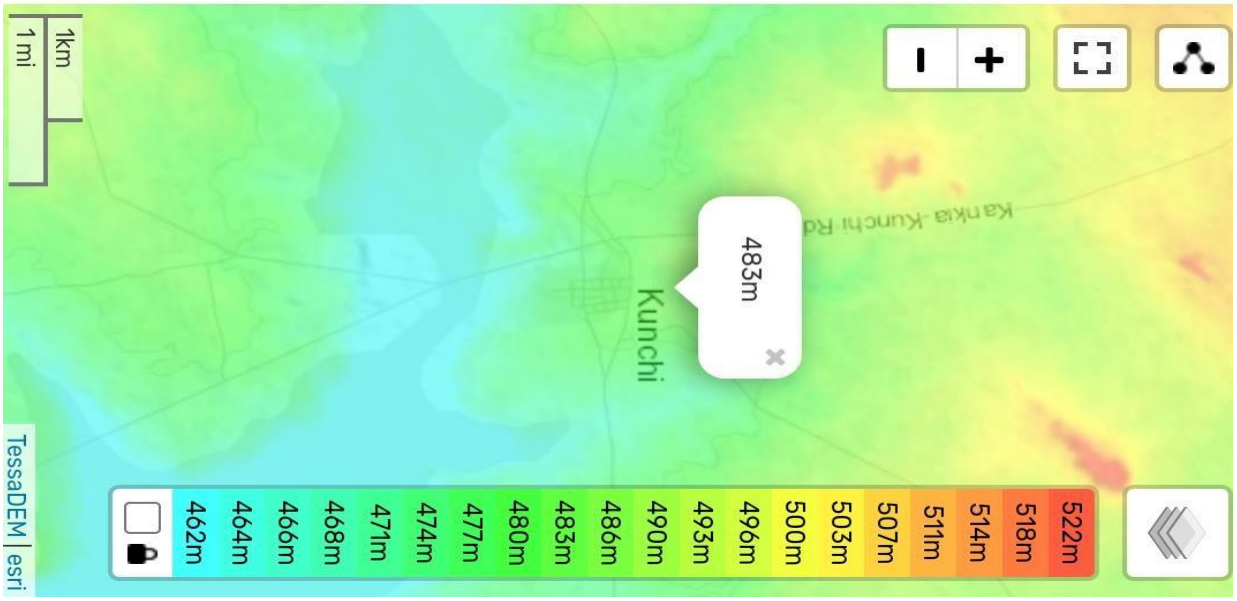

Figure 4.15 Topography Map of Kunchi (Source: ArcGIS online ESRI)

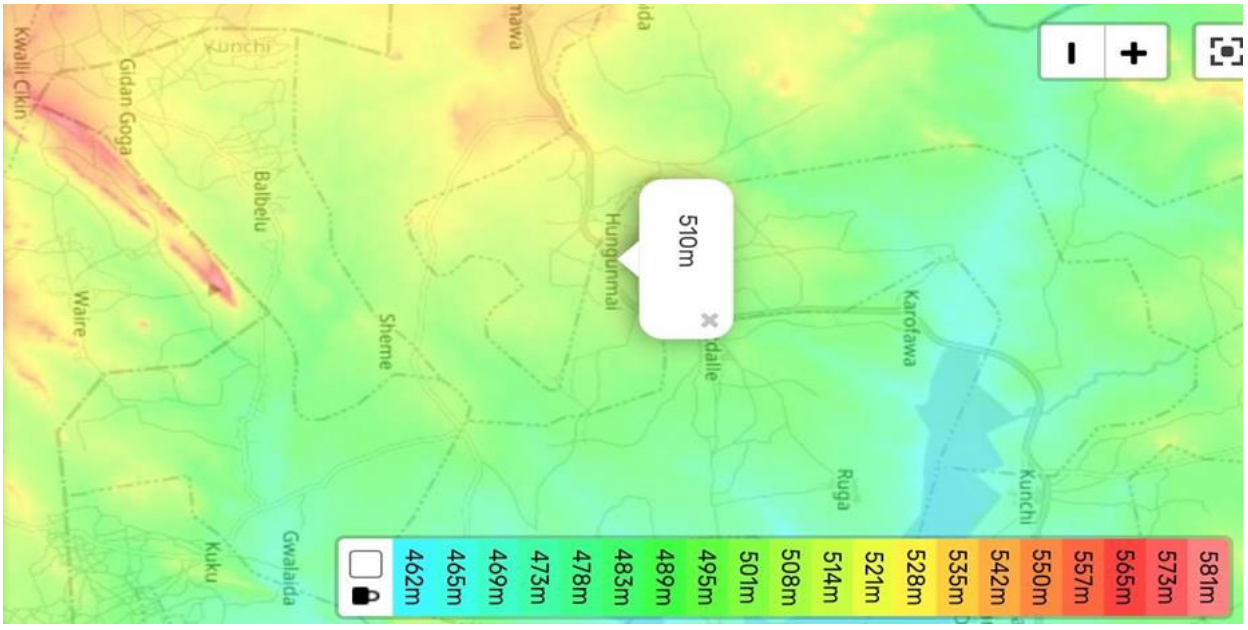

Figure 4. 16 Topography Map of Hugungumai (Source: ArcGIS online ESRI)

4.5 Geology

The Nigerian basement complex forms part of the Pan-African mobile belt and lies between the West African and Congo Cratons and south of the Tuareg Shield. It is

intruded by the Mesozoic calc-alkaline ring complexes (Younger Granites) of the Jos Plateau and is unconformably overlain by Cretaceous and younger sediments.

The Nigerian basement was affected by the 600 Ma Pan-African Orogeny, and it occupies the reactivated region, which resulted from plate collision between the passive continental margin of the West African Craton and the active Pharusian continental margin. The basement rocks are believed to be the results of at least four major orogenic cycles of deformation, metamorphism and remobilisation corresponding to the Liberian (2,700 Ma), the Eburnean (2,000 Ma), the Kibaran (1,100 Ma), and the Pan-African cycles (600 Ma). The first three cycles were characterised by intense deformation and isoclinal folding accompanied by regional metamorphism, which extensive Migmatization further followed. The Pan-African deformation was accompanied by regional metamorphism, migmatization, extensive granitization, and gneissification, which produced syn-tectonic granitesand homogeneous gneisses. Late tectonic emplacement of granites and granodiorites and associated contact metamorphism accompanied the end stages ofthis last deformation. The end of the orogeny was marked by faulting and fracturing within the basement complex of Nigeria's four major petro-lithological units are distinguishable, namely:

- Migmatite-Gneiss Complex (Migmatites, Gneisses, Granite -Gneisses)
- Schist Belts (Metasedimentary and Metavolcanic rocks) (Phyllites, Schists, Pelites, Quartzites, Marbles, Amphibolites)
- Older Granites (Pan African Granitoids) (Granites, Granodiorites, Syenites, Monzonites, Gabbro, Charnockite).
- Undeformed Acid and Basic Dykes (Muscovite-, tourmaline- and beryl-bearing pegmatites, aplite and syenite dykes; basaltic, doleritic and lampropyric dykes).

Basement complex rocks of Precambrian origin underlie Kano state. Prolonged weathering of the rocks produced deep clay-rich regolith.

The lateritic soil in some parts of the upland plain area caped the regolith hills, e.g., Goron Dutse and Dala hills. Well-joined younger granites of Jurassic origin occur in ring complexes in the extreme south. A narrow strip of the Chad Formation occursto the east (Olofin, 1981). In height, the relief ranges from lower plains (500 m) to highlands of more than 1,000m above sea level. The landforms include the Rishi hills, plains with

grouped hills, sandy plains, and alluvial channel complexes.

In their natural state, the soils divide into four main groups. The ferruginoustropical soils formed on crystalline acid rocks occupy about two-fifths of the State to the south, southwest, and southeast; the brown and reddish-brown soils and lithosols occur in the northern half; the brown and reddish soils are in the north-eastern corner; and the juvenile and hydromorphic soils occur along the alluvial channel complexes.

The soil reflects the influence of parent materials. Intensive use of the soils and adding manure and chemical fertilisers have altered their character, profile, texture, structure, and chemical characteristics.

Regional Geology

Nigeria lies east of the West African Craton in the late Precambrian to early Palaeozoic orogenesis. The basement complex comprises Precambrian rocks, consisting of the schist belt infolded in them. The Precambrian rocks in the study area are part of the Basement of Nigeria, which comprises the migmatite-gneiss complex, the schist belts and the granitoids. The main lithologic units in the study area include suites of granites, migmatite gneiss, and remnants of schists, which have well-delineated geologic boundaries. These rocks have undergone polycyclic deformation, thereby causing the deformation of both micro and macro structures, as displayed in the field. Geologic structures in rocks that can be used as clues in determining the geologic history of an area include folds, fractures, foliation, dyke etc. Some are not deformational but secondary structures developed during metamorphism after the rocks' emplacement—figure 4.17.

Property Geology

The study area falls within the Pre-Cambrian crystalline basement complex of the central part of Nigeria, consisting of a migmatite-gneiss-granite sequence, which forms a distinctive unit of granitic intrusion within the Basement. The Area is underlain by granites of various degrees of crystallisation, ranging from fine grains to porphyritic. The Lithology of the rock in the proposed quarry is biotite granite. The texture of the rocks is fine to coarse grain size to porphyritic; physical mineral composition includes quartz, feldspars, and biotite/muscovite mica. Field observation and measurements reveal structural interplay in the area, and observed structural elements appear coaxially

correlated with NE-SE and NW SEtrends. The prominence of micro faults will make the blasting work more straightforward and a good prospect in aggregate production. Laboratory analysis and geotechnical tests were conducted on the rock sample. The laboratory test is comprised of an analysis to determine the composition of the rock within the Eso Terra site. **Tables 2 and 3 of Appendix 2 contain the test results, which show geotechnical properties such as soundness, compressive strength, absorption of aggregate, crushing value,** etc. The result reveals that the samples contain 74.4% silica content with a moisture contentof about 0.96%. Other parameters tested were on a satisfactory scale. Figure 4.18 shows the mineral map of Nigeria.

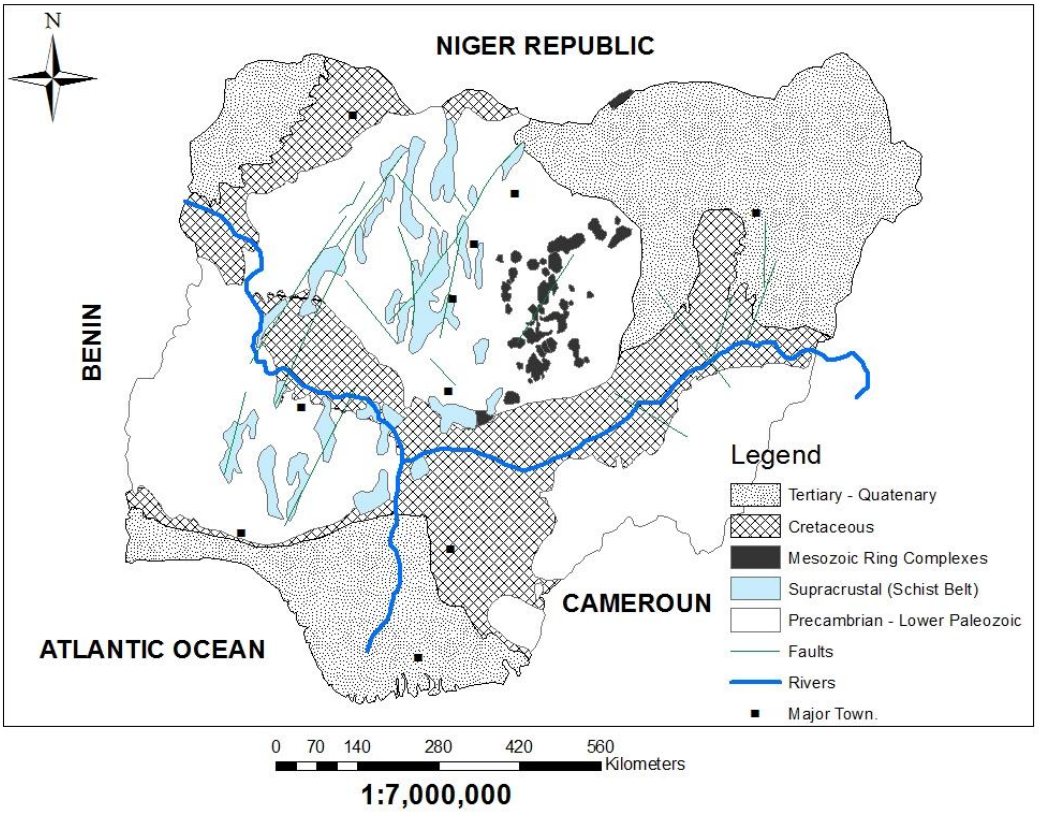

Figure 4.17: Geological Map of Nigeria.

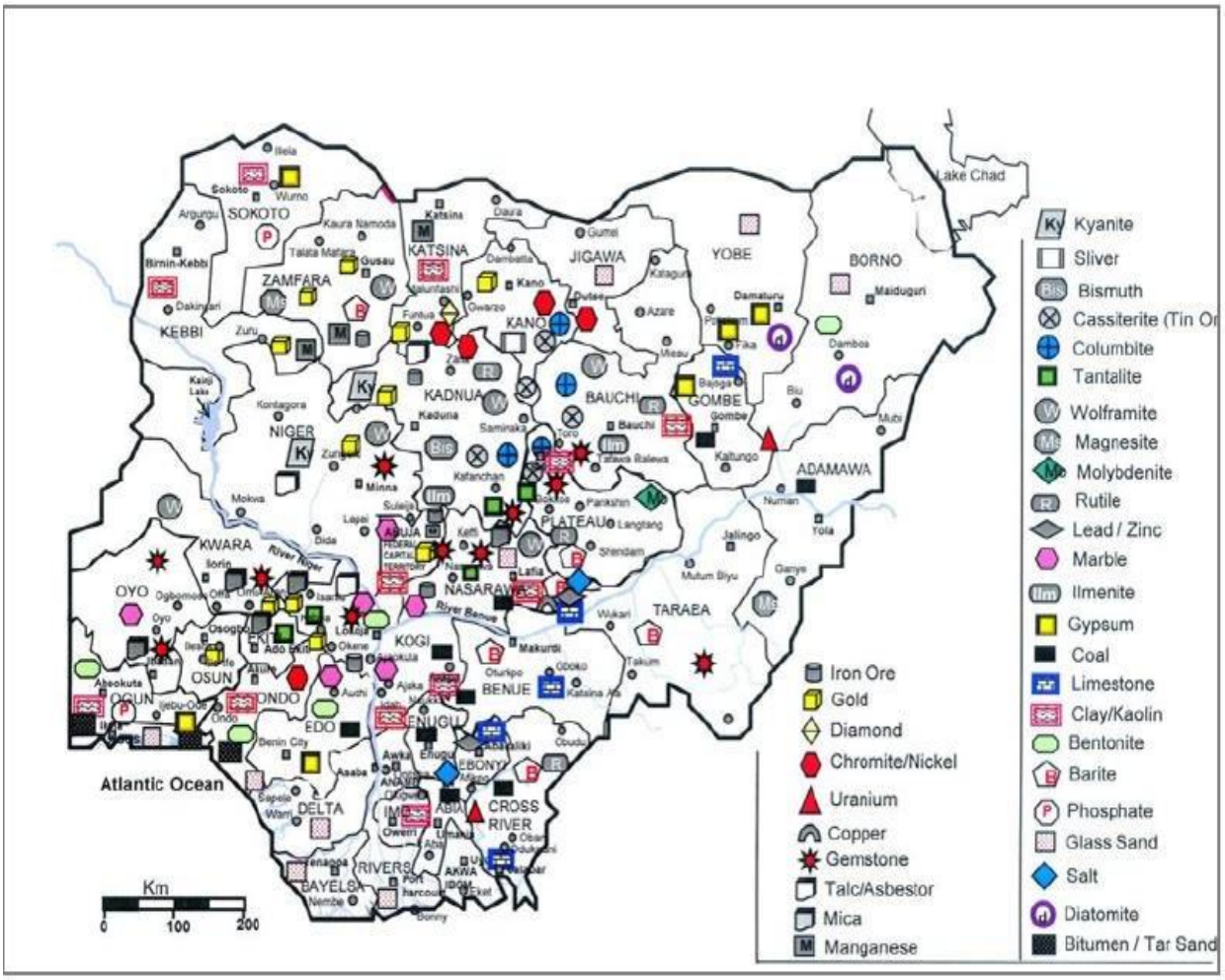

Figure 4.18 Mineral Map of Nigeria (NGSA)

4.6 Ambient Air Quality Assessment

Air quality test was conducted in 11 random locations within the site and a control outside the site. The result is presented in Table 4.5 and Appendix **1**. The atmosphere is a layer of gases held in its place by gravity. These layers of gases constitute what is known as air. Air is a mixture of nitrogen and oxygen with lesser amounts of carbon dioxide, noble gases, and water vapour essential to life on Earth. Introducing any chemical, physical, or biological agent into the air in quantities large enough to produce harmful effects on man and its surroundings is a call for concern.

Effects of air pollutants on human health, vegetation, property, or the global environment, as well as aesthetic insults in the form of brown or hazy air or unpleasant smells, have been reported in the literature (Smith, 1991; Rim-Rukeh & Okokoyo, 2003; Pope, 1992. McComicket al., 1995).

The pollutants monitored concerning air quality are nitrogen dioxide (NO_2), sulphur

dioxide (SO_2), suspended particulate matter (SPM), ammonia (NH_3), hydrogen sulphide (H_2S), carbon monoxide (CO), methane (CH_4), carbon dioxide (CO_2), Chlorine (Cl2), phosphine (PH_3), Total volatile organic content (TVOC), formaldehyde (HCHO), hydrogen cyanide (HCN). The observed air quality and noise data of the study area are presented in Table 4.4. The data is compared with permissible limits recommended by NESREA (2007).

Table 4.4 Air Quality and Noise Level Measurement (Field Work, 2022)

SN	Parameters	Unit	KQAN1	KQAN2	KQAN3	KQAN4	KQAN5	KQAN6	KQAN7	KQAN8	KQAN9	KQAN10	KQAN11	CONTROL KQAN12
1	Latitude		$12^{0}25^{I}46.4^{II}$	$12^{0}25^{I}36.5^{II}$	$12^{0}25^{I}28.8^{II}$	$12^{0}25^{I}44.8^{II}$	$12^{0}25^{I}43^{II}$	$12^{0}25^{I}42.4^{II}$	$12^{0}25^{I}45.7^{II}$	$12^{0}25^{I}45.8^{II}$	$12^{0}25^{I}46.3^{II}$	$12^{0}25^{I}55.1^{II}$	$12^{0}26^{I}05.6^{II}$	$12^{0}26^{I}14.9^{II}$
2	Longitude		$008^{o}13^{I}48.8^{II}$	$008^{o}13^{I}49.5$	$008^{o}13^{I}48.9^{II}$	$008^{0}13^{I}41.4^{II}$	$008^{0}13^{I}32.6^{II}$	$008^{0}13^{I}26.7^{II}$	$008^{0}13^{I}54.2^{II}$	$008^{0}13^{I}59.5^{II}$	$008^{0}14^{I}04.8^{I}$	$008^{0}13^{I}52.0^{II}$	$008^{0}14^{I}03.2^{II}$	$008^{0}13^{I}53.7^{II}$
3	SO2	ppm	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0
4	NO2	ppm	0.2	0.3	0.2	1	1.1	0.8	0.3	1	1	0.9	0.9	0.8
5	CO2	ppm	532	541	519	552	562	511	521	534	596	591	591	588
6	CO	ppm	0	0	0	0	0	0	0	0	0	0	0	0
7	NH3	ppm	0	0	0	0	0	0	0	0	0	0	0	0
8	H2S	ppm	0	0	0	0	0	0	0	0	0	0	0	0
9	HCN	ppm	0	0	0	0	0	0	0	0	0	0	0	0
10	HCl	ppm	0.4	0.4	0.6	0.1	0.2	0.3	0.2	0.8	0.6	1.4	1.7	1.7
11	TVOC	µg/m³	0.056	0.168	0.084	0.224	0.294	0.308	0.028	0.028	0.168	0.686	0.616	0.49
12	HCHO	µg/m³	0.008	0.024	0.014	0.032	0.046	0.044	0.004	0.002	0.022	0.096	0.088	0.07
13	Pm2.5	mg/m³	3	4	3	3	4	3	3	3	4	3	3	3
14	Pm10	mg/m³	3	3	3	3	3	3	3	3	3	4	3	4
15	Pm1.0	mg/m³	1	2	2	1	1	1	1	1	2	1	1	2
16	PH3	ppm	0	0	0	0	0	0	0	0	0	0	0	0
17	C2H4	ppm	0	0	0	0	1	0	0	0	0	0	0	0
18	Cl2	ppm	0	0	0	1	1	0	0	0	0	0	0	0
19	Sound (Noise)	dB	58.7	56.8	57	53	51.3	52	58.7	59.6	52.9	48.4	59.5	63.9

NOTE:

Pm = Particulate Matters
TVOC = Total Volatile Organic Compound
dB = Decibels
KQ = Kunchi Quarry
AN = Air and Noise

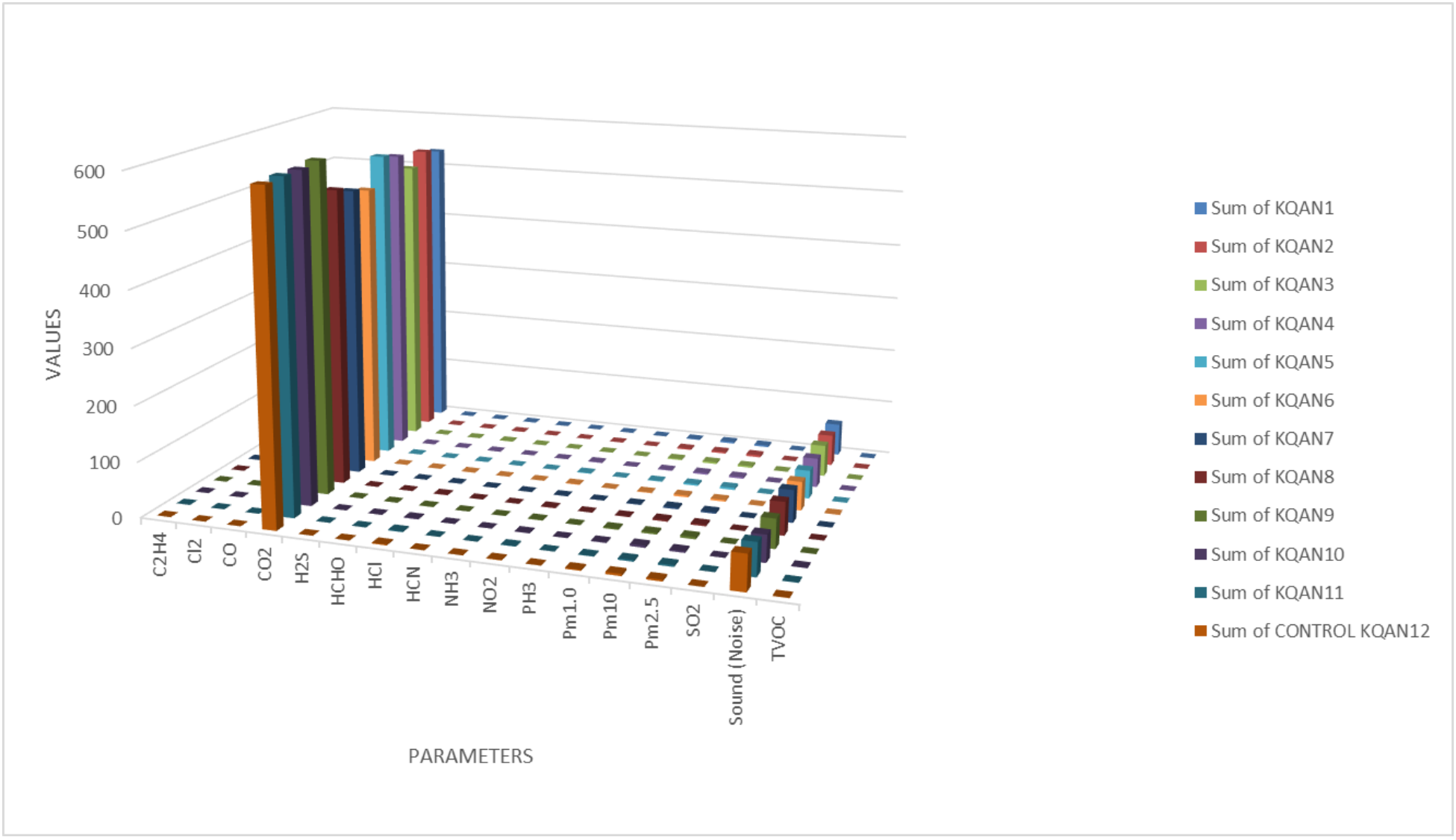

Figure 4.19 3D Representation of Air Quality and Noise Level Measurement (Field Work, 2022)

Table 4.5: Nigerian Ambient Air Quality Standard (NESREA 2007)

Pollutants	Time of Average	Limit
Particulates	Daily Average	250µg/m³
Sulphur Oxides	Daily Average	0.01ppm
Carbon Monoxide	Daily Average	10ppm
Nitrogen Oxides	Daily Average	0.04ppm-0.06ppm
VOCs	Daily Average	50µg/m³

Discussion of Air Quality Result

Suspended Particulate Matter: Suspended particulate matter (SPM) is a finely divided particle of anthropogenic and natural origin in ambient air in dust, smoke, and other aerosols. High concentrations of suspended particulate matter (SPM) are known to irritate the mucous membranes and may initiate a variety of respiratory diseases. Fine particulates may causecancer and aggravate morbidity and mortality from respiratory dysfunctions (CCDI, 2001). Dust, smoke, and diesel exhaust are particulate pollutants that pose direct health threats to people. People living with Asthma, people with other lung problems, and children are most vulnerable to this pollution. Some particulates also indirectly affect people when combined with chemical pollutants. These Particulate Matter of Microbe 10 (PM-10) particulates can penetrate and damage people's lungs and cause the worst health problems. SPM can also cause damage to materials by soiling clothing and textiles, corroding metals (at relative humidity above 75%), eroding building surfaces, and discolouring/destroying painted surfaces (Peavy et al., 1985).

Ambient SPM levels in the study area ranged from 001 to 004 mg/m³. These recorded values were above the FMEnv daily average maximum limit permitted of 0.25 mg/m³ (FMEnv, 1995).

Carbon Monoxide: Carbon monoxide (CO) is a colourless, odourless, and tasteless gas produced by the incomplete combustion of carbonaceous materials or fossil fuels, such as gas, oil, coal, and wood. Adverse health effects have been observed with carbon monoxide concentrations of 12 - 17ppm for 8 hours, while prolonged (45 minutes to 3 hours) exposure to concentrations of CO between 200ppm and 800ppm often results in severe headache, dizziness, nausea, and convulsions (CCDI, 2001).

Ambient CO levels in the study area were 0.00 ppm across all sampling stations, including the control station. These recorded values were within FMEnv's daily average maximum limit permitted of 10ppm (FMEnv, 1995).

Sulphur Dioxide: Sulphur dioxide (SO_2) is a colourless gas produced from biological decay and forest fire releases. It is also produced from the combustion of sulphur-containing fuels, smelting, manufacture of sulphuric acid, incineration of refuse, and production of elemental sulphur. The gas is known to be a harsh irritant and is capable of aggravating asthma, bronchitis, and emphysema. It can also cause coughing and promote impaired functions in the human system (CCDI, 2001). Also, sulphuric acid aerosols (formed from dissolved sulphur dioxide) will readily attack structure materials, especially those containing carbonates such as marble, limestone, and mortar. Sulphuric acid mists can damage cotton, linen, rayon, nylon fabrics, and paper. Excess exposure to sulphur dioxide accelerates corrosion rates for metals such as iron, steel, zinc, and copper, especially at relative humidity over 70% (Peavy et al., 1985). Manmade sources of sulphur oxides are burning fossil fuels (e.g., coal, petroleum), smelting of sulphur ores, and manufacturing of sulphuric acid (H_2SO_4); paper making and burning domestic acid. Ambient SO_2 levels in the study area ranged from 0.00 ppm to 0.1 ppm across all sampling stations. The concentration was above the dangerous limit of 0.01ppm forsampling points 1, 2, and 3, which are within the proposed quarry site and close to the settlement; the elevated concentration may have resulted from activities from the surrounding settlement.

Excess exposure to High Levels of SOx may cause allergic reactions, asthmatic episodes, and lung damage. Examples of allergic symptoms include coughing, shortness of breath and fatigue, difficulty breathing, coughing, runny eyes, throat irritation, and headaches.

Hydrogen Sulphide: Hydrogen sulphide (H_2S) is a toxic and corrosive gas rapidly oxidised to SO_2 in the atmosphere. It is odorous and can typically be perceived at levels of 0.1 ppm. It can be in natural gas in certain areas and released by sulphate-reducing bacteria (SRB) in specific aquatic environments. Adverse health effects can be encountered with longer-term exposures above 1 ppm; exposure to concentrations over 500 ppm can befatal (SIEP, 1995).

Ambient H_2S levels in the study area were 0.00 ppm across all sampling stations.

Nitrogen Dioxide: Nitrogen dioxide (NO_2) is a member of the family of highly reactive gases called nitrogen oxides or oxides of nitrogen, which are formed during combustion processes. NO_2 results when fuel is combusted at elevated temperatures and occurs from motor exhaust and stationary sources such as electric utilities and industrial boilers (SIEP, 1995). It is the only oxide of nitrogen that has been shown to have significant human health effects. Exposure to concentrations higher than 0.5 ppm (1 mg/m^3) can trigger changes in pulmonary function in healthy people (SIEP, 1995).

Ambient NO_2 levels in the study area were 0.2 ppm-1.1 ppm across all sampling stations. This concentration falls above the regulatory limit of 0.06 ppm. The high concentration may be due to the bean plants within the project area.

Ammonia (NH_3): Ammonia is a remarkably soluble gas that has been shown to have significant human health effects. Exposure to concentrations higher than 0.5 ppm (1 mg/m3) can trigger changes in pulmonary function in healthy people (SIEP, 1995). The ambient NH_3 level in the study area was 0.00 ppm across all sampling stations.

Methane (CH_4): Methane gas in the atmosphere arises from fugitive emissions, vents, and incomplete combustion of fuels, mainly where fuel-to-air ratios are too high. Most members of this group are significantly toxic, and exposure to high concentrations in the atmosphere (about 1000 ppm or more) could result in interference with oxygen intake and acute leukaemia (SIEP, 1995). Ambient CH_4 levels in the study area ranged from 0.0 to 1 ppm across all sampling stations.

Chlorine: Chlorine can enter the body when breathed in through contaminated air. The effects of chlorine depend on the amount inhaled, length and frequency of exposure. Effects include coughs, chest pain, lung water retention, and skin irritation. Environmental effects of chlorine include the formation of acid rain, global warming, and the depletion of the ozone layer. These effects are not likely to occur at levels of chlorine that are usually found in the environment. The concentration of chlorine ranged from 00ppm-1ppm.

Hydrogen Cyanide: Hydrogen Cyanide is a colourless gas or a bluish-white liquid with a bitter almond odour. The air odour threshold concentration of hydrogen cyanide is 0.58 parts per million. HCN can cause rapid death due to metabolic

asphyxiation. Death can occur within seconds or minutes of the inhalation of high concentrations of HCN. The concentration of HCN was 0 ppm across the entire sampling station.

Formaldehyde: Formaldehyde irritates the nose, eyes, and throat. These irritations can happen at a low level. Other short-term effects include headache, runny nose, nausea, and difficulty breathing. Exposure to a high concentration may also lead to wheezy asthmatic attacks and other respiratory symptoms. The US Occupational Safety and Health Administration has set the permissible exposure limit at 0.75 g/m3 for 15 minutes. The concentration of HCHO ranged from 0.002 µg/m3 to 0.088µg/$m^{3.}$

Phosphine: Inhaling phosphine causes respiratory irritation, compromises heart and circulatory functions, depresses the central nervous system and produces severe gastrointestinal pain. The concentration of PH_3 was 0 ppm across the sampling station.

4.7 Noise and Vibration

Noise is a periodic fluctuation of air pressure. The frequency expressed in hertz (cycles per second) is the rate at which these fluctuations occur. The range of sound pressures encountered is extensive, and to keep values in manageable proportions, noise levels are measured in decibels (dB), which have a logarithmic scale. Noise pollution is defined as 'unwanted sound.' In addition to causing a disturbance, excessive noise can affect human health and physiology (Rim-Rukeh, 2009).

The noise levels at the sampling stations ranged from 48.4 to 63.9 (dBA). The highest value was recorded at the Control station. These values are within FMEnv's permissible exposure limits of 90dB (A) per day for an 8-hour working period (FMEnv, 1995)—table 4.6.

Table 4.6: Noise Exposure Limits for Nigeria (NESREA, 2007)

DurationDay, Hour	Permissible Exposure Limit dB (A)
3	97
8	90
6	92
4	95
3	97
2	100
1.5	102
1 0.5	105 110
0.25 or less	115
Note: Exposure to impulsive or impact noise should not exceed 140 dB (A) peak sound pressure level.	

4.8 Soil Study

The study area's soil was sampled at the surface or from within 0-15cm of the surface and 15-30cm below the surface with a soil auger. Twelve soil sample locations were randomly established across the study area, and a control station was to represent the soil zones or ecoregions in the project area. A composite sample for each point was analysed in the laboratory—a uniform cross-section soil auger collected uncontaminated and reproducible soil sample units. Surface litres of undecomposed plant materials were removed to ensure that uncontaminated soil samples were collected. The samples were transferred into laboratory-cleaned labelled sample materials, preserved, and transported to the laboratory following the Standard Procedures of ASTM (Anon, 1994), FMEnv (1991) and APHS (1975).

Table 4. 7 Soil Analysis Result (Field Work, 2022)

SN	Parameters	Unit	KQAN1	KQAN2	KQAN3	KQAN4	KQAN5	KQAN6	KQAN7	KQAN8	KQAN9	KQAN10	KQAN11	CONTROL KQAN12
1	Latitude		$12^{0}25^{I}46.4^{II}$	$12^{0}25^{I}36.5^{II}$	$12^{0}25^{I}28.8^{II}$	$12^{0}25^{I}44.8^{II}$	$12^{0}25^{I}43^{II}$	$12^{0}25^{I}42.4^{II}$	$12^{0}25^{I}45.7^{II}$	$12^{0}25^{I}45.8^{II}$	$12^{0}25^{I}46.3^{II}$	$12^{0}25^{I}55.1^{II}$	$12^{0}26^{I}05.6^{II}$	$12^{0}26^{I}14.9^{II}$
2	Longitude		$008^{o}13^{I}48.8^{II}$	$008^{o}13^{I}49.5$	$008^{o}13^{I}48.9^{II}$	$008^{0}13^{I}41.4^{II}$	$008^{0}13^{I}32.6^{II}$	$008^{0}13^{I}26.7^{II}$	$008^{0}13^{I}54.2^{II}$	$008^{0}13^{I}59.5^{II}$	$008^{0}14^{I}04.8^{II}$	$008^{0}13^{I}52.0^{II}$	$008^{0}14^{I}03.2^{II}$	$008^{0}13^{I}53.7^{II}$
A. SOIL CHARACTERISTICS														
4	Colour	TCU	Brownish	Dark Brown	Brownish	Brownish	Reddish	Reddish-Brown	Pale Brown	Dark Brown	Dusky Brown	Brownish Grey	Dark Grey	Greyish Brown
5	pH	-	8.6	8.7	8.1	8.1	8	7.9	8.3	8.3	8.9	9	8.3	8.6
6	Alkalinity	mg/kg	2.8	2.9	1.7	1.2	2.8	3.1	2	2	2.2	2.4	1.3	0.9
7	Conductivity	mg/kg	3461	2881	4001	3899	3481	5091	864	801	946	871	1968	2706
8	Salinity	mg/kg	12	11.1	10.1	9.4	6.3	7	14.2	14.2	19.1	18	9.9	9.6
9	Texture	-	Loam	Clay Loam	Sandy	Sandy	Loam	Clay Loam	Clay	Clay	Loam	Loam	Loam	Loam
10	Permeability	Cm/hr	13.8	19.8	9.6	8.7	14.1	15.3	20.6	23.1	14.3	15	15	15.1
11	Grain Size	mm	0.82	0.71	0.61	0.93	0.63	0.26	0.18	0.2	0.63	0.7	0.68	0.67
12	Bulk Density	g/cm^2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	Moisture Content	%	1.73	2.81	1	0.83	2.01	2.06	4.31	3.8	2	1.73	1.46	1.77
EXCHANGEABLE CATION														
14	Ca^{2+}	mg/kg	0.83	0.81	0.63	0.74	0.88	0.89	1.08	0.96	1.88	2	1.78	0.98
15	Mg^{2+}	mg/kg	1.41	1.43	0.97	1.43	1.06	1	0.81	0.86	0.91	1	0.73	0.86
16	Na^{+}	mg/kg	23	16	19	15	31	14	32	30	30	27	28	29
17	K^{+}	mg/kg	0.36	0.4	1.42	1.48	0.11	0.42	0.17	0.28	0.31	0.46	1.43	0.99
18	NH^{4+}	mg/kg	3.3	3.4	3.9	3.9	3.1	3.3	2	2	2.1	2.6	1.43	1.81
B. EXCHANGEABLE ANION														
19	SO_4^{2-}	mg/kg	0	0	0	0.1	0	0.1	0.1	0	0	0	0.1	0
20	NO_3^{2-}	mg/kg	23.2	21.7	20.8	20	22.9	23.7	17.4	12.5	20.8	19.5	14.8	10.7
21	NO_2^{2}	mg/kg	0	0	0	0	0	0	0	0	0	0.01	0	0
22	N_2	mg/kg	5.1	4.6	5.1	5.8	3.3	6	8.1	2.3	1.9	5.5	7	4.3
23	Cl_2	mg/kg	3	2.8	1.5	0.8	2.9	2.2	2.4	2.2	3	0.6	2.4	1.5
C. HEAVY METALS														
24	CU^{2+}	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
25	Cd^{2+}	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
26	Ni^{2+}	mg/kg	0.001	0.001	0	0	0	0	0	0	0	0	0	0.001
27	Ar	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
28	Hg^{+}	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
29	Zn	mg/kg	1.3	1.3	3	2	1.4	2	0.3	0.9	1	2.3	1	3
30	Fe^{2+}	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
D. ORGANICS														
31	Oil & Grease	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
32	TPH	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
33	Xylene	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
34	Benzene	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
35	Toluene	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
36	PAH	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0

Discussion

Soil Physicochemical Quality

The chemical characteristics of the soil in the project area are presented in Table 4.8 and Appendix 1. The soils of the study area varied from moderately alkaline to slightly alkaline, with a pH ranging from 7.9 to 9.0. The alkalinity could be attributed to the leaching loss of exchangeable anions. The textural distribution of the soil samples of the site area ranged from clay to sandy loam soil while the colour ranged from grey, brown to deep brown. The sandy and clayed nature of the soil is associated with the soil grain size. The salinity level raged from 6.3-19.1mg/kg with a conductivity level ranging from 801-4001. The moisture content of the soil samples was low. This is associated with the period the samples were collected (Dry Season).

Nutrients: The concentration of Nitrite, Nitrate, sulphate, Nitrogen, and chlorine in the form of anions was tested in the soil samples.

The importance of these nutrients in plants cannot be over-emphasized. Chlorophyll, plant proteins, and nucleic acids are nitrogen compounds which play significant roles in plant growth (Donahue et al., 1990). The concentration of Nitrite, Nitrate, Sulphate, Nitrogen, and Chlorine ranged from $SO4^{2-}$ (0.00-0.1mg/kg) $NO3^{2-}$ (10.7-23.7mg/kg), N2 (1.9-8.1mg/kg) and Cl2 (0.6-3.0mg/kg), while $NO2^{2-}$ (0.00mg/kg) across all the three samples.

Cation Exchange Capacity (CEC): Exchangeable cations are readily released from the surface of the soil minerals or within the crystal lattice and substituted with cations absorbed from the leaching solution. A soil's cation exchange capacity (CEC) can be estimated by the sum of the concentrations of all the exchangeable cations expressed in milli-equivalents per 100g of soil (meq/100g). Different cations have varying replacement powers, butthe predominant ones are calcium, magnesium, sodium, potassium, iron, aluminium,manganese, and ammonium. The exchange capacity varies with the pH, the type of clay minerals and the amount of organic matter. Measuring CEC provides an indication of soil fertility as well as physical soil properties. The distribution of exchangeable cations in a profile is a measure of weathering since soil cations leached by acidic waters are only slowly replaced by primary minerals. Na+ recorded the highest number of cations with values ranging from 14-32mgl/kg, while K^{+1} recorded the lowest

with values ranging from 0.11-1.48mg/kg.

Heavy Metals

The study shows low concentrations of heavy metals in the soil samples. The heavy metals tested include copper, cadmium, nickel, mercury, zinc, and iron. The concentrations were low except for the zinc concentration, which ranged from 0.3 to 3mg/kg.

Organics

Table 4.9 shows the soil's organic content (TPH, benzene, xylene, toluene, PAH, and Oil and Grease) within the study area. The Total Organic Content of the soil samples was 0.0mg/kg.

4.9 Water Quality

Water samples were collected from two quarry pits (KQW1 and KQW2) within the site that represent surface or open water sources and a well in the Hugungumai community (KQW3) for the groundwater source, which is about 2km from the site. The groundwater sample was colourless and transparent, while the quarry pit water samples were cloudy and light greyish.

Numerous physical variables, such as topography, land cover, soil conditions, mineralogy, and groundwater conditions, may affect surface water characteristics, which may be affected by geologic conditions. Stream flow is also affected by numerous climatic variables, including timing, intensity, precipitation amount, and other variables affecting evaporative processes. The physiochemical characteristics of surface water samples from the area are presented in Table 11 and Appendix 1.

The groundwater chemistry varies from place to place depending on the subsoil's nature and the rocks it passes through. Daly (1994) observed that in areas with typical limestone bedrock and limestone-dominated subsoil, groundwater is often 'hard', containing high calcium, magnesium, and bicarbonate concentrations. However, softer water is typical in areas where volcanic rocks or sandstones are present. Therefore, in considering the impact of human activities, it is necessary first to consider the natural (or baseline) water quality. Groundwater is usually considered pure and safe to drink as it undergoes a filtering and cleansing process through a subsoil cover and rock medium that surface

water does not have. However, this does not guarantee groundwater purity. Problems canarise due to the ground's natural conditions or human activities' pollution. A water sample was collected and analysed from a well in the project area. The result is presented in Table 4.8 and Appendix 1.

Table 4.8. Water Quality Test Result (Field Work, 2022)

SN	Parameters	Unit	KQW1	KQW2	KQW3	
A. COORDINATES						
1.	Latitude	-	12°25'43.0''	12°25'46.9''	12°26'22.0''	
2.	Longitude	-	008°13'49.6	008°13'46.8	008°13'44.0	
B. PHYSICOCHEMICAL						
3.	Appearance	TCU	GreyishLight	Cloudy	Clear	
4.	Temperature	^oC	33.0	30.0	31.0	
5.	pH	-	8.41	8.25	6.57	
6.	Total Dissolve Solid	ppm	73	108	605	
7.	Electrical Conductivity	µs/cm	152	235	1062	
8.	Turbidity	NTU	9	12	2	
C. CHEMICAL TEST						
9.	Calcium	mg/L	3.89	2.76	7.43	
10.	Magnesium	mg/L	0.06	0.12	0.01	
11.	Nitrate	mg/L	23.90	30.86	6.51	
12.	Nitrite	mg/L	0.629	0.722	0.002	
13.	Phosphate	mg/L	2.26	1.80	0.24	
14.	Total Hardness	mg/L	4	5	16	
15.	Total Chlorine	mg/L	0.19	1.06	0.03	
16.	Ammonium	mg/L	54	36	1	
17.	B.O. D	mg/L	2.81	2.99	0.6	
18.	C.O. D	mg/L	68.9	74.3	0	
D. HEAVY METAL						
19.	Aluminium (Al)	mg/L	1.432	1.921	0.000	
20.	Chromium (Cr)	mg/L	0.361	0.470	0.000	
21.	Nickel (Ni)	mg/L	0.112	0.176	0.001	
22.	Copper (Cu)	mg/L	0.0187	0.0279	0.000	
23.	Cobalt (Co)	mg/L	0.000	0.000	0.000	
24.	Cadmium (Cd)	mg/L	0.001	0.000	0.000	
25.	Zinc (Zn)	mg/L	2.732	2.612	0.031	
26.	Mercury (Hg)	µg/L	0.000	0.000	0.000	
27.	Lead (Pb)	µg/L	0.000	0.000	0.000	
E. ORGANICS						
28.	TPH	mg/L	0	0	0	
29.	Toluene	mg/L	0.0	0.0	0.0	
30.	Benzene	mg/L	ND	ND	ND	
31.	Oil and Grease	%	0	0	0	
32.	Ethylbenzene	mg/L	0.000	0.000	0.000	
F. MICROBIOLOGICAL TEST						
33.	E. Coli	Cfu/ml	3	6	0	
34.	Total Coliform	Cfu/ml	0	1	0	

Note:	

KQ	=	Kunchi Quarry Project
W	=	Water samples
WW	=	Well Water Sample

Colour: The colour of the water sample was colourless. The appearance of colour in drinking water is caused by the absorption of specific wavelengths of normal white light by dissolved or colloidally dispersed substances. The appearance of colour in the water sample may be due to the presence of coloured organic substances originating in the decay or aqueous extraction of natural vegetation, such as in soil runoff; the presence of metals such as iron, manganese, and copper, which are abundant in nature, are weathered from the rock as have been similarly reported (Black et al., 1963). The obtained accurate colour units (TCU) of water samples are within the aesthetic objective for colour has therefore been set at ≤ 15 TCU (APHA, 1998). Water should be free from colour and odour for domestic consumption, and its taste should be agreeable. The groundwater sample in the project area was colourless and transparent, while the quarry pit's water sample colours were cloudy and greyish light.

pH: pH is one of the most common water quality parameters tested. It is the negative logarithm of hydrogen ion concentration. By its logarithmic nature, pH is a dimensionless quantity expressed in equation 4.1.

$$pH = - \log [H^+]$$

pH affects many chemical and biological processes in the water. For example, different organisms flourish within different ranges of pH. The largest variety of aquatic animals prefers a range of 6.5-8.0 (KWW, 2001). pH outside this range reduces the stream's diversity because it stresses most organisms' physiological systems and can reduce reproduction. Low pH can also allow toxic elements and compounds to become mobile and available for uptake by aquatic plants and animals. This can produce toxic aquatic life conditions and susceptible species like rainbow trout. Changes in acidity can be caused by atmospheric deposition (acid rain), surrounding rock, and certain wastewater discharges. The pH of the water samples from the quarry pits was slightly alkaline; the value was inconsistent with the underground water sample, whose pH was slightly acidic.

Temperature: The temperature of a water sample is the most critical parameter measured because excessive temperature (> 35^{o}C) through the addition of heated liquid effluents to water bodies alters the state of the recipient body in several waters. Elevated

temperatures increase the level of turbidity and invariably result in a reduced rate of light penetration, and this, in turn, sets the photosynthetic process of phytoplankton (the beginners of the food chain), which is the primary food link between fry and fingerlings and the adult fish. An elevated temperature increases the metabolic rate of aquatic organisms and causes a reduction in dissolved oxygen (DO) levels. This may retard the growth and reproduction of fish and, in severe conditions, result in the death of marine life. Elevated temperatures cause suspended solids to settle faster (2.5 times faster at $35^{o}C$ than at $0^{0}C$). The density and viscosity of water will also reduce at higher temperatures. Temperature values recorded in the water samples (KQW1, KQW2and KQW3) were $33.0^{O}C$, $30.0^{O}C$ and 31.0 ^{O}C, respectively.

Turbidity: Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye. The measurement of turbidity is a crucial test of water quality. Turbidity is an optical property relating to light adsorption and scattering in water. It is an important parameter because it affects the penetration of sunlight into the water body. Their presence leads to high biochemical oxygen demand (BOD), low DO, and a high total suspended load in the aquatic system. High turbidity also reduces visibility and directly interferes with autotrophic production. Settling of particulate by gravity to the bottom can smother benthic organisms. The units of turbidity from a calibrated nephelometer are called Nephelometric Turbidity Units (NTU). The turbidity of the water sample was 9, 12 and 2 NTU for samples (KQW1, KQW2 and KQW3)respectively. Well water (sample 3) has a lower turbidity than the quarry pits samples.

Electrical Conductivity: Electrical conductivity refers to the specific electrical conductance of water, i.e., the ability of water to pass electric current. The conductivity of water in µS/cm is proportional to the concentration of dissolved solids (primarily inorganic salts) it contains. Thus, conductivity is important in ecology and environmental management to indicate the total dissolved inorganic salts and other solids in water. The electrical conductivity of the water samples (KQW1, KQW2 and KQW3) was 152µS/cm, 235µS/cm, and 1062 µS/cm, respectively.These values were consistent with the corresponding TDS value of the water samples. Most underground water contains more dissolving solids than surface water, leading to high conductivity levels. The permissible EC level by FMEnv was set for 1000µS/cm.

Total Dissolved Solids (TDS) are the total amount of mobile charged ions, including minerals, salts, or metals, dissolved in each volume of water. They are expressed in units of mg per unit volume of water (mg/L), also referred to as parts per million (ppm). TDS is related to water's electrical conductivity as TDS (mg/L) = EC (µS/cm at 25^{o}C) x 0.6.

The TDS level in the water samples (KQW1, KQW2, and KQW3) was 73, 108, and 605ppm, respectively, with corresponding values of 91.2, 141, and 637 mg/l. As a rough estimation, fresh water may have a TDS of 1500 mg/l; brackish water, 5000 mg/l; saline water, above 5000 mg/l; and seawater TDS values between 30,000 and 34,000 mg/l. The recommended maximum value for drinking water is 500 mg/l (DPR, 2002).

Biochemical Oxygen Demand (BOD): Biochemical oxygen demand (BOD) is the amount of oxygen microorganisms require to stabilise decomposable organic matter at a particular time and temperature. BOD tests are widely used to determine the strength of pollution in domestic and industrial wastes regarding the oxygen required to deliver end products such as CO_2 and H_2O. The most widely used parameter of organic pollution applied to both wastewater and surface water is the 5-day BOD (BOD_5) at 20°C. BOD determination involves the measurement of the dissolved oxygen used by microorganisms in the biochemical oxidation of organic matter. The BOD of the sample is the decrease in the dissolvedoxygen concentration values, expressed in mg/l divided by the decimal fraction of the sample used.

BOD is used in water quality measurement and assessment, ecology, and environmental science. It is an indication of the quality of a water source. Most pristine rivers will have a 5-day BOD below 1 mg/l. Moderately polluted rivers may have a BOD value of 2 to 8 mg/l. Municipal sewage is efficiently treated by a three-stage process, which would have a value of about 20 mg/l. Untreated sewage varies but averages around 600 mg/l in Europe and as low as 200 mg/l in the United States or where there is severe groundwater or surface water infiltration (APHA, 1998). BOD levels in the water samples (KQW1, KQW2 and KQW3) were 2.81, 2.99 and 0.6 mg/l, respectively.

Chemical Oxygen Demand (COD): COD, the amount of (dissolved) oxygen required to oxidise and stabilise (organic and inorganic content of) the sample solution, is a crucial concept in water quality analysis. It measures the oxidisable organic and inorganic matter content in the given water sample. Understanding the relationship between COD and biochemical oxygen demand (BOD), another standard test, is key. While BOD measures

the amount of oxygen consumed by microbial oxidation and is most relevant to waters rich in organic matter, COD does not necessarily measure the same types of oxygen consumption. For example, COD does not measure the oxygen-consuming potential of certain dissolved organic compounds such as acetate, ammonia, and nitrite. This knowledge is essential for accurate water quality assessment. The COD levels in the water samples (KQW1, KQW2 and KQW3) were 68.9, 74.3 and 0 mg/l, respectively.

Nutrients: Nitrates, Nitrites, sulphate, and phosphates are essential plant nutrients in water. The ionic forms of nitrogen, sulphur, and phosphorous, key elements in plant growth, are the utilities of nitrogen.

Excess nitrates, a form of nitrogen, play a significant role in freshwater bodies. They can cause enrichment or fertilisation, a process known as eutrophication. This can lead to the overproduction of plankton, which, upon decomposition, can deplete oxygen levels and harm oxygen-dependent organisms. Understanding this process is crucial for environmental scientists, water quality analysts, and researchers to be aware of the potential impacts of excess nitrates on water bodies.

Phosphates, like nitrates, can stimulate the growth of plankton and other aquatic plants, providing a food source for fish. However, an excess of phosphates in a water body can lead to the overgrowth of algae and aquatic plants, which can then consume large amounts of oxygen. This condition, known as eutrophication, can harm the balance of the water body. It is our responsibility to be aware of this potential harm and work diligently towards maintaining the balance of water bodies.

Many aquatic and microscopic organisms utilise sulphates for their growth. These minerals are essential in maintaining the intricate food chain that supports all life forms. Reduced concentrations (<0.5mg/l) of sulphur in water may have a detrimental effect on algal growth. The concentration of nitrate, nitrite, ammonium, chlorine, and phosphate was tested in the water samples (KQW1, KQW2 and KQW3); the value was Nitrate (23.90, 30.86 & 6.51mg/l) nitrite (0.629, 0.722 & 0.002mg/l) ammonium (54, 36 & 1mg/l) chlorine (0.19, 1.06 & 0.03mg/l) & Phosphate (2.26, 1.80 and 0.24 mg/l) respectively.

Exchangeable Cations: Magnesium (Mg) and calcium (Ca) were the exchangeable cations determined. Calcium causes hardness in water and, if present with sulphate, may cause boiler scale (GEMS, 1992). The concentrations of magnesium and calcium in the

Water samples (KQW1, KQW2, and KQW3) were magnesium (0.06, 0.12, and 0.01 mg/l) and calcium (3.89, 2.76, and 7.43 mg/l), respectively.

Total Hardness (Carbonate and Bicarbonate): Hard water is water that has ahigh mineral content (in contrast with soft water), usually consisting of calcium (Ca2+) and magnesium (Mg2+) ions, and possibly including other dissolved metals, bicarbonates, and sulphates. It is defined as "Water which does not produce lathers with soap solution but produces white precipitate (scum) is called hard water."

The uncomplicated way to determine the hardness of water is the lather test: soap, when agitated, is quickly produced in soft water but not in hard water. Total water hardness (including both Ca2+ and Mg2+ ions) is reported in water units of ppm or mg/l of calcium carbonate (CaCO3). Although we usually measure the total concentration of calcium and magnesium (the two most prevalent metal ions), iron, aluminium and manganese may also be present at elevated levels in some locations. The total hardness of the water samples (KQW1, KQW2 and KQW3) was 4, 5 & 16 mg/l.

Heavy Metals: The availability of trace metals in water is controlled by physical and chemical interactions. These interactions are affected by factors like pH, redox potential, temperature, CO_2 level, the type and concentration of available ligands and chelating agents, and the type and concentrations of the metal ions. Trace orheavy metals, from an environmental perspective, have the potential for bioaccumulation and bio-concentration in aquatic organisms. Severe effects of heavy metal contamination include reduced growth and development, cancer, organ damage, nervous system damage, and, in extreme cases, death. Exposure to some metals, such as mercury and lead, may also cause the development of autoimmunity, in whicha person's immune system attacks its cells.

The results of analysis of the concentrations of heavy metals in the water sample (KQW1, KQW2 and KQW3) are Al (1.432, 1.921 & 0.000 mg/l); Cr (0.361, 0.470 & 0.000 mg/l); Ni(0.112, 0.176 & 0.001 mg/l), Cu (0.0187, 0.0279 & 0.000 mg/l), Co (0.000, 0.000 & 0.000 mg/l), Cd (0.001, 0.000 & 0.000mg/l), Zn (2.732, 2.612 & 0.031mg/l), Hg (0.000, 0.000 & 0.000 mg/l) and Pb (0.000, 0.000 & 0.000 mg/l) respectively. The concentrations of the heavy metals fall within the regulatory limit except the concentration of Zinc, whose value was above the regulatory limit in the quarry pits

(KQW1 and KQW2).

Microbiological Characteristics of the Water Samples

Microbiology is the scientific study of living organisms which the naked eye cannot see but are around us. Microorganisms are essential components of the aquatic ecosystem. They are involved in the synthesis of many organic and inorganic compounds during primary production and the decomposition of organic matter. For drinking water, the presence of bacteria is as dangerous as bad water. The water samples show the presence of E. coli in samples KQW1 and KQW2, while E. coli was absent in KQW3. The total coliform count was 0Cfu/ml for KQW1 and KQW3. KQW2 recorded 1 cfu/ml.

4.10 Biodiversity

The biodiversity study was carried out to assess the area's vegetation and wildlife composition.

4.10.1 Vegetation Studies

Vegetation studies were carried out within the project site and the neighbouring community to determine the species composition, diversity, and population of plant species. The plant community structure was observed, and species within each quadrant were identified. Unidentified plant species' floral and vegetative parts were collected, pressed in the field with herbarium press, and taken to the laboratory for herbarium. A total of 9 plant species were encountered in the area as the predominant vegetation of these areasis characterised by a continuous scanty tree (66.7%), shrubs (11.1%) and grass/herb (22.2%) cover that is characteristic of Sudan Savanna and an occasional collection of dense tree/shrub strata. The average height of the trees across the area is between 8m-13m. *Balanites aegyptiaca, Bauhinia thonningii and Parkia Biglobosa* dominate the project site, while in residential areas, non-indigenous species, specifically Azadirachta Indica, are the most dominant species. Eichhornia crassipes and Zannichellia palustris characterised the ponds in the sites. Trees are used to create shelter belts around farms, while tree branches are used to fuel wood. Other encountered species are documented in the plant species table 4.9.

Table 4.9: Types of Plant Species Encountered in the Study Area

Botanical Name	Family	Local Names	Life Form	IUCN	Uses
Ficus thonningii	Meliaceae	Gamji	Tree	LC	Medicinal
Azadirachta Indica	Meliaceae	Maina	Tree	LC	Medicinal
Parkia Biglobosa	Fabaceae	Dorawa	Tree	LC	Medicinal
Balanites aegyptiaca	Zygophyllaceae	Aduwa	Tree	LC	Food
Bauhinia thonningii	Fabaceae	Kargo	Tree	LC	Medicinal
Hyphaene thebaica	Arecaceae	-	Tree	LC	Human Diet
Lagenaria siceraria	Cucurbitaceae	-	Shrub	EN	Traditional Medicine
Eichhornia crassipes	Pontederiaceae	-	Plant	LC	Bioenergy Purpose
Zannichellia palustris	Potamogetonaceae	-	Plant	LC	Flowering

LC: Least Concern, E: Extinct, EN: Endangered

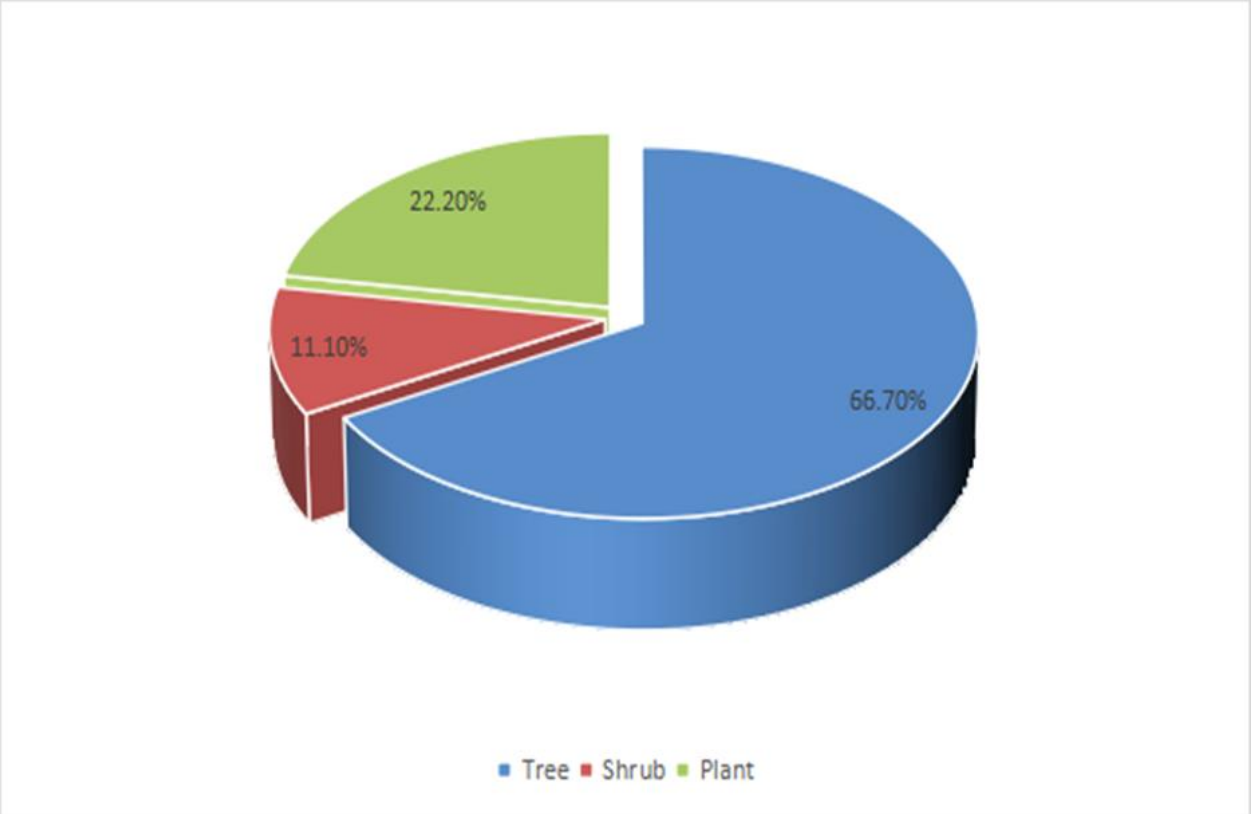

Figure 4.20: Species Composition in the Project Area

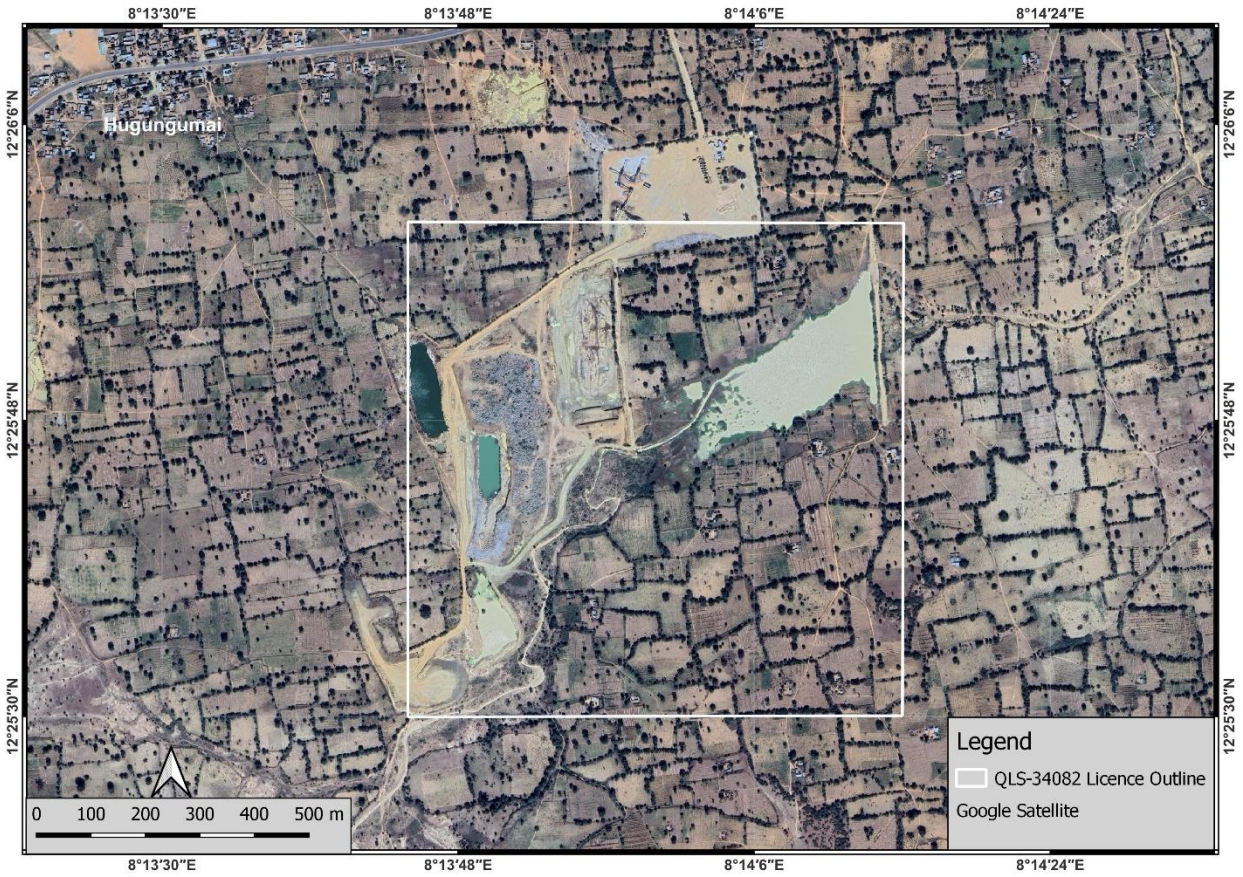

Figure 4.21: Satellite Map of the Area Showing Sparse Vegetation

Plate 4.5: *Lagenaria siceraria* and *Hyphaene thebaica* (Field Work, 2022)

Plate 4.7*: Eichhornia crassipes* (Field Work, 2022)

Plate 4.9. Neem Tree in Residential Area of Hugungumai. (Field Work, 2022)

Plate 4.10: *Zannichellia palustris*

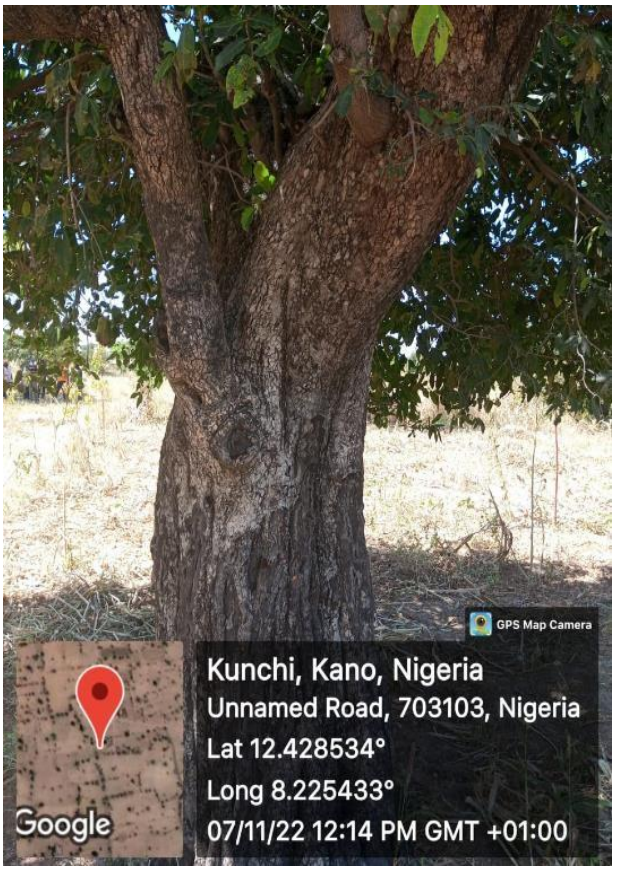

Plate 4.11: *Parkia Biglobosa*. (Field Work, 2022)

Termite infestation on Shrubs

In the study area, termite infestations were observed on shrubs. Termites are common pests of forest tree species; they attack various parts of trees, such as roots and stems, resulting in severe damage, the decline in tree vigour and subsequent death of trees. Seriously infested trees may die off, especially if the diseases caused by termites overstress them. As eusocial insects, termites live in colonies that, at maturity, numbered from several hundred to several million individuals. They are prime examples of self-organised systems using swarm intelligence. They use this cooperation to exploit food sources and environments that could not be available to any insect acting alone (Van, 1997). The extent to which termites are problems for trees and the nature of loss they cause is very much related to the geographic region (Logan et al., 1990). In the tropical and sub-tropical regions of the world, where rainfall is low and a dry savannah-type situation has developed, termite attacks appear most acute, and this has caused severe problems in the development of nurseries and young tree plantations.

The plants shown in the plate below have been heavily infected. Due to the region's arid nature, termites tend to cause more severe damage.

Plate 4.12 Termite Infected Shrub Plate & Field Officer Evaluating a Termite Shrub (Field Work, 2022)

Both chemical and traditional methods can control termite infestation. Current chemical control methods employed are soil treatment, treatment of seedlings before transplanting and baiting techniques, and the chemicals currently used include chlorpyrifos, imidacloprid and fipronil (Debelo & Degaga, 2017). In addition to the current chemical control methods employed, there are several alternatives, traditional control methods relating to silvicultural practices or plantation management, which are also essential and should be considered before chemical intervention is attempted (Debelo & Degaga, 2017). Many traditional methods of control of termites in forest plantations have a sound basis in the principles of ecology (UNEP, 2000).

4.10.2 Fauna/Wildlife

This involved a survey/census of mammals, birds, reptiles, and amphibians around the study area. Using a pair of binoculars, the direct count method was employed to census wildlife readily available for observation. The presence of some of the animals was ascertained by probing such humid habitats as logs, heaps of dead decaying leaves, forest undergrowth, ponds, and burrows. Thus, all sighted, captured, or dislodged animals were identified often on the spot to possible taxonomic levels using field guides and keys (Walkey et al., 1968; Elgood, 1960; Happold, 1987; Brach, 1988). The indirect method,

which uses evidence of animal's presence (Dasmann, 1963), was used for species that do not offer themselves readily for observation. Interviews with hunters also provided further information on the wildlife diversity abundance and use in the area. The conservation status of the wildlife species was also consideredto determine whether this species needs any form of conservation or is on the International Union for Conservation of Nature (IUCN) red list. The common wildlife around the site were white egrets, agama lizards and frogs. All the wildlife species in the area are not endangered as their conservation status is classified as least concern (LC) according to the IUCN list of endangered species. The presence of ponds on the site was observed to be the significant factor that influenced the presence of the observed species on site.

Table 4.10: Fauna Composition

COMMON NAME	SCIENTIFIC NAME	FREQUENCY
Aves (Birds)		
White Egret	Ardeola sp.	14
Reptilia (Reptiles)		
Agama Lizard	Agama	5
Amphibians		
Frogs	Xenopus laevis	24

Plate 4.14: Frogs in a Pond (African clawed) on Site (Field Work, 2022)

Plate 4.15: One of the Pond Attracting and Supporting the Presence of Wildlifeon the Site (Field Work, 2022)

Plate 4.15: Bird Nest Indicating Evidence of Bird Habitation on the Site (Field Work, 2022)

4.11 Socio-Economic Characteristics and Consultation with Stakeholders

The socio-economic baseline study provides information on the demographics, housing, public services, and the aesthetic quality of the communities where the proposed project will be carried out. This section of the ESIA is designed to establish the socioeconomic baseline condition of the project area and assess, from an external and independent point of view, the scale and range of the social impacts of the proposed project.

4.11.1 Demography Characteristic of Kano State

The demographic profile of Kano state shows it is a centre of rapid population growth with a dynamic population size, composition and distribution that goes along with the historical and cultural development of the defunct former Hausa States. In pre-colonial times, population growth was low, with less than one per cent annual growth rate and a density of about 1 - 4 persons per Km^2 (Maigari, 1998). From the 1930s to date, however, the population grew exponentially with slight variation around the Kano Closed-settled Zone, moderate in the southwards and wide variation in northwards. According to Maigari (2012), the annual growth rate in 1931 was 1.5%; it rose to 2% in 1952, 2.5% in 1991 and 15 years later (from 1991 to 2006 and 2022), which increased by 3.34%. The details of population distribution are presented in Table 4.11, and local government areas, wards and distance from the city core are shown in Table 4.12.

Table 4.12: Population Growth in Kano - 1931 - 2022

CENSUS YEAR	TOTAL POPULATION	GROWTH RATE	DENSITY/KM^2
1931	2,438,844	1.5	53.3
1952	3,396,350	2.0	74.2
1962	4,832,609	2.4	105.5
1991	5,810,470	2.5	273.09
2006	9,383,682	3.34	441.03
2013	29,050,081	3.34	1,365.33
2022	39,044,823	3.34	1,365.33

Source: Maigari, 2012

Kano was among the 12 states created in May 1967 out of the former Northern Region. The state remained intact until August 27, 1991, when Jigawa State was carved out. It is in the northwest geo-political zone of Nigeria. Hausa and Fulani, who are Muslims, inhabit Kano State. It has 44 local governments, with an area of 20,479.6 square kilometres. The

population density is about 458 persons per square kilometre. The walled city of Kano, which serves as the state capital, is the commercial nerve centre of Kano State and northern Nigeria. Many immigrants, Yoruba and Igbo, live in Kano City. Six local government areas (Fagge, Gwale, Tarauni, Kano Municipal, Nassarawa and Dala) have virtually merged to form the Kano metropolis, as shown in Table 4.12. The official language of Kano State is Hausa.

Table 4.12: LGA and Wards within Kano State

SN	LGA	POLITICAL WARDS	DISTANCE (KM)
1.	Ajingi	10	75
2.	Albasu	10	115
3.	Bagwai	10	60
4.	Bebeji	14	95
5.	Bichi	11	56
6.	Bunkure	10	40
7.	Dala	12	Metropolis
8.	Dambatta	10	60
9.	Dawakin Kudu	15	26
10.	Dawakin Tofa	11	40
11.	Doguwa	10	190
12.	Fagge	10	Metropolis
13.	Gabasawa	10	65
14.	Garko	10	80
15.	Garun Mallam	10	50
16.	Gaya	10	67
17.	Gezawa	11	43
18.	Gwale	10	Metropolis
19.	Gwarzo	10	85
20.	Kabo	10	60
21.	Kano Municipal	13	Metropolis
22.	Karaye	10	130
23.	Kibiya	10	82
24.	Kiru	15	75
25.	Kumbotso	11	25
26.	Kunchi	10	130
27.	Kura	10	40
28.	Madobi	12	45
29.	Makoda	11	65
30.	Minjibir	11	45
31.	Nassarawa	11	Metropolis
32.	Rano	10	50
33.	Rimin Gado	12	45
34.	Rogo	10	167
35.	Shanono	10	94
36.	Sumaila	11	88
37.	Takai	10	98
38.	Tarauni	10	Metropolis
39.	Tofa	15	41
40.	Tsanyawa	10	90
41.	Tudun Wada	11	145

42.	Ungogo	11	35
43.	Warawa	15	43
44.	Wudil	10	50
Total		**484**	

Source: Wikipedia, 2022

4.11.2 Traditional Administration of Kano Emirate

The emirate system of traditional local administration was practised in all the predominantly Muslim States of Northern Nigeria. The Emir appoints officials to assist in making decisions and governing the emirate. Each official in the Emirs cabinet had a unique role to play. For example, Waziri was the Prime Minister and the closest to the Emir; Galadima oversaw the capital and oversaw matters that pertained to the emirate's capital; Madawaki was the army's commander. When an external conflict arose, the Emir summoned the Madawaki through the Waziri. While the Madawaki led the army, Dogari oversaw the police, and the Ma'aji managed the Treasury department. Other title holders of the traditional emirate include the three Sarki of the emirate, who were also quite close to the Emir. Sarkin Fada saw to the welfare and running of the Palace. The Sarkin Pawa was the head of the butchers in the emirate. Sarkin Ruwa oversaw fishing activities in the emirate. Each of these officials was sought out when it came to running the activities of the emirate; however, the Emir still served as the preeminent voice of authority and had the power to relinquish any officer of his position.

Due to its landmass and population, the Emirate system was further subdivided into districts. These districts were supervised by officials known as Hakimi. The Hakimi were responsible for collecting taxes and had the power to appoint village heads (Dagachi) who made collecting taxes easier. The emirates also had Alkali courts led by Alkali judges. These judges ruled based on the precepts of Sharia law and delivered judgment on issues such as marriage, murder, and debt, to mention a few. Court cases of more significant consequence to the emirate were heard in the Emir's palace, where the Emir was the judge. The Emir is the head of the emirate council and commander-in-chief. At the local level, the Mai Angora is the closest to the residents, and all disputes and misunderstandings are first reported to him for settlement. The Mai Angora reports to the Adachi (Village Head) or Magaji, who is answerable to the Hakimi (District Head). The District Head reports tothe Emir. In terms of information/instructions from the emir to the people, the hierarchy trickles down from the emir to the people in the communities.

4.11.3 Demography Composition of Respondents

The Hugungumai community in Kunchi LGA is predominantly rural, with agriculture being the main economic activity. The area has fertile land supporting maize, millet, and vegetable cultivation. Livestock rearing is also a common practice in the area. Among the 178 respondents in Hugungumai, they primarily Hausa, the dominant ethnic group in the area, LGA, and Kano State.

The sex composition of a population is a crucial factor in determining its socio-economic well-being. Figure 4.22 revealed that about 22% of the sample population were females, while about 78% were males. This response rate implies that the study was not gender biased. Although there were more male than female respondents, this was because, in most surveyed households, the men were the household heads.

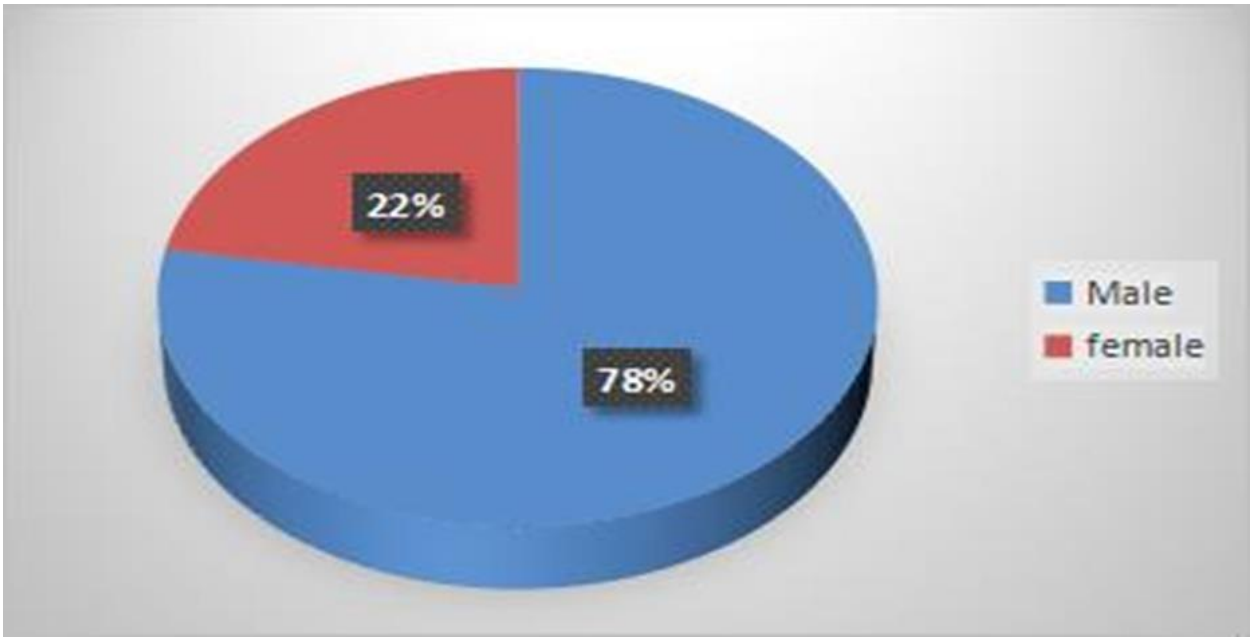

Figure 4.22: Gender of the Respondents. (Field Work, 2022)

Age Distribution of Respondents

The survey reveals that the respondents' age groups. 38.1% were between 18 and 25 years old, 23.8% were between 26 and 40, 18.2% were in the 41-60 age bracket, and 9.5% were above 61. This means most sampled households and individuals fall within the active population.

Marital Status of Respondents

The marital status of a sample respondent describes the relationship between adults (male and female) within that population. Figure 4.23 revealed that single persons account for

11.2%, married at 86.8%, and widowed at 2%. This shows that married people are more in the host community than others. This implies a potential population increase, which determines the household type, the consumption power and the infrastructure needs of the area's residents.

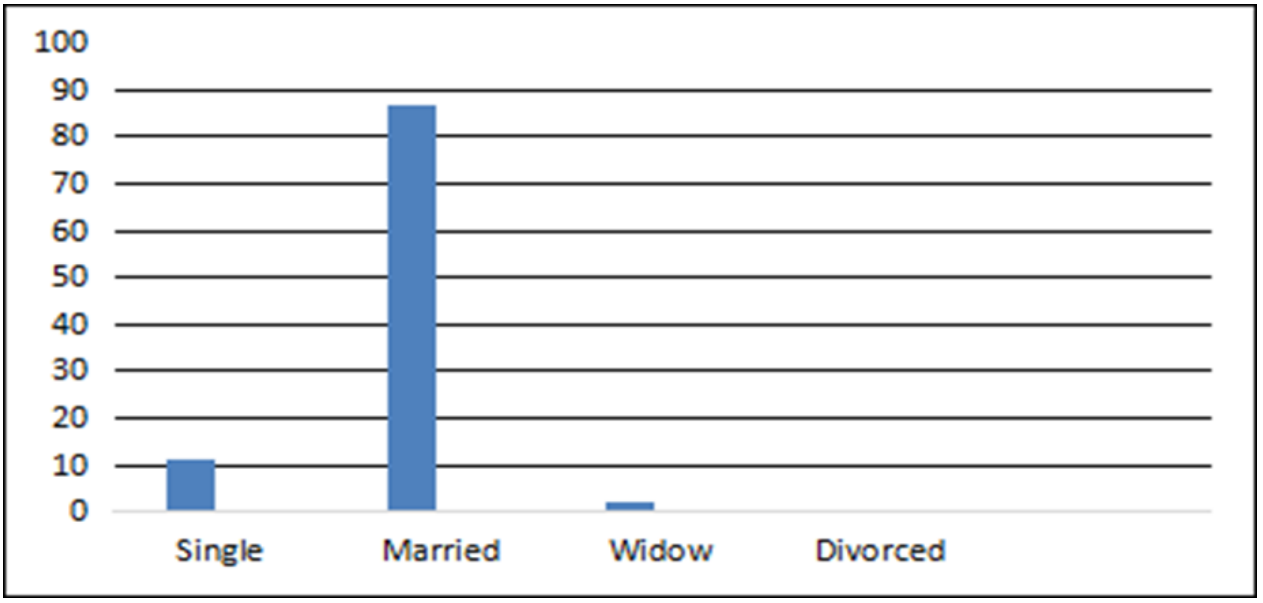

Figure 4.23: Marital Status of Respondents. (Field Work, 2022)

Religious Beliefs of the Respondents

Figure 4.24 shows that 6.25% of the respondents were Christians, and 93.75%were Muslims. This implies that the residents of the proposed project sites are people of faith.

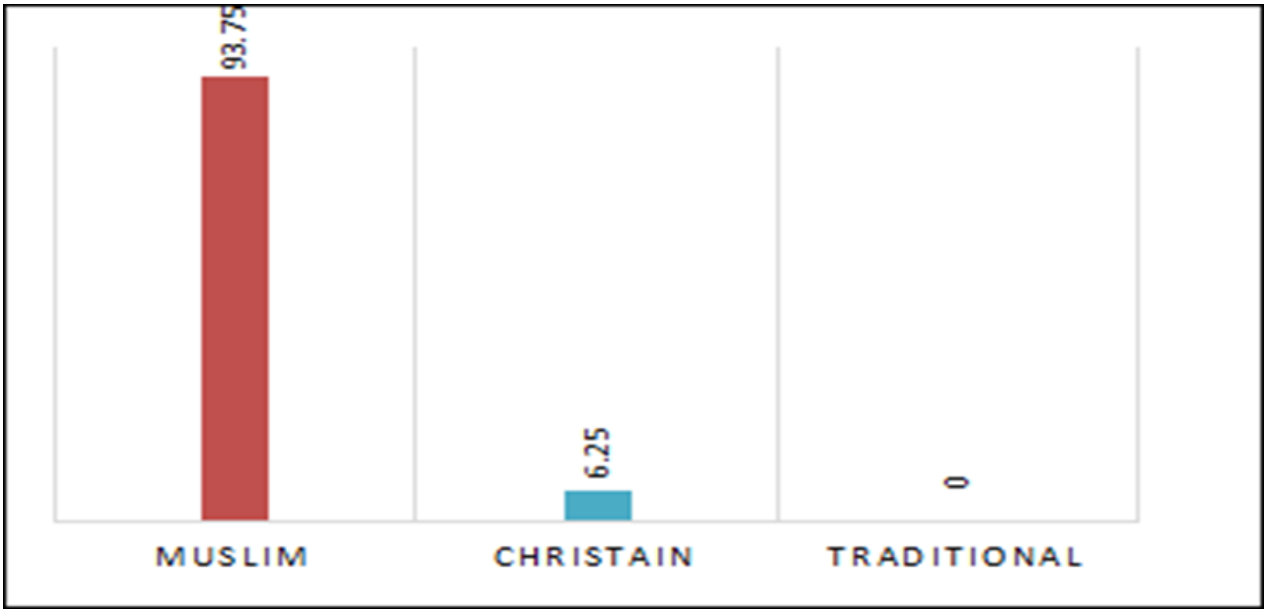

Figure 4.24. Religious Status of Respondents. (Field Work, 2022)

Occupational Status of Respondents

Figure 4.25 revealed that respondents in the proposed project area engaged in diverse types of occupations, such as trading, recorded 32%; farming, 43%; artisanal, 17%; civil

servants, 6%; and others, 2%.

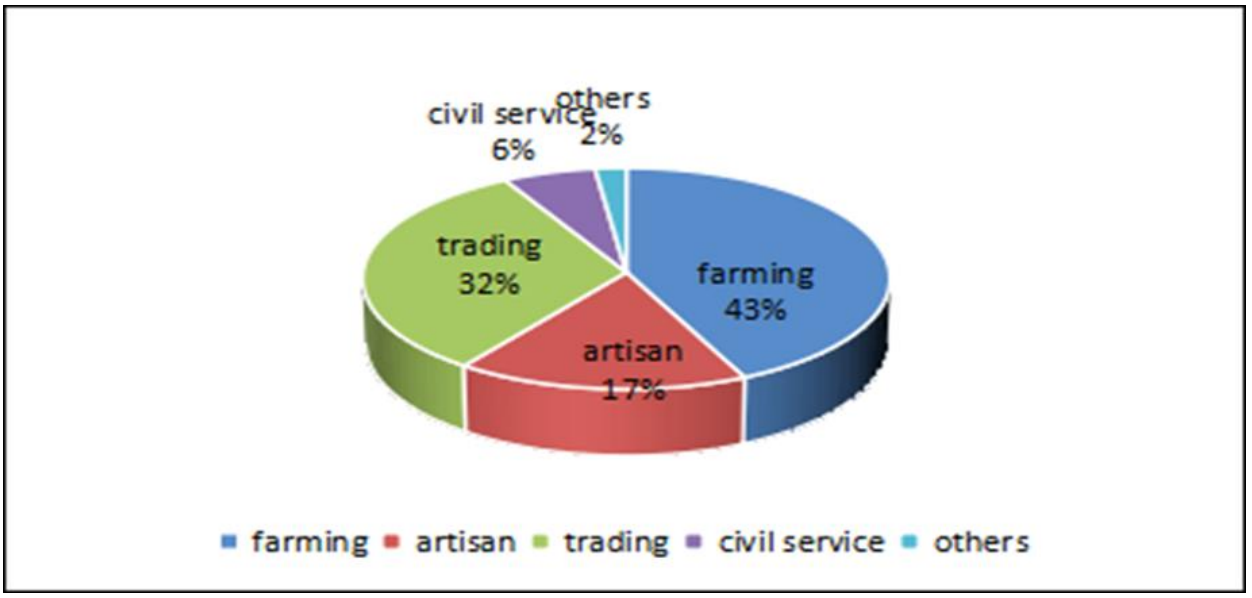

Figure 4.25. Occupational Status of Respondents. (Field Work, 2022)

Income Level of the Respondents

Figure 4.26 revealed that the monthly income of respondents within the proposed project area ranges < ₦5, 000-₦10, 000 (8.4%); ₦10, 000 – ₦15, 000 (13.1%); ₦15, 000-₦ 20,000 (15%) ₦20, 000- to₦ 30,000 (21.7%) and above ₦ 30,000 (41.8%). This study also shows that most residents earn less than ₦100,000. Therefore, the implication is that the households in the proposed project are not financially stable, Figure 4.26.

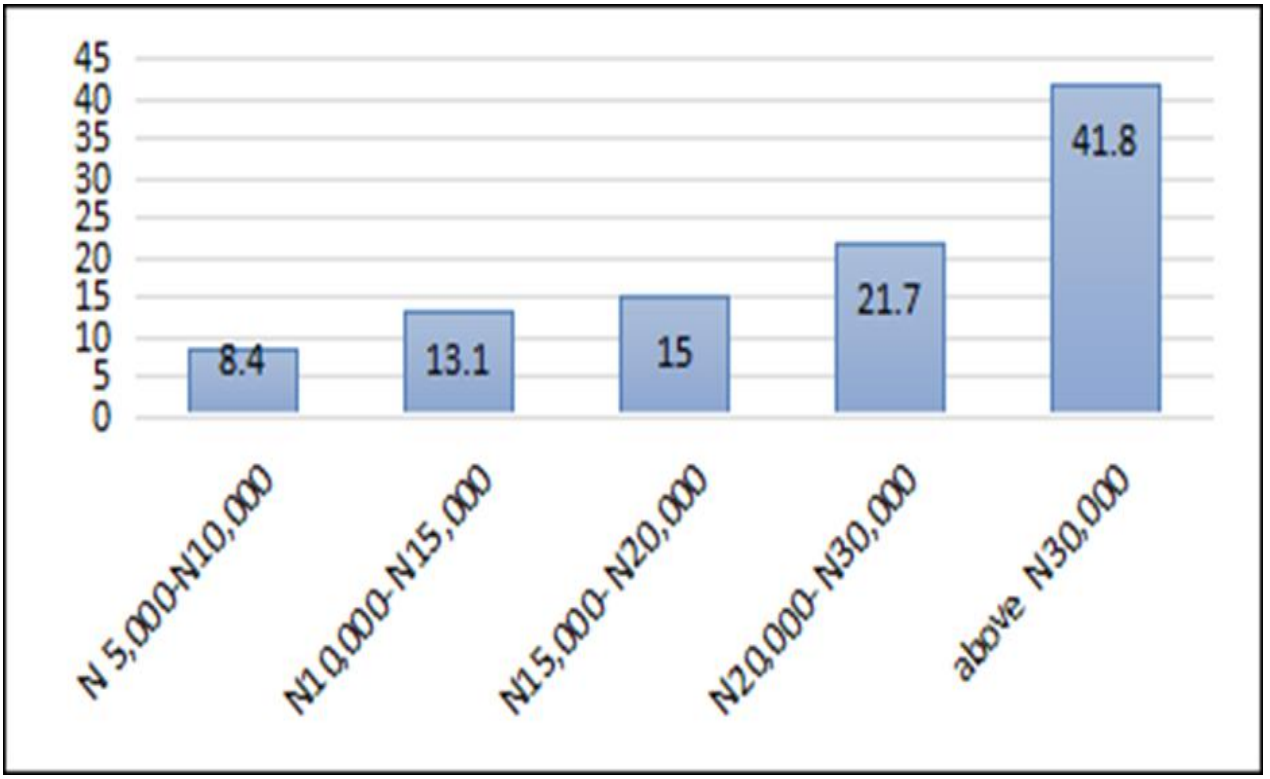

Figure 4.26. Level of Income of Respondents. (Field Work, 2022)

Plate 4.16: Socioeconomic Activities of Residents. (Field Work, 2022)

Educational Status of Respondents

Figure 4.27 revealed that 3% of the respondents had no education; 18% attained primary education, 32% had secondary education, 16% had tertiary education, and 22% had vocational education. Most respondents in the proposed project location had attained one form of education or the other; hence, most are literate. Therefore, communication and understanding of the proposed project intervention were made more transparent and better understood during consultation.

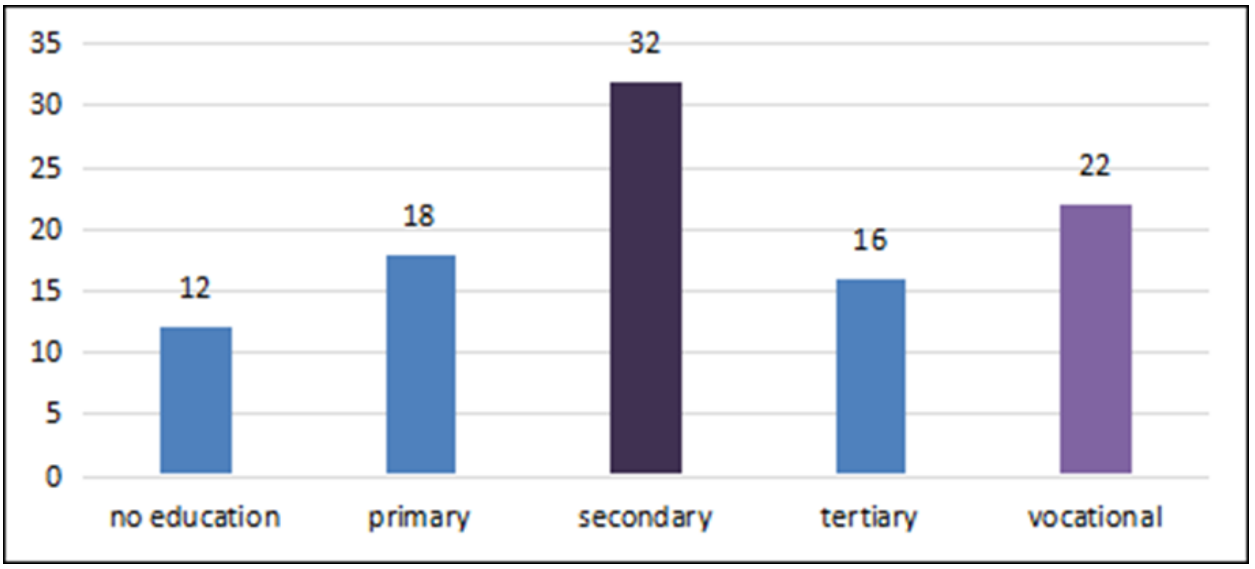

Figure 4.27. Educational Status of Respondents. (Field Work, 2022)

Housing Characteristics of Respondents

Table 4.13 shows that 59.3% of the dwellings in the proposed project location are constructed using plastered mud, 31.4% are constructed with mud and 9.3% with cement block. Also, 85.2% used Asbestos sheet. Meanwhile, 68.5% of the sampled dwellings used earthen, and 31.5% used cement as building materials for flooring. The study also revealed that 64.8% of respondents within the proposed projectarea practice open

defecation. At the same time, 7.4% use a pit latrine, and 27.8% use a toilet facility outside the dwelling. The thatched roofs with plank walls are not standard in the area.

Table 4.13: Type of Building in the Study Area

BuildingParts	Variables	Percentage (%)	Decision in Population distribution
Construction Material (Wall)	Plastered Mud	59.3	Abundant
	Mud	31.4	Abundant
	Cement Block	9.3	Less Abundant
	Total	**100.0**	
Construction Material (Roofing)	Asbestos Sheet	85.2	Abundant
	Corrugated Aluminium sheets	14.8	Less Abundant
	Thatched roof	0.0	
	Total	**100.0**	
Construction Material (Floor)	Earthen	68.5	Abundant
	Cement	31.5	Abundant
	Tiles	0	
	Other	0	
	Total	**100.0**	
Toilet Facility	Pit latrine	7.4	Less Abundant
	Water system	0	
	Toilet facility outside dwelling	27.8	Abundant
	Nearby bush	64.8	Abundant
	None	0	
	Total	**100.0**	

Source: Field Work, 2022

Plate 4.17: Type of Housing in the Study Area. (Field Work, 2022)

Sources of Power Supply within the Proposed Project Area

Energy consumption and usage are charcoal and firewood for cooking, the Kano Electricity Distribution Company (KEDCO) supplies power, and the use of generators for lighting. Figure 4.28 shows that 3% of the residents within the proposed project location rely on KEDCO for lighting, while 87.8% depend on generators as alternative power sources for lighting. Also, 17.2% of the respondents use kerosene, 28.3% use firewood, 50.1% use charcoal, and 4.4% use gas. This implies that over 95% of the community households do not rely on electricity from the national grid (KEDCO) for power supply; therefore, in the absence of power from the national grid, using a generator becomes a substitute.

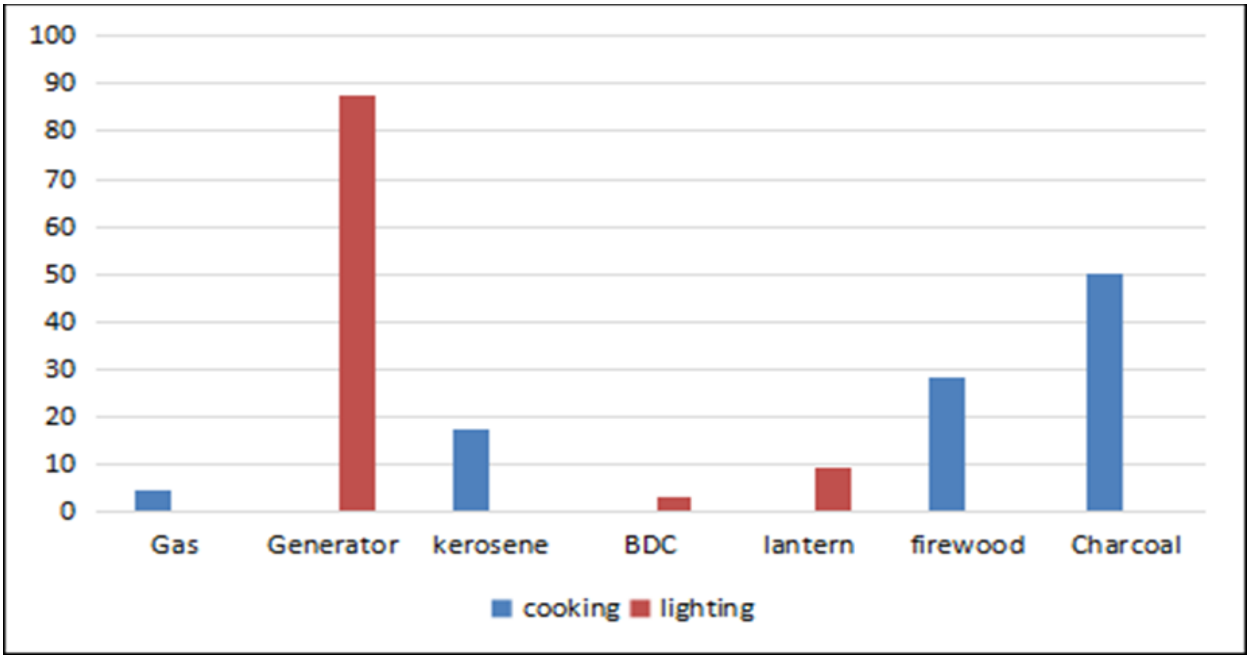

Figure 4.28: Source of Power Supply. (Field Work, 2022)

Constraints Facing Respondents in the Study Area

Table 4.14 shows that lack of financial capital was ranked first as the most severe constraint facing most respondents (74.6%). Other constraints that compound the

challenges include Health problems (60.2%), Lack of financial capital (55.5%), Lack of portable water (52.5%), inefficient market (49.3%), and inadequate skill (45.2%). Respondents are facing one form of constraint or the other.

Table 4.14: Constraints Facing Respondents.

Constraints	Serious constraint	No constraint	Mild constraint	Rank
Lack of human capital	55.5	25.5	30.3	3rd
Lack of financial capital	74.6	15	31.1	1st
Health problems	60.2	27.5	30.0	2nd
Inadequate skill	45.2	10	30	6th
Lack of potable water	52.5	21.3	27.5	4th
Inefficient market	49.3	18.4	28.9	5th

Source: Fieldwork, 2022

Plate 4.18: Source of Water Supply in The Study Area. (Field Work, 2022)

Table 4.15: Measurement of Poverty in the Study Area

VARIABLE	VERY SEVERE	SEVERE	NOT SEVERE	MEAN
Inadequate access to portable water	70.6	29.4	0	50
Poor access to good security	40.9	59.1	0	50
Low-income level	30.1	60.8	9.1	33.3
Poor access to health facilities	40.1	59.5	0.4	33.3
weak community organisations	3.1	13.8	83.1	33.3
Lack of access to credit facilities	27.7	62.9	9.4	33.3

Source: Fieldwork, 2022

Telecommunication Infrastructure

Private telecommunication companies that provide mobile phone (GSM) and digital data services (Internet) in the project area include MTN, 9Mobile, Airtel and Glo.

Communal Land Disputes/Litigations

Communal land disputes and litigations are rare in the project area. This is partly due to transparent land tenure systems and land inheritance under Sharia adopted by adherents of Islamic religion in the area. Under the system, when a landowner dies, his/her heirs, both male and female, are entitled to their shares in a given ratio, as specified by Sharia law.

Land Use Pattern of the Proposed Project Site

The primary land use observed in the project area is agricultural, followed by residential, institutional, commercial, and, to a lesser extent, recreational. Agricultural land use in the project area includes farming/orchards and rearing animals. People in the proposed project area are mainly farmers and fishermen. Institutional land use is mainly in schools and administrative and office accommodation. The present land use surrounding the proposed site is a mixture ofindustrial, agricultural, and residential land uses.

Land Ownership Structure

Land ownership in the area includes private, family, community, and institutional ownership. Private and family ownership mainly involves residential and business buildings and land parcels owned by individuals and families in the project area. Community ownership is for lands and properties commonly used by community members, such as cemeteries, markets, motor parks, town squares, etc. Institutional ownership of land in the area is for lands and properties belonging to Local, State and Federal Governments.

Waste Management

The household waste stream comprises bio-degradable and non-biodegradable products, such as human waste, vegetable matter, food remnants, plastics, and other organic materials. Artisans, such as automobile mechanics and carpenters, also generate various forms of waste. Waste is disposed of by free litter. Most of the residents of the affected areas burn their solid waste. However, dumping waste on the open ground behind living homes or into the bush is common in the area. The dump siteswere poorly maintained, and domestic animals foraged through the waste.

The health risks include breeding vectors, the likelihood of fire, and water contamination. Because of water scarcity, many households do not use the water closet system to dispose

of human waste. The focus group discussion and in-depth interview show that most respondents dispose of their sewage/waste through the bush and stream/river drainage channels. This method of waste disposal creates an ideal situation for vector and air-borne diseases and constitutes an unsafe sanitary condition in the community.

Plate 4.18: Type of waste generated in the study area. (Field Work, 2022)

Perception of the Respondents about the Proposed Project

During the Focus Group discussion (FGD), the study revealed that residents of the study area have different views about the proposed project intervention. About 99.8% of the respondents' state that they are aware of the proposed project, and only 0.2% of the respondents say they only heard about the proposed project during the consultation exercise conducted by the ESIA in the community; 97% of the respondents were of the view that the project would provide jobs during the construction stage as locals will be hired, and 3% were indifferent as to whether the project will create such jobs opportunity.

Police station

School

Mosque

Telecom mast

Vigilante's office

Primary health centre

Plate 4.19: Facilities Within the Study Area. (Field Work, 2022)

4.11.4 Health Care Situation in Kano State

The poverty rate in Kano State is over 61%. Life expectancy is 51 years for males and 52.2 years for females. Only 37.6% of the population had access to running water (KSEEDS, 2005). Kano has a high dependency ratio compared to other parts of Nigeria; it was estimated that for every individual of economically active age (15-64), there is another household member who is under 15 or over 65 years old,giving a ratio of 1.0 as compared to the national figure of 0.8. The National Demographic and Health Survey (NDHS, 2008) shows that the North-west zone where Kano is located has the worst nutritional statistics in Nigeria, with 55% of all under-fives stunted and 42.9% underweight.

Kano State has a literacy rate of 35%, and the average overall enrolment rates in 2008 stood at 90% for primary education, 80% for secondary education and 60% for tertiary education. Enrolment for females, however, was 40%, 35% and 20%, respectively. The infant mortality rate was around 110 per 1000 live births (KSEEDS, 2005). For the North-west zone, the infant mortality rate was 114, of which 55 deaths per 1000 were neonatal deaths. The maternal mortality ratio was 1,700 deaths per 100,000 births (KSEEDS, 2005).

Health Impact Assessment of Proposed Project Community

Kano state has 1147 primary healthcare service providers, 39 secondary healthcare providers, and two tertiary healthcare providers. Kunchi LGA has 32 healthcare service providers, as shown in Table 4.16. Among the aged, fever, malaria, and rheumatism are the prevalent diseases.

Table 4.16: Health Care Facilities Distribution in Kunchi LGA

SN	Facility Name	Types	State	LGA	Ownership
1	Kunchi PHC	Primary	Kano	Kunchi	Public
2	Bumai HP	Primary	Kano	Kunchi	Public
3	Danjaka HP	Primary	Kano	Kunchi	Public
4	Jangefe HP	Primary	Kano	Kunchi	Public
5	U/gyartai HP	Primary	Kano	Kunchi	Public
6	Rigana HP	Primary	Kano	Kunchi	Public
7	Gwarmai BHC	Primary	Kano	Kunchi	Public
8	Dan Kwai HP	Primary	Kano	Kunchi	Public
9	Jodade HP	Primary	Kano	Kunchi	Public
10	Kasuwar Kuka MPHC	Primary	Kano	Kunchi	Public
11	Tabanni HP	Primary	Kano	Kunchi	Public
12	Tofawa HP	Primary	Kano	Kunchi	Public

13	Sodawa HP	Primary	Kano	Kunchi	Public
14	Falle HP	Primary	Kano	Kunchi	Public
15	Gadaba HP	Primary	Kano	Kunchi	Public
16	Kaya HP	Primary	Kano	Kunchi	Public
17	Matan Fada Disp	Primary	Kano	Kunchi	Public
18	Ridawa HP	Primary	Kano	Kunchi	Public
19	Baji Shama HP	Primary	Kano	Kunchi	Public
20	Gwadama BHC	Primary	Kano	Kunchi	Public
21	Shamakawa HP	Primary	Kano	Kunchi	Public
22	Dunbule HP	Primary	Kano	Kunchi	Public
23	Galadimawa HP	Primary	Kano	Kunchi	Public
24	Hugungumai HP	Primary	Kano	Kunchi	Public
25	Shuwaki MPHC	Primary	Kano	Kunchi	Public
26	Karofawa HP	Primary	Kano	Kunchi	Public
27	Magawata HP	Primary	Kano	Kunchi	Public
28	Yan Dadi Disp	Primary	Kano	Kunchi	Public
29	Yan Kifi HP	Primary	Kano	Kunchi	Public
30	K/Kunchi HP	Primary	Kano	Kunchi	Public
31	Kuku HP	Primary	Kano	Kunchi	Public
32	Gidan Nasau HP	Primary	Kano	Kunchi	Public

Source: Field Survey, 2022

Prevalent Ailment in the Proposed Project Area

Table 4.17 shows that the most common ailment in the study area is malaria/typhoid fever, which accounts for 78.6% and 15.7%, respectively.

Table 4.17: Prevalent Ailment in the Study Area

Ailment	Percentage (%)
Whooping Cough	0.0
Tuberculosis	0.0
Asthma	1.4
Dysentery	0.0
Diarrhoea	0.0
Cholera	0.0
Pile	0.0
Hypertension	1.4
Congestive Health Problem	0.0
Pneumonia	0.0
Epilepsy	0.0
Rheumatism	0.0
Rashes	0.0
Eczema	2.9
Ringworm	0.0
Eye pains	0.0
Cataract	0.0
Glaucoma	0.0
Typhoid fever	15.7
Malaria	78.6

Sickle Cell Anaemia	0.0
STDs	0.0
Total	100

Source: Field Survey, 2022

HIV/AIDS Status in Kano State

The first case of AIDS was reported in Nigeria in June 1986. By the end of 1986, only 2(two) cases were officially reported. In 1987, another 2(two) cases were reported. 1988 saw 33 cases; ten years later, in 1998 alone, 18,490 cases were reported, followed by 16,188 cases in 1999. 9715 and 3661 cases were reported in 2000 and 2001, respectively. The advent of HIV/AIDS has posed a lot of socio-economic challenges to human life, dignity, and existence. According to the 2016 joint United Nations Program Report on HIV/AIDS (UNAIDS), the number of HIV-positive people receiving antiretroviral therapy (ART) was about 18.2 million in2016. Nigeria has the second highest HIV/AIDS population in the world, with about 3.5 million people living with the disease as of 2016, with a prevalence rate of 3.1%.Death from HIV/AIDS in the year 2015 in Nigeria was 180,000 people. About 24%of adult HIV-positive patients in Nigeria are on antiretroviral treatment. The current prevalence rate of HIV in Kano state is 1.3%. Table 4.18 shows the prevalence of HIV/AIDS vulnerable groups in Nigeria.

Table 4.18: Prevalence in Vulnerable Groups

GROUP	PREVALENCE (%)
Sex workers	35-66%
Long-distance truck drivers	20-25%
Sexually transmitted disease patients	11.5-13%
TB patients	17%
Injection drug users	8.9%

Source: UNAIDS, 2016

4.11.5 Gender-Based Violence

Gender-based violence is one faced by different communities and countries, but its crucial effects are global. Gender-based violence is one with many forms, such as domestic violence, child marriage, female genital mutilation, partner violence and sexual assault (Rape). Both men and women face these forms of violence, though it is most common in women and highly reported, under-reported for men (Tade & Udechukwu, 2020). On the other hand, the term rape culture shows how the victims of rape are blamed for sexual assault done to them. Rape culture is a term that was coined by feminists in the United

States in the 1970s. According to Emilie Buchwald (1993), rape culture is" a complex set of beliefs that encourage male sexual aggression and supports violence against women". Tamar Sexual Assault Referral Centre (SARC) revealed within two years of its activity from 2014 to 2016 that there were 641 rape victims and survivors, of which 401 of them were under-aged, 240 were over 18, and 183 of them were below 10. In any case, out of the 641 victims, 629 were females, while 12 were male victims, and 24 out of the females were victims with disabilities. According to the National Survey conducted in 2014 on issues regarding Violence Against Children in Nigeria, one out of four females endure sexual violence during adolescence, with 70% reporting instances of sexual violence more than once. During the same study, about 24.8% shows that females between the age of 18-24 suffer rape before age 18, of which 3.5% get any service out of the 5% that seek help, as shown in Table 4.19.

Table 4.19: Strategy of Curbing GBV in the Study Area

Questions	Response
Is gender equality practised in your community?	95% of respondents said that adults, boys,and girls should be treated equally in terms of access to equal opportunities and being free from abuse. While 5% of respondents felt male domination in the community should remain based on culture and religion
Have you heard about gender-based violence?	97% of the respondents mentioned that they had heard of the term gender-based violence, and 3% had not heard of the term gender-based violence.
In what way should religion and culture ameliorate the GBV?	45% of respondents indicated that religion and culture must provide more empowermenton women's rights. 20% of respondents stated that women and men should be protected adequately. 20% of respondents felt that gender-based violence should be resolved socially and within the family structures. 15% of respondents indicated that the religious leaders and traditional rulers needed to play an active role in providing counselling support to victims of domestic violence.
Prevention of GBV?	80% of respondents state the need to promote women's and girls' education and economic empowerment. While 20% of respondents state that there is a need to raise awareness of laws, structures and systems that support gender-based violence both culturally and religion.

Source: Field Survey, 2022

4.11.6 Consultation

The Public Consultation process ensures that all persons or organisationsaffected or

interested in the project are informed of potential issuesand can register their views and concerns. Building from there, the process providesopportunities to influence the project design to maximise its benefits and minimise potential negative impacts. The current best practice model is to engage in continuous dialogue with the affected community and other stakeholders as plans for the project evolve and the environmental assessment is prepared. An elevated level of interaction is maintained, potential and actual social and environmental impacts are identified, and community needs and concerns are discussed and, wherever possible, built into the project's planned activities, including decision-making and management practices. Good consultation helpsfoster genuine and positive relationships with mutual respect, shared concerns and objectives between the company pursuing the development and the community. The public participation facilitator's role is to facilitate that dialogue process to ensure transparency and accountability in decision-making and publicconfidence in the proposed project and its management.

Objectives of the Consultation

The objectives of the consultation of the proposed project intervention are summarised as:

- Creating public awareness and understanding of the proposed project
- Informing the stakeholders on the proposed project activities and ensuringits acceptance
- Develop and maintain a medium of communication channels between the project proponent and stakeholders' opinions about the Socio-Environmental risks and potential benefits associated with the project and the measures and actions put in place to mitigate any anticipated impact.
- Discuss the nature and scale of any adverse impact the proposed project might cause and lay down the mitigating measures directly and transparently.
- Getting feedback from the stakeholders on issues of concern and expectation about the proposed project to optimise the project.
- Creating a solid social and institutional dialogue to assess the strength and perception of the proposed social acceptability.
- Document all the views and opinions raised by the stakeholders about the proposed project and sensitise the community members from cluster level to

state level about the project activities and intervening opportunities.

Identification and involvement of Key Stakeholders

Key relevant stakeholders were duly consulted. The approach used in the consultation exercise is as follows: Identification of critical stakeholders, issuance of notice of intent to carry out an ESIA for the proposed development, terms of reference to regulatory Agencies and potential stakeholders, consultation with stakeholders with explanations on critical issues as they arise and affect the people. The primary stakeholders identified for the proposed project are within the Immediate vicinity of the Hugungumai community in the Local Government, Traditional councils in the project area, and the Kano State Government. Also, the regulatory bodies identified are the Federal Ministry of Environment Abuja (FMEnv), the Ministry of Solid Minerals Development and the Kano State Ministry of Environment and Physical Development. Also, community-based organisations within and around the proposed project environment were consulted. Stakeholder consultation for the proposed project took several forms, which include public consultations, questionnaire administration, personal interviews, and FGDs, which were conducted on 7th and 8th November 2022 at the Kunchi Local Government Secretariat, Hakimi's Office in Kunchi Village and Kunchi Police Station.

The stakeholders were duly informed through formal letters of invitation and phone calls. During the consultation exercise, the stakeholders were informed that the ESIA was being conducted to identify the impacts of the proposed project on humans and the environment to minimise or mitigate where the impacts cannot be avoided. The stakeholders were informed that the ESIA team had visited the project site and collected vegetation, soil, and water soil samples. They will analyse these samples to determine the baseline conditions of the area concerning health, economy, and cultural imperatives. The survey outcome will help provide mitigation or enhancement measures needed to evaluate and monitor project performance. The participants were informed that the draft final report of the ESIA will be displayed at the Ministry of Environment for their perusal and comments.



Plate 4.20: Consultation exercise at Kunchi LGA Secretariat. Source: Fieldwork,2022

Table 4.20: Consultation Exercise Schedule

Exercise	Venue And Date	No. of Attendance	Stakeholders Consulted
Kunchi LGA	LGA Secretariat, Kunchi 7th November, 2022	38	LGA Chairman
Kunchi Traditional Council	Hakimi's Palace, Kunchi 7th November, 2022	19	Traditional Rulers
Kunchi Police Command	Kunchi Police station	11	Security Agents

Source: Fieldwork, 2022

Plate 4.21: Consultation Exercise at Hakimi's Office, Kunchi LGA. (Field Work, 2022)

From the consultation exercise, environmental and socio-cultural issues regarding the proposed development were discussed with the stakeholders. The proponent and

consultant responded to the issues and concerns discussed regarding mitigating the issue. Furthermore, recommendations from regulators (FMEnv) and the Kano State Ministry of Environment, Kunchi Local Government Authority, and other representatives) were noted for further consideration and incorporation in the project implementation.

Feedback from the Consultation Meetings

The consultation with the inhabitants of the proposed project host communities gathered some concerns. Also in attendance at the consultation meetings were community heads, council of chiefs/elders, community youth leaders, men and women, various groups from all the project-affected communities, FMEnv, and Consultants. The following were the Community needs, concerns, and questions.

Table 4.21. Summary of Concerns & Responses

No	Concerns	Response
1	Community members raised concerns about the overcompensation for those whose houses and lands will be affected by the proposed project.	The proposed project proponent team told the community members that the company would ensure that all affected stakeholders were sensitised to the proposed infrastructure activities and assessed farmlands, economic trees, and other assets likely to be affected by the proposed project.
2	The communities appealed that women and youth be engaged during the implementation.	The consultant also assures that potential project activities (infrastructural provision) will not affect farmlands and economic trees and will avoid farmlands as much as possible by sticking to the corridor stipulated in the design.
3	The community members raise another source of concern whether the proposed project proponent will have to come to community heads for sweeping (compensation) of the palace before any development can take place within the community (this means that it is the custom and tradition of the community, to give right of access to any developer to commence workin any pieces of land, a specific compensation and traditional rights must be done through the community heads) and that the proposed project proponent should take their community social responsibility seriously when the proposed project is fully implemented.	Community members were assured that other amenities would be provided soon after the project implementation commences.

CHAPTER FIVE

POTENTIAL AND ASSOCIATED IMPACT ASSESSMENT

5.1 General

This chapter presents the results of Eso Terra Investment Limited's assessment of the potential and associated environmental impact studies of the proposed Hugungumai Quarry. The evaluation covered impacts on the biophysical environment, human health, and safety.

Therefore, the impact assessment approach entailed matching the different onsite activities and project phases described in Chapter 3 with the baseline components of the project environment presented in Chapter 4.

5.2 Impact Assessment Methodology

A modified ISO 14000 approach for assessing environmental aspects and impacts was used to systematically evaluate the potential and associated impacts of the proposed project. This method, known for its thoroughness, entailed the identification/assessment/evaluation of the potential and related impacts of the proposed project using a three-stage approach. The process involved extracting specific project tasks with environmental undertones, first identifying the environmental aspects using screening criteria. The checklist of identified aspects was evaluated for significance using set environmental criteria, which included stakeholder expectations, regulatory requirements, public perception, industry best practices, abatement costs, relative contribution, scientific evidence, and sensitivity to the receiving environment. Following this, the identified significant aspects were recorded. The output (environmental aspects records) in conjunction with various source reference materials to identify and characterise the potential and associated impacts of the proposed project. The identified impacts were evaluated, and mitigation measures were proffered for significant adverse impacts. The output (environmental aspects records) was used with various source

reference materials to identify and characterise the potential and associated impacts of the proposed projects. The identified impacts were then evaluated, and mitigation measures were proffered - **tables 5.1- 5.6**

Mitigation measures, which are means to prevent, reduce, or control adverse environmental effects of a project, were developed for the adverse significant potential impacts through a review of industry experience, consultations, and expert discussions with a multi-disciplinary team of engineers and scientists - **table 6.1**

5.2.1 Impact Identification

The environmental aspects of the proposed projects were obtained from the planned project activities. These aspects were then systematically matched with the existing baseline description of the project environment. This matching process was crucial in developing a comprehensive checklist of the proposed projects' cumulative potential and associated impacts, ensuring a thorough impact assessment.

5.2.2 Impact Characterizations

The identified impacts of the proposed projects were further characterised, as explained in the items listed below. The characterisation was based on the nature, characteristics, and estimated duration of the various project activities on the ecological components of the project environment as well as human health and safety.

Beneficial Impacts: These are impacts that have a positive effect on the environment. Chapter 2 of this report highlights the primary benefits of the proposed projects.

Adverse Impacts: These are impacts that may result in undesirable change(s) in the biophysical environment, a decrease in its quality, limitation, restriction, or denial of access to or use of any component of the environment to others, including future generations, and sacrifice of long-term environmental viability or integrity for short-term economic goals.

Direct Impacts: Direct impact occurs through direct interaction of an activity with an environmental, social, or economic component.

Indirect Impacts: Indirect impacts on the environment are impacts that are not a direct

result of the project or are at least one step removed from a project activity. They do not follow directly from a project activity.

Short-term Impacts: These are defined as impacts that will last only within the period of a specific project activity.

Long-term Impacts: These effects remain even after a specific project activity.

Reversible Impacts: These impacts can be addressed by applying adequate mitigation measures.

Irreversible Impacts: These are impacts whose effects are such that the subject (impacted component) cannot be returned to its original state even after adequate mitigation measures are applied.

Cumulative Impacts: Cumulative impacts consist of an effect created from the combination of the project evaluated in the ESIA and other projects, causing related impacts resulting from the interaction between ongoing project activities and different activities taking place simultaneously.

Incremental Impacts: These impacts progress with time or as the project activity advances.

Residual Impacts: These would remain after mitigation measures have been applied.

5.2.3Impact Evaluation

Impact evaluation assesses the changes that can be attributed to a particular intervention. At this stage, the potential and associated impacts identified and characterised at the previous stage of the assessment process (**see Sections 5.2.1 – 5.2.2**) were evaluated. The evaluation was based on clearly defined criteria (legal/regulatory requirement, risk, impact frequency, importance, and public interest/concern) to determine the significance or otherwise of each impact. The criteria and weighting scale adopted for the evaluation are described below:

Legal/Regulatory Requirements (L)

The project activities that resulted in impacts were weighted against existing

legal/regulatory provisions to determine the requirement or otherwise for permits before the execution of such activities. Such legal/regulatory requirements were identified from the laws/guidelines, which have been reviewed in Chapter 1 of this report and those guidelines in the source references relating to the proposed project activity as presented in Section 5.2 and subsection 5.2.1.

Table 5.1: The Weighting Scale

CONDITION	RATING
No legal/regulatory requirement attached to environmental impact	• 1= Low
Legal/regulatory requirements associated with environmental impact	• 3= Medium
A permit is required before carrying out project activity with environmental aspects, which may result in an impact on the environment	• 5= High

Risk Posed by Impact (R)

The criteria used to categorise the risk posed by the impacts of the proposed projects address the severity of the consequence and its probability or likelihood of occurrence. The consequence criterion considers the project area's environmental and socio-economic (workers/public health and safety) attributes, as shown below in **Table 5.2**.

Table 5.2: Consequence Criterion

CONSEQUENCE	SEVERITY RATING	ATTRIBUTE – ENVIRONMENTAL	ATTRIBUTE– WORKERS/PUBLIC HEALTH AND SAFETY
Negligible	1	Minor/Little or No Response Needed	• Slight injury (no medical/first aid treatment required)
Minor	2	Moderate/Limited Response of Short Duration	• Minor injury (no lost time) • No impact on public
Moderate	3	Serious/Significant Resources Commitment	• Major injury (lost time) • Limited impact on public
Major	4	Major/Extended Response Duration/Full-scale	• Single fatality • Multiple major injuries • Serious impact on public
Severe	5	Multiple Occurrences/Elongated Duration/Larger Scale Response	• Multiple fatalities • Loss of life

These consequence criteria are combined with the probability of occurrence to evaluate and categorise the risks posed by impacts into "high = 5", "medium = 3", and "low = 1"

risks, as summarised below in **Figure 5.3**.

Table 5.3: Risk Rating

RISK	ATTRIBUTE
1= Low	• This means that no further mitigation may be required
3= Medium	• This means that the impact can be mitigated with additional control and modification
5= High	• This means that the impact requires avoidance or significant control/mitigation

Magnitude of Occurrence of Impacts (F)

Each impact's occurrence's magnitude (anticipated nature, duration, and frequency) was also evaluated. The magnitude of occurrence was rated as "high," "medium", or "low" based on the historical records of accidents/incidents, consultation with experts (mining and construction industry) and professional judgment. The magnitude criterion is summarised below:

Table 5.4. Magnitude Criterion

Magnitude	Attribute – Environmental, Human Health and Safety
5 = High	• Major degradation in quality in terms of scale (>1% of the study area or habitat within the study area), appearance, duration (beyond the duration of the project) • Irreversible or only slowly recoverable (change lasting more than one year) in degradation of environmental ecosystem level (population, abundance, diversity, productivity) • High frequency of impact (occur continuously and throughout the project execution period • Wider geographic extent
3 = Medium	• Degradation in quality in terms of scale (>0.1% of the study area, habitat), appearance, duration (a few months) • Effect beyond naturally occurring impacts variability • Slow reversibility (change lasting a few months before recovery), lasting residual impact • Potential for cumulative impact • Intermittent frequency of impact (occurs on only a few occasions during the project execution period) • Limited geographic extent of impact

1 = Low	• Minor degradation in quality in terms of scale (<0.1% of the study area, habitat, very localised), appearance, duration (a few days to a month), effect within range of naturally occurring impacts, changes, dynamics • Rapid reversibility (change lasting only a few weeks before recovery), no lasting residual impact of significance • No potential for significant, cumulative impact, low frequency of impact (occur on just about one occasion during the project execution period) • Only very localised geographic extent of impact (e.g. not more than a few meters from impact source point)

Importance of Environmental Component (I)

The importance of the target environmental component with respect to the identified potential impact was also determined and rated as "high," "medium," or "low." The ratings were based on the Consensus of opinions among consulted experts, including project engineers/scientists and other stakeholders of the proposed project. The importance criterion is summarised in **Table 5.5**.

Table 5.5: Importance Criterion

Importance	Attribute – Environmental
5 = High	• Highly undesirable outcome (impairment of endangered,protected habitat, species) • Detrimental, extended flora and fauna behavioural change (Breeding, spawning, melting) • Major reduction or disruption in value, function, or service of impacted resource. • Impact during environmentally sensitive periods of continuous non-compliance with the statute
3 = Medium	• Negative outcome • Measurable reduction or disruption in value, function, or service of impacted resource • Potential for non-compliance with international best practices
1 = Low	• Imperceptible outcome • Insignificant alteration in value, function, or service of impacted resource • Within compliance, no controls are required

Public Interest/Perception (P)

The public's interest in and perception of the proposed projects and the identified potential/associated impact were determined through consultation with the proposed project stakeholders. Based on the consensus of opinions among the consulted stakeholders, ratings of "high," "medium," or "low" were assigned. The public perception/interest criterion is summarised in **Table 5.6**.

Table 5.6: Public Perception / Interest Criterion

Public Perception	Attribute – Human Health and Safety
• = High	• Elevated incremental risk to human health, acute and or chronic • Possibility of endangering life for on-site personnel and nearby residents • Major reduction in social, cultural, and economic value • Continuous non-compliance with statute • Any major public concern among the population in the project area
3 = Medium	• Limited incremental risk to human health, acute and chronic • Unlikely life endangered for on-site personnel and residents • Some reduction in social, cultural, and economic value • Possibility of adverse perception among the population • Potential for non-compliance
1 = Low	• No risk to human health, acute and or chronic • No possibility of life endangered for on-site personneland residents • Minor reduction in social, cultural, and economic value • Unlikely adverse perception among the population

5.2.4 Overall Significance Ranking

The overall significance rating (Level of Significance) assigned to each evaluated impact, as presented in tables 5.7 and 5.8, is without consideration for mitigation measures, including those controls built into project design. The ratings were basedon the following considerations:

High Significance

(L+R+F+I+P) ≥ 15 or (F+I) > 6 or P = 5

This category's adverse impacts would require avoidance or significant control/mitigation.

Medium Significance

(L+R+F+I+P) ≥ 8 but < 15

This category's adverse impacts can be mitigated with additionalcontrols and modifications.

Low Significance

(L+R+F+I+P) < 8

Impacts in this category may require no further modification.

Table 5.7 Phases of Project Development Activities and Source of Impact

SN	Project Phases	Activities/Source of Impact
1	Mobilisation	• Road Traffic in local routes and roads connecting to Hugungumai community and the proposed Hugungumai quarry site, • Influx of persons into Hugungumai village and surrounding settlements within Kunchi LGA (Kunchi & Tudun Wada communities)
2	Site Preparation	• Road Traffic along major and minor roads connecting to Hugungumai and neighbouring areas within and outside Kunchi LGA • Bush Clearing affecting areas within the quarry tenements and its effect on the surrounding environment • Waste Disposal • Dust affects Hugungumai inhabitants and users of roads linking Kunchi and Bichi LGAs in Kano state and Kazaure LGA in Jigawa state. • Land take and possible grievances from the landowners
3	Quarry Plant Construction	• Pilling, Welding, and Painting, resulting in increased waste generation and disposal • Road traffic along the road in Hugungumai and major connecting roads in the area • Noise generation because of the quarry plant construction along major and minor roads connecting to Hugungumai and neighbouring areas within and outside Kunchi LGA
4	Operation and Maintenance	• Blasting, Use of Explosive, Noise, Waste Generation, Influx of Persons, Dust Emissions,Traffic Generation/Accident due to the Hugungumai quarry operations and maintenance.
5	Decommissioning and Abandonment	• Dismantling and Removal of Equipment/Structures, Waste Disposal, Residual Contamination, Road Traffic/accident due to the decommissioning and abandonment activities in the quarry

5.3 Beneficial Impact

- Improvement of the economic status of landlords and traditional rulersthrough payment of adequate compensation.
- Mining and producing chippings of assorted sizes will contribute to government revenue generation at various levels (payment of dues to Kunchi Local

Government Authority, revenue to the KNSG, and royalty/ground rent to the Federation Account).

- Contribute to the country's general economic growth as it would positively or indirectly affect formal and informal sectors of the economy.
- Creation of employment opportunities for skilled and unskilled labour employed at various project phases.
- The increase in socioeconomic activities due to the presence of the quarry.
- Chippings of many sizes will be made available for construction activities for the Kano-Maradi Rail Line.
- There will be a transfer of technical knowledge in the mining industry to Quarry workers.

Table 5.8. Associated and Potential Impacts of the Project

	Project Phase	Project Activity	Environmental Component	Potential and Associated Impact	
Planning & Pre-Operation	Site Acquisition	Land take	Flora and Fauna, Land use	Restriction of access by the proposed quarry to Hugungumai inhabitants and neighbouring communities	
			Socioeconomic	Improvement of the economic status of landowners in the Hugungumai community, such as farmers, artisans and traditional rulers, through payment of compensation & livelihood restoration program	
				Security challenges are due to the influx of workers to Hugungumai and other areas in Kunchi LGA, including the possibility of kidnapping and community disputes.	
				Conflicts due to the displacement of Hugungumai artisanal miners from their source of livelihood.	
				Conflict due to an unsatisfactory compensation process	
		Site Survey	Personnel Health & Safety	Risk of injury to personnel due to exposure in the bushes	
	Mobilisation to site	Transportation of equipment/materials/person		Increased traffic volume on the road linking Kunchi, Bichi and Kazaure LGAs	
				Risk of injury, death, asset damage due to road traffic accidents and incidents	

		nel to worksite	Air quality and personnel Safety	Adverse effects on the air quality of Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	
	Quarry Development	Site Clearance	Flora and Fauna, Land use	De-vegetation of the 34082 QL area and loss of local flora and economic trees	
		Stripping of topsoil and compaction of same with earth-moving equipment within the proposed project location	Soil and Water	Changes in drainage and hydrological patterns may result in erosion and flooding in and surrounding the 34082 QLS quarry area.	
			Air Quality and Personnel Safety	Adverse effects on air quality in Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	
		Construction of Quarry (Quarry Plant Offices, Base camps)	Soil	Soil compaction caused by heavy vehicle movement and excavated material will affect the diversity of soil fauna within the area and alter the drainage pattern.	
			Health (Radiation and Heat) of workers	Welders exposed to heat and light radiation, heat rashes, welding flashes leading to eye diseases	
			Socioeconomic and Health Impact	An increase in population leads to the transmission of infectious diseases, especially sexual transmission infections.	
				Community conflicts resulting from labour and recruitment issues and compensation leading to security problems	
				Creation of job opportunities for locals in Kunchi LGA and neighbouring areas	
			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_X, NO_X, etc.) from earth-moving equipment and localised increase in background noise level	
Quarry Operation	Rock Operation (Extraction)	Overburden removal to expose rock, pit development, and hole drilling with the use of drill wagons	Soil and Water	Pollution of soil and groundwater sources around 34082QL quarry from improper management of wastes	
		Blasting and loading broken or disintegrated rock with excavators into dump	Socioeconomic (Health and Safety, Assets, Security)	Risk of injury, death, and asset damage due to accident associated with quarry operation	
				Increased demand for existing community health and sanitation infrastructure due to the influx of mine workers and camp followers.	

		trucks and conveyed to the crushing machine.		Threats to community health and safety, including the risk of infectious diseases such as STDs, including HIV/AIDS, from the influx of mine workers	
				Indiscriminate disposal of sanitary and domestic wastes during drilling and other operations.	
				Management of explosives to ensure no leakages of material.	
				Damage to community assets as a result of blasting (crack in the building)	
			Air Quality & Noice	Localised increase (above baseline values stated in sections 4.7 and 4.6) in ambient concentrations of air pollutants (NO_2, SOx, COx, C_xHy, H_2S, & SPM)—noise and vibration from machines and blasting.	
			Soil, Flora/Fauna and Water	Damage to ecological resources and environmental degradation by spillages during fuelling of drilling Machines.	
				Wildlife migration due to noise and vibration, exposure of soil to weather conditions, fauna habitat loss and injury to wild animals	
			Geology and Hazard	Risk of geological hazards such as ground quivering, land subsidence	
		Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening. Stockpiling		Structural damage to nearby buildings.	
	Rock Crushing Stage	Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening. Stockpiling	Socioeconomic (Health and Safety)	Injury/death/assets damage due to accidents during dumping of materials from the point of the quarry to the feed hopper. Reduction in cases of dumping of materials within and around crushing locations.	
		Haulage of granite aggregates to the required area along the railway alignment		Increased traffic volume/delays due to the daily movement of work trucks and personnel to the site	
				Risk of injury, death, and asset damage due to road traffic accidents and incidents	
			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, PM2.5, PM10, NO_X, etc.) from internal combustion engines/exhausts during personnel movement	

		Maintenance and general operations of the facility	Soil and Water	Pollution of soil and groundwater sources around the facility from improper management of wastes meant for incineration and ash residue.	
				Risk of the improperly abandoned quarry site, e.g. drowning of humans and animals, particularly children, in mining pits, environmental degradation, etc	
			Socioeconomic (Health and Safety)	Fire outbreak, destruction of facility, loss of life of personnel due to malfunctioning of facility or operators' fault	
				Health-related hazards on operational staff due to constant inhalation of crushing materials	
				Kidnap/forceful abduction of operation staff	
Post Quarry Operation	Demobilisation (Movement of vehicles and personnel)	Transportation of equipment, materials, and personnel to worksite	Socioeconomic (Health and Safety)	Increased traffic volume and delays due to daily movement of trucks and personnel along the Hugungumai road and major roads connecting the area	
				Risk of injury, death, and asset damage due to road traffic accidents and incidents	
			Air Quality & Noise	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from earth moving Equipment and localised Increase in background noise level	
	Decommissioning /Abandonment	Decommissioning /abandonment and ancillary facilities	Soil and Water	Soil and groundwater contamination from wastes abandoned at the site	
			Socioeconomic (Health and Asset)	Risk of poor management of decommissioned facilities	
				Availability of land for alternative uses	

5.4 Result of Impact Assessment

The results of the impact assessment exercise, as discussed in the previous sections, are presented in Table 5.9. The table presents the various project phases, planned activities, the proposed project's environmental aspects, and the identified associated and potential impacts. Also included in the table are the impact significance evaluation criteria: legal/regulatory requirements (L), risk posed by the impact (R), and magnitude of occurrence (M), Importance of affected environmental component (I) and Public Perception (P). In addition, each impact's overall ratings of impact significance (High, Medium, or Low) are considered to have been included. These were based on the summations already described.

Table 5.9: Potential and Associated Impact Assessment of the Proposed Project

	Project Phase	Project Activity	Environmental Component	Potential and Associated Impact	Impact Characterization	Impact Significance Evaluation						Overall Significance Rating
						L	R	M	I	P	Total	
Planning & Pre-Operation	Site Acquisition	Land take	Flora and Fauna, Land use	Restriction of access by the proposed quarry to Hugungumai inhabitants and neighbouring communities	Adverse, direct, long-term, normal	0	1	3	3	3	10	Medium
			Socioeconomic	Improvement of the economic status of landowners in Hugungumai community, such as farmers, artisans and traditional rulers, through payment of compensation & livelihood restoration program	Beneficial, direct, normal, short-term, incremental	-	-	-	-	-	0	Beneficial
				Security challenge due to the influx of workers to Hugungumai and other areas in Kunchi LGA. Possibility of kidnapping and community disputes.	Adverse, indirect, abnormal, Long- term	0	3	3	3	5	14	High
				Conflicts due to the displacement of Hugungumai artisanal miners from their source of livelihood.	Adverse, indirect, abnormal, short-term	0	3	3	3	5	14	High

				Conflict due to an unsatisfactory compensation process	Adverse, indirect, abnormal, short-term	0	3	3	3	5	14	High
		Site Survey	Personnel Health & Safety	Risk of injury to personnel due to exposure in the bushes	Adverse, direct, abnormal, short-term, residual	0	1	3	3	3	10	Medium
	Mobilisation to site	Transportation of equipment/materials/personnel to worksite		Increased traffic volume on the road linking Kunchi, Bichi and Kazaure LGAs	Adverse, direct, normal, short-term, reversible,	0	5	1	1	3	10	Medium
				Risk of injury, death, and asset damage due to road traffic accidents and incidents	Adverse, direct, abnormal, short- term or long-term, residual	3	5	1	1	5	15	High
			Air quality and personnel Safety	Adverse effects on air quality of Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	Adverse, direct, normal, short-term	3	1	1	1	1	7	Low
	Quarry Development	Site Clearance	Flora and Fauna, Land use	De-vegetation of the 34082 QL area and loss of local flora and economic trees	Adverse, direct, normal, long-term	3	1	3	3	3	13	Medium

		Stripping of topsoil and compaction of same with earth-moving equipment within the proposed project location	Soil and Water	Changes in drainage and hydrological patterns may result in erosion and flooding in and surrounding the 34082 QLS quarry area.	Adverse, direct, short-term, abnormal,	0	3	3	3	3	12	Medium
			Air Quality and Personnel Safety	Adverse effects on air quality in Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_x, etc.) from internal combustion engines/exhausts	Adverse, direct, normal, Short- Term	3	1	1	3	1	9	Medium
		Construction of Quarry (Quarry Plant, Offices, Base camps)	Soil	Soil compaction caused by heavy vehicle movement and excavated material will affect the diversity of soil fauna within the area and alter the drainage pattern.	Adverse, direct, short-term, abnormal,	0	3	3	3	3	12	Medium
			Health (Radiation and Heat) of workers	Welders exposed to heat and light radiation, heat rashes, welding flashes leading to eye diseases	Adverse, direct, normal, short-term	0	1	3	3	3	10	Medium

			Socioeconomic and Health Impact	An increase in population leads to the transmission of infectious diseases, especially sexual transmission infections.	Adverse, direct, abnormal, short-term, residual	0	1	3	3	3	10	Medium
				Community conflicts resulting from labour and recruitment issues and compensation leading to security problems	Adverse, direct, abnormal, short- term or long-term, residual	3	5	1	1	5	15	High
				Creation of job opportunities for locals in Kunchi LGA and neighbouring areas	Beneficial, direct, normal, short-term, incremental	-	-	-			0	Beneficial
			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_x, NO_x, etc.) from earth-moving equipment and localised increase in background noise level	Adverse, direct, normal, short- Term	3	1	1	3	1	9	Medium

Quarry Operation	Rock Operation (Extraction)	Overburden removal to expose rock, pit development, and hole drilling with the use of drill wagons	Soil and Water	Pollution of soil and groundwater sources around 34082QL quarry from improper management of wastes	Adverse, direct, normal, short-term, incremental, cumulative	3	1	1	1	1	7	Low
		Blasting and loading broken or disintegrated rock with excavators into dump trucks and conveyed to the crushing machine.	Socioeconomic (Health and Safety, Assets, Security)	Risk of injury, death, and asset damage due to accident associated with quarry operation	Adverse, direct, abnormal, long-term, irreversible, residual	3	5	1	5	5	19	High
				Increased demand for existing community health and sanitation infrastructure around Kunchi LGA due to the influx of mine workers and camp followers.		0	1	1	1	1	4	
				Threats to community health and safety, including the risk of infectious diseases such as STDs, including HIV/AIDS, from the influx of mine workers		0	1	1	1	1	4	Low

				Indiscriminate disposal of sanitary and domestic wastes during drilling and other operations.	Adverse, direct, abnormal, short-term, reversible	0	1	1	1	1	4	Low
				Management of explosives to ensure no leakages of material.	Adverse, direct, abnormal, long-term, irreversible, residual							
				Damage to community assets as a result of blasting (crack in the building)	Adverse, direct, abnormal, long-term, irreversible, residual	3	5	1	5	5	19	High
			Air Quality & Noice	Localised increase (above baseline values stated in chapters 4.7 and 4.6) in ambient concentrations of air pollutants (NO_2, SOx, COx, C_xHy, H_2S, & SPM)—noise and vibration from machines and blasting.	Adverse, direct, normal, short-term, cumulative, residual	3	3	1	3	1	11	Medium
			Soil, Flora/Fauna and Water	Damage to ecological resources and environmental degradation by spillages during fuelling of drilling Machines.	Adverse, direct, abnormal, short-term	0	1	1	3	1	6	Low

				Wildlife migration due to noise and vibration, exposure of soil to weather conditions, fauna habitat loss and injury to wild animals	Adverse, direct, long-term, reversible	0	5	5	3	5	18	High
			Geology and Hazard	Risk of geological hazards such as ground quivering, land subsidence	Adverse, direct, abnormal, short-term, irreversible	0	1	1	3	1	6	Low
		Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening. Stockpiling		Structural damage to nearby buildings within 500m radius.		0	1	1	1	1	4	Low
	Rock Crushing Stage	Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening. Stockpiling	Socioeconomic (Health and Safety)	Injury/death/assets damage due to accidents during dumping of materials from the point of the quarry to the feed hopper. Reduction in cases of dumping of materials within and around crushing locations.	Adverse, direct, abnormal, short- term or long-term, Residual	3	5	1	5	5	19	High
		Haulage of granite aggregates to the required area along		Increased traffic volume/delays due to the daily movement of work trucks and personnel to the site	Adverse, direct, normal, short-term, reversible,	0	5	1	1	3	10	Medium

		the railway alignment		Risk of injury, death, and asset damage due to road traffic accidents and incidents	Adverse, direct, abnormal, Short-term or long-term, residual	3	5	1	1	5	15	High
			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, PM2.5, PM10, NO_X, etc.) from internal combustion engines/exhausts during personnel movement	Adverse, direct, normal, short-term, reversible,	0	5	1	1	3	10	Medium
		Maintenance and general operations of the facility	Soil and Water	Pollution of soil and groundwater sources around the facility from improper management of wastes meant for incineration and ash residue.	Adverse, indirect, abnormal, short –or long-term	0	3	3	3	5	14	High
			Socioeconomic (Health and Safety)	Fire outbreak, destruction of facility, loss of life of personnel due to malfunctioning of facility or operators' fault	Adverse, direct, abnormal, long-term, irreversible	3	5	1	5	5	19	High
				Health-related hazards on operational staff due to constant inhalation of crushing materials	Adverse, direct, short- or long-term, reversible	3	3	1	3	1	11	Medium

				Kidnap/forceful abduction of operation staff	Adverse, direct, abnormal, short-term, reversible	3	5	1	5	5	19	High
Post Quarry Operation	Demobilisation (Movement of vehicles and personnel)	Transportation of equipment/materials/personnel to worksite	Socioeconomic (Health and Safety)	Increased traffic volume and delays due to daily movement of trucks and personnel along the Hugungumai road and major roads connecting the area	Adverse, direct, normal, short-term, reversible,	0	5	1	1	3	10	Medium
				Risk of injury, death, asset damage due to road traffic accidents and incidents	Adverse, direct, abnormal, Short-term or long-term, Residual	3	5	1	1	5	15	High
			Air Quality & Noise	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from earth moving Equipment and localised Increase in background noise level	Adverse, direct, normal, short-term	3	1	1	1	1	7	Low
	Decommissioning/Abandonment	Decommissioning /abandonment and	Soil and Water	Soil and groundwater contamination from wastes abandoned at the site	Adverse, direct, abnormal, long-term	3	3	1	3	3	13	Medium

		ancillary facilities	Socioeconomic (Health and Asset)	Risk of poor management of decommissioned facilities	Adverse, direct, abnormal, long-term	0	3	1	3	3	10	Medium
				Risk of improperly abandoned quarry site, e.g. drowning of humans and animals, particularly children, in mining pits, environmental degradation, etc	Adverse, direct, abnormal, short – or long-term, reversible	3	3	3	3	3	15	High
				Availability of land for alternative uses	Beneficial, direct, normal, long-term	-	-	-	-	-	0	Beneficial

Impact Significance Criteria

L = Legal/Regulatory requirement P = Public Perception/Interest R = Riskposed by impact M = Envisaged magnitude of impact

Significance Rating Criteria

High = (L+R+M+I+P) = ≥ 15 or (M+I) > 6 or P = 5

Medium = (L+R+M+I+P) ≥ 8 but < 15Low = (L+R+M+I+P) < 8

5.5 Summary of Impact Significance Ranking

The proposed project's impact assessment (i.e., the interaction of different Project Phases and Project Activities/Environmental Aspects) resulted in 27 impacts with different impact significance ratings: Beneficial, Low, Medium, and High. The summary is presented in Table 5.10 below.

Table 5.10. Summary of Impact Significance Ranking

Project Phase	Project Activity/Environmental Aspect	Number of Identified Impacts	Impact Significance Ranking			
			Beneficial	Low	Medium	High
Site Acquisition	Land Take/site survey, Vegetation	4	1	-	2	1
Site preparation	Clearing and general site prep; Stripping andcompaction of topsoil with earth-moving equipment	4	1	-	3	-
Mobilisation/Demobilization	Transportation of equipment and personnel to and from the site	4	-	2	1	1
Rock Quarrying extraction process	Overburden removal is done to expose rock/rock drilling for pit development/holes using an air or hydraulically-powered drilling machine. Crushing plant installation / Loading of broken or disintegrated rock fragments with excavators into dump trucks and conveyed to the crushing machines.	5	-	3	1	1
Rock Processing Stage	The dump truck dumps the material into the crushing machine and then into the feed hopper of the primary jaw crusher. Screening of the materials leaving the cone crushing stage. Maintenance and general operations of the facility	7	1	-	1	5
Abandonment/Decommissioning	Decommissioning/abandonment of Quarry Plant and other ancillary facilities	3	1	-	2	-
Summary (Total Number of Impacts)		**27**	**4**	**13**	**10**	**8**
% Significance			**14.81**	**48.15**	**27.04**	**29.63**

The summary of the Impact Significance Rating above shows that approximately 14.81% of the identified impacts fall within Beneficial and Low Impacts; approximately 48.15% fall within the Medium and High Significance Impact categories that require mitigation. Notably, the percentage fall within the High Significance category is 29.63%. The impacts that resulted in the 27.04% high significance rating do not require concept modification but can be mitigated. Mitigation measures for all medium and high-significance effects are provided in Chapter 6 of this report.

CHAPTER SIX

IMPACT MITIGATION MEASURES

6.1 General

The primary purpose of this Impact Assessment Report is to examine the environmental impacts, both beneficial and adverse, of a proposed development project and to ensure that these impacts are considered in project design. An Environmental Impact Assessment's principal and most important objective is developing and establishing suitable actions (mitigation measures) fora proposed project's identified significant and adverse impacts. In presenting the mitigation measures, the primary objectives were:

- Prevention by ensuring that significant and adverse potential impacts and risks do not occur.
- Reduction by ensuring that the effects or consequences of those significant potential and associated impacts that cannot be prevented are reduced to as low as reasonably practicable (ALARP).
- Control by ensuring that residual significant impacts are reduced to ALARP.

Again, as in reduction measures for potential and associated impacts, reasonable practicability was determined based on best industry practice and economic, environmental, technical, health, and safety considerations.

Some potential and associated impacts are anticipated during rock quarrying, the processing stage of crushing the rocks, operation, and decommissioning. The nature of the effects identified has been described in Chapter 5. The proposed mitigation measures for high and medium-significance adverse impacts are presented in Table 6.1. Thus, all low impacts, which are non-adverse, were dropped (i.e., no mitigation was proffered for them).

Table 6.1. Proposed Mitigation Measure for Significant Impacts

	Project Phase	Project Activity	Environmental Component	Potential and Associated Impact	Impact Characterization	Significance Rating Before Mitigation	Mitigation Measures	Significance Rating After Mitigation
Planning & Pre-Construction	Site Acquisition	Land take	Flora and Fauna, Land use	Restriction of access by the proposed quarry to Hugungumai inhabitants and neighbouring communities	Adverse, direct, long-term, normal	Medium	• Eso Tarra Investment will limit its land take to the acquired 34082QL and the portion owned and purchased from Kunchi LGA. • Where it is necessary to use beyond the acquired area, Eso Terra shall engage with the owner and ensure adequate compensation.	Low
			Socioeconomic	Improvement of the economic status of landowners in Hugungumai community, such as farmers, artisans and traditional rulers, through payment of compensation & livelihood restoration program	Beneficial, direct, normal, short-term, incremental	Beneficial	• Eso Terra Investment Limited shall ensure that all issues about land take are adequately discussed with the landowners and adequate compensation is paid for the acquired land.	Low
				Security challenge due to the influx of workers to Hugungumai and other areas in Kunchi LGA. Possibility of kidnapping and community disputes.	Adverse, indirect, abnormal, Long- term	High	• Eso Terra, in conjunction with police, local vigilantes and internal security architecture, shall provide 24-hour security within the site.	Low
				Conflicts due to the displacement of Hugungumai artisanal miners from their source of livelihood.	Adverse, indirect, abnormal, short-term	High	• Eso Terra shall ensure that the local artisan miners are engaged in the quarry workforce or develop alternative livelihoods for those unwilling to take jobs in the quarry.	Low

				Conflict due to an unsatisfactory compensation process	Adverse, indirect, abnormal, short-term	High	• Eso Terra Investment Limited shall ensure that all issues about land take are adequately discussed with the landowners and that adequate compensation is paid for the acquired land.	Low
							• Eso Terra Quarry shall identify the traditional ruling structure of the community, The CDC, youth organisation and actual landowners of the area; they shall be adequately consulted at each stage of the proposed project	Low
							• Eso Terra shall develop and implement Rehabilitation Action Plan (RAP)	Low
							• Eso Terra shall ensure that the local artisanal miners are engaged	Low
		Site Survey	Personnel Health & Safety	Risk of injury to personnel due to exposure in the bushes	Adverse, direct, abnormal, short-term, residual	Medium	• Eso Terra shall ensure personnel make use of PPEs while on-site • Safety measures are adhered to	Low
	Mobilisation to site	Transportation of equipment/ materials/personnel to worksite		Increased traffic volume on the road linking Kunchi, Bichi and Kazaure LGAs	Adverse, direct, normal, short-term, reversible,	Medium	• Eso Terra & Quarry Managers shall strictly ensure that the movement of heavy equipment & vehicles follows the traffic management plan to avoid or reduce accidental. • Ensure the placement of proper signage in critical areas to educate road users. • Deploy traffic management personnel in critical areas, such as the junction linking the quarry with the road linking Bichi, Kunchi and Kazaure	Low
							• Eso Terra Quarry shall ensure that all drivers and captains are certified competent before movement with vehicles is allowed.	Low

							• Eso Terra Quarry shall maintain an efficient journey management plan to reduce the risks of accidents.	Low
							• Eso Terra & Quarry Managers shall ensure that all vehicles and vessels are pre-mobilized and certified fit before transporting equipment, materials and personnel.	Low
				Risk of injury, death, asset damage due to road traffic accidents and incidents	Adverse, direct, abnormal, short- term or long-term, residual	High	• Eso Terra Quarry shall ensure that drivers/captains adhere to the speed limit, which shall be equipped in all operational and support vehicles.	Low
							• Eso Terra Quarry shall prohibit night movement.	Low
							• Eso Terra Investment Limited shall check the health status of personnel regularly.	Low
			Air quality and personnel Safety	Adverse effects on air quality of Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	Adverse, direct, normal, short-term	Low	• Eso Terra Quarry shall ensure vehicles/vessels and utilities mobilised for the project adhere to strict environmental guideline	Low
Development	Quarry Development	Site Clearance	Flora and Fauna, Land use	De-vegetation of the 34082 QL area and loss of local flora and economic trees	Adverse, direct, normal, long-term	Medium	• Eso Terra shall ensure that equipment used in excavation, compaction and consolidation of soil is confined to areas acquired for the proposed rock quarrying and processing project. • Eso Terra investment shall develop a flora and fauna management plan to minimise damage and protect existing vegetation	Low

		Stripping of topsoil and compaction of same with earth-moving equipment within the proposed project location	Soil and Water	Changes in drainage and hydrological patterns may result in erosion and flooding in the area within and surrounding the 34082 QLS quarry area	Adverse, direct, short-term, abnormal,	Medium	• Eso Terra shall ensure materials and foreign bodies do not enter the aquatic system. • Eso Terra shall ensure vehicles and utilities mobilised for the project adhere to strict environmental guidelines. • Eso Terra investment shall ensure that vehicles carrying materials are fit and suitable for the environment. • Ensure regular service and maintenance of equipment	Low
			Air Quality and Personnel Safety	Adverse effects on air quality in Hugungumai community and others along the road due to the emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	Adverse, direct, normal, Short- Term	Medium	• Eso Terra shall ensure that equipment and operational vehicles are serviced based on manufacturer specifications. • Eso Terra Investment shall ensure all personnel operating machines and vehicles are appropriately kitted PPEs	Low
		Construction of Quarry (Quarry Plant, Offices, Base camps)	Soil	Soil compaction caused by heavy vehicle movement and excavated material will affect the diversity of soil fauna within the area and alter the drainage pattern.	Adverse, direct, short-term, abnormal,	Medium	• Eso Terra ensures that the movement and operation of heavy vehicles are restricted to the quarry site and avoid green areas. • Eso Terra shall ensure the use of erosion-resistant material for the access road in the 34082QLS quarry • The quarry manager shall ensure the development of drainages for adequate stormwater management	Low
			Health (Radiation and Heat) of workers	Welders exposed to heat and light radiation, heat rashes, welding flashes leading to eye diseases	Adverse, direct, normal, short-term	Medium	• Eso Terra shall ensure all personnel operating welding equipment and machines are adequately kitted and use PPEs. • Eso Terra shall ensure regular safety meetings/talks where staff are reminded of the need to use the PPEs. • Put a mechanism in place to impose the use of PPEs.	Low

			Socioeconomic and Health Impact	Increase in population leading to transmission of infectious diseases, especially sexual transmission infections	Adverse, direct, abnormal, short-term, residual	Medium	• Eso Terra shall create awareness among personnel on infectious diseases and STDs • Put a mechanism for early detection through regular health check	Low
				Community conflicts resulting from labour and recruitment issues and compensation lead to security problems	Adverse, direct, abnormal, Short-term or long-term, residual	High	• Eso Terra Investment shall ensure continuous community engagement and fair labour practice. • Eso Terra shall ensure full implementation of its grievances redress mechanism	Low
				Creation of job opportunities for locals in Kunchi LGA and neighbouring areas	Beneficial, direct, normal, short-term, incremental	Beneficial	• Eso Terra shall prioritise local hiring for temporary and permanent job opportunities in the Hugungumai quarry project. • Eso Terra shall provide a training program to equip Hugungumai community members with the necessary skills and qualifications to fill the newly created position.	Low

			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_X, NO_X, etc.) from earth-moving equipment and localised increase in background noise level	Adverse, direct, normal, Short- Term	Medium	• Eso Terra shall ensure the scheduling of equipment movement by planning and scheduling the movement of equipment during off-peak hours to minimise disruption to nearby residents or sensitive areas. • Eso Terra shall implement a noise barriers policy by installing physical barriers, such as walls or fences, to help block and reduce noise levels from equipment movement. • Eso Terra shall ensure that equipment is well-maintained to reduce emissions and noise levels. Regular maintenance will help improve equipment efficiency and reduce its environmental impact. • Eso Terra shall ensure the Implementation of monitoring systems to track noise levels and emissions from equipment movement; this data can help identify areas for improvement and track progress over time.	Low
Quarry Operation	Rock Operation (Extraction)	Overburden removal to expose rock, pit development, and hole drilling by the use of drill wagons	Soil and Water	Pollution of soil and groundwater sources around 34082QL quarry from improper management of wastes	Adverse, direct, normal, short-term, incremental, cumulative	Low	• Eso Terra shall ensure proper storage and containment of overburden waste on the Hugungumai quarry site to designated areas that are lined and adequately contained to prevent contaminants from leaking into the soil and groundwater.	Low

		Blasting and loading broken or disintegrated rock with excavators into dump trucks and conveyed to the crushers.	Socioeconomic (Health and Safety, Assets, Security)	Risk of injury, death, and asset damage due to accident associated with quarry operation	Adverse, direct, abnormal, long-term, irreversible, residual	High	• Eso Terra shall ensure continuous safety training for all personnel involved in the blasting and loading operations. These personnel shall receive proper training on safety procedures, including handling explosives, operating equipment, and emergency response protocols. • Use of proper alarm system during blasting • Eso Terra shall require all workers to wear appropriate PPEs, such as hard hats, safety glasses, hearing protection, gloves, and high-visibility clothing, to reduce the risk of injury. • Eso Terra shall establish and enforce safe exclusion zones around the blasting and loading areas to prevent unauthorised personnel from entering the danger zone.	Low
				Increased demand for existing community health and sanitation infrastructure due to the influx of mine workers and camp followers.		Low	• Eso Terra shall engage with the local community to raise awareness about the situation and encourage them to take prompt measures to reduce the strain on existing infrastructure, including promoting good hygiene practices, waste management, and responsible use of health services. • Eso Terra shall develop and implement emergency response plans to quickly address any spikes in demand for health and sanitation services. This can help ensure a coordinated and effective response to sudden increases in demand. • Eso Terra shall prioritise health as part of community development interventions.	Low

				Threats to community health and safety, including the risk of infectious diseases such as STDs, including HIV/AIDS from the influx of mine workers		Low	• Eso Terra shall ensure the implementation of health education programs to educate workers on preventive measures to reduce the risk of illness and disease. This can help reduce the risk of health challenges and exposure to STDs and HIV/AIDS by promoting healthier and risky behaviours.	Low
				Indiscriminate disposal of sanitary and domestic wastes during drilling and other operations.	Adverse, direct, abnormal, short-term, reversible	Low	• Eso Terra shall properly dispose of hazardous waste and treat contaminated soil and groundwater using appropriate methods such as bioremediation, soil washing, or chemical treatment. • Eso Terra shall implement spill prevention measures such as berms, secondary containment systems, and spill response plans to prevent accidental spills from contaminating soil and groundwater.	Low
				Management of explosives to ensure no leakages of material.	Adverse, direct, abnormal, long-term, irreversible, residual	High	• Eso Terra shall ensure adherence to rules and regulations governing the use of explosives as provided in the Nigerian Explosive Act of 1951, Minerals and Mining Act 2007 and Guidelines for Minerals and Mining Sector 2011. • Put mechanisms for checks and balances in place by engaging security apparatuses in every stage of explosive handling.	

				Damage to community assets as a result of blasting (crack in the building)	Adverse, direct, abnormal, long-term, irreversible, residual	High	• Eso Terra shall use proper blasting techniques and design to minimise the risk of fly rock, ground vibration and air blast overpressure that could cause injury or damage to Hugungumai community and nearby assets. • Eso Terra shall continuously monitor and record blast vibrations, air overpressure, and ground movement to ensure safety standards and regulations compliance.	Low
			Air Quality & Noice	Localised increase (above baseline values stated in chapters 4.7 and 4.6) in ambient concentrations of air pollutants (NO_2, SOx, COx, C_xHy, H_2S, & SPM)—noise and vibration from machines and blasting.	Adverse, direct, normal, short-term, cumulative, residual	Medium	• Eso Tera shall use Noise Barriers. Erecting noise barriers around the blasting site can help reduce the spread of noise to surrounding areas. These barriers can be earth berms, concrete walls, or sound-absorbing panels. • Eso Terra shall implement controlled blasting techniques, which can help minimise the noise and vibration generated during the blasting process. These techniques include using smaller charges, proper drilling techniques, and timing the blasts to minimise the impact on nearby residents or sensitive structures. • Eso Tera shall notify and communicate by informing nearby residents and businesses about upcoming blasting activities, which can help to manage expectations and allow them to take necessary precautions. Clear communication channels should be established to address any concerns or complaints.	Low

			Soil, Flora/Fauna and Water	Damage to ecological resources and environmental degradation by spillages during fuelling of drilling Machines.	Adverse, direct, abnormal, short-term	Low	• Eso Terra shall implement Spill Prevention Measures, such as spill containment berms, secondary containment systems, and spill response plans, to prevent accidental spills contaminating soil, groundwater, and Fauna. • Put adequate monitoring facilities to detect problems at the early stage	Low
				Wildlife migration due to noise and vibration, exposure of soil to weather conditions, fauna habitat loss and injury to wild animals	Adverse, direct, long-term, reversible	High	• Eso Terra shall identify and avoid sensitive areas or critical habitats, breeding grounds, and migration routes of wild animals while sitting in the blast area. • Eso Terra shall employ time restrictions by scheduling noisy activities when wildlife is less active, such as avoiding construction during breeding or migration.	Low
			Geology and Hazard	Risk of geological hazards such as ground quivering, land subsidence	Adverse, direct, abnormal, short-term, irreversible	Low	• Eso Terra shall conduct thorough geological surveys and assessments to identify areas prone to these hazards. • Eso Terra shall implement proper land-use planning and zoning regulations to restrict development in high-risk areas. • Eso Terra shall Develop emergency response plans and evacuation procedures in case of a hazardous event.	Low
				Structural damage to nearby buildings.		Low	• Eso Terra shall develop emergency response plans and evacuation procedures in case of a hazardous event. • Eso Terra shall ensure protective measures by installing vibration isolation systems, adding structural reinforcement, or using blast mats to mitigate the effects of blasting on nearby structures. • Ensure adequate compensation	Low

							where damage is confirmed on the Hugungumai inhabitants and surrounding area	
	Rock Crushing Stage	Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening. Stockpiling	Socioeconomic (Health and Safety)	Injury/death/assets damage due to accidents during dumping of materials from the point of the quarry to the feed hopper. Reduction in cases of dumping of materials within and around crushing locations.	Adverse, direct, abnormal, short- term or long-term, Residual	High	• Eso Terra shall develop and communicate an emergency response plan that outlines procedures for responding to accidents, injuries, fires, or other emergencies that may occur during the dumping of materials and loading operations.	Low
		Haulage of granite aggregates to the required area along the railway alignment		Increased traffic volume/delays due to the daily movement of work trucks and personnel to the site	Adverse, direct, normal, short-term, reversible,	Medium	• Eso Terra shall develop comprehensive transportation plans considering the impact of increased traffic volumes and truck movements on road networks and communities. • Eso Terra Traffic shall ensure the Implementation of traffic management strategies such as signal optimisation, lane management, and speed limit enforcement to reduce congestion and improve traffic efficiency.	Low
				Risk of injury, death, and asset damage due to road traffic accidents and incidents	Adverse, direct, abnormal, short- term or long-term, residual	High	• Eso Terra shall ensure route planning: Establishing designated truck routes and enforcing restrictions on truck movements in residential areas or sensitive zones to minimise the impact of heavy vehicles on local communities. • Eso Terra shall ensure truck safety measures: Implementing truck safety measures such as weight	Low

							restrictions, speed limits, and mandatory safety inspections to reduce the risk of accidents and damage to infrastructure and environmental considerations	
			Air Quality	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, PM2.5, PM10, NO_X, etc.) from internal combustion engines/exhausts during personnel movement	Adverse, direct, normal, short-term, reversible,	Medium	• Eso Terra shall ensure that equipment is well-maintained to reduce emissions and noise levels. Regular maintenance will help improve equipment efficiency and reduce its environmental impact. • Eso Terra shall ensure the Implementation of monitoring systems to track noise levels and emissions from equipment movement; this data can help identify areas for improvement and track progress over time.	Low
		Maintenance and general operations of the facility	Soil and Water	Pollution of soil and groundwater sources around the facility from improper management of wastes meant for incineration and ash residue.	Adverse, indirect, abnormal, short –or long-term	High	• Eso Terra shall ensure proper disposal and management plus treatment: Dispose of hazardous waste properly and treat contaminated soil and groundwater using appropriate methods such as bioremediation, soil washing, or chemical treatment and incineration	Low

			Socioeconomic (Health and Safety)	Fire outbreak, destruction of facility, loss of life of personnel due to malfunctioning of facility or operators' fault	Adverse, direct, abnormal, long-term, irreversible	High	• Eso Terra shall conduct regular fire risk assessments to identify potential hazards and implement necessary controls. • Install and maintain fire detection and suppression systems such as smoke detectors, fire alarms, sprinkler systems, and fire extinguishers. • Develop and communicate emergency evacuation plans and conduct regular drills to ensure all employees are familiar with evacuation procedures. • Keep fire exits clear and easily accessible at all times. • Store flammable materials properly and keep them in designated areas away from ignition sources. Implement security measures to prevent unauthorised access to the facility, which can help reduce the risk of arson. • Regularly inspect and maintain the facility's infrastructure, electrical systems, and equipment to prevent potential fire hazards.	Low
				Health-related hazards on operational staff due to constant inhalation of crushing materials	Adverse, direct, short-or long-term, reversible	Medium	• Eso Terra shall implement proper ventilation systems to ensure good indoor air quality and reduce the risk of inhalation of harmful substances. • Provide respiratory protection equipment to employees working in areas with a risk of exposure to hazardous fumes or gases. • Store chemicals and other hazardous materials in well-ventilated areas and ensure proper handling procedures are followed to minimise the risk of inhalation exposure.	Low

				Kidnap/forceful abduction of operation staff	Adverse, direct, abnormal, short-term, reversible	High	• Eso Terra shall provide security training: Staff will be trained on personal security awareness, including recognising and responding to potential threats. • Travel safety protocols: Implement strict travel safety protocols for staff travelling to high-risk areas, including pre-travel risk assessments, secure transportation arrangements, and communication procedures. • Security escorts for staff when travelling in high-risk areas or during high-risk activities. • Eso Terra shall equip staff with communication devices such as satellite phones or GPS trackers to quickly signal for help in an emergency. • Eso Terra shall conduct background checks: Conduct thorough background checks on staff and contractors to identify potential security risks. • Eso Terra shall secure facilities by implementing physical security measures at offices and accommodations to prevent unauthorised access and enhance staff safety.	Low
Post Quarry Operation	Demobilisation (Movement of vehicles and personnel)	Transportation of equipment/ materials/personnel to worksite	Socioeconomic (Health and Safety)	Increased traffic volume and delays due to daily movement of trucks and personnel along the Hugungumai road and major roads connecting the area	Adverse, direct, normal, short-term, reversible,	Medium	• Eso Terra shall ensure truck route planning: Establishing designated truck routes and enforcing restrictions on truck movements in residential areas or sensitive zones to minimise the impact of heavy vehicles on local communities.	Low

				Risk of injury, death, and asset damage due to road traffic accidents and incidents	Adverse, direct, abnormal, Short-term or long-term, Residual	High	• Eso Terra shall ensure truck safety measures: Implementing truck safety measures such as weight restrictions, speed limits, and mandatory safety inspections to reduce the risk of accidents and damage to infrastructure and the risk of death	Low
			Air Quality & Noise	Adverse effects on air quality due to emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from earth moving Equipment and localised Increase in background noise level	Adverse, direct, normal, short-term	Low	• Eso Terra shall Raise awareness among workers and the public about the importance of minimising noise and vibration impacts on the environment and emission of pollutants by ensuring vehicles are maintained according to manufacturer specifications. • Eso Terra shall use equipment to produce lower noise and emissions levels. This can include electric or hybrid vehicles and equipment with noise-reducing features.	Low
	Decommissioning/Abandonment	Decommissioning /abandonment and ancillary facilities	Soil and Water	Soil and groundwater contamination from wastes abandoned at the site	Adverse, direct, abnormal, long-term	Medium	• Eso Terra shall implement Best Management Practices (BMPs) by Following best management practices, such as covering waste piles, using impermeable liners, and implementing proper drainage systems to prevent contamination. • Ensure adherence to the EPRP guideline provided by MSMD.	Low

			Socioeconomic (Health and Asset)	Risk of poor management of decommissioned facilities	Adverse, direct, abnormal, long-term	Medium	• Eso Terra shall develop a comprehensive decommissioning plan: Create a detailed plan that outlines the steps and processes involved in decommissioning the facility; this plan should include timelines, responsibilities, and budget estimates. • Eso Terra shall ensure proper waste and hazardous materials management and develop a plan for managing and disposing waste and dangerous materials generated during the decommissioning process. It shall also ensure that all waste is managed and disposed of following regulations.	Low
				Risk of improperly abandoned quarry site, e.g. drowning of humans and animals, particularly children, in mining pits, environmental degradation, etc	Adverse, direct, abnormal, short – or long-term, reversible	High	• Eso Terra shall implement a proper reclamation plan: Develop a comprehensive reclamation plan before starting quarry operations. • Ensure reclamation of pits without creating damage to the damage. Where the pit would be retained due to community demand or conversion for other usage, it shall be properly fenced and clearly marked. • This plan should outline how the site will be restored and reclaimed once quarrying activities are completed. • Eso Terra shall involve local communities and stakeholders in the planning and monitoring quarry operations. • This can help ensure that concerns are addressed and the site is abandoned correctly to benefit the community.	Low

				Lost of Employment due to closure	Adverse, direct, abnormal, long-term	Medium	• Eso Terra shall notify staff before time and prepare staff for post-closure life. • Pay pension, outstanding salaries and arrears	Low
				Availability of land for alternative uses	Beneficial, direct, normal, long-term	Beneficial	• Eso Terra shall support and encourage land conservation programs to preserve natural habitats, agricultural land, or open spaces. These programs may offer incentives or tax benefits to land users who agree to use their land in alternative ways. • Eso Terra shall ensure Land trusts: Support land trusts that work to acquire and protect land for conservation purposes. Donating or selling land to a land trust can ensure that land property will be preserved and used for alternative purposes instead of abandonment	Low

6.2. Ranking After Mitigation

Notably, all impacts associated with the proposed project were reduced to LOW after mitigation. This is based on the following:

- The area proposed for the quarry is a secondary forest with very sparse vegetation and wildlife. Thus, the impact on biodiversity is minimal.
- Firefighting and ancillaries, which will be installed within the facility yard, will adequately address issues associated with fire outbreaks and safety risks.
- Eso Terra Investment Limited management shall ensure adequate and continuous consultation and interaction with the landlords and the entire community to prevent crises arising from acquiring the quarry site.

However, Chapter 7 (Environmental and Social Management Plan) has been provided to ensure that each case's prescribed mitigation measures reduce the impacts to zero.

Grievance Redress Mechanisms

As part of the FMEnv requirement, GRM is recommended to be established as part of the process so that the stakeholders involved are given freedom to raise their concerns to relevant representatives at no cost or threat of any negative repercussions; those concerns arising during project implementation are adequately addressed in a timely and respectful manner; and that participation in the grievance process does not preclude pursuit of legal remedies under the laws of the country. In regard to FMEnv guidelines, the project proponent will set up and train its staff and beneficiaries in addressing GBV. So, as to reduce and mitigate the risks of GBV especially during and after project implementation. The purpose of establishing Grievance Redress Mechanism (GRM) is thus:

- Ensure transparency and accountability throughout the implementation of projects and programmes amongst the relevant stakeholders including project beneficiaries.

- Address complaints, grievances and enhance conflict resolution arising from, and during programme implementation and

- Resolve any emerging environmental and social issue within project areas and foster effective communication skills/relationship between project implementers, executers and beneficiaries.

The project proponent will up measures to address GBV and Sexual Exploitation Abuse (SEA) within its proposed project supported area. Such measures and actions are:

- Mandatory contractors code of conduct on sexual harassment
- Community and workers' sensitization on GBV/SEA.
- Setting up team monitor GBV/SEA for its proposed project location.
- Develop Codes of Conduct for contractors with prohibitions against GBV/SEA,
- Hire a resolute GBV/SEA specialist or training of its social safeguard officer on project induced GBV/SEA
- Building capacity knowledge and conflict resolution mechanism amongst local communities and other relevant stakeholders to address the risks of GBV/SEA by developing and providing guidance, training, awareness, and dissemination of relevant information through radio, TV, print and social media. Therefore, GRM does not deal with grievances relating to internal communication or disputes between the project team, implementing agency, other agencies; nor intra/inter-community conflicts that are not project related. The project proponent grievance resolution process will involve four key phases.
- Receive/ Assess the potential risks.
- Investigate and capacity building.
- Respond
- Follow up/Review.

During the FGDs, the community elders and youth explained that conflicts in the community are resolved at the level of the traditional ruler palace. However, setting-up of GRM for a project such as mining is imperative. Grievances may not be limited to but can arise from any of the following; involuntary resettlement and compensation

issues, violence extremism, exclusion from project benefits and non-compliance of the contractual agreement.

The likelihood of dispute is much reduced because the few affected persons due to the quarry project have been extensively consulted. Nevertheless, if grievances arise, this redress mechanism has been prepared. The affected persons have already been helped to appreciate that there are provisions for addressing complaints or grievances. The grievance procedure will further be made available to the affected person through project implementation.

The significant grievances that might require mitigation include:

- Dispute between contractors and the stakeholders;
- Dispute between contractors and the host community;
- Losses not identified correctly;
- Inadequate assistance;
- Dispute about ownership;
- Delay in disbursement of assistance and improper distribution of assistance;
- PAPs not listed;

Grievances and Appeals Procedure

To forestall the lengthy litigation process, which could affect the project's progress, it is in the best interest of all parties to provide a forum locally to receive, hear, and resolve disputes. Therefore, setting up a Grievance Redress Committee early during project implementation is desirable.

For the Batagarawa Quarry project, a complaint is a notification (in written, verbal, or electronic form) regarding project activities and the conduct of staff, consultants, partners, and subcontractors directly or indirectly supporting the project or associated with its implementation that the complainant believes is wrong, either under the law or on the grounds of unacceptable behaviour.

The complainant(s) need not be personally aggrieved or impacted and may be acting merely in accordance with a sense of civic duty in bringing an occurrence to the attention of project authorities.

In defining the levels of grievance redress, priority was given to aligning with the existing mechanism and strengthening it as required. This mechanism was designed based on consultation and stakeholder inclusion while preparing the EIA report.

Grievance Redress Process

There is no ideal model or one-size-fits-all approach to grievance resolution. The best solutions to conflicts are generally achieved through localised mechanisms that take account of the specific issues, cultural context, local customs, and project conditions and scale. In its simplest form, grievance mechanisms can be broken down into the following primary components:

- Receiving and registering a complaint.
- Screening and assessing the complaint.
- Formulating a response.
- Selecting a resolution approach.
- Implementing the approach.
- Announcing the result.
- Tracking and evaluating the results.
- Learning from the experience and communicating back to all parties involved.
- Preparing a timely report to management on the nature and resolution of grievances.

Court Resolution of Grievance Matters

The possibility of seeking a grievance resolution in court may be a last resort but should be expected, especially where the complainant felt dissatisfied with the GRC's resolution.

The GRM provision for this project is that grievances concerning non-fulfilment of contracts, levels of compensation, or seizure of assets without compensation shall be addressed to the state local courts system of administration of justice. The court hierarchy would, in ascending order, therefore, be land dispute tribunals/chiefs,

followed by magistrate courts and then finally, the high courts. The state's high court is designated the highest appellate court to settle grievances.

Admittedly, this is a costly and time-consuming procedure. Nevertheless, affected persons will be exempt from administrative and legal fees incurred under this grievance redress procedure.

Awareness of GRM

Eso Terra will create an effective awareness program to educate the PAPs on the following:

- Members of GRC and its location
- Method of complaining or reporting the grievance
- Taking part in the GRC meeting (are any companions of the complainant allowed)
- The steps of resolving the process and timeline adopted in this mechanism.
- Needed documents and evidence to support the complaint.

This information should be part of a simple brochure that explains the different grievance redress possibilities for PAPs.

Grievance Redress Mechanism will be implemented to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied to all complaints from affected parties or PAPs. Eso terra will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome. Eso Terra, shall set-up a grievance redress committee that will address any complaints during project implementation. Grievances should be resolved within 15 working days.

The grievances, influenced by their physical, situational (e.g., employment), and/or social losses, can surface at different stages of the project cycle. Some grievances may arise during the project design and planning stage, while others may come up during project implementation. Not only should affected persons (AP's) be able to raise their

grievances and be given adequate hearing, but also satisfactory solutions should be found that mutually benefit both the APs and the Eso terra.

Members Of the Grievance Redress Committees (GRC)

The GRC members shall comprise of qualified, experienced, and competent personnel who will be able to interact and gain the trust of the AP's in their communities. The GRC should consist of both male and female representatives. They should be able to accept complaints, provide relevant information on the process, discuss the complainants' situations with AP's, and explore possible approaches for resolution.

The committee will include the following members:

- The Resettlement Action Plan (RAP) Consultant
- A representative of women residing in the affected Project study area;
- A representative from the Private sector (if a private company is located within the affected area);
- A representative of a voluntary organization, NGOs;
- A representative of Local Government Area Council of the affected area;
- A representative appointed by the Community head.

The Grievance Redress Committee will be responsible for:

- Communicating with the Affected persons (AP's) and evaluate if they are entitled to recompense;
- Making the list of affected persons public and the established grievance redress procedure.
- Recommending to the Social Safeguard Officer of the project solutions to such grievances from affected persons;
- Communicating the decisions to the AP's; to acknowledge appeals from persons, households or groups who rightfully will not be affected by the project manager,

but claim to be, and to recommend to the project officer whether such persons should be recognized as AP's, and to communicate back the decisions to the Claimants.

Community Expectations When Grievances Arise

The members of the community will expect that their grievances will be addressed by the project manager especially at the local level, which will be achieved through the GRC. When local people present a grievance, they generally expect to receive one or more of the following:

- A concession in recognition of their problem
- An honest response to questions about the proposed activities
- An apology
- Compensation when applicable
- Modification of the activities that caused the grievance
- Some other fair remedy.

Setting up of Grievance Redress Committee

The following are the steps needed to address GRM that may arise as a result of the proposed project.

Step One: GRC at the Site/Community Level

The first step or channel for filing grievance shall be through the site supervisor/community or district heads. The benefit of this approach is that the leadership system within the host community prove to be a cordial and notable channel for conflict resolution. The community or district shall be the head committee while membership of the committee will consist of:

- The district head or representative (Chairman)
- The village/ward head (member)
- The woman and youth leader in the community (member)

- The representative of PWD/ PAP in the community (member)
- Representative of the quarry company (member)
- Representative of the Local Government Authority (member)

Step Two: GRC at the Company Level

The second channel for filing grievances shall be at the level of the company organisation. The project or site coordinator shall constitute a team which shall receive, hear and address complaints that may have not be resolved at community or district level GRCs. The project coordinator shall head this committee while membership of the committee shall be:

- Communication officer/ Public relations officer; Environmental officer (Secretary);
- Monitoring and Evaluation officer, and the project Engineer (member)
- Representative of quarry workers (member)
- Representative of the community or NGO (member)
- Representative of the Local Government Authority (member)

Step Three: GRC at the State Steering Committee Level:

The committee at this level shall be headed by the Permanent Secretary of the State Ministry of Mines while the project coordinator shall serve as the secretary of the committee. Membership of the GRC at this level shall constitute as follows:

- The Permanent Secretary Katsina State Ministry of Mines or representative (Chairman);
- Director Katsina State Ministry of Land & Survey or representative (Member)
- Director Katsina State Ministry of Environment or representative (Member)
- A witnessing NGO

Informing Parties on Levels and Channels of Grievance Uptake

During public consultation meetings held within the host community members have been sufficiently informed that there will be three (3) levels at which aggrieved persons can channel his/her complaints for redress. These shall include:

- The project site/community level,
- The Company level and
- The State Steering Committee level.

The community members were also informed that the process of grievance redress shall be free seamless to the aggrieved/complainant for redress. The PAPs have also been informed that it is their right to seek redress in the court of law as the last resort if they felt dissatisfied with the judgments obtained from the grievance redress committees set up.

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 GENERAL

An Environmental and Social Management Plan (ESMP) is an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of a project's design, construction, operation, decommissioning, and maintenance are prevented and that the positive benefits of the projects are enhanced. It also defines the legal requirements for the project and identifies the regulatory permits and licenses required for construction activities. To this end, an EMP ensures that impact mitigation and enhancement measures outlined in the ESIA report form the basis for the actual implementation of the proposed project.

This EMP provides the program for achieving the environmental protection/conservation objectives of the proposed rock quarrying and processing Project. The programme includes the designation of responsibility and means of achieving these objectives during the project's life.

Effective implementation of the ESMP ensures increased efficiency, improved compliance assurance, enhanced environmental security and global stabilisation. Below is a summary of the EMP for the proposed project.

7.1.1 ESMP OBJECTIVES

The objectives of this ESMP for the proposed project are to:

- Ensuring compliance with regulatory authority stipulations and guidelines.
- Demonstrate that a systematic procedure to ensure that all project activities are executed in compliance with applicable legislation/guidelines and relevant Eso Terra Investment Limited policies has been established for the project.
- Ensure progressive reduction of the project activities' impacts on the

biophysical, health, and social environment to eliminate them.

- Ensure that all mitigation and enhancement measures prescribed in the impact assessment document to eliminate or minimise the adverse project impacts and optimally enhance the beneficial impacts are fully implemented.
- Ensure that appropriate recovery preparedness is in place if control is lost during the implementation of the proposed project.
- Provide part of the basis and standards needed for overall planning, monitoring, auditing, and environmental performance review throughout the project life cycle.

7.1.2 SCOPE OF THE ESMP

The scope of this EMP includes health, safety, environment (HSE), and social considerations and will address the activities at the facility that can potentially have impacts on the following:

- ambient air quality.
- soil and land use.
- physical environment of the area.
- natural resources (including groundwater) and biological environment.
- socioeconomics; and
- workplace conditions.
- health and workplace status

This EMP is not a static document, but a dynamic working tool that is designed to adapt to changes in prevailing circumstances, environmental regulations, guidelines, and policies. Its adaptability ensures that it will always be in line with the latest regulatory requirements and best practices. It will be regularly reviewed to consider changes in the regulatory regime. If new policies or guidelines are issued by FMEnv, other governmental agencies, or Eso Terra Investment Limited, these will be promptly incorporated. If necessary, the EMP will be updated and revised during the project life cycle to incorporate better environmental technologies, management systems, and economic policies.

7.2 Resourcing and Responsibilities

Resourcing

The HSE manager is tasked with overseeing all environmental, health, and socio-economic matters throughout the project implementation. This includes ensuring strict compliance with regulatory standards and Eso Terra Investment Limited's HSE policy, as well as coordinating with other project stakeholders to address any issues that may arise. Our commitment to compliance is unwavering, ensuring the project's legal and ethical standing.

To ensure effectiveness in managing environmental, Health and socio-economic issues and commitments, Eso Terra Investment Limited HSE Head shall supervise the Quality Assurance Engineer (QAE), the site project Engineer, the site HSE officers and the community relations officer. These resource persons shall be approved by Eso Terra Investment Limited's management and supervised by the HSE. The organogram showing the line of authority for implementing the EMP guidelines is shown in Figure 7.1.

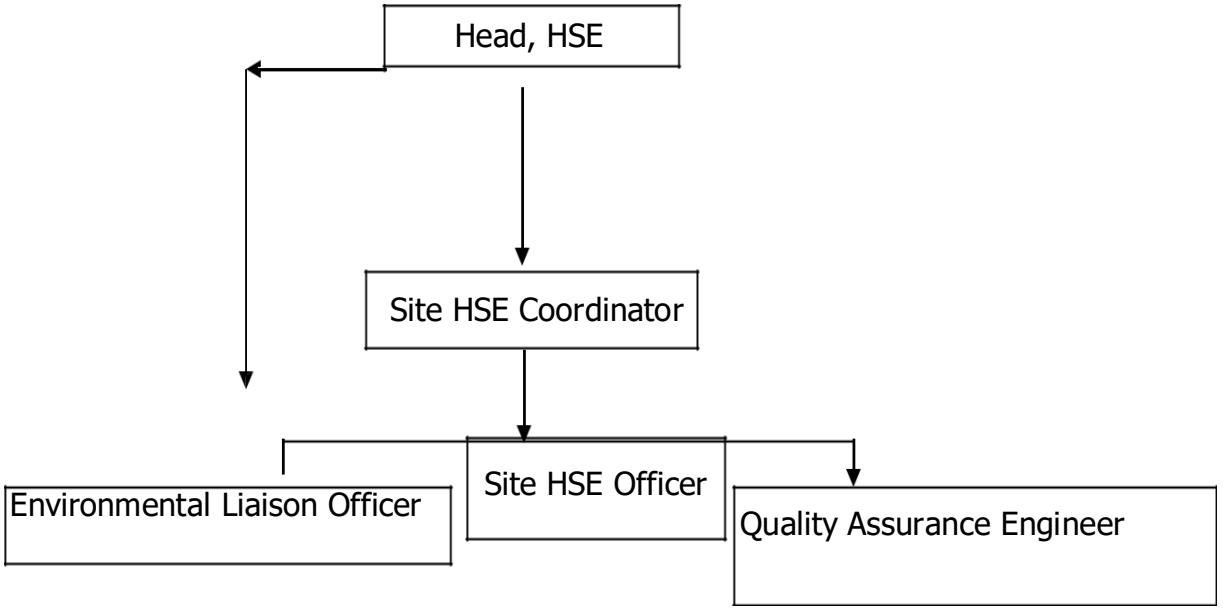

Figure 7.1: EMP Implementation Organogram

Responsibility

Eso Terra Investment Limited shall ensure that environmental and social commitments are met throughout the proposed project implementation. The company shall establish a schedule for responsibility and training on biophysical and socio-economic environmental matters. Environmental and social issues shall be a line of responsibility for which all levels of personnel are accountable. Responsibility for environmental

management shall lie with top management, ensuring that all environmental and social considerations are integrated into project execution. The HSE Unit shall be required to offer expert advice on protection measures and monitor performance. Also, the relevant regulators shall be consulted at all project phases.

Eso Terra management

The management is the final decision maker; they are to be contacted in case of any setbacks, even those concerning significant environmental, ecological, and archaeological discoveries.

Eso Terra Health, Safety and Environment (HSE) Manager

The Company HSE Manager liaises with relevant regulatory agencies. He coordinates the project HSE managers and works with an Environmental Consultant. He ensures that the company's HSE policy is adhered to and complies with national/international regulations. He informs the management of relevant progress reports.

Project Manager

The Project Manager ensures that all arms of project development and monitoring run smoothly. The project HSE Manager also reports to him.

Project Health Safety and Environment (HSE) Manager

Each company project shall have an HSE manager responsible for ensuring that company policies and relevant regulatory and legislative guidelines of environmental and HSE protections are adhered to during all project stages.

Project Maintenance Manager

The project Maintenance Manager shall ensure adequate housekeeping in the project area. He shall collect, sort, and correct project waste disposal (executing an efficient waste management plan) and facilitate a good maintenance culture.

Environmental Consultants

The client shall be required to employ environmental consultants to advise the project manager and the HSE manager on appropriate mitigation measures. They may also liaise with national regulatory bodies.

Environmental Committee

The Environmental Committee shall be composed of all company departments. The company's HSE manager shall head it and ultimately oversee the formulation of HSE plans, policies, and procedures. In effect, it shall constitute a platform whereby the company (and all its projects) shall continuously adhere to internal, national, and international HSE rules and regulations.

7.3 EMP Guidelines

Table 7.1 below presents the detailed preliminary EMP guideline covering the project activities/environmental aspects, impacts of the activities, mitigation/enhancement measures, and designated responsibility for implementation.

Table 7.1 Environmental and Social Management Plan for the Quarry

	Project Phase	Project Activity	Environmental Component	Potential Impact	Management Action	Responsibility		Mitigation Cost ($)
						Implementation	Supervision	1$= ₦1500
Planning & Pre-Construction	Site Acquisition	Land take	Socio-economic	Land acquisition	• There shall be Transparent and fair compensation and compensation processes within one month of acquisition.	Eso Terra Quarry Management	Kano State Ministry of Land & Physical Planning, Kunchi LGA	4,000
				Dispute over land	• Limit land acquisition • Provision of security		Lands and Survey, Kano State, Kunchi LGA	
		Site Survey	Personnel Health & Safety	Risk of injury to personnel due to exposure in the bushes	• Provision of PPEs & Adequate safety training	Eso Terra Quarry Management through HSE Department	FMEnv, Kano State Ministry of Environment	2,000
	Mobilization to site	Transportation of equipment / materials /personnel to worksite	Air quality and personnel Safety	Negative effects on air quality of Hugungumai community and others along the road due to emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	• Vehicles carrying materials must be fit and suitable for the environment. • All vehicles and utilities mobilised for the project must adhere to strict environmental guidelines.	Eso Terra Quarry Management through Maintenance Department, HSE Department	FMEnv, NESREA, Kano State Ministry of Environment	2,000
Development	Quarry Development	Site Clearance	Flora and Fauna, Land use	Loss of vegetation and humus soil. Loss of medicinal and rare species. Erosion of exposed land surfaces. Risk of dumped stripped soil blocking surface water channels. Risk of	• Shall carry out vegetative surveys to identify medicinal plants and culturally important land. • Rare and medicinal species shall be cultivated for replanting purposes. • Shall clear only areas requiredfor immediate	Eso Terra Quarry Management. Cultural/Archaeological National Commission of Museums and Monuments (For Finds).	FMEnv, NESREA, Kano State Ministry of Environment, State Culture and Tourism Board	6,000

				encroachment into culturally important land	needs. • Shall return topsoil directly torehabilitation areas, if possible, to avoidstockpiling. • Shall remove topsoil only when dry to appropriate depths. • Shall re-vegetate with local species as soon aspossible. • Shall development of designated dump andstockpile sites. • Stockpile vegetative material, trees and rocks for use during rehabilitation. • Do not disturb			
		Stripping of topsoil and compaction of same with earth moving equipment within the proposed project location	Soil and Water	Erosion of exposed land surfaces.	• Shall clear only areas required for immediate needs. • Develop adequate drainage system		FMEnv, NESREA, Kano State Ministry of Environment, Kano State Ministry of Land & Physical Planning	
		Construction of Quarry (Quarry Plant, Offices, Base camps)	Soil	Risk of dumped stripped soil	• Shall return topsoil directly to rehabilitation areas, if possible, to avoid stockpiling.	Eso Terra Quarry Manager.	Eso Terra Management	
Quarry Operation	Rock Operation (Extraction)	Overburden removal to expose rock, pit development, holes drilling	Soil and Water	Blocking surface water channels and undercutting into water table.	• Shall remove topsoil only to appropriate depths & reuse.	Eso Terra Management	FMEnv, KASEPA	3,000

		with the use of drill wagons		Risk of encroachment into culturally important land	• Shall limit removal of topsoil in the area except where necessary	Eso Terra Quarry Management	FMEnv, NESREA, State Culture and Tourism Board	1,000
		Blasting and loading of broken or disintegrated rock with excavators into dump trucks and conveyed to the crushing machine	Socioeconomic (Health and Safety, Assets)	Risk of damage to community assets as result of blasting (crack in the building)	• Proper blasting techniques and design to minimize the risk of fly rock, ground vibration and air blast overpressure that could cause injury or damage	Eso Terra Quarry Management through HSE/Production Departments	MSMD through Mines Environmental Compliance, FMEnv, Kano State Ministry of Environment	2,000
			Visual impact	Destruction of site aesthetics	• Stage developments and locate screening to reduce visual impacts. • Rehabilitate benches as soon as possible. • Carry out progressive rehabilitation if possible. • Re-vegetate the area, including the facilities and settlement areas, with native species as • soon as possible;	Eso Terra Quarry Management through HSE/Production Departments	Kano State Ministry of Environment Environmental Consultants	2,500
			Air Quality & Noice	Localized increase (above baseline values in ambient concentrations of air pollutants (NO_2, SOx, COx, C_xH_y, H_2S, & SPM). Noise and vibration from machines and blasting.	• Implement controlled blasting techniques & timing the blasts to minimize impact on nearby residents or sensitive structures & reduce noise. • Use water sprinkler to control dust where necessary	Eso Terra Quarry Management	FMEnv, NESREA, Kano State Ministry of Environment	2,000
	Rock Processing Stage	Dumping of the material conveyed by the dump truck to crushers. Crushing and Screening.	Socioeconomic (Health and Safety)	Injury, death, assets damage due to accidents during dumping of materials from point of quarry to the feed hopper.	• Reduction in cases of dumping of materials within and around crushing locations & outlines procedures for responding to accidents, injuries or emergencies that may	Eso Terra Quarry Management	FMEnv, NESREA	3,000

		Stockpiling			occur during dumping of materials and loading operations.			
				Project operations could attract hawkers and peddlers. Increase in criminal activities, possible illegal transactions between workers and the public. Disregard of warning signs.	• Shall assign a designated area for hawkers and peddlers near the site. • Employ 24-hour security guards on site. • Periodic reporting of security guards on activities. • Daily inventory of stock. • Increased presence of law enforcement	Eso Terra Quarry Management & Head of Security	Quarry Security, Police & other Agent	1000
		Haulage of granite aggregates to required area along the railway alignment		Risk of injury, death, assets damage due to road traffic accidents and incidents	• Establishing designated truck routes and enforce restrictions on truck movements in residential areas or sensitive zones to minimize accident • Use proper signage and protective cover of aggregates when driving on major roads to flying rocks	Eso Terra Quarry Management, Quarry HSE Department	FMEnv, Kano State Traffic Management Authority	3,000
		Storage of dangerous goods		Accidental discharge of explosives. Accidental spills	• Shall ensure storage areas are accessible to emergency crews. • Maintain accurate inventory of dangerous goods. • Store, handle and label chemicals, liquids and explosives according to national regulations.	Eso Terra Quarry Management through Maintenance Department, HSE Department and Production Department	Maintenance Department, HSE Department, DSS, Police, MSMD through the Mines Inspectorate Office	1,000

					• Train staff in correct usage and spill procedures. • Report spills an accidental detonation immediately. • Maintain all equipment (including emergency equipment) in good working condition. • Place guards at explosives storage sites;			
		Waste Management		Generation of Domestic and production waste. Incorrect disposal of soil and water pollution and health risks. Un-kept environment.	• Provide waste bins around the site and practice good housekeeping. • Establish appropriate frequency of cleaning activities. • Collect waste oil in steel • Containers for appropriate disposal. • Use waste rocks as fillmaterials for access roads and erodedsections around the quarry. • Compost organic waste if necessary. • Dispose hazardous wastes to State Environmental Protection Board Licensed carrier/facility. • Collect waste oils and solvents for recycling or/and dispose according to State Environmental	Eso Terra Quarry Management through Maintenance Department, HSE Department	FMEnv, NESREA, Kano State Ministry of Environment, KEPA	1,000

					Protection Board regulations. • Capture runoff from workshops by drainages. • Do not discharge solvent/detergent contaminated waters tothe environment. • Place rocks and blocks away from water bodies. • Clean-up accidental oil spills and drips immediately. • Trap silt and other debris around water bodies using silt settlement techniques.			
Post Quarry Operation	Demobilization (Movement of vehicles and personnel)	Transportation of equipment / materials /personnel to worksite	Socioeconomic (Health and Safety)	Risk of injury to personnel due to exposure in the bushes. Work related accidents. Public safety (during decommissioning);	• Provision of PPEs & Adequate safety training • Shall educate all staff on company HSE policy andprocedures and ensure adherence to it. • Place warning signs prominently in dangerous areas. • Erect perimeter fencing a minimum of 1m high and place prominent signs along the edges at regular intervals. • Place danger signs prominently in dangerous areas. • Provide triangular reflectors on vehicles. • Enforce traffic regulations, both on road and off site; • Provide readily	Eso Terra Quarry Management	FMEnv, Kano State Traffic Management Authority	2,500

					available on-site first aid equipment and medics. • Traffic control at project access points. • Carry out project activities away from facilities. • Provide appropriate PPEs and enforce usage. • Check and double check,equipment.			
			Air Quality & Noise	Negative effects on air quality of Hugungumai community and others along the road due to emission of atmospheric pollutants (CO_2, CO, NO_X, etc.) from internal combustion engines/exhausts	• All vehicles and utilities mobilised for the project demobilisation must adhere to strict environmental guidelines.	Eso Terra Quarry Management	FMEnv, NESREA, Kano State Ministry of Environment	4,000
	Decommissioning/Abandonment	Decommissioning /abandonment and Rehabilitation of ancillary facilities	Risk of Hazard/ Health & Safety	Unstable post-quarry slopes. Erosion. Visual impacts. Reduce public safety. Menace from scavengers	• Adhere to company and national regulationsregarding decommissioning and rehabilitation. • Station security guards ensure no trespassingor scavenging. • Re-vegetate using native species of shrubs, grasses and trees. • Favour species with strong germination rates.	Eso Terra Quarry Management	FMEnv, NESREA, MSMD, Kano State Ministry of Environment, AfDB	3,000

Table 7.2 Summary Budget for ESMP Implementation

Item	Responsibility	Cost Estimate	Cost Estimate
		NGN (₦)	USD ($)
Mitigation	Eso Terra	₦10,000,000.00	$6,666.67
Monitoring	FMEnv, MSMD, Kano State Departments/Ministries, Consultancy for Compliances	₦64,500,000.00	$43,000.00
Capacity Building	Eso Terra Management, Community Leaders/CBOs /NGOs	₦10,250,000.00	$6,833.33
Grievance Redress Mechanism	Eso Terra Management, Grievance Redress Committee	₦7,527,500.00	$5,018.33
Community Development Agreement/CSR	Eso Terra, FMEnv, Kunchi LGA	₦85,000,000.00	$56,666.67
Environmental Protection & Rehabilitation Plan	Eso Terra, MSMD, FMEnv	₦120,000,000.00	$80,000.00
Sub- Total		**₦297,277,500.00**	**$198,185.00**
Contingency - 5% of Sub Total		**₦14,863,875.00**	**$9,909.25**
Total		**₦312,141,375.00**	**$208,094.25**

Currency Unit = Nigerian Naira
US$1 = ₦1500

7.4 Environmental Monitoring Programme

The Eso Terra Investment Limited shall strictly operate a monitoring programme that would lead to a sustainable project-environment relationship. The monitoring programme shall commence from the site preparation through rock quarrying, crushing/installations stages to operations, and the decommissioning/abandonment stage to keep track of the entire project's activities and performance. The monitoring programme provides information on the impacts compared with prediction. By so doing, provide advanced warning of any adverse changes in the biophysical and socio-economic environment.

Specifically, the objectives of the monitoring programme shall be to:

- Determine the effectiveness of the mitigation and enhancement measures for adverse and beneficial impacts, respectively.
- Provide a basis for recommending additional mitigation/enhancement measures.
- Ensure that the established transparent procedures for theproposed project are sustained.
- Determine whether any detected environmental changes are caused by the project or other natural factors.
- Monitor alterations in the existing biophysical characteristics of the environment.
- Monitor and control emissions and discharges and ensure compliance with local, national, and international standards.
- Ensure sustenance of accountability and a sense of local ownership through the project lifecycle
- Provide early warning on any potentially serious problems.
- Measure long-term impacts.

The Eso Terra Investment Limited shall comply with the FMEnv regulatory controls and monitor specific environmental parameters during the proposed project activities. The HSE department shall be responsible for ensuring that the monitoring programme is implemented.

Periodic reviews shall also be carried out to check the monitoring programme's

effectiveness and redefine frequency, responsibilities, etc., as necessary. The monitoring programme designed for the proposed project is shown in Table 7.3.

Table 7.3: Environmental Monitoring Programme

Components	Impact Indicator	Location/Method of Monitoring	Frequency/Duration	Responsibility
Biodiversity (Vegetation and wildlife)	Abundance and diversity of native plant and animal species, presence of exotic plant species, Type, density.	Within the facility	Yearly	Regulators/ HSE Department
Socio-economic and Health	Settlements and housing types, population and population distribution, income levels, social infrastructures/ Health records from previous studies and current studies	Hugungumai Communities settlements around the site	Yearly	Community Liaison Officer
Water/Aquatic Life	Fisheries Diversity and abundance, Phyto/zooplankton and Benthos, Diversity, and abundance	Within the quarry pits and the Hugungumai earth pond	Yearly	Regulators/ HSE Department
Air Quality and Noise Level	CO, SO_2, NO_2, VOC, CO_2, Wind direction, Wind speed, Temperature, Relative humidity, SPM, Noise Level dB (A)	Within the facility and the circumference of a 200m radius outside the facility along the predominant wind direction	Daily, Monthly, Quarterly, yearly	Regulators/ HSE Department
Soil Quality	pH, Temperature, EC, DO, COD, Hardness, Alkalinity, Chloride, Nutrient characteristics, Metals, Oil and Grease, TPH, Microbial characteristics etc.	Scattered around the facility area and immediately after the perimeter fence	Monthly, Quarterly, yearly	Regulators/ HSE Department
Surface and underground Water Quality	pH, Cond., TDS, BOD, COD, Turbidity, Oil and Grease, Colour, Temperature, DO, Salinity, TSS, TPH, TOG, Metals, THB, THF, HUB, HUF	Within the quarry pits and the Hugungumai earth pond	Monthly, Quarterly, yearly	Regulators/ HSE Department
Sediment Characteristics	pH, Temperature, EC, DO, COD, Hardness,	Within the quarry pits and the Hugungumai	Monthly, Quarterly,	Regulators/ HSE Department

7.5 Guideline for Consultation

Eso Terra Investment Limited recognises the importance of consultations in all phases and activities of the proposed project. This is because appropriate and adequate consultations will ensure smooth project implementation and guarantee economic and commercial sustainability of future development in the area. Consultations, which began during the baseline data gathering in the project area, would continue throughout the project life cycle via an initiative-taking and structured approach, namely, interviews, administration of questionnaires, courtesy calls, and meetings with landlords, which also incorporate some components of the RAP (Appendix 3).The objectives of consultations are to:

- Ensure that all stakeholders are given early and adequate information on the activities involved in the proposed project.
- Provide a framework for improving the understanding of the proposed project's potential impacts on the socioeconomics and biophysical environment.
- Include stakeholders' views and concerns in the ESIA execution, especially regarding potential impacts.
- Identify contentious issues in the proposed project execution.
- Establish transparent procedures for carrying out the proposed project.

Eso Terra Investment Limited shall apply the following consultation techniques: Hold informal field visits with the immediate residents and other stakeholders to discuss the effectiveness of the project, its impact on the people's lives, and other concerns about the project. The consultation programme that Eso Terra Investment Limited will adopt for the proposed project is presented in Table 7.4, and the proposed stakeholder for consultation is presented in 7.5.

Table 7.4: Consultation Programme

Body	Consultation Goal	Duration
Stakeholder community/landlords	• Identify concerns/opinions. • Identify areas of conflict • Formation of appropriate mitigation/enhancement measures	Throughout the project lifecycle

Table 7.5: Proposed Stakeholders for Consultation Activities

Body	Computational Goal	Duration	Responsibility
Federal Ministry of Environment (FMEnv)	Environmental procedures and standards	Throughout the project life cycle	Environmental Assessment Department
Ministry of Solid Minerals Development (MSMD)	Mining Procedure and Standard	Throughout the project life cycle	• Mines Environmental Compliance • Mines Inspectorate
Kano State Key Stakeholders	Determine stakeholder concern	Throughout the project life cycle	• State Ministry of Environment • KASEPA
African Development Bank	Implementation Support	Twice per annum	• Compliance & Safety Department
Kunchi LGA	LGA Concern, Local Security, Community Engagement	Throughout the project life	• LGA Community Department • LGA Chairman • Local Security Agents (DPO, DSS, NSCDC)
Host Communities	Identification of concern Identify areas of conflict Formation of appropriate mitigation measures	Throughout the project life cycle	• CLO/Administrativ emanager • Community Youth Organization • Traditional Leader • Religious Leaders • Political Leaders • Women Group

7.6 Guideline for Waste Management

These guidelines apply to projects that generate, store, or handle any quantity of waste. Waste is any solid, liquid, or gaseous material discarded by disposal, recycling, burning or incineration. How waste is dealt with, stored, and disposed of is dictated by the nature of the waste; this waste management guideline considers the nature of all waste generated during the proposed project. The standard for the guideline includes the regulations of the Department of Petroleum Resources (DPR) and other national and

international environmental agencies, and these standards are binding on all staff and contractors involved in the proposed project with respect to the:

- Emission or release pollutants, exhaust, and fugitive gases.
- Discharge or spill effluent into surface water or land.
- Discharge solid wastes (including domestic waste) into surface water orland. Generation of noise and vibration.

7.6.1Waste Handling Guidelines

Waste disposal/handling can sometimes be complicated and expensive, and regulations designed to ensure proper waste disposal have dramatically increased. For proper handling and disposal, waste shall be well defined at a source, and the definition will be transmitted along with the waste to the final disposal points. Eso Terra Investment Limited shall define and document all waste generated during work. Basic information that must be provided, as a minimum, for adequate definition of wastes include:

- Waste type identification.
- Proper waste categorisation.
- Waste segregation information; and
- Recommended management practices.

7.6.2Waste Minimization Guidelines

Waste minimisation implies reducing the volume or toxicity of waste materials to the minimum extent possible. It involves a set of processes and practices intended to reduce the amount of waste produced. By reducing or eliminating the generation of harmful and persistent waste, waste minimisation supports efforts to promote a more suitable society. The four principles of the waste minimisation process; recycle, reduce, reuse, and recovery shall be adopted as applicable. Opportunities to achieve significant waste volume reductions during the proposed project include activity level, age depreciation and maintenance level of facilities and operating equipment. In addition, all oil, hydraulic fluids, oily sump water, etc., shall be recycled or treated before disposal at any government-approved site in Kano State.

7.6.3 Waste Segregation Guidelines

This process separates waste into different elements (dry or wet), which could occur manually or automatically in materials recovery facilities or mechanical biological treatment systems. To effectively implementappropriate waste disposal methods, waste must be segregated, preferably at source, into designated bins at strategic locations. Particular attention shall be given to work areas where various wastes are generated, such as scrap metals, pigging waste, cans, drums, etc.

7.6.4Waste Disposal Guidelines

All debris, spoiled materials, rubbish, and other waste shall be disposed of at government-approved dump sites. Instructions on the material safety handling sheet shall be strictly adhered to and form the basis for waste disposalrelated to such products. Wastes on transit shall be accompanied and tracked by consignment notes. The waste consignment notes shall contain the following information as a minimum:

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

7.6.5Operational Wastes and Disposal Methods

Eso Terra Quarry's waste management manager (or his equivalent) shall be responsible for production and domestic waste management in and around the project site. The company and the appointed district waste collectors shall coordinate waste collection and disposal.

The main objectives of the waste management plan are:

- Progressive reduction of all waste with the target of having control over all emissions/discharges which harm the environment
- Ensuring that all activity planning addresses waste management issues for domestic and industrial waste to recycle non-hazardous waste as much as practicable and
- Ensuring that staff and contractors (if applicable) are responsible for effectively

managing and transporting waste from source todisposal/recycling facilities.

The management shall ensure that this commitment is translated into the necessary resources to develop, operate, and maintain an effective waste management system.

The HSE (and waste manager) shall fully implement the company's waste management policy objectives by overseeing the day-to-day handling and appropriate disposal of generated waste.

The section head/manager/supervisors are responsible for ensuring that all waste generated within their units is appropriately sorted out, weighed, or received before final disposal. They shall ensure that good housekeeping is maintained at all sites.

The waste management plan shall be developed and adopted during the various phases (preparation, operation to abandonment) of the project as follows:

Waste Management During Site Preparation

During site development, the top humus soil shall be carefully stripped and stored for future re-vegetation, and other excavated materials shall be used as fill and backfilling materials for erosion control and reclamation works after de-commissioning.

Waste Management During Operational Phase

Eso Terra Quarry shall be responsible for monitoring, controlling, and disposing (working with an appointed state waste collector) of all waste (both production and domestic) generated during the operational phase. A waste inventory shall be kept to protect the data integrity. The HSE manager shall work with the maintenance manager to ensure the waste plan is fully implemented at the site. He shall collect data for all the departments and operations (quarry and non-quarry-related activities) to manage waste effectively.

Waste Management in Abandonment

Abandoned machines, equipment, and containers shall be sold as scrap metals or re-used in other projects. Standing buildings, if any, shall be carefully disassembled to salvage reusable materials like doors, metals and aluminium frames, blocks, and roofing sheets. Contaminated containers and toxic

Specifically, Table 7.6 below articulates the management of waste generated by the proposed development project.

Table 7.6: Waste Management Plan

Waste type	Handling methods	Frequency of collection	Responsibility
Broken blocks	Collected for reuse	Daily	• HSE/maintenance manager
Hardened waste cement	Collected for onward disposal in designated dumpsites	Daily	• HSE/maintenance manager
Metal scraps	Stored, reused, or resold	Daily	• HSE/maintenance manager
Paper waste	Collected in bins and disposed of in a designated dump site.	Daily	• HSE/maintenance manager
Clinical waste (scalpers, soaked blood cloth, bandages, syringes, blades	Collected in containers and incinerated on site.	Daily	• HSE/ waste manager
Contaminated soil	Remediation by appropriate clean-up techniques	Weekly	• HSE/SMEnv
Explosives (when used)	Collected in boxes and marked explosives, returned to the Nigerian Police Anti Bomb Squad Unit for safekeeping by the vendor.	Daily or after blasting activities	• Project manager • Explosive Vendor • Nigerian Police Force
Waste plastics	Collected and recycled where possible	Daily	• HSE/maintenance manager
Empty drums	Stored for reuse or sold to community people	Weekly	• HSE/maintenance manager
Excavated earth/ topsoil/ overburden	Heaped for backfilling and vegetation purposes	Weekly	• HSE/maintenance manager/ project manager
Kitchen and other biodegradable waste	Collected for composing.	Daily	• HSE/maintenance manager
Waste rocks and quarry fine	Collected for our use or sales.	Daily	• HSE/project manager

Noise Minimisation Guidelines

Noise and vibration generated by facilities and equipment shall meet the ergonomic requirements of Eso Terra Investment Limited and other national and international standards, codes of practice and statutory regulations. Where the noise level exceeds the stipulated limits, it shall be treated as a nuisance. Eso Terra Investment Limited shall implement adequate mitigation measures to address the situation appropriately.

All personnel working for an extended period in high-noise areas (e.g., welding and generator areas) shall always be required to use earmuffs. Permanent warning signs shall be posted at the boundaries of these restricted areas. Through the Site Environmental and HSE Officers at work sites, the HSE Manager shall ensure the full implementation of this plan.

7.7 Transport Operations

This plan is developed to mitigate the increased traffic caused by the influx of the proponent's vehicles on local roads, especially if that area already has a high traffic density.

This plan is as follows:

- All vehicles and equipment operators shall be acquitted with the national highway codes and traffic rules and regulations and shall be mandated to obey
- Vehicles and motor equipment shall use recommended routes as shall be pre-defined by the transportation manager
- Where construction or project development activities are likely to impede traffic, temporary detours shall be required to be built adjacent to thesesites. Where construction of this is not possible, the contractor shall plan works such as controlled single-lane traffic to serve road users before completion.
- A traffic warden shall be used to control traffic at the entry and exit points ofthe site if deemed necessary
- If traffic signs are to be placed by the proponent, they shall conform to national/international standards and form
- Traffic signs shall be placed on or about critical points along the project site
- Along narrow dirt roads, safe pedestrian and non-vehicular traffic access shall be provided along haulage access routes.
- Barricades and other movable concrete barriers shall be placed only after consultation with the FRSC
- Underaged and unfit drivers shall not be employed or used by the proponent
- Drivers or operators of construction vehicles shall have valid Nigerian Driver's Licenses, which shall be appropriate to the vehicle in question.
- Drivers shall have their schedule designed in such a manner that shall

eliminate fatigue or the need for speed.

7.8 Prevention of Workplace Accidents/Incidents

The JHA tool and written work procedure are pivotal in preventing workplace accidents and incidents during the proposed project. The engineering team, as the key player, is responsible for conducting JHA for all operations and developing comprehensive work instructions. These work instructions, culminating in the JHA's recommendations, are not just documents but crucial tools for ensuring the safety of our project. Upon submission of the written work instructions and the supporting JHA or risk assessment document, the HSE Manager or site HSE Coordinator / Officer may consider the project activity for approval. Project activities may only be approved if the HSE Manager or site HSE Coordinator / Officer is objectively convinced that the work instructions are practical, safe, and following regulatory requirements.

7.9 Plan for Training and Awareness

To assure HSE competence and awareness, the project team headed by HSE and Construction Managers shall ensure that the company employees and other parties that will be involved in the project have the appropriate training and competence for various aspects of the project, including HSE critical activities, e.g., welding offshore, loading and offloading, etc. The competency requirements for contractor staff shall be stipulated in the contract document. The project team shall be subjected to periodic competence gap analysis from which training needs can be derived for the current job. The programme shall be reviewed on an ongoing basis as the project progresses by the HSE and Project Managers (based on reports from the site EHS officer) and shall, among others, include the following aspects:

- HSE induction course.
- Emergency response drill included.
- First aid.

7.10 Communication Plan

Eso Terra Investment Limited and its contractors shall maintain effective two-way communication regarding HSE issues at all project phases. This will include an

awareness programme to motivate staff and contractors. The site HSE Coordinator/Officer, as a key player in our HSE strategy, is responsible for making available to the entire project team the necessary HSE information and experiences to facilitate improvement in HSE performances. They ensure everyone has the knowledge and experiences to contribute to our HSE objectives. HSE personnel at all levels shall be made aware of the importance of compliance with the HSE policy and goals and their roles and responsibilities in achieving them. They shall be made aware of the risks and hazards of their work activities, the preventive and mitigation measures, and the emergency response procedures that have been established. They shall also be made aware of the potential consequence(s) of departure from agreed operating procedures.

A duty officer's programme shall be established to manage and maintain effective communication. Contractors shall set up appropriate lines of communication to handle HSE issues, e.g., direct access to the nearest clinic and emergency services.

The Eso Terra Investment Limited management already has an established HSE performance scheme to promote staff HSE performance improvements, e.g., personal recognition, suggestion schemes, HSE performance bonus schemes for specific performance or at the end of a recognisable milestone, or a small give-away for recognisable performance. These shall apply during the proposed project.

7.11 Emergency Response / Contingency Plan

Compliance with regulatory standards, codes, specifications, and HSE guidelines shall form the basis for executing the proposed project. However, emergencies could still occur because of equipment failure, negligence, and sabotage. Consequently, Eso Terra Investment Limited shall develop a contingency plan, an organised and predetermined course of action to be pursued in the event of an accidental occurrence, as a backup to other containment systems to be put in place to handle such occurrences. At a minimum, the contingency plan (with responsible parties for actions to be taken), which shall apply to both Eso Terra Investment Limited and contractors, addresses the following:

- Fires and explosions.
- Severe injury or illness.
- Hydrocarbon or chemical spills.

- Road accidents and
- Security issues.

Emergency Response Plan Framework

Eso Terra Quarry shall implement its Emergency Response Plan and other applicable national guidelines or legislations as given by relevant government agencies. For emergency response, the following measures are also recommended: -

Training Needs

The ESIA has assessed the training needs of the various categories of staff that would implement the ESMP drawn from this ESIA, and hence, is considered an essential component of the project to provide for their training. This shall ensure the efficiency and applicability of the plan itself. Staff emergency response training shall be tailored towards:

- Familiarity with the aims and objectives of the plan
- Familiarity with the implementation procedures of the plan
- Identifying emergencies or what constitutes an emergency
- Familiarity with emergency contact numbers and appropriate respondents
- Ensuring immediate or timely staff response to situations
- Proper documentation
- Availability and knowledge of areas where relevant items are stored, of allnecessary materials needed for quick response to an emergency

Line of Respondents

The following is a proposed outline of the respondents' lines.

First on the scene

Any person who first sees or identifies an emergency shall be responsible for alerting all workers near the incident and reporting to the HSE Manager (or equivalent personnel).

HSE Manager

The HSE Manager must be able to identify the type of emergency and determine the hazards posed to human health, safety and environment, the likelihood and potential severity of harm, and the appropriate emergency procedures applicable to the situation.

Site Medics and Emergency Response Units

Injuries and other health issues that can be treated on-site shall be referred to the site medical personnel, and incidents like fires and collapsed structures shall be the responsibilities of the firefighting units (an effort should be made to make such readily available on-site) and engineers.

Hospitals and Relevant Agencies

Severe injuries and health hazards that cannot be treated on-site should be promptly referred to the nearest hospitals (affiliated with Eso Terra Quarry if necessary) and relevant agencies, such as the National Emergency Management Authority (NEMA).

Emergency Response Procedures

The plan's procedure must be such that all the staff quickly understands it. It must be effective during implementation such that it affords the management a fast and efficient means of evacuating people and prompt means of arresting a situation. In ensuring the health and safety of people on site, the HSE officer shall:

- Ensure that workers are conversant with the procedure.
- Ensure that more than one health worker is readily available
- Determine safe evacuation routes, which shall be well known to all.
- Establish an emergency safe zone away from the site
- Provide emergency contact numbers.
- Develop an effective means of emergency reporting and documentation.

7.12 Environmental Audit and Review

To ensure that environmental and social commitments and management procedures are being adhered to, that the project phases and activities are performed following laid-down procedures/standards, and that appropriate controls are in place, a periodic Environmental and Social Audit of 3-year interval and reviews shall be carried out at predetermined milestones as management checkpoints throughout the project lifespan.

Eso Terra Investment Limited shall constitute a team led by the HSE Manager or his designate to embark on periodic audits of the proposed project activities as they progress to:

- Identify prevalent environmental issues.
- Evaluate periodic management practices and monitor standards.
- Compare environmental status with established baseline conditions and national/international regulatory standards and requirements; and
- Recommend areas of improvement in the EMP.

The Environmental audit shall be conducted in liaison with NESREA or FMEnv. Figure 7.2 shows the procedure for conducting an environmental audit with FMEnv.

In implementing the audit programme, activities or structures in the project area perceived as having high environmental risks shall be thoroughly investigated, and recommendations made for improving the operation's management system where it is found wanting.

Audit recommendations shall be used to review and improve the operation management system where shortcomings arefound.

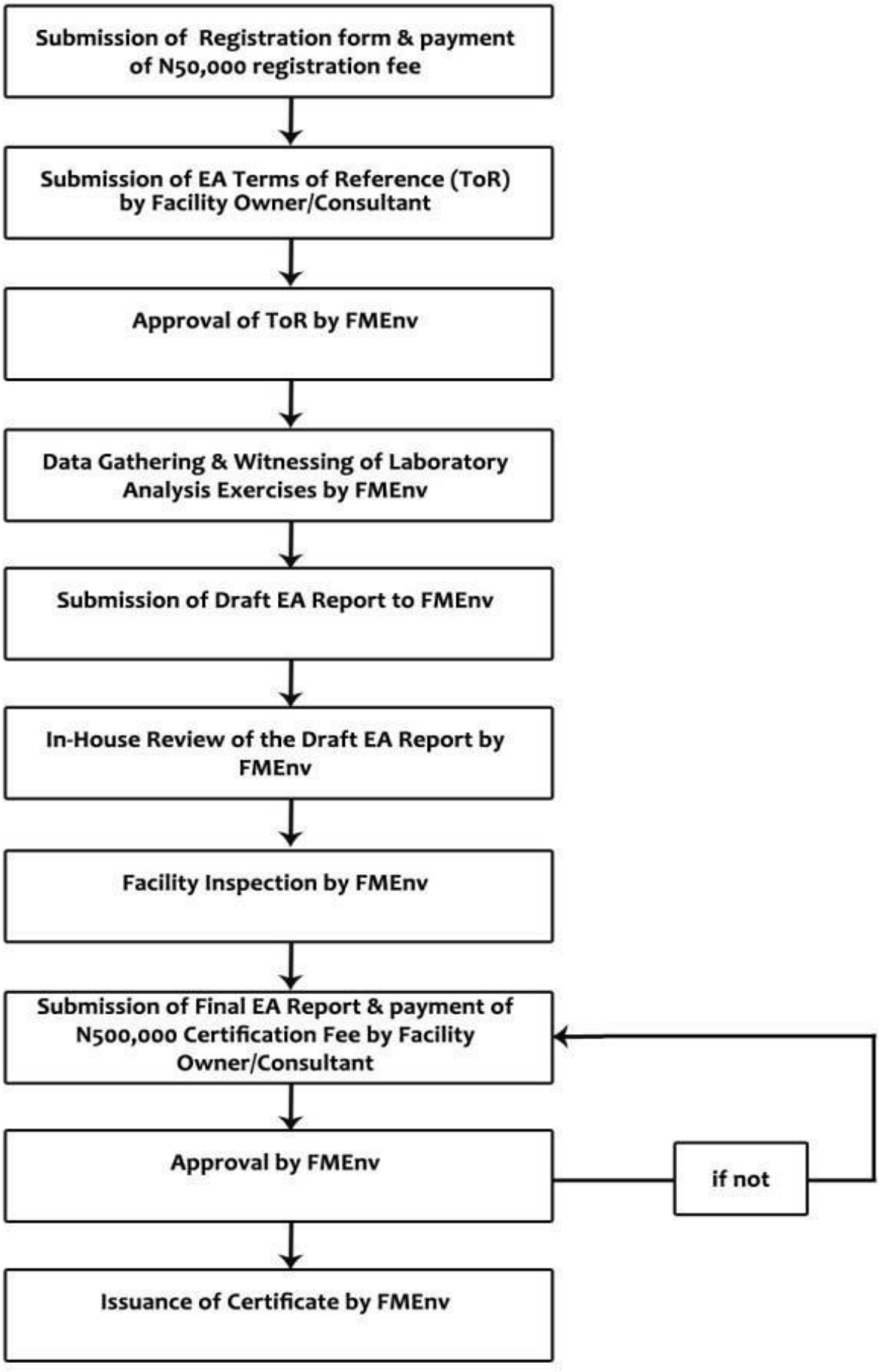

Figure 7.2 Environmental Audit Process

CHAPTER EIGHT

DECOMMISSIONING AND RECLAMATION FRAMEWORK

8.1 General

This framework shall be used as a guideline by the proponent when developing their decommissioning and reclamation plan. These measures aim to ensure security, health and safety, and protection of the natural and human environment after the discontinuance of quarrying operations. Emphasis shall be put on safety, re-vegetation, and backfilling.

8.2 Abandonment and Restoration Plan

At the expiration of the mine, the Eso Terra quarry shall fence the site using wire gauze, and the area will be put under lock. A preliminary abandonment and restoration plan shall be developed by Eso Terra quarry and reviewed by the relevant regulatory bodies. The plan shall consider all technically feasible options for restoration, decommissioning and abandonment, including alternative uses for the asset, following company policy and government regulations. Such considerations shall include:

- Restoration of land to conditions capable of prior land use, equivalent uses,or environmentally acceptable uses.
- Uses of overburden and topsoil for reclamation.
- Re-contouring of slopes of more than 300 to minimise run-offs.
- Contouring slopes to minimise erosion and run-offs.
- Planting native vegetation to prevent erosion and encourage self-sustaining development of a productive ecosystem on the reclaimed land.

8.2.1 Decommissioning

Before removing equipment, the contractor shall ensure that the equipment has been approved for decommissioning by reviewing the equipment decommissioning note. After removal, Eso Terra shall be consulted regarding the disposal of the equipment.

8.2.2Demolition

All relevant international and national best practices standards shall be employed in the civil demolition to be carried out. Structures such as camps and site offices which cannot be handed over to the adjoining communities or stakeholders for use shall be demolished. Buildings shall not be destroyed until all their equipment has been removed.

8.3 Restoration

A detailed site survey will be carried out on the condition of the soil. Any polluted soil will be treated in situ or removed from the site and treated/disposed of safely and in an environmentally acceptable manner. All cement, steel or wooden structures not being left to others for use will be removed. It is, however, not envisaged that the quarry site would be abandoned in the future.

For the site restoration, Eso Terra quarry shall implement the following.

- Survey the site for contamination.
- All equipment and debris should be removed from the environment.
- All cleared spaces resulting from the decommissioning and removal of associated structures shall be re-vegetated using native species.
- All excavated routes shall be reinstated to their original topographical status to minimise negative impacts such as erosion.
- A good waste management plan would be put in place
- Building used for administrative and residential functions shall be leased out for other purposes.

8.4 Reclamation Activities

All stakeholders shall thoroughly discuss and agree upon land use after reclamation. The alternatives that shall be considered shall include:

1. **Agriculture-**

- Arable use
- Livestock grazing
- Specialist food production (fishponds, nurseries etc)

2. **Forestry**
   - Utilization of food crops for commercial production
3. **Amenity**
   - Informal recreation (outdoor sport, camping, picnic, gathering, etc.)
   - Planned water reservoir
4. **Building Development**
   - Residential
   - Commercial (shopping centres, markets, motor stations etc)
   - Recreational (indoor facilities)
5. **Landfill**
   - City waste dump (controlled bio-degradable waste)
   - Construction waste (inert)

8.5 Labour Demobilization

Eso Terra shall implement the following.

- Consult with labour at least one year before commencement of decommissioning
- Embark on a retraining process to enable labour to acquire other skills
- Project workers shall either be adequately paid off or shall be relocated to other areas for employment
- Appropriate pension schemes shall be established for project workers' upkeep when a project is closed or decommissioned.

8.6 Environmental Protection and Rehabilitation Programme (EPRP)

A detailed EPRP shall be developed and implemented appropriately following the Federal Republic of Nigeria Mining Act.

EPRP outlines practical procedures for all project activities and personnel (i.e., employees, contractors, and suppliers) to reduce or eliminate the potential environmental effects of the mining site's development, operations, and post-operational phases.

The purposes for which EPRP shall be developed, among other things, include:

- ensuring that commitments to reduce environmental effects are met.
- documenting environmental concerns and appropriate protection measures.
- provide a reference document for personnel when planning and conducting specific activities.
- provide direction for developing contingency plans for accidental events.
- communicating changes in the program through the revision process.
- provide a reference to and instructions for and understanding applicable legal and other requirements.
- including a quick reference for both project personnel and regulators to monitor compliance and recommend improvements; and
- provide direction at the corporate level to ensure commitments made in policy statements are implemented and monitored.

CHAPTER NINE

CONCLUSION

The ESIA of the proposed Quarry in Hugungumai Community, Kunchi LGA, Kano State, has been carried out by Eso Terra Investment Limited to identify andpredict the likelihood of the impact of this project on the recipient environment (ecological and socio-economic). Hence, the status and sensitivities of the project environment's various environmental and socio-economic components have been carefully established and assessed through literature research, field sampling and measurements within the proposed project axis, using a multi-disciplinary team of experts.

The study revealed that the air quality indices were within regulatory limits except for NO_2 and SO_2, whose concentrations exceeded regulatory limits. The noise levels were below the tolerable noise limit (90 dBA). The pH of the water samples from the quarry pits was slightly alkaline; the value was inconsistent with that of the underground water sample, whose pH was slightly acidic. The water samples show the presence of E. coli in the quarry pits.

The soil has a high concentration of heavy metals and zinc. The groundwater collected from the well within the host community has an elevatedlevel of TDS and EC. The biodiversity (microflora, macroflora, microfauna, and macrofauna life) was low. Identified wildlife species in the project area include amphibians, reptiles, birds, and mammals. Adherence to the EMP will reduce the negative impact of the Quarry activities in this area.

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APPENDICES

APPENDIX 1. LABORATORY RESULT

MINISTRY OF ENVIRONMENT, KANO STATE
(GREEN HOUSE)
BLOCK 5, AUDU BAKO SECRETARIAT, P.M.B. 3022.
Hon. Commissioner ☎: 064-668371 Perm. Secretary Fax: 669413

Our Ref: Your Ref: Date:

Name: ESO TERRA Investment Limited

Project Site & Address: Proposed Granite Quarry Site at Hugungumai, Kunchi Local Government Area, Kano State

Date of Sampling & Analysis: 9th November, - 15th November, 2022

WATER QUALITY ASSESSMENT

Preservation Method: Iceing/Refrigeration

Quantity of the Sample: 1Litre

Please find below the result of water Quality assessment carried out on your water samples brought from the granite quarry site on the condition brought to the laboratory.

S/N	Parameters	Unit	KQW_1	KQW_2	KQW_3	FM_{ENT} Limit
A. COORDINATES						
1.	Latitude	-	$12^0 25^l 43.0^{ll}$	$12^0 25^l 46.9^{ll}$	$12^0 26^l 22.0^{ll}$	
2.	Longitude	-	$008^0 13^l 49.6$	$008^0 13^l 46.8$	$008^0 13^l 44.0$	
B. PHYSICOCHEMICAL						
3.	Appearance	TCU	Greyish Light	Cloudy	Clear	
4.	Temperature	°C	33.0	30.0	31.0	
5.	pH	-	8.41	8.25	6.57	
6.	Total Dissolve Solid	ppm	73	108	605	
7.	Electrical Conductivity	µs/cm	152	235	1062	

31.	Oil and Grease	%	0	0	0	
32.	Ethylbenzene	mg/L	0.000	0.000	0.000	
F. MICROBIOLOGICAL TEST						
33.	E. Coli	Cfu/ml	3	6	0	
34.	Total Coliform	Cfu/ml	0	1	0	

Note:

KQ = Kunchi Quarry Project

W = Water samples

WW = Well Water Sample

8.	Turbidity	NTU	9	12	2	
C. CHEMICAL TEST						
9.	Calcium	mg/L	3.89	2.76	7.43	
10.	Magnesium	mg/L	0.06	0.12	0.01	
11.	Nitrate	mg/L	23.90	30.86	6.51	
12.	Nitrite	mg/L	0.629	0.722	0.002	
13.	Phosphate	mg/L	2.26	1.80	0.24	
14.	Total Hardness	mg/L	4	5	16	
15.	Total Chlorine	mg/L	0.19	1.06	0.03	
16.	Ammonium	mg/L	54	36	1	
17.	B.O.D	mg/L	2.81	2.99	0.6	
18.	C.O.D	mg/L	68.9	74.3	0	
D. HEAVY METAL						
19.	Aluminum (Al)	mg/L	1.432	1.921	0.000	
20.	Chromium (Cr)	mg/L	0.361	0.470	0.000	
21.	Nickel (Ni)	mg/L	0.112	0.176	0.001	
22.	Copper (Cu)	mg/L	0.0187	0.0279	0.000	
23.	Cobalt (Co)	mg/L	0.000	0.000	0.000	
24.	Cadmium (Cd)	mg/L	0.001	0.000	0.000	
25.	Zinc (Zn)	mg/L	2.732	2.612	0.031	
26.	Mercury (Hg)	µg/L	0.000	0.000	0.000	
27.	Lead (Pb)	µg/L	0.000	0.000	0.000	
E. ORGANICS						
28.	TPH	mg/L	0	0	0	
29.	Toluene	mg/L	0.0	0.0	0.0	
30.	Benzene	mg/L	ND	ND	ND	

Air Quality Measurement

Please find below the result of Air Quality Assessment carried out at the proposed Granite Quarry Site located in Hugungumai village, Kunchi LGA, Kano State on 7th November, 2022.

S/N	Parameters	Unit	$KQAN_1$	$KQAN_2$	$KQAN_3$	$KQAN_4$	$KQAN_5$	$KQAN_6$	$KQAN_7$	$KQAN_8$	$KQAN_9$	$KQAN_{10}$	$KQAN_{11}$	**CONTROL** $KQAN_{12}$
1.	Latitude		12°25'46.4"	12°25'36.5"	12°25'28.8"	12°25'44.8"	12°25'43"	12°25'42.4"	12°25'45.7"	12°25'45.8"	12°25'46.3"	12°25'55.1"	12°26'05.6"	12°26'14.9"
2.	Longitude		008°13'48.8"	008°13'49.5	008°13'48.9"	008°13'41.4"	008°13'32.6"	008°13'26.7"	008°13'54.2"	008°13'59.5"	008°14'04.8"	008°13'52.0"	008°14'03.2"	008°13'53.7"
3.	SO_2	ppm	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.	NO_2	ppm	0.2	0.3	0.2	1.0	1.1	0.8	0.3	1.0	1.0	0.9	0.9	0.8
5.	CO_2	ppm	532	541	519	552	562	511	521	534	596	591	591	588
6.	CO	ppm	0	0	0	0	0	0	0	0	0	0	0	0
7.	NH_3	ppm	0	0	0	0	0	0	0	0	0	0	0	0
8.	H_2S	ppm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.	HCN	ppm	0	0	0	0	0	0	0	0	0	0	0	0
10.	HCl	ppm	0.4	0.4	0.6	0.1	0.2	0.3	0.2	0.8	0.6	1.4	1.7	1.7
11.	TVOC	$\mu g/m^3$	0.056	0.168	0.084	0.224	0.294	0.308	0.028	0.028	0.168	0.686	0.616	0.490
12.	HCHO	$\mu g/m^3$	0.008	0.024	0.014	0.032	0.046	0.044	0.004	0.002	0.022	0.096	0.088	0.070
13.	$Pm_{2.5}$	mg/m^3	003	004	003	003	004	003	003	003	004	003	003	003
14.	Pm_{10}	mg/m^3	003	003	003	003	003	003	003	003	003	004	003	004
15.	$Pm_{1.0}$	mg/m^3	001	002	002	001	001	001	001	001	002	001	001	002
16.	PH_3	ppm	0	0	0	0	0	0	0	0	0	0	0	0
17.	C_2H_4	ppm	0	0	0	0	1	0	0	0	0	0	0	0
18.	Cl_2	ppm	0	0	0	1	1	0	0	0	0	0	0	0
19.	Sound (Noise)	dB	58.7	56.8	57.0	53.0	51.3	52.0	58.7	59.6	52.9	48.4	59.5	63.9

NOTE:

Pm = Particulate Matters

TVOC = Total Volatile Organic Compound

dB = Decibles

KQ = Kunchi Quarry

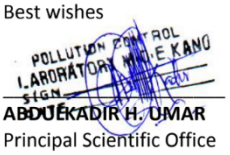
AN = Air and Noise

SOIL ANALYSIS RESULT

S/N	Parameters	Unit	$KQAN_1$	$KQAN_2$	$KQAN_3$	$KQAN_4$	$KQAN_5$	$KQAN_6$	$KQAN_7$	$KQAN_8$	$KQAN_9$	$KQAN_{10}$	$KQAN_{11}$	**CONTROL** $KQAN_{12}$
1.	Latitude		12°25'46.4"	12°25'36.5"	12°25'28.8"	12°25'44.8"	12°25'43"	12°25'42.4"	12°25'45.7"	12°25'45.8"	12°25'46.3"	12°25'55.1"	12°26'05.6"	12°26'14.9"
2.	Longitude		008°13'48.8"	008°13'49.5	008°13'48.9"	008°13'41.4"	008°13'32.6"	008°13'26.7"	008°13'54.2"	008°13'59.5"	008°14'04.8"	008°13'52.0"	008°14'03.2"	008°13'53.7"
3.	SO_2	ppm	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A.	**SOIL CHARACTERISTICS**													
4.	Colour	TCU	Brownish	Dark brown	Brownish	Brownish	Reddish	Reddish brown	Pale brown	Dark brown	Dusky Brown	Brownish Grey	Dark Grey	Grayish Brown
5.	pH	-	8.6	8.7	8.1	8.1	8.0	7.9	8.3	8.3	8.9	9.0	8.3	8.6
6.	Alkalinity	mg/kg	2.8	2.9	1.7	1.2	2.8	3.1	2.0	2.0	2.2	2.4	1.3	0.9
7.	Conductivity	mg/kg	3461	2881	4001	3899	3481	5091	864	801	946	871	1968	2706
8.	Salinity	mg/kg	12.0	11.1	10.1	9.4	6.3	7.0	14.2	14.2	19.1	18.0	9.9	9.6
9.	Texture	-	Loam	Clay Loam	Sandy	Sandy	Loam	Clay Loam	Clay	Clay	Loam	Loam	Loam	Loam
10.	Permeability	Cm/hr	13.8	19.8	9.6	8.7	14.1	15.3	20.6	23.1	14.3	15.0	15.0	15.1
11.	Grain Size	mm	0.82	0.71	0.61	0.93	0.63	0.26	0.18	0.20	0.63	0.70	0.68	0.67
12.	Bulk Density	g/cm^2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13.	Moisture Content	%	1.73	2.81	1.00	0.83	2.01	2.06	4.31	3.80	2.00	1.73	1.46	1.77
EXCHANGEABLE CATION														
14.	Ca^{2+}	mg/kg	0.83	0.81	0.63	0.74	0.88	0.89	1.08	0.96	1.88	2.00	1.78	0.98
15.	Mg^{2+}	mg/kg	1.41	1.43	0.97	1.43	1.06	1.00	0.81	0.86	0.91	1.0	0.73	0.86
16.	Na^+	mg/kg	23	16	19	15	31	14	32	30	30	27	28	29
17.	K^+	mg/kg	0.36	0.40	1.42	1.48	0.11	0.42	0.17	0.28	0.31	0.46	1.43	0.99
18.	NH_4^+	mg/kg	3.3	3.4	3.9	3.9	3.1	3.3	2.0	2.0	2.1	2.6	1.43	1.81
B.	**EXCHANGEABLE ANION**													
19.	SO_4^{2-}	mg/kg	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0
20.	NO_3^{2-}	mg/kg	23.2	21.7	20.8	20.0	22.9	23.7	17.4	12.5	20.8	19.5	14.8	10.7
21.	NO_2^{2-}	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
22.	N_2	mg/kg	5.1	4.6	5.1	5.8	3.3	6.0	8.1	2.3	1.9	5.5	7.0	4.3
23.	Cl_2	mg/kg	3.0	2.8	1.5	0.8	2.9	2.2	2.4	2.2	3.0	0.6	2.4	1.5
C.	**HEAVY METALS**													
24.	CU^{2+}	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
25.	Cd^{2+}	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26.	Ni^{2+}	mg/kg	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
27.	Ar	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
28.	Hg^+	mg/kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29.	Zn	mg/kg	1.3	1.3	3.0	2.0	1.4	2.0	0.3	0.9	1.0	2.3	1.0	3.0
30.	Fe^{2+}	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0
D.	**ORGANICS**													
31.	Oil & Grease	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0

32.	TPH	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33.	Xylene	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
34.	Benzene	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.	Toluene	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36.	PAH	mg/kg	0	0	0	0	0	0	0	0	0	0	0	0

Best wishes



ABDULKADIR H. UMAR
Principal Scientific Office

APPENDIX 2. 34083 QUARRY LEASE & AGREEMENT

FEDERAL REPUBLIC OF NIGERIA
MINISTRY OF MINES AND STEEL DEVELOPMENT
MINING CADASTRE OFFICE

Quarry Lease

No.: 34082 QLS

(Granted under the Nigerian Minerals and Mining Act, 2007)

A Quarry Lease is hereby granted to:

MUJTABA YUSUF RABIU

for the following mineral(s):

GRANITE

The Perimeter of the lease is delineated by geographic coordinates (Longitude/Latitude, Degree/Minute/Second) on Topographic map sheet of 1:50,000 scale (as in the plan annexed to this lease).

Number of Cadastral Units (CU): 4

Area (km^2): 0.8

Local Government Area(s): KUNCHI

State(s): KANO

The Quarry Lease is valid for a period of Five(5) years and is renewable. The holder of this Quarry Lease is required to perform his obligations in accordance with the provisions of the Nigerian Minerals and Mining Act, 2007, and its Regulations.

Effective Date: 12TH MAY, 2021

Expiry Date: 11TH MAY, 2026

Director General

Date: 02-07-2021

Warning: Failure to comply with the statutory obligations by the holder of this licence may lead to cancellation / revocation

Note: Renewals and endorsements are shown overleaf

FEDERAL REPUBLIC OF NIGERIA
MINING CADASTRE OFFICE
No. 37, Lobito Crescent Off Adetokumbo Ademola
Crescent, Wuse II, Abuja

MCO/CONC/QLS/34082.
12th May,2021.

MUJTABA YUSUF RABIU
NOTIFICATION OF GRANT FOR APPLICATION NO. 34082QLS..

I am directed to convey the Director General's approval on your application for Quarry Lease No. 34082QLS.

Number of Cadastral Units (CU)	-	**4**
Area (km^2)	-	**0.8**
Local Government(s)	-	**KUNCHI**
State (s)	-	**KANO**

2. Licences/Leases will be issued subject to full payment of the Annual Service Fee of **Two Hundred Thousand Naira (₦200, 000.00) only.** Payment has to be made and Treasury receipt obtained within **14** days from the date of receipt of this letter, failure of which will lead to the withdrawal of the grant in line with the provisions of Nigerian Minerals and Mining Regulations, 2011.

3. Payment should also be made into **NIGERIA MINING CADASTRE OFFICE AND CENTRES,** CBN e-Payment Platform with any Commercial Bank in Nigeria.

A. H. Damagum
For: Director General

MINISTRY OF MINES AND STEEL DEVELOPMENT

mmsdkano@gmail.com No. 2 Zaria Road, Kano.

MMSD/MID/KN/OP/QLS/125/1/39 26th October, 2021

Mujtaba Yusuf Rabiu,
No.5 Airport Road,
Kano State.

RE: NOTIFICATION FOR COMMENCEMENT OF OPERATION ON 34082 QL LOCATED AT HUGUM GUMAI VILLAGE, KUNCHI L.G.A., KANO STATE

May I Please refer to your letter dated 31st August, 2021 on the above subject matter, I am under obligation to grant you permission to commence operation on your Quarry Lease No. QL 34082

i. That you should work in line with the Nigeria Minerals and Mining Act, 2007 and it's regulation 2011.
ii. That you should always keep this office posted of any development on the course of your operation and that routine inspection shall be carried out by this office periodically as contained in section 17(a,b,f,g and h) of the Nigeria Minerals and Mining Act 2007 and section 121, 122, 140 and 145 of its regulation 2011.
iii. That you should abide by the content of the Community Development Agreement (CDA) and Minimum Work Programme (MWP).

Accept the warmest regards of this office, please.

Engr. Abah Paul O.
For: Federal Mines Officer,
Kano State.

.C:

1 The Honourable Chairman,
Kunchi L.G.A.
Kano State.

2 The Divisional Police Officer,
Kunchi L.G.A.
Kano State.

3 The Officer In-Charge,
Department of State Services
Kunchi L.G.A, Kano State.

4 The Officer In-Charge,
NSCDC,
Kunchi L.G.A, Kano State.

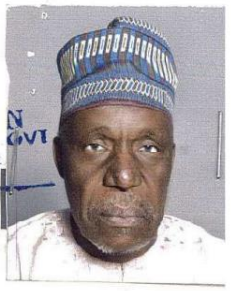
5. The District Head,
Kunchi L.G.A, Kano State.

6 The Village Head,
Hugum Gumai Village,
Kunchi L.G.A, Kano State.

Find attached the Quarry Lease No. QL34082 granted by the Ministry in accordance with Nigerian Minerals and Mining Act, 2007 and its Regulations, 2011.

Overleaf for your information, please.

Engr. Abah Paul O.
For: Federal Mines Officer,
Kano State.



KUNCHI LOCAL GOVERNMENT

KANO STATE

P.M.B. 3021
Kano - Nigeria

Tel:
Mobile:

(OFFICE OF THE EXECUTIVE CHAIRMAN)

In case of reply please quote reference
No. KCLG/FIN/S/27/VOL.II/28

Date: 7th June, 2021

Alh. Mujtaba Yusuf Rabi'u,
No. 5 Airport, Kano,
Kano State.

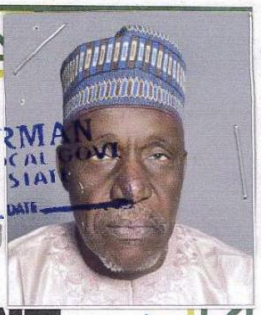
ALLOCATION OF LAND AT HUGUNGUMAI TOWN

To begin with the clear need for the Local Government Council to provide Socio-economic development of its populace; Kunchi Local Government Council after consideration to your application for the above captioned has grant you an approval based on the following conditions:-

1- The land of 83,500 Square Metres on approval plan situated at HUGUNGUMAI Town.
2- To be developed within the period of six months from the date of the allocation Letter.
3-That the land is only for Granite Quarry Operation Purpose only.
4. There should be no extension beyond the approval dimension.
5- You are to pay the sum of **₦ 5,000,000:00** only as allocation fee.
6. That the sum of **₦500,000:00** only as administrative charges to Kunchi Local Government.
7. That you are take care of community development corporate responsibilities.
8. Empowering and employment to the teeming populace.
9- Change of ownership should be reported to the Local Government Land Office.
10- That Failure to abide by any of the above conditions renders this permission null and avoid.

CHAIRMAN
KUNCHI L.G. GOVT
7-June 21

Executive Chairman
Kunchi Local Government



KUNCHI LOCAL GOVERNMENT

KANO STATE

The Land Native Rights Ordinance
(Chapter 05)
The Native Authority (Control Settlement)
Regulation 1949

Certificate of Occupancy

RESIDENTIAL, FARM LAND/PLOT OR BUILDING

DATE: 28/6/2021 ..... REF. NO: KCIG/FIN/VOLUME ..... II ..... PAGE 28 ...

This is to Certify

That: MUJTABA YUSUF RABIU of No.5 AIRPORT, KANO

Is entitled to a customary Right of Occupancy of GRANITE QUARRY OPERATION AT HUGUNGUMAI TOWN.

Settlement Area of Kunchi Local Government Kano State. And hold the said land for a term of 100 Year commencing from the: 28 Day of JUNE 20 2021 According to the true intent and meaning of the Land and Native Rights ordinance and of the Native Authority 1 {Control of Settlement and Regulations, 1949} and to the following terms of conditions vis:

Commencing Rate N #5,000,000,;OC K

Building Condition The: LAND ALLOCATION IS MAINLY FOR GRANITE QUARRY OPERATION ONLY.

The right of Occupancy under regulation 8 (2) (a) of the regulations, is granted For GRANITE QUARRY OPERATION Purposes only and is subject to condition set-out in Regulation 17 (I) and the following special conditions, vis:

granted on behalf of the Government and given under our hands for the year written above.

Sign.: 28-6-21

EXECUTIVE CHAIRMAN
Kunchi Local Government
Kano State

QUARRY SUBLEASE AGREEMENT

This Sublease Agreement ("this Agreement") is made effective **1 November, 2022** between **Mujtaba Rabiu Yusuf**, of **No 5 Airport Road, Kano State Nigeria** and **Esoterra Investment**, of **No.20 Ali Akilu Road Zadina Plaza Kaduna,**

In this Agreement, the party who is granting the right to use the leased property will be referred to as **"the Lessor"** and the party who is receiving the right to use the leased property will be referred to as **"the Lessee."**

I.RECITAL

1. The Lessor is the owner of a piece of land lying and situate at **Hugum Gumai Village, Kunchi L.G.A Kano, Nigeria** more particularly described in the Schedule hereunder written.

2. The said land and the surface underneath thereof is a quarry site fit for mining granite.

3. The Lessor is owner of **Quarry Lease No 34082** granted by the Mining Cadastral Office (MCO) Abuja, Nigeria, the government agency responsible for grant of lease to interested lessors.

4. The Lessee wishes to lease said land for the purpose of quarrying aggregate thereon and to obtain easements and rights of way for roads to the leased land so that it can operate the quarry.

5. The Lessor is willing and able to sublease said land lying and situate at Hugum Gumai Village, Kunchi L.G.A Kano to the lessee.

6. The sublease shall be for a **2 year term**, with an option to renew every 2 years.

I. NOW THIS DEED WITNESSES AS FOLLOWS:

Pursuant to this agreement and in consideration of the sublease fee and attendant royalty agreed to be paid by the Lessee as hereinafter provided and subject to the covenants terms, and conditions hereinafter mentioned, the Lessor shall sublease to the Lessee the said piece of land more particularly described in the Schedule hereunder written for a term of two years from the date hereof.

LESSOR OBLIGATIONS

(7) The Lessee shall pay to the Lessor an **annual lease fee of 25 million naira.**

(8) The Lessee shall pay to the Lessor at the time of signing this agreement and for a two year term, a **lump sum of 50 million naira.**

(9) The Lessee shall pay royalty according to statutory terms set out in the Minerals and Mining act of 2007.

(10) The Lessee shall be entitled to do, operate and bring in all equipment, tools, articles and things required to carry on quarrying operations.

(11) The Lessee shall be allowed to construct buildings temporary and/or permanent, put up infrastructure temporary and/or permanent, keeping and fixing equipment, articles and things as may be required and at convenient places on the said land.

(12) The Lessee shall be entitled to excavate and dig any part or parts of the said land for searching and obtaining stones accordingly.

(13) The Lessee shall not encroach upon or use any part of the land adjoining the said land, whether it belongs to the Lessor or any other person.

(14) The Lessee shall reserve the right to assign this lease or any right given hereunder.

(15) The Lessee will be entitled to engage contractors for carrying or transporting the stones from the said land.

(16) The Lessee shall pay royalty and all annual fees due to the Government for carrying on quarry operations.

(17) The Lessee shall develop and implement a social impact and community development program designed and implemented for the immediate local community.

LESSORS OBLIGATIONS

(18) The Lessor has in himself good right and full authority to sublease unto the Lessee the said land and in the manner herein appearing.

(19) That on the Lessee paying the said sublease fee and royalty in the manner aforesaid and observing and performing the covenants conditions and stipulations herein contained and on the part of the lessee to be observed and performed shall peaceably and quietly hold, possess and enjoy the subleased land during the term hereby created without eviction interruption, disturbance, claim and demand whatsoever by the Lessor or any person or persons lawfully or equitably claiming by, from, under or in trust for him.

III. IT IS FURTHER AGREED AS FOLLOWS:

20. DEFAULTS. Each party will abide by the obligations of this Agreement, either party shall have the option of cancelling this Agreement by providing 30 days' written notice to the other, with the option of preventing the termination of this Agreement by taking corrective action that cures the default, if such corrective action is taken prior to the end of the time period stated in the previous sentence, and if there are no other defaults during such time period.

21. CONFIDENTIALITY Each party shall treat as strictly confidential all information received or obtained as a result of entering into or performing this Agreement. Each party may disclose information which would otherwise be confidential if and to the extent: (i) required by the law of any relevant jurisdiction; (ii) the information has come into the public domain through no fault of that party; or (iii) the other party has given prior written approval to the disclosure, provided that any such information disclosed shall be disclosed only after consultation with and notice to the other party.

22. ARBITRATION. The parties will attempt to resolve any dispute arising out of or relating to this Agreement through friendly negotiations amongst the parties. If the matter is not resolved by negotiation within 30 days, the parties will resolve the dispute using the below Alternative (ADR) procedure. Any controversies or disputes arising out of or relating to this Agreement will be resolved by binding arbitration under the rules of Arbitration in the Federal Republic of Nigeria. The arbitrator's award will be final, and judgment may be entered upon it by any court having proper jurisdiction.

23. TRANSFER OF RIGHTS. This Agreement shall be binding on any successors, personal representatives, executors, and assigns of the parties.

24. TERMINATION. This Agreement may be terminated by either party by providing 30 days' written notice to the other party.

25. MAIN AGREEMENT. This agreement represents the fundamental understanding between parties and supersedes any prior or subsequent written or oral agreements between the parties.

26. AMENDMENT. This Agreement may be modified or amended, if the amendment is made in writing and is signed by both parties.

27. SEVERABILITY. If any provision of this Agreement shall be held to be invalid or unenforceable for any reason, the remaining provisions shall continue to be valid and enforceable. If a court finds that any provision of this Agreement is invalid or unenforceable, but that by limiting such provision it would become valid or enforceable, then such provision shall be deemed to be written, construed, and enforced as so limited.

28. REPRESENTATIONS AND WARRANTIES.

Each party to this Agreement represents and warrants to the other party that he/she/it:-

(a) has full power, authority and legal right to execute and perform this Agreement; (b) has taken all necessary legal and corporate action to authorize the execution and performance of this Agreement;

(c) this Agreement constitutes the legal, valid and binding obligations of such party in accordance with its terms; and

(d) shall act in good faith to give effect to the intent of this Agreement and to take such other action as may be necessary or convenient to consummate the purpose and subject matter of this Agreement.

29. INDEMNITY

(a) The Lessee shall indemnify and keep indemnified the Lessor against all losses costs, charges and expenses that the Lessor may suffer or incurs by:

(b) The Lessee committing breach of any law, rule or regulation or directions in connection with the quarrying operations.

(c) Any accident occurring during quarrying operations and transport of stones, any damage to property during quarrying operations.

30. TERMINATION

(a) The party to this agreement may terminate this lease by three months' prior notice to the Lessor.

(b) On the termination of this Lease by efflux of time or otherwise, the Lessee shall remove forthwith all the equipment, articles and things, sheds and quarried stones from the said land save for those exclusively acquired as part of a separate partnership agreement between the Lessor and Lessee.

31. APPLICABLE LAW This Agreement shall be governed by the laws of the Federal Republic of Nigeria.

32. SIGNATORIES. This Agreement shall be signed on behalf of Party A by **Mujtaba Yusuf Rabiu** and **Metteden Abba.Abdulrahman** on behalf of **Party B, Esottera Investment**, and shall be effective as of the date first above written.

LEASOR:

Mujtaba Rabiu Yusuf

Sign: _____

Date: 22/9/2022

In the Presence of:

Name: AMMAR MUJTABA

Address: SANI MAINAGGE B

Occupation: TREDING

Signature: _____

LEASEE:

ESOTERRA INVESTMENT

Metteden Abba.Abdulrahman

Sign: _____

Date: 23/09/2023

Lessee: _____

Esoterra Investment

Abdulrahman Abba Metteden

Sign:_____

Date: 23/09/2023

THE COMMON SEAL OF ESOTERRA INVESTMENT is hereby affixed and executed in the presence of:

Director:

Sign:_____

Director: Suleiman Nasiru Wada

Sign:_____ 30/09/22

DRAFT ADDENDUM TO QUARRY SUBLEASE AGREEMENT

This addendum is made as part of the initial quarry sublease agreement made between, **Mujtaba yusuf Rabiu**, the sublessor of **No 5 Airport Road, Kano state Nigeria** and **Eso Terra investment**, of **No 20 Ali Akilu road zadina plaza Kaduna**. the **sublessee.** It shal hereinafter refer to as (the agreement) and shall be effective this **23rd day of October 2023**.

RECITAL

1. The sublessor is the owner of a piece of land lying and situated at **Hugungumai Village, Kunchi LGA Kano Nigeria** more particularly described in the schedule hereunder written.
2. The said land and the surface underneath thereof is a quarry site fit for mining granite.
3. The sublessee wishes to sublease said land for the purpose of quarrying aggregate there on and to obtain easements and rights of way for roads to the subleased land so that it can operate the quarry.
4. The sublessor is owner of **Quarry Lease No 34082** Granted by the mining Cadastral office (MCO) Abuja, Nigeria, the government agency responsible for grant of lease to interested sublessors.
5. The sublessor is willing and able to sublease said and lying and situate at Hugungumai Vilage, Kunchi L.G.A Kano to the sublessee.
6. This addendum is made within the period of the current and subsisting sublease tenure and shall form part of this agreement.
7. All other terms contained in the initial agreement remain valid.
8. Both parties hereby mutually agree to make additional provisions to their initial agreement as follows.

Page 1 of 3

ADDENDUM

1. There shall be an extension of the agreement from the initial period of two (2) years, payment for which has been made by the sublessee to the sublessor, to a further and extended period of two (2) years, payment for which shall be made at the expiration of the current sublease tenure.

2. The sublessee shall pay to the sublessor the sum of (62,500,000) sixty two million five hundred thousand naira for the extended tenure of two (2) years at the expiration of current sublease tenure, and sublessee well pay 10% out of the total amount after sign this agreement. Which is (6,250,000) six million two hundred and fifty thousand naira only. The remaining blance are (56,250,000) will be paid on or before 30th October, 2024.

3. The sublessor shall transfer the Quarry license 34082 to the sublessee for a period of 3 years, commencing from the execution of this addendum, and include the extended period of 2 years.

4. The said license shall revert back to the sublessor and the end of the (3) year tenure, for the period as above written.

5. The transfer of mining title is to ensure hitch-free operation of the Quarry by the sublessee.

6. All expenses for transfer of said title from the sublessor to the sublessee shall be borne by the sublessee.

This addendum supplements, supersedes and revokes any inconsistenr provision that may be contained in the intial quarry sublease agreement.

IN WITNESS where of the addendum has been executed and delivered on the date first above written.

LEASOR:

Mujitaba Yusuf Rabiu

Sign: ____________________

Date: 14/11/2023

In the Presence of:

Name: Ammar Mujitaba Yusuf

Address: SANI MAINAGGE B

Occupation: SON

Signature: ____________________

LEASEE:

ESO TERRA INVESTMENT LIMITED

Metteden Abba Abdulrahman

Sign: ____________________

Date: 15/11/2023

THE COMMON SEAL OF ESO TERRA INVESTMENT is hereby affixed and executed in the presence of:

Director: Suleiman Wada

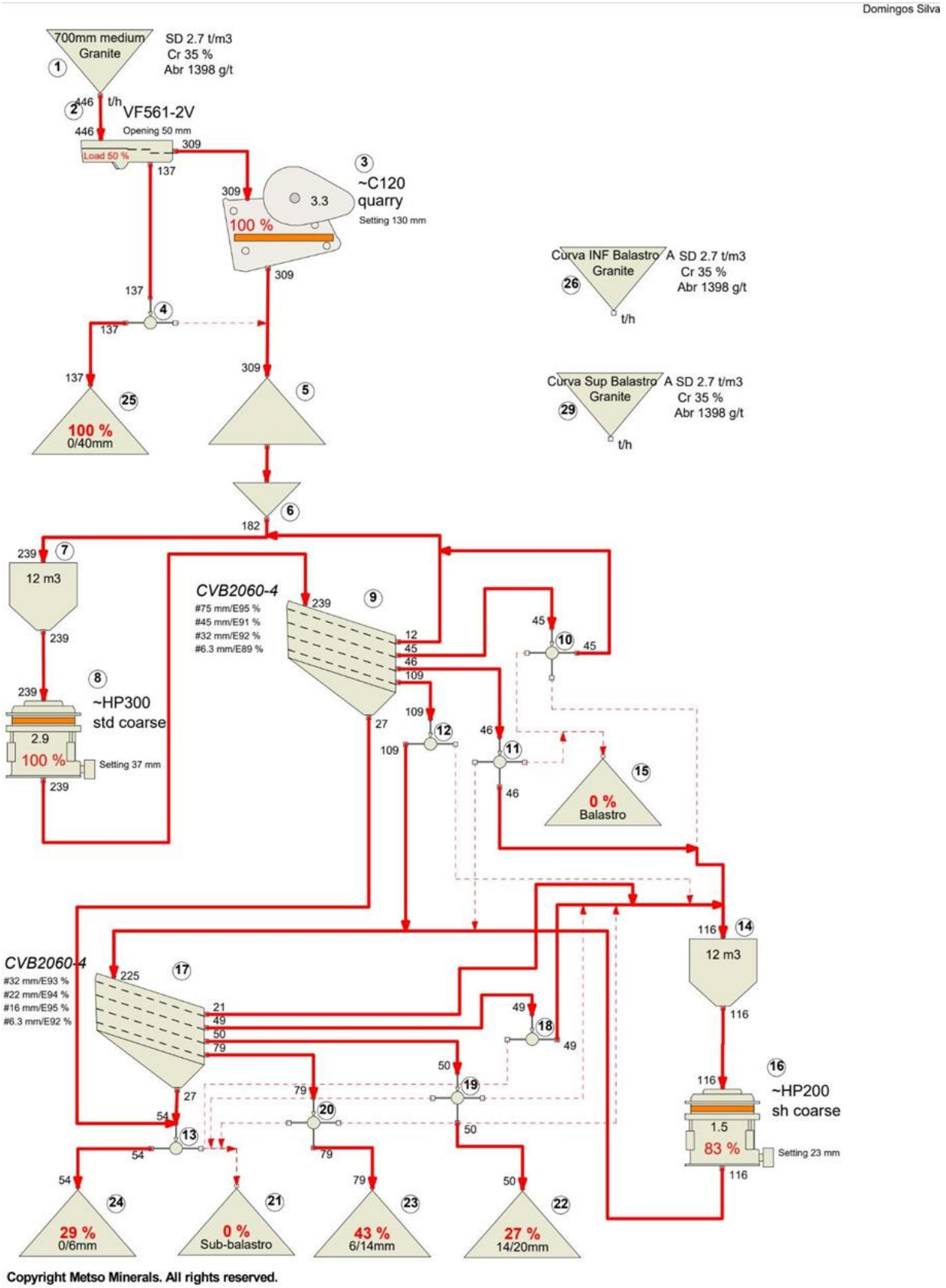
Sign: ____________________

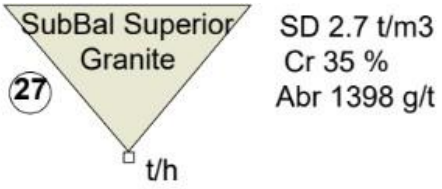
Director: Muhammed Bashir Wada

Sign: ____________________

Page **3** of **3**

APPENDIX 3. QUARRY DESIGN

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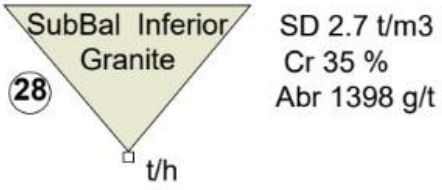
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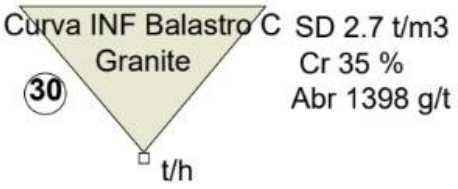
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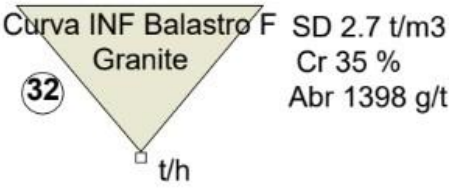
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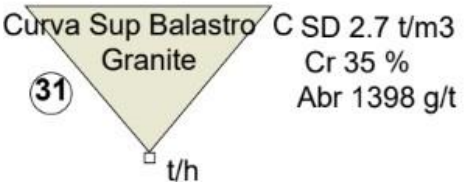
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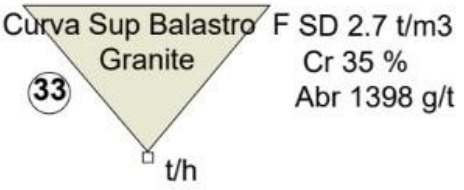
Curva Sup Balastro F
Granite
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Cr 35 %
Abr 1398 g/t

APPENDIX 4. SOCIO ECONOMIC QUESTIONAIRRE

SOCIOECONOMIC

Snafcore Limited
RC1637728

QUESTIONNAIRE ON SOCIO-ECONOMIC, CHARACTERISTICS OF SETTLEMENT/NEIGHBORHOOD (S) FOR ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT (ESIA)

FCDA is conducting an Environmental Impact Assessment of a proposed Infrastructural development project, located in _____ Area Council of _____ This is to minimize/reduce the impact of the road project in the surrounding environment.

Please, take time to complete this questionnaire. The questionnaire will NOT be used to provide a basis for gain or compensation to any individual or the community. So kindly provide realistic answers as close to the correct situation as possible.

SECTION A

EIA Project. _____

Community _____

LGA _____

Date _____ / _____ /_____ Time _____

Major Community _____

State _____

Name of the major community association _____

Chairperson _____

Vice Chairperson _____

Secretary _____

Functions of Association _____

SECTION B

HISTORY, TRADITIONAL AND ADMINISTRATIVE STRUCTURE OF COMMUNITY/GROUP OF COMMUNITIES

Is the village part of a clan? ☐ Yes ☐ No

Name of clan: if yes _____

When was the community founded? _____

Traditional chiefs of the village /group of villages. Provide Titles, Name and Rank (after the highest traditional ruler) _____

Name the ethnic group(s) that founded the village/Community _____

Who is the overall/Highest traditional and administrative ruler of the community:

Title _____

Name _____

Where does he reside? _____

Is there a Council of Chiefs? ☐ Yes ☐ No

State Functions of Council of Chiefs

Is there a Council of Chiefs? ☐ Yes ☐ No

Name

Title

SECTION C
CULTURAL, RELIGION AND ARCHEOLOGICAL

Please complete

	Name of shrine/Deity Worshipped in community	Location e.g., House, farm, road junctions etc.	Material used for worshipping	Time of year/Frequency for worshipping
1				
2				
3				

Name of sacred forest and their locations

Name of Sacred Forests	Locations

Name of Festival	Time of Year Celebrated
i	

Name forest reserve (s) within the near community

Name of lakes

Name sites of archaeological interest e.g., for digging ground to study culture of area

Name of River/Streams

Name two major social clubs in community

Name community –based improvement schemes/organization including community bank or monthly contributions paid per household

Give name & type of religion observed in the community ☐ Islam ☐ Christianity ☐ Traditional ☐ Others

SECTION D
DEMOGRAPHY

Give estimate of: Male Female Children Total

Ethnic population of the community:

SN	Ethnic group	Total Population
1		
2		
3		
4		
5		
6		
7		
8		

Age distribution. Give estimate of age groups in community

	Male	Female	Total
Number below 10 years			
Number between 10-20 years			

Number between 21-30 years			
Number between 31-40 years			
Number between41-50 years			
Number 50 years and above			
Total			

Gender Issues

Do you think males and females should have equal rights?	☐ Yes	☐ No	If you were to choose, what sex of children would you prefer?	☐ Yes	☐ No
Do you think it is all right for a married couple to have equal say on important decision in the house?	☐ Yes	☐ No	Do you think women should have same opportunities as men in leadership?	☐ Yes	☐ No
Do you think that parents should encourage their daughters to aspire for professional position in life?	☐ Yes	☐ No	Do you think a woman can make good decisions on important matters?	☐ Yes	☐ No

Household Facility Ownership

Which of these facilities do you own, and (are available in community and in use)?

☐ Radio ☐ Television ☐ Refrigerator ☐ Telephone ☐ GSM Phone ☐ Wristwatch ☐ Bicycle ☐ Motorcycle ☐ Motor Car

Others

Transportation

What is the major means of transportation in the community?

☐ Motor Car/Lorry/Truck ☐ Bicycle ☐ Motorcycle Others

Means of Communication

Which of these telecommunication services are available in your community or what means of communication is in use?

☐ MTN ☐ GLO ☐ ETISALAT ☐ MULTI-LINKS ☐ STARCOM Others

SECTION E

ECONOMY

Occupation/Employment Profile of community and income

Occupation type	Number of people	Amount earned per month	Occupation type	Number of people	Amount earned per month
Farming			Local gin brewing for sale		
Trading			Lumbering/timber extraction		
Casual labourers			Livestock breeding for selling		
Chemist storekeepers			Mechanic		
Contractors			Medical doctor		
Craft making			Native doctor		
Canoe building			Night security guard/security		
Domestic servant /Houseboy/H. girl			Nursing		
Drivers (commercial motor)			Public servant/LGA worker		
Drivers (Okada)			Privately employed		
Canoe ferrying			Sand collection/selling		
Electrician			Teaching		
Food cooking for selling			Trading/petty selling /marketing		
Firewood collection for sale			Unemployed		
Fishing activities			Total		
Hunting					

Major crops grown in community

i. ii. iii.

iv. v. vi. vii.

Major Livestock Reared in the community

i. ii. iii.

iv. v. vi. vii.

Fishing Equipment?

☐ Cast Net ☐ Hooks on thread and stocks ☐ Fishponds ☐ Basket traps ☐ Fish Fences ☐ Pensioning fish with chemicals

SECTION F

INDUSTRIAL

Name companies/industries present in the area.

	Name	**Address or location**
a		
b		
c		
d		
e		
f		

Name and address/locations of hotels and guest house present within or near the community

Hotels/Guest House	**Address**

Name of banks in or near community/communities

Hotels/Guest House	**Address**

SECTION G

EDUCATION

Name, address, and ownership of educational institution in the area

Nursery/Primary School	**Address**

Secondary/Commercial	**Address**

Technical School	**Address**

SECTION H

HEALTH FACILITIES

Is there a health care facility in your community? ☐ Yes ☐ No

What are the sources of the medical supplies?

What kind of health facility do you have? ☐ First Aid ☐ Clinic ☐ Health Centre ☐ Maternity Ward ☐ Hospitality

Does the health facility have qualified health personnel? ☐ Yes ☐ No

Does it have adequate medical supplies? ☐ Yes ☐ No

How long does it take to reach the facility from your house? ☐ <15min ☐ 15-30min ☐ 30-45min ☐ >60 min

Do you visit the clinic whenever you or any other member of your household falls sick? ☐ Yes ☐ No

If no to question 77, why is it so? ☐ Poor and inadequate drugs ☐ Too far from my house ☐ Health staff over-stretched Others

Which diseases are most prevalent in your community?

State major environmental problems that are envisaged in the area with the proposed project. Tick, where appropriate.

Flooding: _____
ii. Deforestation: _____
iii. Wildlife disappearance: _____
iv. Air pollution: _____
v. Soil erosion: _____
vi. Solid waste disposal: _____
vii. Water pollution: _____
xiii. Unfertile soil: _____
ix. Plant/crop diseases: _____
x. Water supply: _____
xi. Others:_____

What type of toilet do you use in your household? ☐ Pit Latrine ☐ Near Bush ☐ Water Closet Others

How does this household dispose of its rubbish (solid wastes?) ☐ Collected by Government ☐ Buried by Household ☐ Public Approved Dump ☐ Unapproved Gump Site ☐ Dispose to farmlands ☐ Burning ☐ Family Refuse Dump

SECTION I
ENERGY SOURCES

What type of energy/fuel (source) do you use in your house for lighting? ☐ Electricity ☐ Gas ☐ Kerosine ☐ Candle ☐ Solar Others

What type of energy/fuel (source) do you use in your house for cooking? ☐ Firewood ☐ Kerosene ☐ Animal Dump ☐ Sand Dust ☐ Cornstalk ☐ Rice Chaff ☐ Charcoal ☐ Sugarcane wastes Others

WATER SUPPLY

Which of these water sources is available to you for both domestic and livestock consumption? ☐ Pipe Bone ☐ Borehole ☐ Open well ☐ Stream ☐ Earth Dam Others

How long does it take you to reach the source (to and from)? ☐ <20min ☐ 20 – 40min ☐ 40 – 60min ☐ >60min

SECTION H
ENVIRONMENTAL IMPACT OF THE PROJECT ON COMMUNITY

How do you think the proposed project will affect the community base on the following?

		Adverse	Decrease	Increase	Positive	Beneficial	None

1	Population of community						
2	Employment opportunities						
3	Income						
4	Traditional rulers/village headship						
5	Settlement pattern						
6	Sacred shrine						
7	Medicinal plants						
8	Religious worship						
9	Sacred forest						
10	Water bodies						
11	Festivals/celebrations						
12	Ethnic composition						
13	Age distribution of comm.						
14	Fisheries						
15	Wildlife						
16	Farming						
17	Companies/other estates						
18	Educational institutions						
19	Literacy level of community						
20	Housing						
21	Transport						
22	Electricity supply						
23	Roads and drainage						
24	Health institutions						
25	Water						
26	Land						
27	Air quality						
28	Communication system						
29	Fuel for households						
30	Community security						

SECTION I

What are the community concerns regarding this proposed project?

APPENDIX 5. FMEnv CORRESPONDENCES

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Email: info@ead.gov.ng, www.ead.gov.ng, www.eia@ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMEnv/EA/EIA/6711/Vol.1/32
31st October, 2022

The Managing Director,
Eso Terra Investment Limited,
No 2 Waziri Ibrahim Crescent,
Abakpa GRA, Kaduna,
Kaduna State.

RE: APPLICATION FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED GRANITE QUARRY (34082QL) IN HUGUNGUMAI VILLAGE, KUNCHI LGA KANO STATE.

Please refer to the letter through your Environmental Consultant Snafhcore Limited dated 24th October, 2022 on the above project.

2. I am directed to acknowledge receipt of the letter and evidence of payment of Fifty Thousand Naira (₦50,000.00) only with Remita Retrieval Reference (RRR) No.2307-3121-5123 dated 24th October, 2022 as EIA Registration fee for the project.

3. Please note that you are requested to forward to the Ministry a letter introducing the Environmental Consultant for the proposed project. However, the Site verification exercise has been scheduled to hold in fourth quarter, 2022. The exercise will be carried out by officials of this Ministry and Kano State Ministry of the Environment.

4. Consequently, you are to pay the sum of Four Hundred and Ninety-Nine Thousand Seven Hundred Naira (₦499,700.00) only for the exercise. You are also requested to kindly provide necessary logistics support and Technical Personnel on site to ensure a hitch free exercise please.

5. Furthermore, the exercise shall take into cognizance the COVID-19 Prevention Guidelines as issued by the Nigeria Center for Disease Control (NCDC), the Federal Ministry of Health and State's regulations.

6. You may wish to contact the undersigned on GSM number 08037869670 or Ladula, H.D. (08020910889) to confirm the receipt of this letter and for any clarification please.

7. Thank you for your co-operation.

Engr. Gomwalk, Celestine W.G.
For: Honourable Minister

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Email: info@ead.gov.ng, www.ead.gov.ng, www.eia@ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMEnv/EA/EIA/6711/Vol.1/31
7th November, 2022

The Managing Director,
Eso Terra Investment Limited,
No 2 Waziri Ibrahim Crescent,
Abakpa GRA Kaduna,
Kaduna State.

RE: APPLICATION FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED GRANITE QUARRY (34082QL) IN HUGUNGUMAI VILLAGE, KUNCHI LGA KANO STATE.

Please refer to your letter dated 24th October, 2022 on the above project.

2. I am directed to inform you that regulators from the Federal and State Ministries of Environment shall participate in the Scoping Workshop Exercise.

3. Consequently, you are to pay the sum of Two Hundred and Fifty Thousand Naira (₦250,000.00) only for the exercise. You are also requested to kindly provide necessary logistics to ensure a hitch free exercise

4. You may wish to the contact the undersigned on GSM number 08037869670 or Ladula, H.D. (08020910889) to confirm the receipt of this letter and for any clarification please.

4. Thank you for your Co-operation.

Engr. Gomwalk, Celestine W.G.
For: Honourable Minister

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Email: info@ead.gov.ng, www.ead.gov.ng, www.eia@ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

FMEnv/EA/EIA/6711/Vol.1/32
7th November, 2022

The Managing Director,
Eso Terra Investment Limited,
No 2 Waziri Ibrahim Crescent,
Abakpa GRA Kaduna,
Kaduna State.

RE: APPLICATION FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED GRANITE QUARRY (34082QL) IN HUGUNGUMAI VILLAGE, KUNCHI LGA KANO STATE.

Please refer to your letter dated 24th October, 2022 on the above project.

2. I am directed to inform you that officials from the Federal Ministry of Environment shall participate in the Data Gathering and witness the Laboratory analysis Exercises.

3. Consequently, you are to pay the sum of Five Hundred Thousand Naira (₦500,000.00) only for both exercises. You are also requested to kindly provide necessary logistics to ensure a hitch free exercise

4. You may wish to the contact the undersigned on GSM number 08037869670 or Ladula, H.D. (08020910889) to confirm the receipt of this letter and for any clarification please.

4. Thank you for your Co-operation.

Engr. Gomwalk, Celestine W.G.
For: Honourable Minister

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Email: info@ead.gov.ng, eia@ead.gov.ng www.ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

Ref: FMEnv/EA/EIA/6711/xx
Date: 5th December, 2022

The Managing Director,
Eso Terra Investment Limited,
No. 2, Waziri Ibrahim Crescent,
Abakpa GRA.
Kaduna,
Kaduna State.

TECHNICAL REVIEW EXERCISE ON THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF THE PROPOSED HUGUNGUMAI GRANITE QUARRY PROJECT AT HUGUNGUMAI, VILLAGE, KUNCHI LOCAL GOVERNMENT AREA, KANO STATE.

The above project subject refers please.

2. In line with the stipulations of the EIA Act Cap E12 LFN 2004, I am directed to inform you that the Honorable Minister has approved the constitution of a panel to review the draft EIA report of the project.

3. The panel is made up of experts as well as relevant regulators from Kunchi LGA, Kano State Ministry of Environment, Ministry of Mines and Steel Development (MMSD) as well as the Federal Ministry of Environment. The exercise shall involve a review session in which you the proponent will make presentations of the projects' Technical aspects and EIA study to the Panel and stakeholders present. The review meeting is scheduled to hold in fourth (4th) quarter, 2022. The actual venue for the exercise shall be communicated to you in due course.

4. I am further directed to provide herewith for your information and guidance, the activities and matters to be handled by your Organization for the review exercise: -

i. Payment of the sum of One Million, Nine Hundred and Thirty-two Thousand, Five Hundred Naira **(₦1,932,500.00)** only, being honorarium and travel allowances for the Panel Members and the Secretariat Staff as well as operational charges.
ii. Provision of secure accommodation and feeding for Ten (10) persons including two (2) suites in a hotel to be decided in due course.
iii. Provision of adequate meeting venue within the hotel equipped with public address system and a seating capacity of up to Thirty (30) persons.
iv. Provision of tea and snacks as well as group lunch for the above persons at the same venue.
v. Provision of adequate logistic support to ensure a hitch-free site visit to the project location for the panel members and secretariat staff.
vi. Ensure participation of project host communities.

5. Please note that the Ministry shall not be responsible for the settlement of any bill that may be incurred in the course of the panel review exercise. For further clarification, you may wish to contact the undersigned on **0803-786-9670** or Dr. **Musa Gashau on 0803-314-1766.**

6. Thank you for your cooperation.

Engr. Gomwalk Celestine W. G.
For: Honorable Minister

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja-FCT.
Email: info@ead.gov.ng, www.ead.gov.ng, www.eia@ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

Ref: FMEnv/EA/EIA/6711/Vol.1/123
Date: 13th February, 2023

The Managing Director,
Eso Terra Investment Limited,
No 2, Waziri Ibrahim Crescent,
Abakpa GRA, Kaduna,
Kaduna State.

FINAL ASSESSED CHARGE FOR THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF THE PROPOSED GRANITE QUARRY PROJECT AT HUGUNGUMAI VILLAGE, KUNCHI LOCAL GOVERNMENT AREA, KANO STATE

Please refer to the Technical Review meeting held on 20th December, 2022 on the above named project.

2. Following the conclusion of the review exercise, I am directed to inform you that the draft report was considered satisfactory.

3. I am further directed to inform you of the following matters to be handled by your Company: -

a) The submission of five (5) hard and two (2) electronic (in PDF) copies of the final EIA report having addressed the omissions from the draft report, within two (2) months on receipt of the Ministry's harmonized comments (herewith attached).

b) Payment of the Final Assessed Charge (FAC) to the Ministry for the EIA Approval as per the attached invoice.

4 Kindly note that this is not an Approval Letter and that the EIA Approval shall only be issued on the confirmation that items 3 (a) and (b) above have been satisfactorily complied with.

5. Thank you for your co-operatio

Abbas O. Suleiman
Director, Environmental Assessment Dept.
For: Honourable Minister

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja-FCT.
Email: info@ead.gov.ng, www.ead.gov.ng, www.eia@ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

Ref: FMEnv/EA/EIA/6711/Vol.1/122
Date: 13th February, 2023.

The Managing Director,
Eso Terra Investment Limited,
No 2, Waziri Ibrahim Crescent,
Abakpa GRA, Kaduna,
Kaduna State.

INVOICE

FINAL ASSESSED CHARGE FOR THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF THE PROPOSED GRANITE QUARRY PROJECT AT HUGUNGUMAI VILLAGE, KUNCHI LOCAL GOVERNMENT AREA, KANO STATE

S/N.	ITEM DESCRIPTION	AMOUNT (₦)
I	Impact Mitigation Monitoring (IMM) for the first exercise (Operational)	500,000.00
ii.	Final Assessed Charge for the establishment of granite quarry project at Hugungumai Village, Kunchi LGA, Kano State @ ₦1,000,000.00. Payment of Government Revenue (30%)	300,000.00
iii	Final Assessed Charge for the establishment of granite quarry project at Hugungumai Village, Kunchi LGA, Kano State @ ₦1,000,000.00 Payment of Operational Charges (70%).	700,000.00
	Final Assessed Charge	**1,500.000.00**

The total amount payable as Final Assessed Charge to Federal Ministry of Environment for issuance of Environmental Impact Assessment (EIA) Certificate and Environmental Impact Statement (EIS) for the proposed project is One Million Five Hundred Thousand Naira (₦1,500.000.00) only, as follows:-

a. Project Assessed Charge (Government Revenue): Three Hundred Thousand Naira (₦300,000.00) only
b. Project Assessed Charge (Operational): Seven Hundred Thousand Naira (₦700,000.00) only.
c. Impact Mitigation Monitoring Exercise (Operational): Five Hundred Thousand Naira (₦500,000.00) only.

2. The payment of items a, b and c above shall be made separately into the Federal Government's Treasury Single Account (TSA) via remita platform @ www.remita.net

3. The evidence of both payments shall be forwarded to the Federal Ministry of Environment's Headquarters at Mabushi, Abuja-FCT.

Abbas O. Suleiman
Director, Environmental Assessment Dept.
For: Honourable Minister

FEDERAL MINISTRY OF ENVIRONMENT

Environment House
Independence Way South, Central Business District, Abuja - FCT.
Email: info@ead.gov.ng, eia@ead.gov.ng www.ead.gov.ng

ENVIRONMENTAL ASSESSMENT DEPARTMENT

Ref: FMEnv/EA/EIA/6711/Vol.1/124

Date: 14th February, 2023

The General Manager,
Eso Terra Investment Limited,
No. 2, Waziri Ibrahim Crescent,
Abakpa GRA, Kaduna
Kaduna State.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF THE PROPOSED GRANITE QUARRY PROJECT AT HUGUNGUMAI VILLAGE, KUNCHI LOCAL GOVERNMENT AREA, KANO STATE

I am directed to inform you that the above named project has been registered with the Federal Ministry of Environment for an EIA permit.

2. The EIA approval is at an advanced stage, the Panel/Stakeholder's Review has just been concluded and the EIA was adjudged satisfactory. The EIA Approval and Certificate shall be issued in due course.

3. Thank you for your cooperation.

Dr. Abbas .O. Suleiman
Director, Environmental Assessment Department
For: Honourable Minister.

APPENDIX 6. FIELD PHOTOS