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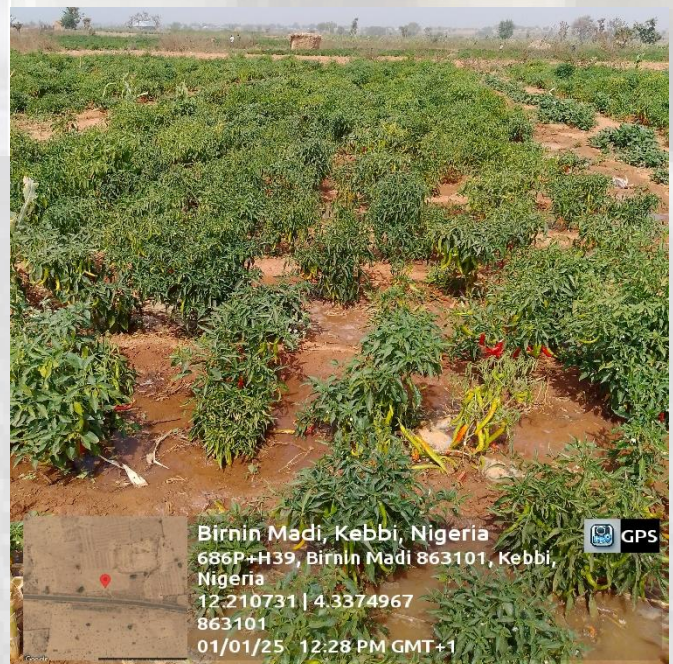
**FINAL ENVIRONMENTAL
AND SOCIAL IMPACT
ASSESSMENT
(ESIA) REPORT**

FOR THE

**PROPOSED SOKOTO-BADAGRY
SUPERHIGHWAY SECTION 2, 323KM:
SPANNING FROM ALFALA (SILAME
LG) SOKOTO STATE, TO BALUGU
(BAGUDO LG) KEBBI STATE,
NIGERIA.**

BY

FEDERAL MINISTRY OF WORKS



FEBRUARY, 2026

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BY



FEDERAL MINISTRY OF WORKS, MABUSHI, ABUJA

**SUBMITTED TO
FEDERAL MINISTRY OF ENVIRONMENT, ABUJA**

FEBRUARY, 2026

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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviations and Units of Measurement

°C	Degrees Centigrade
dB (A)	Decibel Class A
EC	Electrical Conductivity
g/kg	Gram per kilogramme
km	Kilometre
mg/kg	Milligrams per kilogramme
mg/l	Milligrams per litre
ml	Millilitre
mm	Millimetre
NTU	Nephelometric Turbidity Units
Ppm	Parts per million
ug/m ³	micro gram per meter cube
µS/cm	Micro Siemens per centimeter
%	Percentage

General Abbreviations and Acronyms

AC	Alternative Current
AIDS	Acquired Immune Deficiency Syndrome
APHA	American Public Health Association
ALARP	as Low as Reasonably Practicable
ASTM	American Society for Testing and Material
BAT	Best Available Technology
BACT	Best Available Control Technology
BMP	Best Management Practices
Ca	Calcium
Cd	Cadmium
CE	Chief Engineer
CEC	Cation Exchange Capacity
CO	Carbon Monoxide
Cond	Conductivity
CO _x	Oxides of Carbon
Cr	Chromium
Cu	Copper
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agencies
ERM	Emergency Response Management
Fe	Iron
FEPA	Federal Environmental Protection Agency
FME _{env}	Federal Ministry of Environment
FMW	Federal Ministry of Works
GPS	Geographical Positioning System
GIIP	Global International Industry Practice

HCN	Hydrogen cyanide
Hg	Mercury
HIV	Human Immune Virus
HSE	Health, Safety and Environment
HUB	Hydrocarbon Utilizing Bacteria
HUF	Hydrocarbon Utilizing Fungi
ISO	International Organization for Standardization
IPA	International Planning Associate
ITCZ	Inter Tropical Convergence Zone
IFC	International Finance Cooperation
K	Potassium
LGAs	Local Government Areas
Mg	Magnesium
Mn	Manganese
Na	Sodium
NGO	Non-Government Organization
NIIMP	National Integrated Infrastructure Master Plan
Ni	Nickel
NIMET	Nigerian Meteorological Agency
NBS	National Bureau of Statistics
NPC	National Population Commission
NPE	National Policy on the Environment
NO _x	Nitrogen Oxides
NGOs	Non-Governmental Organizations
OMC	Optimum Moisture Content
Pb	Lead
PVC	Polyvinyl Chlorides
PPE	Personal Protective Equipment
PPM	Parts per Million
PSD	Particle Size Distribution
PMT	Project Management Team
PVD	Prefabricated Vertical Drains
QA/ QC	Quality Assurance/Quality Control
RHIDF	Renewed Hope Infrastructure Development Fund
SIA	Social Impact Assessment
SO _x	Oxides of Sulphur
SBS	Sokoto-Badagry Superhighway
SBS-2	SBS, Section 2 (Kebbi Section)
SPM	Suspended Particulate Matter
TAH	Trans-African Highways
TOR	Terms of Reference
TDS	Total Dissolve Solids
V	Vanadium
VOCs	Volatile Organic Compounds
WB	World Bank
WHO	World Health Organization
Zn	Zinc

LIST OF ESIA PREPARERS

S/N	Name	Qualification	Responsibility	Phone Number
1	Dr. Walter Olatunde	PGCM	Project Director	08136309027
2.	Mr. Marquis Okoruwa	PMP, ESGC, IDD	Project Manager	07010350141
3.	Engr. Gomwalk Celestine	M. Sc Chemical Engineering	Lead Consultant	08171521964
4.	Prof. Samaila K. Ahmad	PhD Fluid Dynamics	Planning/Coordination/Zoology Studies	08036120027
5.	Prof. Haliru M. Bandiya	PhD Zoology	Wildlife and Ecology	08065911577
6.	Prof. Alhassan D. Isah	PhD Forestry	Land use, vegetation, and forestry	08036775054
7.	Prof. Murtala A. Gada	PhD Hydrology	Land Resources management, Hydrology, RAP studies and community issues	08036027104
8.	Dr. Murtala Dangulla	PhD Environmental Quality & Conservation	Socio- Economist, Gender studies/ RAP remuneration	08035776554
9	Dr. Emmanuel Afeonkhai	PhD Environmental Management	Noise and Air quality, Meteorology and climatic studies.	080693377446
10	Dr. Putshaka Danladi Julius	PhD Industrial Chemistry	Waste Management Expert	08065305552
11.	Engr. Dr. Tayyib M. Bello	PhD Civil Engineering	Road Transport development, Hydrogeology, Hydrology	08065296698
12.	Engr. Atiku Muhammad Shagari	B. Eng. Civil Engineering	Geotechnical studies, Highway Design and road alignments,	08035073079
14.	Cynthia Azinwa	PGCM	Field Assistance/Gender and Social Inclusion	08067320807
15.	Kelvin Ijoko	B. Sc Business Administration	Field Assistant	08180700404
16.	Elizabeth Ene Joseph	B. Sc Environmental Science & Mngt	Field Assistant	08167269910

EXECUTIVE SUMMARY

ES 01. INTRODUCTION

Background

The Proposed Sokoto-Badagry Superhighway (SBS) is a 950km three-lane dual carriageway initiated by the Federal Government of Nigeria to enhance national and regional economic integration. It will connect **Section 2** at Alfala in Sokoto state, proceeds to Balugu in Kebbi state and link with the Kwara section (**section 3**) at Karunji, Kwara state. The SBS highway spans seven states, including Sokoto, Kebbi, Niger, Kwara, Oyo and Ogun, terminating at Badagry, Lagos state which is home to a proposed deep seaport. It is hoped that this superhighway will serve as a critical north-south economic corridor, linking the Ndjamena-Dakar TAH5 and Lagos-Dakar TAH7 Trans-African Highways. The project aims to address transportation challenges, improve mobility, and boost socioeconomic development in a region projected to reach 120 million people in 25 years. Federal roads, which carry over 80% of the nation's traffic, are in poor condition, with 40% needing urgent rehabilitation; the SBS will help bridge this infrastructure gap. The Renewed Hope Infrastructure Development Fund (RHIDF) has allocated \$25 billion annually for road projects, including the SBS, over the next eight years. The highway will accommodate future rail infrastructure within its 100-meter right-of-way, ensuring long-term scalability and sustainability. The SBS is expected to foster national cohesion by integrating Northern culture with Southern commerce and facilitating regional trade. An Environmental and Social Impact Assessment (ESIA) for the 323km Section 2 in Kebbi State is being conducted by TSL Engineering Limited. The ESIA complies with national and international standards, ensuring sustainable project execution under the Federal Ministry of Works and the Federal Ministry of Environment.

The Project Proponent

The Federal Ministry of Works (FMW) is the proponent of the Proposed Sokoto-Badagry Superhighway, **Section 2**, spanning 323km from Alfala in Sokoto state to Balugu in Kebbi state (Henceforth referred to as SBS-2). The FMW is responsible for planning, developing, and maintaining federal road infrastructure across Nigeria, ensuring compliance with safety standards and stakeholder coordination. Its headquarters is in Mabushi, FCT, Abuja.

ESIA Objectives

The main objective of the ESIA study for the proposed project is to ensure that due consideration is given to the environment at every stage of the proposed project development, i.e. the project planning, construction, operation and decommissioning stages of the project. Other objectives are detailed in the body of this report.

EIA Methodology

The Environmental Impact Assessment study for the proposed SBS-2 was carried out in accordance with the Federal Ministry of Environment's (FMEnv) EIA Act CAP E12 LFN 2004 requirements and EIA Procedural and Sectoral Guidelines of 1995. It involved a multidisciplinary team of experienced researchers employing standard methods from pure science, engineering and social sciences to obtain data for impact identification and establishment of mitigative and monitoring measures.

Administrative and Legal Framework

The construction, operation and decommissioning activities of the proposed project shall be guided by extant national Such as the National Transport Policy, 2010, National Policy on the Environment 1989 (Revised 2016), EIA Act Cap E12 LFN 2004, NESREA Act No. 25, 2007, Federal Road Safety Commission (Establishment) Act, 2007, Forestry Act CAP 51 LFN 1994, National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991 (S.I. No.9), National Environmental (Soil Erosion & Flood Control) Regulations, 2011 (S.I. 12), National Environmental (Noise Standards and Control) Regulations, 2009 (S.I. 35), National Environmental (Construction Sector) Regulations, 2011. (S.I. No. 19), National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, 2011. (S.I No. 20), Land Use Act CAP L5 LFN 2004, Nigerian Urban and Regional Planning Act CAP N138 LFN 2004, The National Road Traffic (Amendment) Regulations 2016, and the National Policy on Occupational Safety and Health, 2016, among others. Similarly, the project will be guided by other International Laws and Agreements such as:

- 1992 United Nations Framework Convention on Climate Change (UNFCCC)
- 1997 Kyoto Protocol
- 2015 Paris Agreement
- 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- 1992 Convention on Biological Diversity (CBD)
- 1968 African Convention on the Conservation of Nature and Natural Resources
- 1996 International Union for Conservation of Nature (IUCN) Guidelines
- 1972 United Nations Guiding Principles on the Human Environment (Stockholm Declaration)
- 2012 United Nations Conference on Sustainable Development (Rio+20)
- 1982 General Agreement on Tariffs and Trade (GATT) Environmental Provisions

ES 02. PROJECT JUSTIFICATION

Need and Benefits for the Road Construction

The proposed Sokoto-Badagry Superhighway (SBS) is a vital infrastructure project aimed at addressing Nigeria's road transport challenges and supporting economic growth. Covering 950km across seven states, it will enhance connectivity between the north and south, facilitating trade and integration. Nigeria's road network, though extensive, faces critical deficits, with poor conditions leading to significant economic losses.

The SBS aligns with the National Integrated Infrastructure Master Plan (NIIMP) and aims to unlock economic potential, reduce logistics costs, and stimulate industrialization. Key benefits of the project include improved mobility, job creation, balanced regional development, and enhanced trade security. The project will reduce travel time to 10 hours and position Badagry as a strategic transit hub for West Africa. It will foster regional trade, promote private sector participation, and boost the agricultural and livestock sectors. The highway is expected to alleviate urban congestion and enhance national security by improving connectivity to underdeveloped areas.

Value of the Project

The Proposed Sokoto-Badagry Superhighway project (extending from Illela in Sokoto State to Badagry in Lagos State) will be executed at approximately Thirteen Trillion (₦13,000,000,000,000.00) Naira which is equivalent to approximately Sixteen Billion United States Dollar (USD 16b). The Kebbi Section (SBS-2) is estimated to cost approximately Four Trillion, Four Hundred and Twenty Billion Naira (₦4,420,000,000,000.00). This is equivalent to approximately Five Billion, Four Hundred and Forty Million, Sixty-Six Thousand, Nine Hundred and Fifty-Four (\$5,440,066,954.67) United States Dollar.

Project Options

A number of project options were considered for the project. These include the “No Project Option” which implies that the proposed SBS-2 will not be constructed, and the status quo will be maintained. Similarly, the “delayed project option” was also considered. This implies that the implementation of the proposed Sokoto-Badagry Superhighway, Section 2, will be suspended until a later date. This option is deemed not viable as the absence of timely intervention will result in further deterioration of the region's transportation infrastructure, exacerbating challenges for road users. In addition, the immediate implementation of the proposed Sokoto-Badagry Superhighway, Section 2, which ensures the prompt realization of the project's inherent benefits, particularly for local farming communities and other road users in the region was considered. Given its numerous advantages over the other options, this option was the preferred and most sustainable option.

Project Alternatives

After considering a number of alignment options, the proposed route alignment was selected. This alignment is a new Greenfield corridor that connected Section 1 at Alfala and proceeded to Balugu in Bagudo Local Government, Kebbi State. Major settlements along this route include Bayawa, Gindi, Zagga, Giro, Dakin Gari, Gwamba and Balugu. The route is designed to facilitate connectivity while ensuring a straight and efficient alignment to reduce travel time and fuel consumption. Some of its advantages include minimal disturbance to sensitive ecosystems, balancing cost efficiency with the strategic use of pre-existing infrastructure, minimizing displacement of communities, reducing the need for large-scale resettlement and facilitating economic integration and improved accessibility in the region.

Other alternatives considered were the Greenfield Alignment which combines a Greenfield alignment with sections of existing brownfield routes, intersecting areas around Jega, Kaiama, Kishi, and Ago Are. This alternative was not selected as it may lead to significant alteration of natural habitats, especially in pristine areas. It is also associated with high construction costs as it requires entirely new infrastructure, including bridges, culverts, and earthworks.

The existing travel routes (Do Nothing Scenario) was also considered. This option follows the existing route from Sokoto, passing through towns like Sifawa, Jaredi, Tambuwal, and Jega, with a potential connection to the A1 through the Makirin Minna stretch. Under this scenario, no new infrastructure is developed, and the current road network remains unaltered. However, this alternative was not selected because it is associated with continued traffic congestion as the

current road network degrades further as well as persistent high rates of accidents and travel delays, negatively impacting quality of life and productivity.

Alternative Construction Methods

For the superhighway construction methods, concrete pavement and asphaltic/bituminous pavement were considered. While concrete pavements offer greater durability, resistance to water seepage, and low maintenance needs, their higher initial cost and complex construction process present challenges. On the other hand, bituminous pavements, which are composed of aggregates and bitumen, are more cost-effective, quicker to construct, and better suited for immediate local availability of materials and resources.

Asphalt pavements, however, are less rigid than concrete and require multiple layers to distribute traffic loads effectively. While asphalt production involves significant greenhouse gas (GHG) emissions during the mixing process, its recyclability and ease of repair make it a practical choice for large-scale highway projects. Consequently, the decision was made to use concrete pavement in the form of a Continuously Reinforced Concrete Pavement (CRCP) for this section of the highway, balancing cost, environmental considerations, and construction efficiency.

Envisaged Sustainability

The proposed SBS-2 project will be undertaken according to best industry practice, including standard and time-tested design, standard construction methods, standard operational procedures and fully trained and qualified personnel to man the project. For any form of development to be sustainable, it should also incorporate an enhancement and the preservation of the existing environment.

The project is environmentally sustainable as all potential environmental impacts of the project have been identified and assessed as part of this ESIA with effective management actions proffered to avoid or reduce those impacts to the barest minimum. These measures have also been mainstreamed into the project specific ESMP developed as part of this ESIA report to ensure their effectiveness in assuring environmental sustainability of the project especially during construction. Also, the FMEnv, in conjunction with Sokoto and Kebbi States Ministry of Environment and other relevant Agencies will monitor the implementation of the environmental and social mitigating measures as contained in the ESMP to ensure great considerations are given to the environment throughout the period of construction.

Economically, development of the proposed SBS-2 is expected to generate both direct and indirect employment opportunities for the people in the adjoining communities. This will significantly improve household income during the construction phase, while also providing long-term benefits for the local population once the road is operational. Improved accessibility to farms, agro-processing centers, and markets will enhance economic opportunities, particularly for farmers, market women, and traders along the corridor. Other economic sustainability indicators include:

- Creation of over 1.6 million jobs due to increased economic activity in agriculture, mining, and related services. This employment boost will significantly reduce unemployment and poverty levels across the region.

- Establishment of over 45,000 businesses in the Micro, Small, and Medium Enterprise (MSME) sector, which will drive economic growth and innovation in the region.
- Establishment of over 100 processing and manufacturing factories along the corridor. These industries will support the local economy by providing jobs and driving economic diversification.

The social sustainability of the project is guaranteed for the fact that, the Federal Ministry of Works is committed to minimizing any adverse impacts on local communities, particularly during the construction phase. Special attention will be paid to maintaining harmonious relationships with the communities and ensuring that the long-term benefits of the project far outweigh any short-term disruptions. The FMW will also prioritize social inclusion by implementing a comprehensive engagement program throughout the project's lifecycle. This program will ensure that the voices of local communities are heard, their concerns addressed, and that they are actively involved in decision making processes.

ES 03. PROJECT DESCRIPTION

Proposed Alignment of the Road

The Sokoto–Badagry Superhighway (SBS) is designed as a Trade, Transport, and Security (TTS) Greenfield Corridor, traversing Sokoto State to Lagos State. This strategic route interconnects two Trans-African Highways: TAH 5 (N'Djamena–Dakar) and TAH 7 (Lagos–Dakar), thereby enhancing regional trade, reducing transport costs, and improving connectivity and economic efficiency. The SBS-2 alignment is a Greenfield project that commences at Alfala (Sokoto-Kebbi State border), and terminating near Balugu, Kebbi State. This corridor is designed to optimize economic advantages, boosting trade efficiency and logistical economies of scale.

Corridor Description:

1. **Starting Point:** The corridor connects with Section 1 (which terminated at Alfala in Sokoto state) and proceeds to Balugu (Bagudo Local Government), Kebbi state.
2. **River Niger Crossing:** It crosses the River Niger at north of Kpatachi in Niger State, employing a robust bridge system designed for heavy-duty logistics and transport.
3. **Alignment Through States:** The corridor traverses nine (9) Local Government Areas in Kebbi state and terminates at Balugu (Kebbi-Niger state border).
4. **Auxiliary Spurs:**
 - o **Spur 1:** A 35KM connection to Birnin Kebbi, Kebbi State.

Local Government Areas (LGAs) Covered

Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri.

This project emphasizes advanced civil engineering practices, with Continuously Reinforced Concrete Pavement (CRCP) surface, including grade-separated interchanges, multi-lane carriageways, structural enhancements for bridges, and geotechnical solutions for challenging

terrains. The alignment integrates feeder roads, ensuring seamless interconnectivity and economic stimulation for local communities.

Project Scope

The project scope involves the development of Section 2 of the proposed Sokoto-Badagry Superhighway, covering a 323km stretch from Alfala in Sokoto state to Balugu in Kebbi state. The project scope includes the following:

- Site Clearing.
- Earthworks.
- Construction of new bridges.
- Construction of retaining walls.
- Pavement works (CRCP).
- Construction of Drainages.
- Construction and installation of culverts.
- Installation of road furniture.
- Installation of railings;
- Road marking.

ES 04. DESCRIPTION OF PROJECT ENVIRONMENT

Field Data Gathering and in-Situ Measurements

The actual field data gathering exercise on the biophysical and socio-economic components of the environment was undertaken between 14th December 2024 and 1st January 2025 (Dry season). The exercise was undertaken in line with FMEnv's directives and witnessed by FMEnv representative. The objective of the field exercise was to obtain the baseline data of the proposed project area to describe the integrated environmental context of the area. The field exercise entailed real-time observations, field sampling and in-situ measurements of fast changing parameters of samples collected from the study area. Samples were preserved on the field and taken to the laboratory for analysis.

Geology

The geology of Kebbi State is dominated by two formations Precambrian Basement complex in the South to southeast and young sedimentary rocks in the North. The basement complex region is composed of very old volcanic and metamorphic rocks such as granites, schist, gneisses, and quartzite consist of Gwandu, Illo and Rima group whose ages range from cretaceous to the Eocene. The sedimentary region consists of the Gwandu, Illo and Rima groups whose ages range from the cretaceous to Tertiary and are composed mostly of interbedded sand, clay, and some limestone, the beds dip gently toward the northwest.

Climate and Meteorology

The SBS-2 project area has a tropical continental climate, with marked dry and wet seasons (As). Annual rainfall average is approximately 629 mm with high temperatures reaching 39°C, particularly in April. The region experiences low humidity during the dry season while

vegetation is the Sudan Savannah type. These harsh climatic conditions pose challenges for infrastructure development and environmental sustainability.

Air Quality and Noise Measurements

Air quality monitoring data was taken at 12 locations and 1 control point between 8 and 24 hours in fulfilment of international lender requirements, specifically the requirement of the IFC for air quality data monitoring. It is also important to note that sampling was undertaken for a single 24-hour period at each location as per the FMEnv guidelines.

The baseline air quality and noise study for SBS-2 indicates generally low pollution levels, with occasional peaks in CO, NO₂, and PM near traffic zones. The highest CO concentration (1.30 mg/m³) was recorded at AQ/M/N13, while noise levels ranged from 40 dBA to 59 dBA, exceeding 50 dBA at some locations. Potential health risks include respiratory issues from PM and CO, and noise-related disturbances. Mitigation measures such as dust suppression, traffic management, and sound barriers are recommended. Compliance with IFC and FMEnv guidelines will help maintain environmental standards.

Hydrology

The geology of Kebbi state consists of Precambrian basement rocks and sedimentary formations from the Cretaceous to Tertiary periods, including the Illo, Gundumi, Rima, and Sokoto Groups. Key aquifers within the Gwandu, Kalambaina, and Rima formations support local water supply, with major rivers and lakes contributing to groundwater recharge. The proposed Sokoto-Badagry Superhighway may face excavation and groundwater management challenges, requiring sustainable measures to protect aquifers. Special attention is needed in high groundwater potential areas to prevent depletion and ensure long-term water availability.

Samples for water quality assessment along the alignment were collected for both surface (where they occur) and groundwater for analysis in the laboratory. Altogether, 23 water samples were collected in the Kebbi section of the alignment. Water quality parameters analyzed include physical parameters such as temperature, pH, DO, EC, TDS and Turbidity. Similarly, chemical and microbial parameters (Total Bacteriological Count and Total Coliform Count) including the major ions Calcium (Ca), Magnesium (Mg), Carbonates (HCO₃⁻), Chlorine (Cl), Nitrates (NO₃⁻), Sulphates (SO₄⁻), Ammonia (NH₄) and the heavy metals (Fe, Zn, Cu) were also analyzed.

Soil Quality Assessments

Soil samples were collected from a total of 26 points across the various communities along the alignment as well as intercepts of the existing road, using soil auger, trowel and polythene bags. At each point, soil samples were collected at 0 – 15cm (top soil) and 15 – 30cm (subsoil/bottom) depth. Soil quality parameters analyzed include physical parameters such as temperature, pH, Electrical Conductivity (EC), bulk density, particle density, texture and porosity. The chemical parameters include Calcium (Ca), Magnesium (Mg), Nitrate (NO₃⁻), Sulfate (SO₄⁻), Bicarbonate (HCO₃⁻), Chlorine (CL⁻) and Ammonium (NH₄⁺). Others are heavy metals including Iron (Fe), Zinc (Zn) and Copper (Cu).

The soil along the proposed SBS-2 project consists of sandy, loamy, and clayey types, each affecting construction stability and drainage. Sandy soils require stabilization to prevent erosion,

while clayey soils need proper drainage to avoid waterlogging. Physicochemical analysis shows favorable conditions for construction, with pH levels ranging from slightly acidic to neutral and metal concentrations within permissible limits. Effective soil management, including erosion control and drainage systems, is essential for long-term highway performance and environmental sustainability.

Laboratory Analyses

All water and soil samples were preserved and transported to the Centre for Advance Science Research and Analytical Services (CASRAS) Laboratory, Usmanu Danfodiyo University, Sokoto for analyses.

Ecological (Vegetation & Wildlife) Studies

Biodiversity is essential for human and environmental sustainability, prompting Nigeria to prioritize its protection through international treaties and national legislation, including the Convention on Biological Diversity and Section 20 of the Nigerian Constitution. The vegetation and wildlife assessment for the proposed SBS-2 aimed to identify sensitive biodiversity components, establish baseline data, and provide flora and fauna composition insights. Special attention is needed near Balugu Community in Kebbi State due to dense vegetation and a protected zone. Critical Habitat areas, home to endangered species and unique ecosystems, must be safeguarded per IFC Performance Standard 6 (PS6), ensuring minimal project impact and promoting sustainable conservation efforts.

Biodiversity Studies

The most dominant woody species include *Azadirachta indica* (22%), *Mangifera indica* (18%), *Moringa oleifera* (12%) and *Piliostigma thonningii* (7.5%). Most dominant herbaceous species on the other hand include *Oryza glaberrima* (23%), *Allium cepa* (13.3%), *Manihot esculenta* (10.3%), *Pistia stratiotes* (7.5%) which are widely cultivated throughout the state. The faunal composition includes a mixture of both aquatic and terrestrial species. Aquatic insects like *Gerris lacustris* (13.94%) and catfish (*Clarias gariepinus*, 8.17%) and *Oreochromis niloticus* (Nile Tilapia) represent the semi-aquatic nature of the area, showing the presence of both water and land-based ecosystems. Bird species, such as cattle egrets (*Bubulcus ibis*, 12.50%) and zebra doves (*Geopelia striata*, 11.54%), further highlight the area's diverse birdlife.

Socio-Economic Study

A socioeconomic survey was conducted along the proposed SBS-2 to assess baseline conditions in affected communities, focusing on demographics, infrastructure, and public perception. Stakeholders in the proximal communities, businesses and the 9 Local Government Areas (Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri Local Government Areas) were identified and consulted. These include the Federal Ministry of Environment, National Environmental Standards and Regulations Enforcement Agency (NESREA) Kebbi Office, District Heads of various Communities and settlements along the alignment. Consultation with all relevant stakeholders who may be directly or indirectly affected by the proposed project will be a continuous process within the lifecycle of the proposed project to promote environmental sustainability and safeguard the well-being of affected communities.

This will be sustained through active stakeholder participation, ensuring that concerns and suggestions are duly considered in the decision-making process.

Household surveys were conducted using stratified random sampling, while a total of Four Hundred and Seventy (470) questionnaires were administered in thirteen (13) communities across the route using structured interview approach. This approach is to ensure adequate reach to respondents and to obtain maximum responses. Out of these, 445 were filled, while 25 copies of the questionnaire could not be retrieved from the sampling population. The 445 filled questionnaires were analysed and presented in descriptive statistics.

FGDs were also conducted with men, women, and youth highlighted support for the project, concerns about compensation, employment opportunities, and infrastructure needs. Key stakeholders, including traditional leaders and government officials, were consulted in compliance with statutory EIA regulations. Stakeholder classification identified primary stakeholders as local communities and secondary stakeholders as NGOs and regulatory bodies. Institutional consultations were conducted with federal and state ministries to ensure regulatory compliance. The engagement process has facilitated stakeholder input, ensuring project sustainability and acceptance.

ES 05. GRIEVANCE REDRESS MECHANISM (GRM)

A Grievance Redress Mechanism (GRM) has been designed to address situations of conflicts or disagreements about some of the project activities during construction and operation phases. The GRM process requires all environmental or social incidents to be documented. The report shall be transmitted to the relevant authority where necessary/applicable. The reporting shall be with a view to taking appropriate mitigation measures and complaints received would be investigated and a response (even if pending further investigation) is to be given to the complainant within 5 days. The required information for the GRM include the following:

- Time, date and nature of the incident/report.
- Type of communication (e.g., telephone, personal meeting).
- Name, house location and contact telephone number of persons making the complaint.
- If this person wishes to remain anonymous then —not identified is to be recorded.
- Details of response and investigation undertaken as a result of the incident/complaint.
- Name of person undertaking investigation of the incident/complaint; ☐ Corrective action taken because of the incident/complaint.

ES 06. ASSOCIATED AND POTENTIAL IMPACTS

The Environmental Impact Assessment focuses on the impacts associated with the design, construction and operational phases while outlining long term impacts. The impacts of the proposed project are seen from the perspectives of effects related to vehicular traffic, air quality, noise level, visual landscape, socioeconomics, construction waste management, water supply, runoff water, fauna and flora, and socio-economy. The potential impacts of the proposed project may also have bearing on the aquatic ecosystem and biodiversity due to the interface of the project components.

The objectives of the assessment are to identify and describe the potential environmental impacts associated with the proposed project activities, predict the likelihood and magnitudes of such impacts, evaluate the significance of changes likely to result from them, and thereafter proffer measures that will be taken to mitigate the predicted impacts.

ES 07. MITIGATION MEASURES

The purpose of mitigation is to identify measures that safeguard the environment and the people affected by a project proposal. Mitigation is both a creative and practical phase of an EIA process. It seeks to find the best ways and means of avoiding, minimizing and remedying impacts.

Elements of mitigation are organized into a hierarchy of actions which include first, avoid adverse impacts as far as possible by use of preventative measures; second, minimize or reduce adverse impacts to ‘as low as practicable’ levels; and third, remedy or compensate for adverse residual impacts, which are unavoidable and cannot be reduced further. Environmental enhancements/ mitigations are essential and should be undertaken in the various phases of the proposed project, that is, during pre-construction (including those already undertaken), construction/installation and operation stages.

ES 08. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The ESMP provides the means of assessing the accuracy of the predicted project impacts and the monitoring of the effectiveness of the proposed mitigation measures contained in the ESIA report. The ESMP should therefore indicate how the environmental concerns highlighted in the ESIA would be managed.

The anticipated impacts of the proposed project, corresponding mitigation measures, residual impact rating, action party, timing, parameters to be monitored and monitoring frequency are provided in the Environmental Management Plan for land acquisition, construction, operation and decommissioning activities.

The FMEnv guidelines require an environmental monitoring plan as part of an ESIA. The aim of the monitoring programme is to ensure that the negative environmental impacts already identified in this ESIA are effectively mitigated in the project design, land acquisition, construction, operational and decommissioning stages of the project.

The ESMP shall remain a dynamic working tool. It shall be reviewed with changes in regulatory regime and in the event of new policies or guidelines from Sokoto and Kebbi States Government or other governmental agencies. Periodic reviews and updating shall also be carried out throughout the project life cycle, to incorporate better environmental technologies, management systems and economic policies.

ES 09. DECOMMISSIONING

The operation life span of the SBS-2 project is anticipated to be 50 years. Typically, road projects are upgraded or constructed and as such it is therefore unlikely that the road infrastructure would be decommissioned and abandoned. In the unlikely event that the FMW decides to decommission and abandon the road, the Contractor engaged shall develop a comprehensive decommissioning, abandonment and remediation plan that is specific to the project. The Plan shall consider the most cost-effective and practicable methods, environmental considerations, legal requirements and Global International Industry Practice (GIIP) applicable at the time.

ES 010. CONCLUSION AND RECOMMENDATIONS

The ESIA for the proposed SBS-2 project highlights economic and social benefits like connectivity and job creation while addressing impacts such as biodiversity loss and resettlement. Mitigation measures include local labor use, grievance mechanisms, and strict ESMP implementation. Key priorities are community engagement, capacity building, gender inclusion, and health and safety.

ACKNOWLEDGEMENTS

The Federal Ministry of Works (FMW) expresses its sincere appreciation to the Federal Ministry of Environment (FMEnv) for its invaluable contributions to the preparation of the Environmental and Social Impact Assessment (ESIA) for the Proposed Sokoto-Badagry Superhighway, Section 2 (323km from Kebbi to Niger).

We extend our profound gratitude to the ESIA Consultants; TSL Engineering Limited and their team of experts, whose dedication and expertise were instrumental in the preparation and successful completion of the ESIA studies and draft report. Their commitment to excellence played a crucial role in ensuring the quality and comprehensiveness of this assessment. Additionally, we acknowledge the efforts of all individuals, organizations, and stakeholders whose support, though not individually mentioned, was essential to the successful completion of this ESIA.

CHAPTER ONE: INTRODUCTION

1.1 Project Background

A well-developed transport network is fundamental to fostering sustainable economic growth, social integration, and regional development (NIIMP, 2020). In Nigeria, the road transport system is the backbone of the country's passenger and freight movement, contributing significantly to its GDP. Road transport accounts for approximately 90% of all movements across the country, supporting over 200 million people and a vehicular density of 12.5 million (Michael et al., 2023).

The **Proposed Sokoto-Badagry Superhighway (SBS)** is a visionary infrastructure project initiated by the Federal Government of Nigeria to address critical transportation challenges and drive national and regional economic integration. Spanning seven states (Sokoto, Kebbi, Niger, Kwara, Oyo, Ogun, and Lagos), the 950km superhighway is designed as a three-lane dual carriageway made of durable concrete with a 100-meter right-of-way to accommodate future rail infrastructure and auxiliary facilities.

This project aims to connect Ilella, Sokoto, a strategic border town linked to the Trans-Saharan trade route, to Badagry, Lagos, home to a proposed deep seaport. The highway will serve as a vital north-south economic corridor, linking two key Trans-African Highways of Ndjamena, Dakar TAH5 and Lagos-Dakar TAH7 thereby strengthening regional trade, integration, and connectivity. With a projected population of 120 million over the next 25 years in the region, the SBS is poised to cater to increasing demand for efficient transport infrastructure.

Despite accounting for only 17% of Nigeria's total road network, federal roads handle over 80% of the nation's vehicular and freight traffic (NIIMP, 2020). However, approximately 40% of these roads are in poor condition, requiring urgent rehabilitation. The Sokoto-Badagry Superhighway is part of the Federal Government's strategic efforts to close the infrastructure gap, with the Renewed Hope Infrastructure Development Fund (RHIDF) providing an annual budget of \$25 billion over the next eight years for critical road projects, including the SBS.

This highway is anticipated to reduce infrastructure bottlenecks, improve mobility and safety, and support industrial and socioeconomic reforms. Integrating Northern culture with Southern commerce, the SBS will serve as a unifying force for national cohesion and prosperity.

In compliance with the Nigerian Environmental Impact Assessment Act CAP E12 LFN 2004 and the requirements of the World Bank/International Finance Corporation (IFC) Performance Standards, the Federal Ministry of Works (FMW), as the project sponsor, is required to conduct an Environmental and Social Impact Assessment (ESIA) to evaluate potential environmental and social impacts and ensure sustainable project implementation. The ESIA for Section 2 of the SBS, covering a 323km stretch from Alfala in Sokoto state to Balugu in Kebbi state (Henceforth referred to as SBS-2), has been commissioned to ***TSL Engineering Limited***, a leading consultancy firm in engineering and environmental studies. This assessment will meet the statutory requirements of the Federal Ministry of Environment (FMEnv) and provide the framework for the project's sustainable execution.

1.2 Project Proponent

The Federal Government, through the Federal Ministry of Works (FMW), is the proponent for the proposed SBS-2: 323km length from the Sokoto-Kebbi state border in the north to Kebbi-Niger state border in the south. The Federal Ministry of Works is responsible for the planning, development, and maintenance of federal roads, bridges, and infrastructure across the country. It oversees the construction and rehabilitation of highways, ensures road safety standards are met, and coordinates with other relevant agencies and stakeholders in the transportation sector. The FMW Headquarters, is located at Mabushi, FCT, Abuja.

1.3 Project Location

SBS-2 is a critical infrastructure project spanning 323 kilometers, within Kebbi state. The section will culminate at the proposed deep seaport in Badagry, Lagos, further enhancing Nigeria's connectivity to regional and international markets. The development of this highway aims to facilitate trade, ease transportation, and contribute to the socioeconomic development of the surrounding regions. The route of the proposed SBS-2 traverses nine (9) Local Government Areas (LGAs) in Kebbi state which include (in alphabetical order) Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri (Figure 1.1 and Figure 1.2).

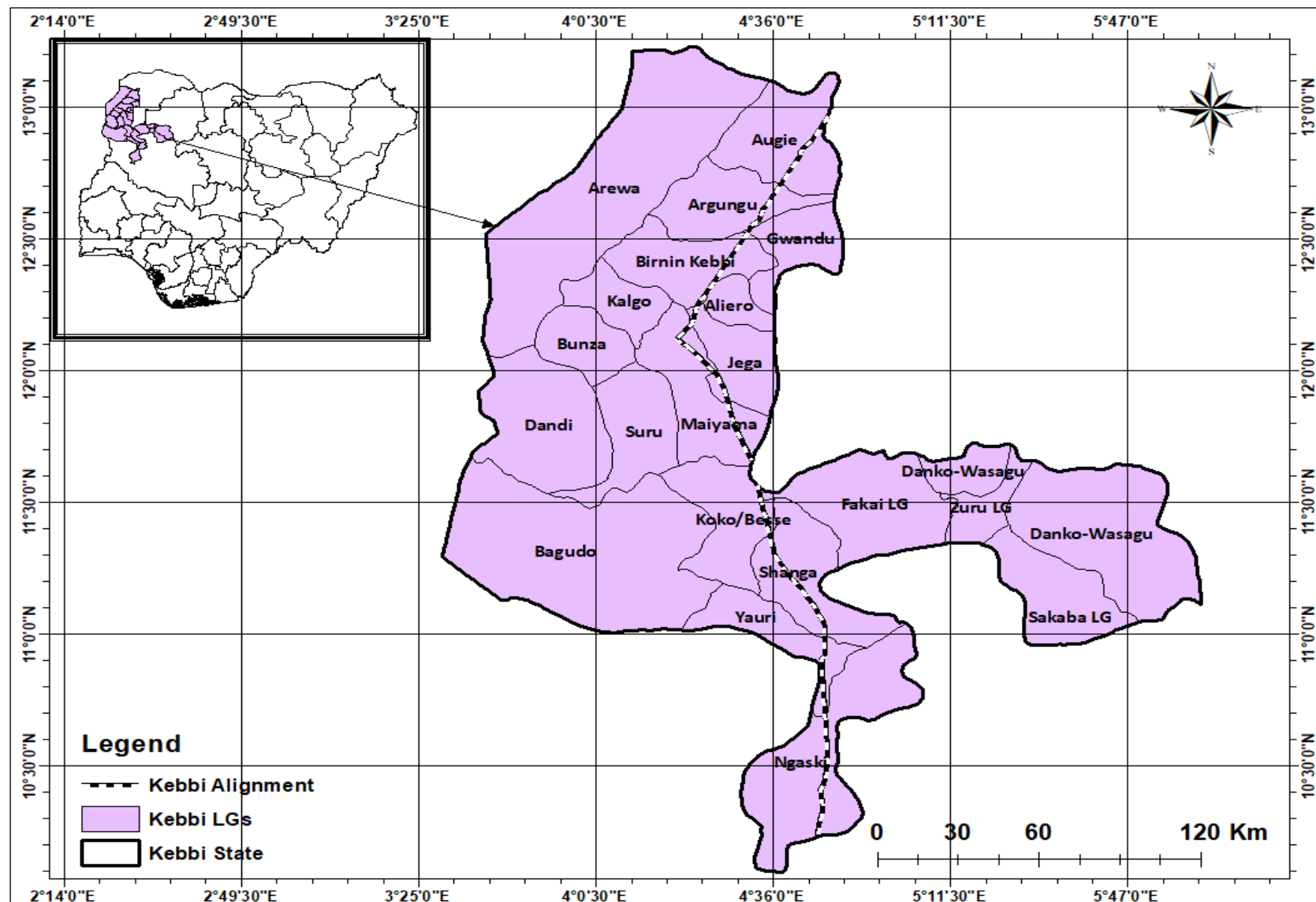


Figure 1.1: Cross section of the Superhighway Alignment in Kebbi State

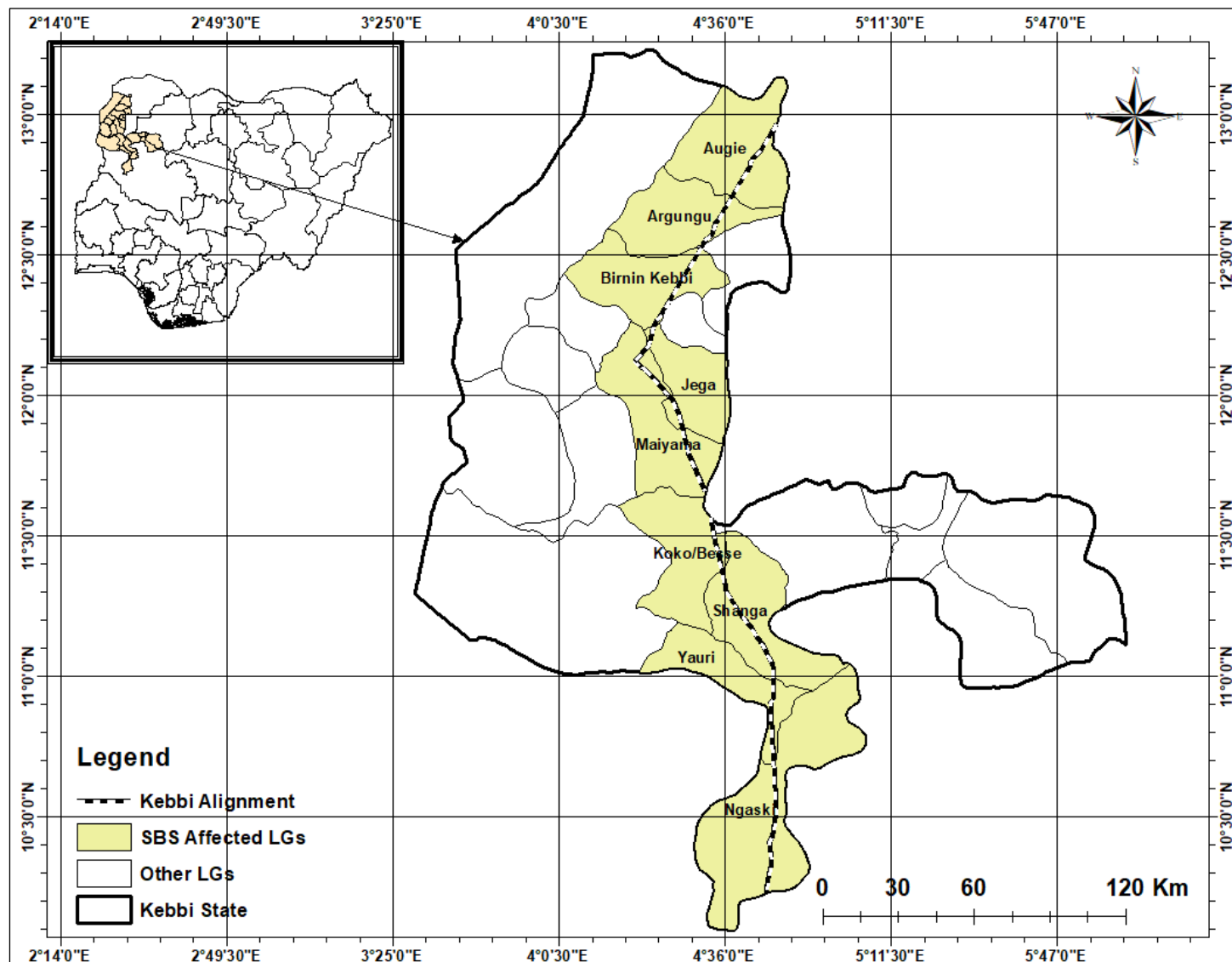


Figure 1.2: The Project Affected Communities on the SBS-2 Alignment

1.4 Objectives of the ESIA Study

The overarching objective of the ESIA is to identify and assess the potential impacts of the proposed Sokoto-Badagry Superhighway, Section 2 on the physical, biological and social environment of the project area with a view to ensuring that significant impacts are prevented, mitigated or offset to assure project sustainability. Other specific objectives of this ESIA include:

- To comply with applicable National and State laws as well as other international requirements for environmental and social sustainability.
- To identify all environmental aspects of the project that may interact positively or negatively with the bio-physical environment and the socio-economic wellbeing of the affected communities.
- To acquire all necessary environmental and socio-economic baseline data that will form the basis for mapping the existing state of the environment in the project area.
- To identify and evaluate the potential impacts of the project activities on the physical, biological and social environment.
- To proffer appropriate measures to avoid, minimize, compensate for or offset potential adverse impacts and enhance beneficial impacts of the project during its pre-construction, construction, operation and decommissioning phases.
- To develop a project specific Environmental and Social Management Plan (ESMP) that includes a monitoring plan for the project.
- To provide opportunities for active engagement with all stakeholders including communities that are likely to be directly affected by the project, regulators, and other interested parties on the environmental and social compatibility and sustainability of the project.

1.5 Methodology and Scope of this ESIA

In line with the Terms of Reference (ToR), the scope of work for the ESIA study includes the following core activities:

- Reconnaissance survey to acquaint the ESIA team with the environmental and social nomenclature of the project area.
- Review of project-specific background documents and other relevant literatures.
- Identification and review of pertinent national and international policies, laws, regulations and guidelines governing environmental quality, environmental assessment and the project.
- Scoping exercise to determine the scope and establish the boundaries for the ESIA study.

- One season field data gathering and laboratory analysis to obtain environmental and socio-economic baseline data of the project area.
- Description of existing bio-physical and social environment of the project area.
- Description of project activities during the pre-construction, construction as well as operation and maintenance and the identification of potential impacts associated with each activity.
- Evaluation of impacts to establish their significance using appropriate methods.
- Identification of effective measures to avoid or reduce the effect of significant impacts on the bio-physical and social environment.
- Identification and extensive consultation with affected communities and other stakeholders.
- Development of a comprehensive and project specific EMP; and Preparation of the ESIA Report.

The methodology adopted for the study is consistent with the National Guidelines on ESIA as stipulated by the Federal Ministry of Environment (FMEnv) and World Bank Guidelines for similar projects.

The Federal Ministry of Environment (FMEnv) established the National EIA Procedural Guideline in 1995 that indicates the process for conducting an EIA for projects in Nigeria in line with the requirements of the EIA Act CAP E12 LFN 2004. The process has been designed to ensure that the proposed project is implemented with maximum consideration for the environment. The basic steps in the EIA process include submission of Project Proposal/TOR, Initial Environmental Examination, Screening, Scoping, EIA Study, Review, Decision Making, Monitoring and Auditing. These steps are shown in Figure 1.3.

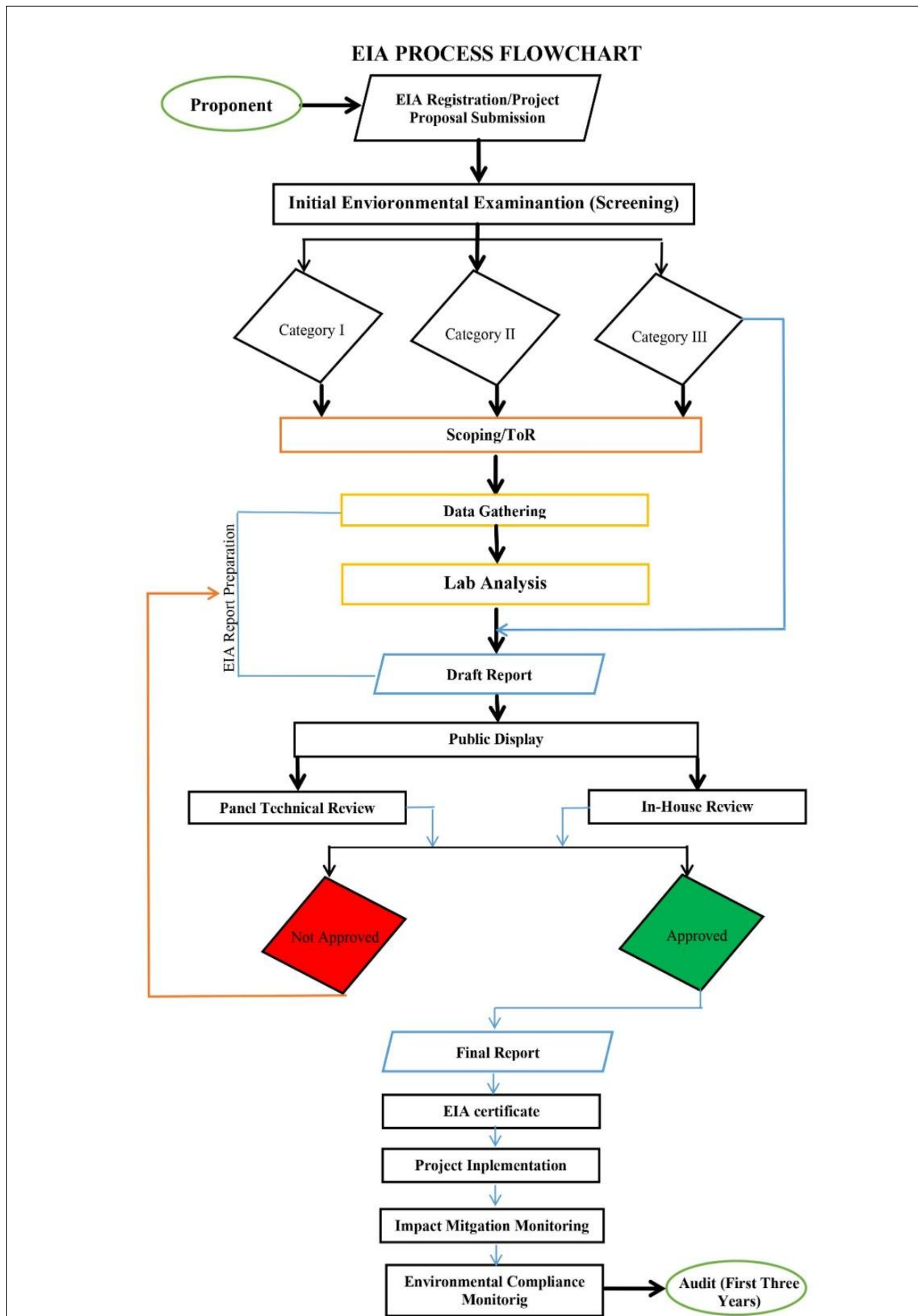


Figure 1.3: The EIA Flowchart

1.6 Legal and Regulatory Framework

The ESIA study was carried out in accordance to FMEnv's relevant policies, laws, regulations and guidelines particularly the EIA Procedural Guidelines and Sectoral Guidelines for Infrastructure. Other applicable and relevant international treaties and agreements to which Nigeria is a party were also considered especially the World Bank Environmental and Social Standards. The section below highlights the environmental, social and infrastructural administrative and legal framework applicable to the proposed road construction project.

1.7 Administrative Framework for Environmental Protection and Infrastructure

1.7.1 Federal Ministry of Environment

The Federal Ministry of Environment (FMEnv) is the statutory government institution mandated to coordinate environmental protection and natural resources conservation for sustainable development in Nigeria. The Environmental Assessment (EA) Department of the Ministry is charged with the responsibility of ensuring that all developmental projects are carried out in compliance with relevant environmental laws and regulations in order to ensure environmental sustainability.

1.7.2 National Environmental Standards and Regulations Enforcement Agency (NESREA)

National Environmental Standards and Regulations Enforcement Agency (NESREA) was established by NESREA Act No 25 of 2007 as a parastatal of the FMEnv. NESREA is charged with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria. It also has the responsibility to enforce compliance with provisions of international agreements, protocols, conventions and treaties on the environment to which Nigeria is signatory.

1.7.3 Federal Ministry of Works

The Federal Ministry of Works (FMW) recognizes the importance of comprehensive environmental planning and management to the success of any project and is committed to undertaking the necessary studies to understand the environmental systems of the proposed project area. This commitment aims to identify and address areas where significant negative environmental impacts (natural, physical, and social) may occur, with a view to mitigating them effectively.

In line with this, the FMW is conducting an Environmental and Social Impact Assessment (ESIA) of the project area prior to the commencement of the project. This initiative aligns with the Federal Ministry of Environment's (FMEnv's) Environmental Impact Assessment Procedural and Sectorial Guidelines for infrastructural projects, as well as other international environmental standards.

1.7.4 Kebbi State Ministry of Environment

The Kebbi State Ministry of Environment is the regulatory body established to protect and enhance the general environment within their respective states. Its primary responsibilities include:

- Monitoring the implementation of Environmental Impact Assessments (EIA) on all developmental projects within the state;
- Regulating and monitoring the disposal of solid, gaseous, and liquid wastes from facilities operating in the state;
- Monitoring environmental components, including air, water, land, and soil, to assess pollution levels within the state; and
- Enforcing environmental laws and applying appropriate penalties for any infringements.

1.7.5 Kebbi State Ministry of Lands and Housing

The Kebbi State Ministry of Lands and Housing plays a pivotal role in the management and development of land and housing resources within the states. The ministry is tasked with ensuring efficient, transparent, and sustainable land resource management systems that promote equitable access to land and housing opportunities for all citizens.

The ministry is dedicated to creating an enabling environment for land delivery, facilitating the implementation of policies that streamline land allocation, titling, and registration processes. By maintaining a comprehensive and accessible land information system, the ministry supports informed decision-making and strategic planning in both public and private sectors.

In addition to land management, the ministry is actively involved in the development and regulation of housing initiatives aimed at addressing the housing deficit and improving the

quality of life for residents. These initiatives focus on creating affordable and sustainable housing solutions that align with the socio-economic aspirations of the states.

Through its policies and programs, the ministry contributes significantly to the overall sustainable development of Sokoto State. It supports economic growth by enabling secure land tenure, fostering investment in real estate, and promoting environmental stewardship in land use and housing development.

1.7.6 Local Government Areas

The proposed SBS-2 traverses nine (9) Local Government Areas (LGAs) in Kebbi State. These LGAs, as the third tier of government, are vested with the responsibility of ensuring the economic planning and development of the communities within their jurisdictions.

The Local Government Councils in the areas along the proposed route play a vital role in administering the common interests of these communities, addressing traditional associations, and maintaining administrative convenience. Their involvement ensures that the development of the highway aligns with the needs and aspirations of the local populations while fostering social and economic integration.

Furthermore, the Environment and Public Health Departments within the respective LGAs are tasked with managing all environmental and health-related matters. These responsibilities include waste management, public health oversight, and enforcement of environmental sanitation edicts and bye-laws. This ensures that the construction and operation of the highway adhere to environmental and public health standards, minimizing negative impacts and promoting sustainability in the region.

The collaboration between the Local Government Councils, community stakeholders, and project proponents is critical to the successful implementation of the SBS-2, as it supports equitable development and enhances the well-being of the affected communities.

1.8 Legal and Policy Framework

1.8.1 Nigerian Legal and Policy Framework

❖ National Policy on the Environment 1989 (Revised 2016)

The National Policy on the Environment describes the conceptual framework and strategies for achieving the overall goal of sustainable development in Nigeria. It underscores inter – alia, the

need to put in place policies, strategies and management approaches to ensure environmental concerns are integrated into major economic decision- making process and that EIA is mandatorily carried out before any major development project is embarked upon.

Specifically, the goal of the Policy is to:

- Secure a quality of environment adequate for good health and well- being;
- Conserve and use the environment and natural resources for the benefit of present and future generations;
- Restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and promote understanding of the essential linkages between the environment, resources and development, and encourage individual and community participation in environmental improvement efforts; and
- Co-operate with other countries, international organizations and agencies to achieve optimal use of trans-boundary natural resources and effective prevention or abatement of trans-boundary environmental degradation.

❖ **National Transport Policy, 2010**

As part of the Government's reform policy; the Transport Sector Reform Implementation Committee (TSRIC) formulated a National Transport Policy. The policy aims to:

- Promote an efficient and affordable integrated transport network.
- Improve the safety, security, quality and speed of movement of goods and operation of transport related services.
- Promote qualitative road infrastructure and operations through greater effectiveness and efficiency in meeting customer needs.
- Structure the infrastructure to ensure environmental sustainability and internationally accepted standards.

- Promote a culture of maintenance and upgrading of existing infrastructure.
- Build strong financial base (both public and private) for the creation, maintenance and upgrading of transport Infrastructure.

❖ **EIA Act Cap E12 LFN 2004**

The EIA Act Cap E12 LFN 2004 is the main legislation that guides EIA in Nigeria. Part 1, Paragraph 2(i) of the Act, categorically states that “the public or private sector of the economy shall not undertake or embark or authorize projects or activities without prior consideration, at early stages of their environmental effects.”

The Act sets the goals and objectives of EIA and procedures including the minimum requirements for the conduct of EIA of public or private projects. The Act makes EIA mandatory for all major development projects likely to have adverse impacts on the environment and gives specific powers to FMEnv to facilitate environmental assessment of projects in Nigeria.

❖ **NESREA Act No. 25, 2007**

The NESREA Act No. 25 of 30th July, 2007 established NESREA and empowers her with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria. The Act spells out the functions, powers, structure, staffing of the Agency as well as financial and other miscellaneous provisions.

❖ **Federal Road Safety Commission (Establishment) Act, 2007**

The act repealed the Federal Road Safety Commission Act, Cap 141 LFN, 1990 (as amended) to establish the Federal Road Safety Commission with the responsibility for traffic management, preventing and minimizing accidents on the highways, the supervision of users of such highways, the regulation of traffic thereon and clearing of obstruction on any part of the highways and for educating drivers, motorists and other members of the public generally on the proper use of highways; and for related matters to safety on the highways. In the exercise of the functions conferred by (510(4) of the FRSC Act, 2007 establishment), members of the corps shall have the right to arrest and prosecute any person reasonably suspected to have committed any traffic Offence(s). It is therefore an offence to:

- i. Use a road that is under construction;

- ii. Disobey or disregard road signs or pavement markings;
- iii. Be on any road without any lights or faulty lights, signs or reflectors or wrongful use of signals
- iv. Obstruct any section of the road with vehicles or in any other way that may affect free flow of traffic
- v. Use a restricted road where it is marked "one way" or "no entry"
- vi. Disobey speed-limits erected at road construction areas or any other road
- ix. Drive a vehicle without a valid learner's permit; driver's license or any other permit required by law
- x. Drive a vehicle without a valid vehicle license of identification mark being displayed
- xi. Overtake another vehicle wrongfully;
- xii. Uncover gravel or other unstable materials with tarpaulin or strong plastics to stop it spilling on the road;
- xiii. Drive a vehicle that emits excessive smoke.

❖ **EIA Procedural Guidelines, 1995**

The FMEnv developed procedural and sectoral guidelines for developmental projects in major sectors of the nation's economy in order to ensure environmental sustainability of these sectors through the EIA Act No. 86 of 1992. The Procedural Guidelines indicate the steps to be followed in the EIA process from project conception to commissioning in order to ensure that the project is implemented with maximum consideration for the environment.

The Guidelines also include the categorization of environmental projects. Projects are classified into three categories as follows:

- Category I projects: Projects that will require a full EIA.
- Category II projects: Projects that may require only a partial EIA, which will focus on mitigation and environmental planning measures, unless the project is located near an "Environmentally Sensitive Area" (ESA) in which case a full EIA is required.
- Category III projects: Projects that are considered to have "essentially beneficial impacts" on the environment, for which an Environmental Impact Statement (EIS) will be prepared by the FMEnv.

- The construction of the proposed road has been classified as a Category 1 project by the FMEnv requiring mandatory EIA studies.

❖ **EIA Sectoral Guidelines for Infrastructure – Transportation Development Project**

(Roads and Highways), 1995

The EIA Sectoral Guidelines for Infrastructure - Transportation Development Project - (Roads and Highways) were designed to assist project proponents in conducting detailed environmental assessment of roads and highways projects with emphasis on the significant associated and potential impacts of such projects on the environment. Mitigation measures for avoiding, minimizing or alleviating any adverse impacts as well as future monitoring programme for ensured sustainability of the project are also contained therein for guidance.

❖ **Forestry Act CAP 51 LFN 1994**

The Act provides for the preservation of forests and the setting up of forest reserves. The Act makes it an offence, punishable with up to 6 months' imprisonment to cut down trees over 61 cm (2 ft) in girth or to set fire to forest except under special circumstances.

❖ **Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991**

The Guidelines and Standards for Environmental Pollution Control in Nigeria, was promulgated in March 1991 to serve as a basic instrument for monitoring and controlling industrial and urban pollution. They relate to six areas of concern, namely: effluent limitations, water quality, industrial emission limitations, noise exposure limitations, management of solid and hazardous wastes and pollution abatement in industries.

❖ **National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991 (S.I. No.9)**

The Regulations impose restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units and machineries for combating pollution. The regulations inter-alia also requires industries and facilities generating wastes to prepare contingency plans; obtain permits for storage and transportation of harmful toxic wastes; adopt strategies for waste reduction; ensure solid wastes are disposed of in environmentally safe

manner; and ensure the safety of employees. It also stipulates offences and penalties for its contravention.

❖ **National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991 (S.I. No.15)**

The Regulations make provisions for the handling and management of solid and hazardous wastes. It defines the objectives of hazardous waste management, the functions of appropriate Governmental agencies and the obligations of industries. It also contains the dangerous waste lists and guidance on the management of spills and discharges into the environment. It requires a manifest system for waste that should include information on packaging, labelling and marking. It defines the requirements of ground water protection, surface impoundment, land treatment, waste piles, etc. It also describes the hazardous substances tracking programme with a comprehensive list of acutely hazardous chemical products and dangerous waste constituent. It also states the requirements and procedure for inspection, enforcement and penalty.

❖ **National Environmental (Sanitation & Waste Control) Regulations, 2009 (S.I. No. 28)**

The purpose of the Regulations is the adoption of sustainable and environment friendly practices in environmental sanitation and waste management to minimize pollution. The Regulation makes provisions for the control of solid wastes, hazardous wastes and effluent discharges. It in addition, spells out roles and responsibilities of State and Local Government Authorities.

❖ **National Environmental (Soil Erosion & Flood Control) Regulations, 2011 (S.I. 12)**

The purpose of these Regulations is to establish technically feasible and economically reasonable standards and procedures to achieve appropriate level of management and conservation practices to abate soil erosion, siltation and sedimentation of the waters of Nigeria, due to soil erosion and flood aggravated by non-agricultural earth-disturbing activities.

❖ **National Environmental (Noise Standards and Control) Regulations, 2009 (S.I. 35)**

The objective of the Regulations is to ensure maintenance of a healthy environment for all people in Nigeria, the tranquillity of their surroundings and their psychological wellbeing by regulating noise levels and generally to elevate the standard of living of the people. The

Instrument prescribes maximum permissible noise levels of a facility or activity to which a person may be exposed; and provides for the control of noise mitigating measures for the reduction of noise.

❖ National Environmental (Surface and Groundwater Quality Control) Regulations, 2011 (S.I. No. 22)

The purpose of these Regulations amongst others is to protect groundwater sources by regulating the discharge of hazardous wastes, fossil fuels energy and any other substances having the potential to contaminate groundwater. The Regulations also include amongst others, the application and general provisions of water quality standards for various uses such as agriculture, industrial, aquatic life and recreation.

❖ National Environmental (Construction Sector) Regulations, 2011. (S.I. No. 19)

The purpose of these regulations is to prevent and minimize pollution from construction, decommissioning and demolition activities in the Nigerian environment. It stipulates that new projects in the construction sector shall apply cost-effective, up-to date, efficient, best available technology, to minimize pollution to the barest degree practicable. In addition, every operator or facility shall carry out an EIA and submit an EMP for new projects or modification including expansion of existing ones before commencement of activity. Part II of these regulations discusses specific provisions for site waste management plans, storm water discharge, lighting activities, control of dust and fugitive emission, noise control, avoiding nuisance, hazardous substances, use of asbestos, spent oil, prevention and control of explosion hazards, radiation, polluter pays-principle, community relations and close-out.

Schedule I of the Regulations discusses the best practices in construction; while Schedule III outlines the guidelines in preparing an EMP. Schedule VI presents the recommended personal protective equipment according to hazard. Schedule VII presents the noise limits for various working environments, while schedule VIII presents the minimum limits for workplace illumination intensity. Schedule IX discusses the blasting guidelines, while schedule X discusses the close-out guidelines.

❖ National Environmental (Air Quality Control) Regulations, 2014. (S.I No. 64)

The purpose of these regulations is to provide for improved control of the nation's air quality to such extent that would enhance the protection of flora and fauna, human health, and other

resources affected by air quality deteriorations. It also provides all users the right to be informed of the potential hazards of any project and to be served timely notice of significant rise in the level of pollution in the atmosphere. Part II, III and V discusses emissions from stationary and mobile sources, fuel additives, and other sources. Schedule VIII of the regulations presents the mobile sources of air pollution and their grouping, while schedule XIII presents the ambient air quality standards.

❖ **National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, 2011. (S.I No. 20)**

The purpose of these regulations is to restore, preserve and improve the quality of air through the improvement of the quality of automobiles that operate on the road way, as well as to improve the health of Nigerians especially in the urban areas with high incidence of air pollution due to increased number of automobiles that ply the roads.

Part II of these regulations discusses the gaseous emission control from petrol engine, while Part III discusses the control of vehicular emissions from diesel engine. Schedules I, II, & III present the emission standard of pollutants for petrol engines, while Schedules VII & VIII present the emission standard of pollutants for diesel engines.

❖ **National Environmental (Protection of Endangered Species in International Trade) Regulations, 2011 (S.I. No. 16)**

The major objective of these Regulations is to protect endangered species of fauna and flora; and prevent their extinction by controlling international trade of their living specimens, parts and derivatives.

❖ **Land Use Act CAP L5 LFN 2004**

The Land Use Act of 1978 reviewed under Cap L5 of 2004 is the legal framework for land acquisition and resettlement in Nigeria. The following are selected relevant sections:

Section 1: Subject to the provisions of this Act, all land comprised in the territory of each State in the Federation are hereby vested in the Governor of that State and such land shall be held in trust and administered for the use and common benefit of all Nigerians in accordance with the provisions of this Act.

Section 2: (a) All land in urban areas shall be under the control and management of the Governor of each State; and (b) all other land, subject to this Act, shall be under the control and management of the Local Government within the area of jurisdiction in which the land is situated. The Act gives the government the right to acquire land by revoking both statutory and customary rights of occupancy for the overriding public interest. In doing so, the Act specifies that the State or Local Government should pay compensation to the current holder/occupier with equal value.

❖ **Nigerian Urban and Regional Planning Act CAP N138 LFN 2004**

The Nigerian Urban and Regional Planning Act **CAP N138, LFN 2004** established a Development Control Department (DCD) charge with the responsibility for matters relating to development control and implementation of physical development plans at Federal, State and Local Government levels within their respective jurisdiction as well as acquisition of land and compensations.

- Approval of the relevant DCD shall be required for any land development
- A developer shall submit a development plan for the approval of the DCD of local Government, State or Federal Government.
- A developer (whether private or government) shall apply for a development permit in such manner using such forms and providing such information including plans, designs, drawings and any other information, as may be prescribed,
- A developer shall at the time of submitting his application for development submit to an appropriate Control Department a detailed Environmental Impact Statement (EIS) for an application for.

According to this act, application for grant may be rejected if

- in the opinion of the Control Department, the development is likely to have major impact upon the environment, facilities, or inhabitants of the community or contains such additional facilities which are not within the estimation of the Physical Development Plan for that community; or

- in the opinion of the Control Department, the development is likely to cause a nuisance to the inhabitants of the community or contains such additional facilities that are not within the estimation of the Physical Development Plan for that community.

Some of the issues related to development control include setback requirements, right of way, building line requirements. The relevant sections are highlighted as follows:

- Section 39 (7) establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
- Section 59 makes it an offence to disobey a stop-work order. The punishment under this section, is a fine not exceeding N10, 000 (Ten thousand naira) and in the case of a company, a fine not exceeding N50, 000.
- Section 72 provides for the preservation and planting of trees for environmental conservation.
- the act also stipulated prompt payment of compensations, on such terms and conditions as may be prescribed, to a person who suffers a loss or damage through the exercise by the authority of its powers in the area.

The above provisions would be respected in obtaining construction approval and permits from relevant authorities.

❖ **Penal Code Act Cap 89 LFN 2004**

Section 247 of the Nigerian Penal Code makes it an offence, punishable with up to six (6) months imprisonment for:

- a) Violating the atmosphere in any place so as to make it noxious to the health of persons in general, whether dwelling, carrying on business in the neighbourhood, or passing along a public way; or
- b) Engaging in any act which is, and which the individual knows or has reason to believe is likely to spread the infection of any disease dangerous to life, whether affecting humans or animals.

This provision underscores the legal obligation to prevent actions that could harm public health and safety, particularly in terms of environmental and disease control measures.

❖ **Endangered Species Act, CAP E9, LFN 2004**

In pursuance of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES, the Federal Government of Nigeria enacted the Endangered Species (Control of International Trade and Traffic) Act 11,1985 which makes among others, provisions for the conservation, management and protection of some of the country's endangered species. This Act focuses on the protection and management of Nigeria's wildlife and some of their species in danger of extinction as a result of overexploitation. These sections are noteworthy:

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

❖ **Employee's Compensation Act, 2010 Act No. 13**

The Act repealed the Workmen's Compensation Act CAP. W6 LFN, 2004, and to make Provisions for Compensations for any death, injury, disease or disability arising out of or in the course of employment; and for related matters. The Act provide for an open and fair system of guaranteed and adequate compensation for all employees or their dependents for any death, injury, disease or disability arising out of or in the course of employment.

❖ **Harmful Waste (Special Criminal Provision) Act CAP, LFN 2004**

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

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

❖ **Federal Road Maintenance Agency (FERMA) (Amended) Act, 2007**

The Bill established the FERMA as an agency under the supervision of the Federal Ministry of Works to primarily, maintain all existing Federal trunk roads or such other roads as may be declared as the Federal trunk roads, from time to time in Nigeria.

The sources of fund for the Agency will include: grants from the Federal, State and Local Governments; grants from the organized private sector and international donor organizations; toll gate collection; all fees on services rendered by the Agency; monies accruing from road concessions; and all other sum which may, from time to time accrue to the Agency.

❖ **Federal Highways Act CAP F13 LFN 2004**

The Act vest the powers of management, direction and control of the Federal highways throughout Nigeria in the Minister of Works, Housing and Urban Development in respect of planning, construction and maintenance, supervision of highway users and the regulation on traffic.

The Minister has the power to acquire land for federal highway construction, compensation in respect of this where appropriate shall be according to the Land use Act. The Minister has right to enter adjacent land, acquire land under special enactments, declare roads to be federal highway by publication in federal gazette.

The Act specifies that no person shall create an obstruction with 50 meters of the center line of any federal highway or plant any crop required to be sown and reaped within 12 months. The act also confers the authority to demolish any obstruction or encroachment of the federal highway or drainages adjacent to it.

❖ **The National Road Traffic (Amendment) Regulations 2016**

The National Road Traffic (Amendment) Regulations 2016, amended 41 regulations and 3 schedules in the National Road Traffic Regulations 2012. Hence, the National Road Traffic (Amendment) Regulations 2016 does not replace the National Road Traffic Regulations 2012, rather, the National Traffic Regulations 2012 is still valid and Operational, although with amendment brought in by that of 2016.

❖ **Climate Change Act 2021**

The Act reinforces Nigeria's commitment to the Paris Agreement on climate change and her updated Nationally Determined Contributions ("NDCs") at the 26th Conference of Parties to the United Nations Framework Convention on Climate Change in Glasgow, which include cutting Nigeria's carbon emissions to reach net-zero by 2060. Climate Change Act passed in 2021, Nigeria continues to prioritize climate action through policy development, institutional frameworks, and international cooperation to address the impacts of climate change and promote sustainable development. Nigeria has developed the National Climate Change Policy and Response Strategy (NCCPRS), which provides a framework for addressing climate change and promoting sustainable development.

❖ **Labour Act CAP L1 LFN, 2004**

The Labour Act CAP L1 LFN, 2004 is a comprehensive piece of legislation that governs labor relations and employment practices in Nigeria. It outlines the rights and obligations of both employers and employees, establishes minimum standards for working conditions, and provides mechanisms for resolving disputes in the workplace. the Labour Act CAP L1 LFN, 2004 serves as a foundational piece of legislation that safeguards the rights of workers, promotes fair labor practices, and fosters harmonious industrial relations in Nigeria.

❖ **National Policy on Occupational Safety and Health, 2016**

The National Policy on Occupational Safety and Health (OSH) in Nigeria, established in 2016, provides a framework for promoting safe and healthy working environments across various sectors of the economy. The policy aims to prevent workplace accidents, injuries, and illnesses by establishing standards, regulations, and guidelines for occupational safety and health practices.

It aims to create a culture of safety and health in the workplace, protect the rights and well-being of workers, and contribute to sustainable development by preventing work-related injuries, illnesses, and fatalities. It serves as a guiding framework for government agencies, employers, workers, and other stakeholders to collaborate and promote OSH excellence across all sectors of the economy.

1.8.2 Relevant International Law and Agreements

Nigeria is a signatory to some international conventions and agreements relating to industry, development, and environmental management. In certain cases, conventions and agreements have influenced Policy, guidelines, and regulations and shall be complied with during the planning, construction, and operation of the Project. Below lists some of the relevant international conventions and protocols to which Nigeria is a signatory. Many of these are incorporated into the various World Bank Operational Procedures and the IFC Performance Standards. So, by conforming to these two sets of standards, the Project will comply with the requirements of the relevant international conventions.

- 1985 Vienna Convention on the Protection of the Ozone Layer
- 1987 Montreal Protocol on Substances that Deplete the Ozone Layer
- 1992 United Nations Framework Convention on Climate Change (UNFCCC)
- 1997 Kyoto Protocol
- 2015 Paris Agreement
- 2010 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits
- 2003 Cartagena Protocol on Biosafety
- 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- 1992 Convention on Biological Diversity (CBD)
- 1968 African Convention on the Conservation of Nature and Natural Resources
- 1996 International Union for Conservation of Nature (IUCN) Guidelines
- 1971 Ramsar Convention on Wetlands of International Importance
- World Heritage Convention, 1972
- 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
- 1991 Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa
- 1972 United Nations Guiding Principles on the Human Environment (Stockholm Declaration)
- 2012 United Nations Conference on Sustainable Development (Rio+20)
- 2000 United Nations Millennium Declaration

- 2015 Addis Ababa Action Agenda on Financing for Development
- 2002 Johannesburg Plan of Implementation (WSSD)
- 1994, UN Convention to Combat Desertification (UNCCD)
- 1982 General Agreement on Tariffs and Trade (GATT) Environmental Provisions

1.8.3 International Best Practice Standards and Guidelines

International lending institutions guide their requirements for the assessment of Environmental and Social Impacts which emphasize achieving sustainable environmental, social, and health outcomes. They also provide environmental standards and limits for emissions and discharges. The number of key project impact mitigation measures such as resettlement (if necessary) is also specified.

The overall project design and this ESIA are based on relevant guidelines published by the World Bank Group and International Finance Corporation (*IFC*) and therefore are expected to meet the environmental requirements of potential lending institutions. The following international requirements and standards have been considered within the ESIA process and are described below:

❖ The Equator Principles

The Equator Principles are standards that guide the management of environmental and social issues in global finance for development projects. These standards are to be adopted by financial institutions and commit them to desist from financing development projects that do not follow the principles.

The Equator Principles were modelled after the environmental standards of the World Bank and the social policies of the International Finance Corporation (*IFC*). It was launched in June 2003 and is adhered to by 60 global financial institutions as of April 2008.

The Equator Principles (EP) objective is to provide a financial industry benchmark for determining, assessing, and managing environmental and social risk in project financing.

The conditions under which the Equator Principles Financial Institutions (“EPFIs”) will provide financing to projects are summarized in Principles 1-10 below.

- **Principle 1:** Review and Categorization
- **Principle 2:** Social and Environmental Assessment
- **Principle 3:** Applicable Social and Environmental Standards
- **Principle 4:** Action Plan and Management System
- **Principle 5:** Consultation and Disclosure
- **Principle 6:** Grievance Mechanism
- **Principle 7:** Independent Review
- **Principle 8:** Covenants
- **Principle 9:** Independent Monitoring and Reporting.
- **Principle 10:** Equator Principles Financial Institution (EPFI) Reporting

❖ **International Finance Corporation (IFC) Performance Standards**

The International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability describes IFC's commitments, roles and responsibilities related to environment and social sustainability. There are eight (8) performance standards that IFC requires their clients to meet to ensure environmental, economic and social sustainability of proposed project. The proposed project triggered the following IFC Performance Standards:

- PS 1: Assessment and Management of Environmental and Social Risks and Impacts.
- PS 2: Labour and Working Conditions
- PS 3: Resource Efficiency and Pollution Prevention
- PS 4: Community Health, Safety and Security
- PS 5: Land Acquisition and Involuntary Resettlement
- PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

❖ The World Bank Environmental & Social Framework for Development, 2017

The World Bank Group (WBG) has prioritized the sustainability of economic development for decades, beginning with the introduction of the *Operational Directive on Environmental Assessment* (OD.4.00) in October 1989. Over the years, the WBG's environmental and social standards have become benchmarks for sustainable development planning globally.

The *Environmental and Social Framework (ESF)*, published in 2017, outlines the WBG's commitment to sustainable development through its Bank Policy and a series of Environmental and Social Standards (ESS). These are designed to support Borrowers' projects with the overarching goal of eradicating extreme poverty and promoting shared prosperity.

The ESF comprises three core provisions:

1. *Vision for Sustainable Development*: Articulates the WBG's aspirations regarding environmental and social sustainability.
2. *Environmental and Social Policy for Investment Project Financing*: Specifies mandatory requirements that apply to the WBG.
3. *Environmental and Social Standards (ESS)*: Establishes mandatory requirements for projects supported by the WBG.

The ESS requires Borrowers to identify and assess environmental and social risks and impacts associated with projects supported by WBG Investment Project Financing. These standards aim to:

- Foster good international practices in environmental and social sustainability.
- Help Borrowers meet national and international environmental and social obligations.
- Promote non-discrimination, transparency, participation, accountability, and governance.
- Enhance sustainable development outcomes through ongoing stakeholder engagement.

Relevance to the Proposed SBS-2

Although the proposed Sokoto-Badagry Superhighway (SBS) project is not directly funded by the WBG, the ESS framework offers globally accepted best practices that can be adopted to

ensure environmental and social sustainability. The project's planning and implementation stages can benefit significantly from these standards by addressing environmental and social risks effectively and fostering sustainable outcomes for all stakeholders.

Environmental and Social Standards (ESS)

The Environmental and Social Standards (ESS) framework identifies 10 standards critical to sustainable development:

1. ESS1 – Assessment and Management of Environmental and Social Risks and Impacts
2. ESS2 – Labor and Working Conditions
3. ESS3 – Resource Efficiency and Pollution Prevention and Management
4. ESS4 – Community Health and Safety
5. ESS5 – Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement
6. ESS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources
7. ESS7 – Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
8. ESS8 – Cultural Heritage
9. ESS9 – Financial Intermediaries
10. ESS10 – Stakeholder Engagement and Information Disclosure

ESS Likely Triggered by the SBS Project

The Sokoto-Badagry Superhighway project is expected to trigger several ESS due to its nature and scope:

1. **ESS1 – Assessment and Management of Environmental and Social Risks and Impacts**

The project involves extensive land use, construction activities, and significant environmental and social interactions. A comprehensive Environmental and Social Impact Assessment (ESIA) is crucial to identify and mitigate these risks.

2. **ESS2 – Labor and Working Conditions**

The labour and working conditions within the framework of environmental and social operations require maximum protection of the workforce, non-discrimination and equal opportunities for all workers, prevention of child labour, occupational health and safety and appropriate grievance redress mechanism. An appropriate labour management plan will accommodate employment and working conditions, workers' needs, aspiration and protection.

3. ESS3 – Resource Efficiency and Pollution Prevention and Management

Construction activities may involve significant resource consumption (e.g., materials, water, and energy) and generate pollution (e.g., air, soil, and water contamination). This standard ensures resource efficiency and pollution control measures are integrated into the project.

4. ESS4 – Community Health and Safety

Construction activities, traffic congestion, and potential accidents along the superhighway could affect community health and safety. ESS4 addresses measures to protect communities from adverse impacts during and after construction.

5. ESS5 – Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement

The project is likely to require land acquisition, potentially leading to displacement or restrictions on land use. ESS5 ensures that affected persons are adequately compensated and resettled in a fair and transparent manner.

6. ESS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources

The superhighway's alignment may pass through ecologically sensitive areas, necessitating measures to protect biodiversity and manage natural resources sustainably.

7. ESS10 – Stakeholder Engagement and Information Disclosure

The project will affect a wide range of stakeholders, including local communities, government bodies, and civil society organizations. ESS10 ensures continuous stakeholder engagement, consultation, and disclosure of project information to build trust and transparency.

Adopting the WBG Environmental and Social Standards for the Sokoto-Badagry Superhighway project ensures alignment with global best practices. Addressing the environmental and social risks highlighted in the ESS, the project can achieve its developmental

goals while minimizing adverse impacts on the environment and local communities. This approach fosters sustainable development, enhances stakeholder confidence, and ensures compliance with national and international environmental and social obligations.

❖ **World Bank Group Environmental, Health, and Safety Guidelines**

The World Bank Group Environmental, Health, and Safety (EHS) Guidelines serve as technical reference documents providing globally recognized good practices for managing environmental, health, and safety risks in various industries, including road construction. These guidelines establish performance standards and measures that align with international best practices and are considered achievable for large-scale infrastructural developments like SBS-2.

1.8.4 Relevance to the Proposed Project

1. Environmental Safeguards

- **Air Quality:** The EHS guidelines emphasize measures to control dust and emissions during construction, which is critical given the arid nature of the Sokoto-Kebbi corridor. Strategies include regular watering of construction sites and maintenance of equipment to reduce particulate emissions.
- **Water Resource Management:** Ensuring proper drainage designs and sediment control to protect surface and groundwater resources aligns with the guidelines, minimizing potential impacts on local water bodies.
- **Biodiversity Conservation:** The guidelines advocate for measures to avoid or minimize impacts on biodiversity. For the superhighway, this includes careful planning to avoid critical habitats and implementing reforestation or compensatory planting programs where habitat disruption occurs.

2. Health and Safety

- **Worker and Community Safety:** The guidelines highlight the importance of occupational health and safety plans. This involves equipping workers with personal protective equipment (PPE), providing training, and implementing traffic management systems to reduce construction-related risks to both workers and nearby communities.

- **Hazardous Materials Management:** Proper handling and disposal of hazardous materials, such as bitumen and fuel used in construction, are outlined to prevent environmental contamination and health risks.

3. Social Considerations

- **Community Engagement:** The EHS guidelines stress stakeholder engagement to address community concerns. For the superhighway project, proactive communication with affected communities along the route will be crucial for resolving grievances and fostering project acceptance.
- **Resettlement and Livelihood Restoration:** The guidelines require adherence to internationally accepted practices for managing displacement and compensation, ensuring affected persons are adequately supported.

4. Sustainable Development Goals

- The EHS guidelines promote sustainable development by ensuring that projects integrate environmental and social considerations into their planning and execution. For the Sokoto-Badagry Superhighway, this means aligning with goals such as reducing environmental degradation, enhancing local socio-economic conditions, and fostering long-term resilience.
- By using the concrete pavement, there is a shift towards greener materials, efficient design, reduced emissions and enhanced safety. This supports Goal 9 of the SDGs (Quality Infrastructure) and promoting Good health & Well-Being (SDG 3) through better connectivity and reduced accidents, as well as SDG 11 (Sustainability of Cities) by integrating public transport, while balancing economic growth with environmental protection.

1.8.5 Structure of EIA Report

In line with the requirements of FMEnv EIA Procedural Guidelines and the Sectoral Guidelines on Transportation Development Project (Roads and Highways), this ESIA Report is presented in nine (9) chapters preceded with an executive summary as follows:

Chapter 1: Introduction

Chapter 2: Project Justification

Chapter 3: Project Description

Chapter 4: Description of the Project Existing Environment

Chapter 5: Associated and Potential Impacts

Chapter 6: Mitigation Measures

Chapter 7: Environmental and Social Management Plan (ESMP)

Chapter 8: Decommissioning and Remediation Plan

Chapter 9: Conclusion and Recommendations of the ESIA study.

CHAPTER TWO: PROJECT JUSTIFICATION

2.1 Introduction

This chapter justifies the project in terms of its needs, benefits and key elements of its sustainability. It also explains the various phases of the project as well the alternative routes and construction options considered for the development of the proposed SBS-2.

2.2 The Need for the Project

Nigeria's extensive road network, the largest in West Africa, plays a pivotal role in driving economic activity and connecting villages, cities, and markets. The importance of this infrastructure cannot be overstated, as it forms the backbone of trade, transportation, and social interaction across the nation. However, despite its vast size, the country's transportation infrastructure faces numerous challenges that impede its ability to support rapid population growth and meet the aspirations for economic development.

Of the total 195,000 km road network in Nigeria, only 35,000 km are federal roads. According to the World Bank (2022), an additional 23,000 km of road infrastructure is urgently required to meet the demands of the country's rapidly growing population and expanding economy. Nigeria's infrastructural deficit is a pressing issue, with estimates suggesting that the country will require between \$100 billion to \$150 billion annually over the next 50 years to bridge this gap. Considering this, the proposed annual budget for critical road infrastructure under the Road and Highway Infrastructure Development Fund (RHIDF) stands at \$25 billion over the next eight years, earmarked for projects like the Sokoto-Badagry Superhighway (SBS) and other strategic transportation initiatives.

The current state of Nigerian roads has serious implications for economic productivity and national development. Poor road conditions lead to significant economic losses, with vehicle operating costs alone valued at N53.8 billion annually. These costs, coupled with the broader economic losses totalling N1trn per year, underscore the urgent need for comprehensive road infrastructure improvements (Ibe, 2025). These figures do not even take into account the additional economic toll stemming from traffic congestion, time lost in long commutes, and the physical and emotional strain that road users endure daily.

The major challenges facing Nigeria's roads include:

- **Inadequate Funding:** A chronic underinvestment in road maintenance and expansion has resulted in the deterioration of existing infrastructure. Despite some funding allocations for road rehabilitation, there is insufficient provision for preventive maintenance, which is crucial to preserving road quality and extending the lifespan of the nation's road networks.
- **Neglect of Inter-Modality:** The lack of integration between the road, rail, and waterway transportation systems has limited the efficiency of the nation's transport infrastructure. A holistic approach that facilitates the seamless movement of goods and passengers across different modes of transport is essential for optimizing the sector's performance.
- **Heavy Burdens on Roads:** With limited options for rail and pipeline transport, the country's roads have become the primary means of transporting goods and passengers. This reliance has placed undue pressure on road infrastructure, resulting in accelerated wear and tear, particularly with the heavy movement of goods such as petroleum products, which should ideally be transported via pipelines.
- **Budgeting Constraints:** Nigeria's short budget cycles hinder optimal allocation and usage of funds, especially during the dry season, which is the most favorable period for construction and road rehabilitation. This limitation slows down the pace of infrastructural development.
- **Poor Drainage and Overloading:** Blocked drainage systems, combined with overloading and improper parking of heavy vehicles, exacerbate the deterioration of roads. These factors contribute significantly to the ongoing damage to the nation's road network.

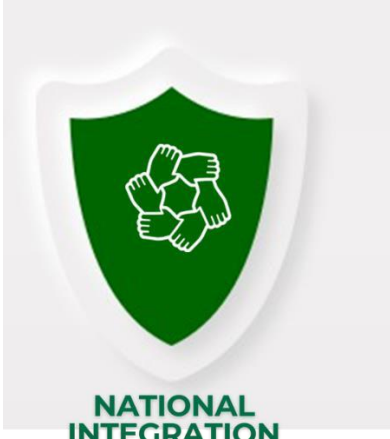
 SOCIOECONOMIC IMPACT The development of road infrastructure is crucial for socioeconomic progress. Nigeria's extensive road network, the largest in West Africa, facilitates connections between villages, cities, and markets. However, despite this extensive network, challenges persist due to inadequate infrastructure. Improved roads are essential for economic growth, as they facilitate trade, transportation, and access to markets. A robust road network is vital for Nigeria to compete with other thriving economies and unlock its full economic potential.	 SOCIOCULTURAL IMPACT The migration trend towards urban centers, particularly Greater Lagos, poses challenges to sustainable development. Without adequate infrastructure and decentralization initiatives, cities like Lagos may face overpopulation and strain on resources. Encouraging population settlement in regions like Sokoto through improved connectivity can alleviate pressure on urban centers and foster balanced regional development. Redirecting migration patterns towards the middle belt and north is crucial for preventing socio-cultural imbalances and promoting national cohesion.	 NATIONAL INTEGRATION Enhancing road and rail connectivity between regions is vital for national integration and economic growth. The lack of efficient transportation networks between regions like Sokoto and the southwest hinders economic development and perpetuates poor migration patterns. Investing in modern infrastructure projects, particularly through private sector involvement, can stimulate economic activity, empower local communities, and strengthen the nation's overall connectivity. This approach promotes the utilization of local resources, fosters regional economic resilience, and contributes to a more integrated and prosperous Nigeria.
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Figure 2.1: SBS Project Need

The Sokoto-Badagry Superhighway (SBS) project presents a transformative opportunity to address many of these challenges while also propelling national economic growth. The Sokoto-Badagry corridor is crucial for enhancing connectivity between the northern and southern parts of the country, serving as a critical link that will integrate local economies, improve national cohesion, and foster regional development. The road will serve as an economic liberation route, creating a vital trade and transportation link between key agricultural, mining, and industrial hubs, particularly in the north and southwest of Nigeria.

This project is directly aligned with Nigeria's National Integrated Infrastructure Master Plan (NIIMP), which seeks to develop robust transportation systems that can drive industrialization, reduce regional disparities, and increase the nation's global competitiveness. The SBS will facilitate the smoother movement of goods and people, cutting down logistics costs, improving market accessibility, and stimulating trade. The economic impact will be felt at multiple levels, from Sokoto's onions and Kebbi's rice to Zamfara's gold products that currently struggle to reach broader markets due to the poor state of infrastructure.

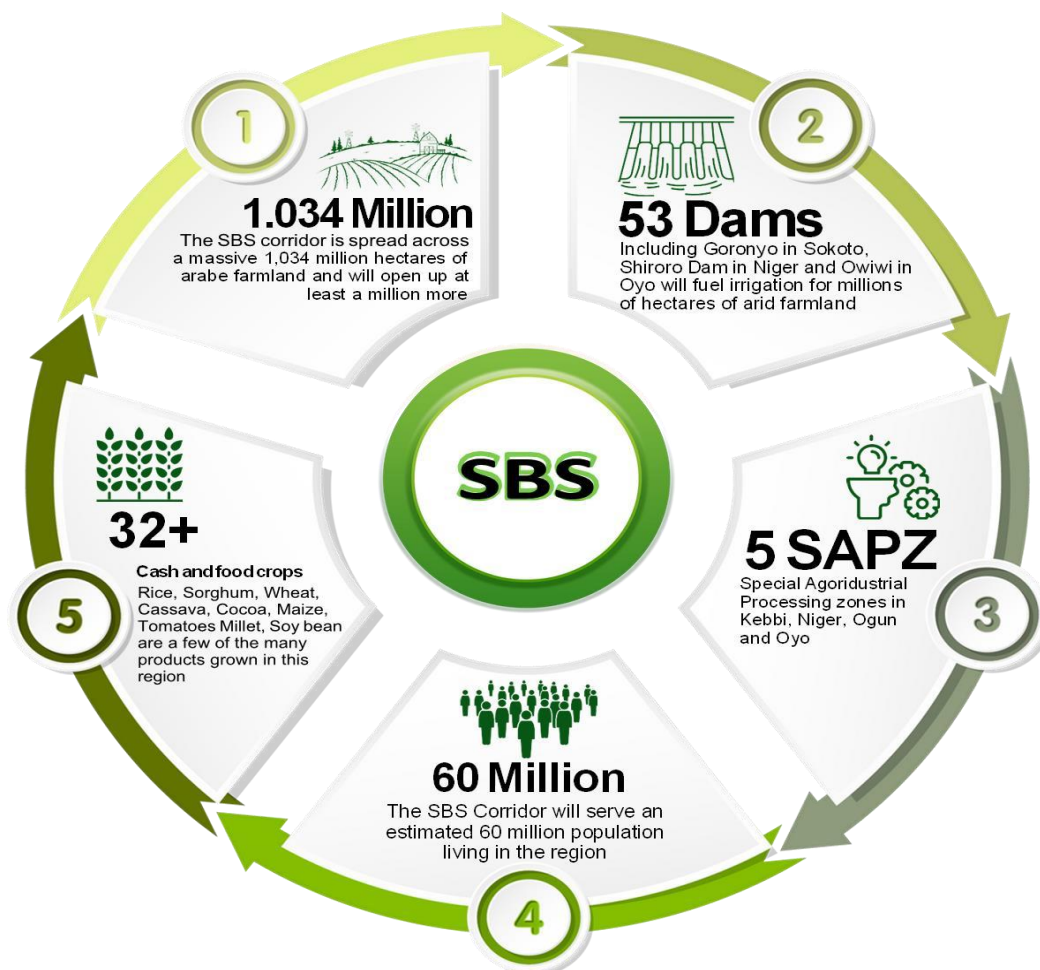


Figure 2.2: SBS Regional Corridor of Economic Dynamism

In addition to its economic benefits, the SBS project will have a significant impact on national security and social cohesion. Improving transportation links, the project will reduce the security risks associated with the isolation of certain regions. Furthermore, better connectivity will foster a more balanced population distribution, encouraging urban migration to areas such as Sokoto and Birnin Kebbi, which are currently underdeveloped compared to urban centers like Lagos. This will alleviate pressure on overstretched cities and contribute to the balanced growth of the country.

2.3 Benefits of the proposed project

Key benefits of the proposed SBS project include:

1. The SBS infrastructural development will enhance mobility, foster job creation, stimulate economic activity along its route, catalyse socio- economic transformation, driving prosperity and fostering inclusive development across the nation.



1.6 Million Jobs

Over 1.2 million jobs would be created by the development of the SBS Economic corridor

45,000 MSMEs

When completed, SBS will power the setup of over 45,000 businesses in the Micro, Small and Medium enterprise sector and boost



100+ Factories

Processing and manufacturing factories would also set up shops along this corridor, further boosting the economy of the region.

Figure 2.3: Key benefits of the SBS project

2. **Economic Revitalization:** The highway will unlock untapped economic potential along its route, including Sokoto's onions, Kebbi's rice fields, and Zamfara's gold reserves, reducing post-harvest losses and stimulating industrialization.

3. **Balanced Regional Development:** Improved connectivity will encourage population settlement in underdeveloped regions like Sokoto and Birnin Kebbi, alleviating pressure on urban centers such as Lagos and fostering national cohesion.
4. **Enhanced Trade and Security:** The highway will improve the transport of goods and people, reduce the cost of production, and address security concerns by providing efficient logistics and surveillance systems.
5. **Private Sector Participation:** Leveraging private sector resources and expertise under the Highways Development and Management Initiative (HDMI) will complement government efforts in achieving sustainable infrastructure.
6. SBS will reduce travel time from Sokoto to Badagry to approximately 10 hours, improved transport accessibility across the region and enhance connectivity between the northern and southern region.
7. SBS positions Badagry as a key transit hub, offering advantages for landlocked countries like Niger and Burkina Faso over traditional ports. This shift in logistics presents opportunities to reroute import traffic and boost revenue for Nigeria as the transit port.

REDEFINING TRADE ROUTES



Badagry as a Gateway: The SBS strategically positions Badagry as a pivotal transit point, offering a compelling alternative to traditional ports like Cotonou and Lome for landlocked countries such as Niger and Burkina Faso. This shift in logistics dynamics presents immense opportunities for import traffic redirection and significant revenue generation for Nigeria as the transit port.

According to recent trade data, approximately 56% of imports bound for Niger and Burkina Faso pass through Cotonou and Lome ports annually. By capturing a portion of this import traffic, Badagry stands to gain substantial revenue from transit fees, customs duties, and related services.

Figure 2.4: SBS potential for Redefinition of Trade Routes

8. SBS will foster regional trade relations across West Africa and beyond, thanks to its proximity to the TAH 5 in the North and TAH 7 in the south, eight (8) border crossings

to neighbouring countries in the region, the African Trans Saharan Trade Route via its interconnectedness with the CAS and loop to the LCCH.

AFCFTA & EXPORTS



Unlocking the AfCFTA: The African Continental Free Trade Area (AfCFTA) creates a vast market for Nigerian exports. The SBS goes beyond just improving domestic transportation. It positions Nigeria to become a major player in the African Continental Free Trade Area (AfCFTA) by making exports more efficient and competitive. The SBS will significantly reduce transportation costs and time, making Nigerian goods more competitive within the AfCFTA.

Figure 2.5: AFCFTA Framework

9. The Proposed Sokoto-Badagry Superhighway (SBS) project will significantly boost the livestock market by improving accessibility to regional and national markets. Livestock farmers and traders will benefit from reduced transportation costs, faster delivery times, and minimized losses. The improved road infrastructure will facilitate increased trade volumes and attract more buyers and sellers, thereby expanding the market. Rural communities along the corridor will experience enhanced livelihoods through income generation and poverty reduction. Additionally, the superhighway will strengthen agricultural value chains by improving the movement of feed, veterinary supplies, and livestock products. It will also reduce post-harvest losses, ensuring higher-quality livestock reaches markets. Finally, the increased market activity will attract investments in livestock farming and related businesses, further driving economic growth in the region.

LIVESTOCK MARKETS BOOM

The SBS is poised to significantly transform the landscape of livestock markets and transport within the corridor. Here's a breakdown of its anticipated impact:

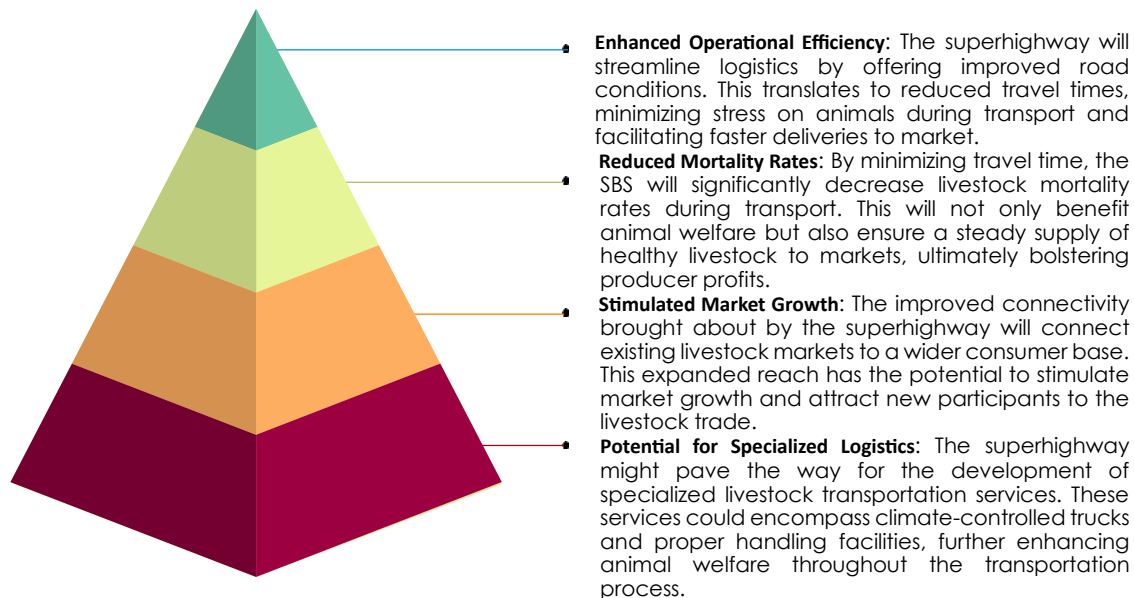


Figure 2.6: SBS potential for boosting livestock marketing

2.4 Envisaged Sustainability

The envisaged sustainability of the proposed project is examined using the four pillars of sustainability, namely; environmental, economic, social and technical sustainability.

2.4.1 Environmental Sustainability

To ensure environmental sustainability of the road construction project, all potential environmental impacts of the project have been identified and assessed as part of this ESIA with effective management actions proffered to avoid or reduce those impacts to the barest minimum. These measures have also been mainstreamed into the project specific ESMP developed as part of this ESIA Report to ensure their effectiveness in assuring environmental sustainability of the project especially during construction. Also, the FMEnv, in conjunction with Sokoto and Kebbi States Ministry of Environment and other relevant Agencies will monitor the implementation of the environmental and social mitigating measures as contained in the ESMP to ensure great considerations are given to the environment throughout the period of construction. Additional measures to ensure environmental sustainability during construction will include the following:

- Excavated materials will be reused or recycled to reduce consumption of raw materials. This will ensure resource efficiency, reduction in pollution and prevention of environmental degradation. Overall, this initiative will greatly reduce the ecological footprint of the project on the environment;
- There will be strict adherence to best practice principles in construction and the use of best available technology especially to keep the disruption to the environment at acceptable levels.

2.4.2 Economic Sustainability

The development of road infrastructure is crucial for socioeconomic progress, and Nigeria's extensive road network, the largest in West Africa, facilitates vital connections between villages, cities, and markets. However, despite this extensive network, the country faces numerous challenges due to inadequate infrastructure, hindering the full economic potential. Improved roads are essential for economic growth, as they enhance trade, transportation, and access to markets, empowering Nigeria to compete with other thriving economies. A robust road network will unlock the country's economic potential, creating new opportunities for both rural and urban populations.

The Sokoto-Badagry Superhighway (SBS) represents a transformative development for the nation, particularly in terms of economic sustainability. The project will not only address infrastructure deficits but also stimulate economic activity in the region, benefiting local communities and broader economic sectors. The primary target groups who will benefit from the project are road users, especially inhabitants of the adjoining communities primarily farmers and market women. This infrastructure upgrade will provide farmers with better access to markets, reduce transport and vehicle operation costs, and enhance opportunities for increased agricultural production.

The Sokoto-Badagry corridor encompasses several states, each contributing significantly to Nigeria's economic landscape. With the current Gross Domestic Product (GDP) of these regions, the corridor boasts immense economic potential waiting to be unleashed. The seven states have a combined GDP of \$147.65 billion and this figure is projected to double within 5 years of the SBS development.

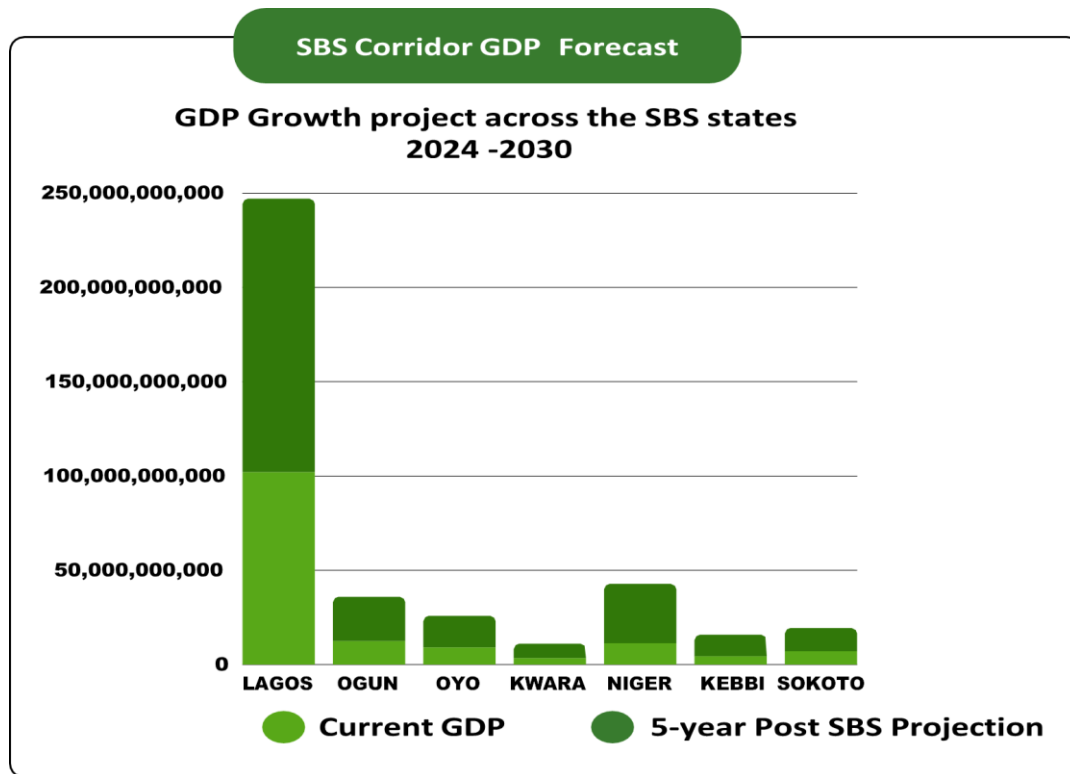


Figure 2.7: SBS Regional GDP Break Down

2.4.2.1 Economic Impact of the SBS

The development of the SBS corridor will have profound economic effects on the region. Key projections include:

1. **1.6 million New Jobs Created:** The establishment of the SBS Economic Corridor will create over 1.6 million jobs due to increased economic activity in agriculture, mining, and related services. This employment boost will significantly reduce unemployment and poverty levels across the region.
2. **Over 45,000 New MSMEs:** The improved transportation network will lead to the establishment of over 45,000 businesses in the Micro, Small, and Medium Enterprise (MSME) sector, which will drive economic growth and innovation in the region.
3. **A GDP Growth Exceeding \$100 Billion:** With a combined GDP of \$147.65 billion across the seven states, this figure is projected to double within five years of the SBS development. The enhanced connectivity will attract investments, boost regional industries, and contribute to national economic growth.

4. **Over 100 Factories & Industries:** The SBS will enable the setup of over 100 processing and manufacturing factories along the corridor. These industries will support the local economy by providing jobs and driving economic diversification.

2.4.2.2 *Agricultural Impact of the SBS*

The agricultural sector will experience a significant boost as a result of improved road infrastructure:

1. **Improved Market Accessibility:** Faster transportation of perishable goods, such as crops from Sokoto, Kebbi, and Niger, to Lagos will reduce post-harvest losses and enhance the profitability of farmers. The timely delivery of farm inputs and products to markets will stimulate agricultural activities across the region.
2. **Increased Agricultural Productivity:** The SBS will provide easier access to key agricultural hubs like Sokoto's Goronyo rice basket, Kebbi's Argungu aquatic hub, and Niger's yam barns. This improved accessibility will encourage increased cultivation of staple crops like rice, maize, and wheat, contributing to national food security.
3. **Specialized Agro-Processing Zones (SAPZs):** The creation of SAPZs along the corridor will further boost the agricultural sector by facilitating the processing of agricultural produce into value-added products, providing employment and increasing the competitiveness of local crops on both domestic and international markets.
4. **Dams & River Basin Integration:** The region's 53 major dams and two river basins will be more effectively utilized, supporting year-round farming through improved irrigation systems. This will help increase agricultural productivity by addressing water scarcity issues and improving soil conditions.

The Sokoto-Badagry Superhighway is more than just a road project; it is an economic engine that will drive growth, enhance agricultural productivity, foster industrial development, and improve the quality of life for millions of Nigerians. With its broad-reaching economic, agricultural, and industrial impacts, the SBS project is a critical investment in Nigeria's sustainable future, contributing to national development, reducing regional disparities, and unlocking the country's full economic potential.

The source of funds is the Federal Government of Nigeria through the Federal Ministry of Works for effective implementation of the proposed road project.

2.4.3 Social Sustainability

The development of the proposed SBS-2 is expected to generate both direct and indirect employment opportunities for the people in the adjoining communities. This will significantly improve household income during the construction phase, while also providing long-term benefits for the local population once the road is operational. Improved accessibility to farms, agro-processing centers, and markets will enhance economic opportunities, particularly for farmers, market women, and traders along the corridor. Social interaction and integration between communities in Sokoto and Kebbi states will be re-established and strengthened, contributing to regional cohesion and cooperation.

After the completion of the road, local communities will benefit from better connectivity, not only facilitating the movement of goods and services but also enhancing access to essential infrastructure such as schools, healthcare centers, and social amenities. The project will play a key role in reducing isolation of rural communities, improving access to urban areas, and facilitating social mobility.

To ensure the social sustainability of the project, the Federal Ministry of Works is committed to minimizing any adverse impacts on local communities, particularly during the construction phase. Special attention will be paid to maintaining harmonious relationships with the communities and ensuring that the long-term benefits of the project far outweigh any short-term disruptions.

The FMW will prioritize social inclusion by implementing a comprehensive engagement program throughout the project's lifecycle. This program will ensure that the voices of local communities are heard, their concerns addressed, and that they are actively involved in decision making processes.

Key concerns raised during the stakeholder consultations have included issues related to land acquisition, potential disruption of livelihoods, and access to critical services such as healthcare and education. These concerns will be carefully addressed through the design and implementation of mitigation strategies, ensuring that the project delivers equitable benefits while minimizing disruptions.

2.4.4 Technical Sustainability

The design of the proposed SBS-2, along with all ancillary infrastructure including culverts, pavements, and other road-related structures, will adhere to national standards set by the Federal Ministry of Works (FMW) and other internationally recognized standards to ensure the technical sustainability of the project. The design will also consider the specific geographic and environmental conditions of the corridor to ensure long-term durability and performance of the road.

To guarantee that the project is executed to the highest technical standards, a competent technical consultant will be engaged to oversee construction activities. This consultant will ensure that the construction contractor strictly adheres to the design specifications and meets all national standards and regulations throughout the construction phase. Regular technical audits will be conducted to ensure compliance with these standards.

TECHNICAL SPECIFICATIONS FOR THE SOKOTO-BADAGRY SUPERHIGHWAY

SBS holds immense strategic importance for Nigeria's economic development and regional integration. Serving as a vital link between northern and southern regions, the corridor will facilitate trade, transportation, and connectivity across diverse sectors.

3-LANE DUAL CARRIAGE ROAD

A 3-lane, dual-carriageway concrete road with 100 meter right-of-way corridor to accommodate future rail infrastructure and other facilities in the median

LIVESTOCK UNDERPASSES

Livestock underpasses to facilitate safe crossing of herding routes.

UTILITY CORRIDOR

Utilities corridor for gas pipelines and fibre optic cables, major truck parks with CNG refilling stations and electric vehicle charging infrastructure.

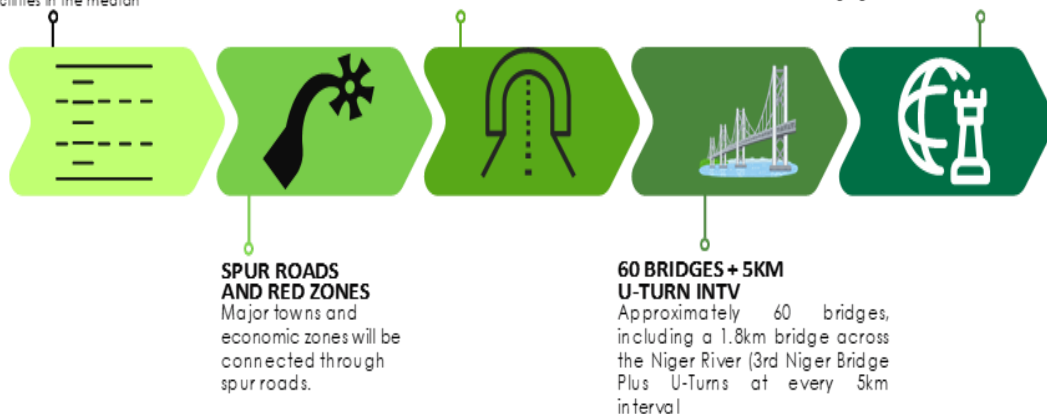


Figure 2.8: Technical Specifications for the Proposed Sokoto-Badagry Superhighway

The use of advanced technologies and engineering designs will be a key aspect of ensuring the technical sustainability of the road. The project will incorporate the best available technology in materials, equipment, and construction techniques. This includes the use of environmentally

friendly and energy-efficient materials such as high-performance concrete (HPC). These innovations not only improve the durability and performance of the road but also offer benefits such as reduced energy consumption, lower emissions, and faster construction times.

The construction process will comply with Highway Engineering Codes and Standards as outlined by the Federal Ministry of Works Design Standards for the specific road classification. Additionally, the project will ensure that adequate and qualified manpower, including skilled engineers, technicians, and laborers, is available to carry out the technical aspects of the project. This ensures that the project will meet its technical goals and maintain high standards throughout the construction and operational phases, supporting the long-term success and sustainability of the Sokoto-Badagry Superhighway, Section 2.

2.5 Project Development Options

2.5.1 No Project Option

The “No Project Option” implies that the proposed SBS-2 will not be constructed, and the status quo will be maintained. In this scenario, the absence of the road infrastructure will continue to exacerbate existing transportation and socio-economic challenges within the region.

The current conditions, which include the absence of reliable road connectivity, increased travel time, and high vehicle operating and maintenance costs, will persist. The failed or non-existent road assets such as culverts and bridges will remain unimproved, further hindering access and mobility for communities along the route. Rural farming communities in the Local Government Areas of Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri in Kebbi State, who rely on improved transport networks for economic activities, will be disproportionately affected.

Adopting the “No Project Option” would represent a significant setback for these communities and other road users by stifling socio-economic growth and development. The potential benefits of the project, including enhanced rural access, reduced travel time, lower vehicle operating costs, improved livelihoods, poverty alleviation, stimulation of local economic activities, and greater integration of communities, would be lost.

Additionally, the strategic importance of the superhighway in linking to regional and transnational trade routes, such as the Trans-Saharan Trade Corridor and Trans-African

Highways (TAH5 and TAH7), would remain unrealized, limiting opportunities for economic integration and trade expansion.

For these reasons, the “No Project Option” is not considered socially, economically, or environmentally favorable and is therefore rejected.

2.5.2 Delayed Project Option

The delayed project option implies that the implementation of the proposed SBS-2 will be suspended until a later date. This option is deemed not viable as the absence of timely intervention will result in further deterioration of the region's transportation infrastructure, exacerbating challenges for road users.

The current deplorable conditions, including inadequate or non-existent road connectivity, will continue to worsen, making life increasingly difficult for road users, particularly rural farmers, traders, and market women in the Local Government Areas of Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri in Kebbi State. The deteriorating road infrastructure will hinder access to markets, healthcare, education, and other essential services, adversely affecting the livelihoods and economic prospects of these communities.

Furthermore, the costs associated with maintaining failed sections of the road will persist, providing only temporary relief without addressing the underlying issues. Delaying the project will also increase its overall cost due to inflation, currency fluctuations, and rising construction material prices, making future implementation economically challenging.

The strategic objectives of the superhighway, including fostering regional trade through connections to the Trans-Saharan Trade Corridor and Trans-African Highways (TAH5 and TAH7), and stimulating socio-economic growth in the area, will remain unachieved.

For these reasons, the delayed project option is considered socially and economically unsustainable and is therefore rejected.

2.5.3 Immediate Project Implementation

The immediate implementation of the proposed SBS-2 is considered the most economically, socially, and environmentally viable option. This approach ensures the prompt realization of the project's inherent benefits, particularly for local farming communities and other road users in the region.

The project has garnered overwhelming support from local communities, the Local Government Areas (LGAs), and the states involved. It is anticipated to address critical transportation challenges, remove bottlenecks, and significantly enhance economic activities. By improving connectivity across Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri LGAs in Kebbi State, the superhighway will play a pivotal role in poverty reduction and economic recovery within rural communities.

The project will facilitate improved access to rural areas, reducing transportation and vehicle operating costs. Additionally, it will boost agricultural production by providing farmers with easier access to inputs, extension services, and markets, thereby increasing their productivity and income.

Comprehensive project preparation and feasibility studies carried out during the appraisal phase have demonstrated that this immediate implementation option is technically feasible, economically viable, environmentally sustainable, and socially justified. Moreover, the strategic alignment of the superhighway with regional trade routes, including its connection to the Trans Saharan Trade Corridor and the Trans-African Highways (TAH5 and TAH7), further underscores its importance.

Given these advantages, the immediate implementation of the proposed Sokoto-Badagry Superhighway, Section 2, is the preferred and most sustainable option.

2.6 Project Alternatives

The identification and analysis of project alternatives are crucial for ensuring that the proposed development achieves its objectives in an environmentally, socially, and economically sustainable manner. This section discusses the three alignment options considered for the 323km stretch of the proposed SBS-2 project.

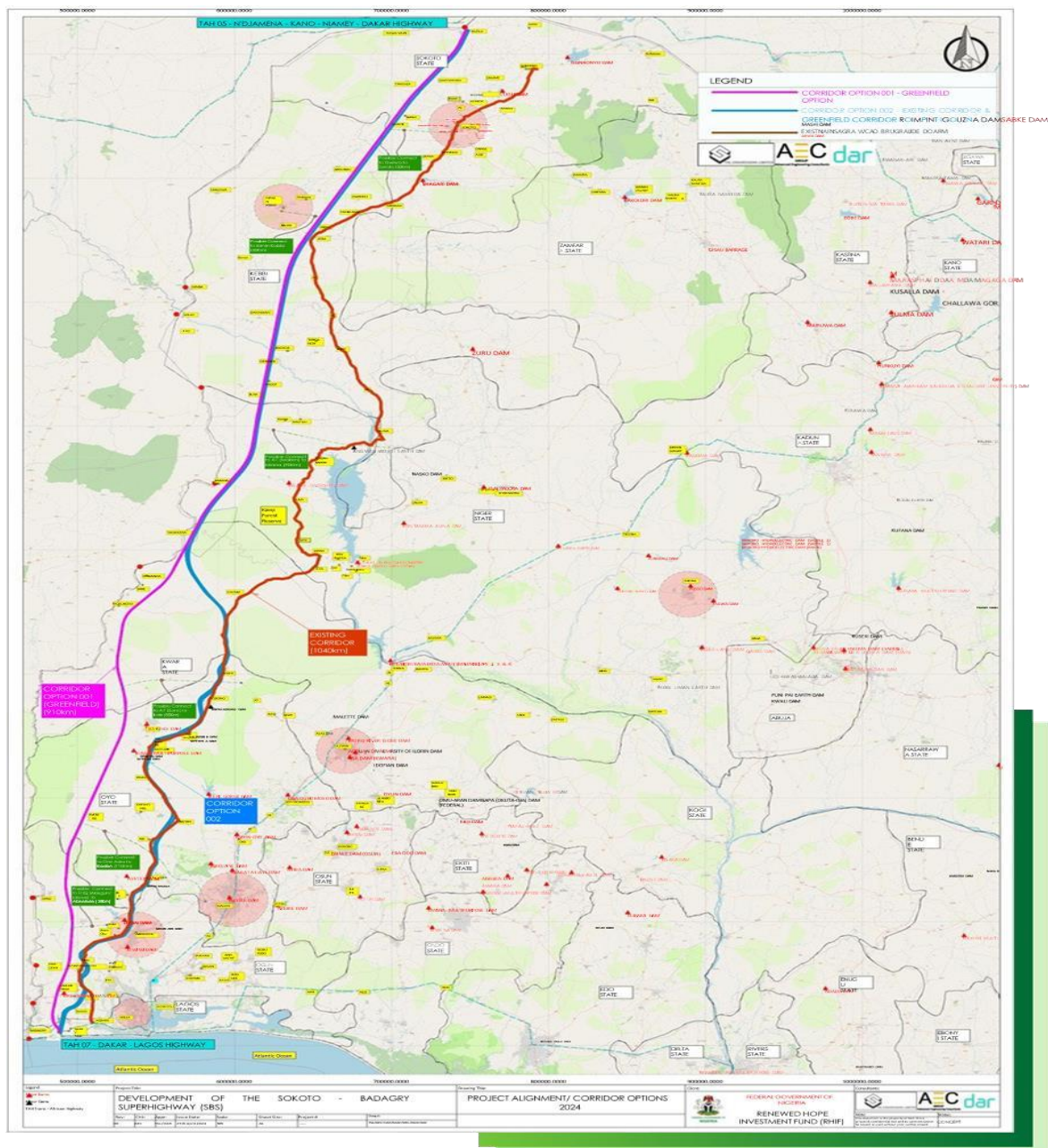


Figure 2.9: SBS Alignment Options

2.6.1 Alternate Project Route / Alignment

Different route alignments were evaluated before settling on the current one. Several options were considered on the basis of cost effectiveness, compensation for right of way acquisition and methodology of construction. Other considerations include avoidance of river paths with minimal intrusion into swamp and areas with wetland, using existing roads while adding bridge

and deck on pile where needed. For the current project, the following options were considered and discussed below:

2.6.1.1 Alternative 1: Proposed Route (Preferred)

Description: This alignment is a new Greenfield corridor that commences at Illela in Sokoto and traverses through Binji, Tambuwal, and Gwandu, crosses the River Niger at north of Kpatachi, and culminates at Badagry. The route is designed to facilitate connectivity while ensuring a straight and efficient alignment to reduce travel time and fuel consumption.

Advantages:

- Ensures minimal disturbance to sensitive ecosystems by utilizing strategic alignments.
- Balances cost efficiency with the strategic use of pre-existing infrastructure.
- Minimizes displacement of communities, reducing the need for large-scale resettlement.
- Provides a better gradient and curvature, enhancing road safety and reducing accident risks.
- Facilitates economic integration and improved accessibility in the region.

Disadvantages:

- May require significant rehabilitation of certain segments to meet superhighway standards.
- Potential challenges in integrating sections that experience high urban activity.

2.6.1.2 Alternative 2: Greenfield Alignment

Description: This option combines a Greenfield alignment with sections of existing brownfield routes, intersecting areas around Jega, Kaiama, Kishi, and Ago Are.

Advantages:

- Opens previously inaccessible areas, fostering new opportunities for economic development.

- Designed for uninterrupted flow with minimal interference from existing urban or rural activities.
- Newly constructed roads typically require less maintenance during their initial lifespan.

Disadvantages:

- Significant alteration of natural habitats, especially in pristine areas.
- High construction costs due to entirely new infrastructure requirements, including bridges, culverts, and earthworks.
- Potential for large-scale resettlement and compensation demands due to extensive land acquisition.

2.6.1.3 Alternative 3: Existing Travel Routes (Do Nothing Scenario)

Description: This option follows the existing route from Goronyo, passing through towns like Sifawa, Jaredi, Tambuwal, and Jega, with a potential connection to the A1 through the Makirin Minna stretch. Under this scenario, no new infrastructure is developed, and the current road network remains unaltered.

Advantages:

- No environmental impact, as the natural environment remains undisturbed.
- Cost savings, as no financial outlay is required for construction, operation, or maintenance.

Disadvantages:

- Continued traffic congestion as the current road network degrades further.
- Missed opportunities for economic development and regional integration.
- Persistent high rates of accidents and travel delays, negatively impacting quality of life and productivity.

2.6.1.4 Preferred Alternative

After a comprehensive evaluation of the alternatives, Alternative 1 (Proposed Route) emerges as the most suitable option for implementation. This alignment provides a balanced approach by leveraging existing infrastructure and minimizing environmental and social impacts while

enhancing regional connectivity and development. Its efficient design reduces travel time and fuel consumption, aligning with economic and sustainability goals.

Although the Greenfield Alignment (Alternative 2) offers significant development opportunities, its associated environmental and social costs, along with higher construction expenses, make it less viable. On the other hand, the "Do Nothing" scenario (Alternative 3) is untenable due to increasing traffic inefficiencies and the urgent need to stimulate economic growth and infrastructure development.

This recommendation ensures alignment with the project's objectives and adheres to environmental and social safeguard policies, promoting sustainable development for the region.

2.6.2 Alternate Construction Techniques

The construction of the proposed SBS-2 involves the careful selection of techniques and materials to ensure durability, cost-effectiveness, and environmental sustainability. Various construction elements, including pavement, drainage systems, bridges, culverts, and other supporting structures, have been analyzed to determine the most appropriate methods for execution.

A decision between two options of concrete and asphalt roads was considered based on factors such as the relative costs/budget, traffic volumes, environmental impact, reliabilities, availability of equipment and materials, and the desired lifespan. Concrete offers a longer lifespan, lower maintenance, and greater durability, particularly in areas with heavy traffic. Asphalt, while more affordable initially, requires more frequent maintenance and has a shorter lifespan.

2.6.2.1 Pavement

Concrete pavement and asphaltic/bituminous pavement were considered for the superhighway. While concrete pavements offer greater durability, resistance to water seepage, and low maintenance needs, their higher initial cost and complex construction process present challenges. On the other hand, bituminous pavements, which are composed of aggregates and bitumen, are more cost-effective, quicker to construct, and better suited for immediate local availability of materials and resources.

Asphalt pavements, however, are less rigid than concrete and require multiple layers to distribute traffic loads effectively. While asphalt production involves significant greenhouse gas (GHG) emissions during the mixing process, its recyclability and ease of repair make it a practical choice

for large-scale highway projects. Consequently, the decision was made to use concrete pavement in the form of a Continuously Reinforced Concrete Pavement (CRCP) for this section of the highway, balancing cost, environmental considerations, and construction efficiency.

2.6.2.2 Drainage Systems

Effective drainage is critical to the longevity of the superhighway, especially in regions prone to heavy rainfall and flooding. Open trapezoidal drains and lined side drains have been considered for areas with high water flow to prevent erosion and waterlogging. Box culverts and pipe culverts will be strategically placed to channel water away from the highway, particularly at water crossings and low-lying terrain. The materials for drainage structures will prioritize reinforced concrete for its durability and ability to withstand varying weather conditions.

2.6.2.3 Bridges

The construction of bridges for river and stream crossings along the Sokoto-Badagry Superhighway requires innovative techniques to ensure structural integrity and long-term durability. Pre-stressed concrete girder bridges are preferred for major crossings due to their strength, reduced maintenance requirements, and ability to span longer distances. For smaller crossings, reinforced concrete slab bridges will be used for their cost efficiency and ease of construction. All bridge designs incorporate features to accommodate both vehicular and pedestrian traffic, ensuring safety and functionality.

2.6.2.4 Culverts

Culverts are essential to managing surface water flow and maintaining road stability. For this project, hydrological/hydraulic study of the co-tributary watershed will be conducted. The study will identify locations and sizes of drainage structures. These structures will be reinforced concrete box culverts and pipe culverts of varying sizes and will be used depending on the flow requirements. The culverts will be designed to prevent clogging and erosion while facilitating smooth water passage. Special consideration will be given to areas with high water tables to ensure proper reinforcement and alignment.

2.6.2.5 Earthworks

The highway alignment involves significant earthworks, including excavation, embankment construction, and grading. Modern techniques such as the use of geotextiles will be applied to stabilize weak soils and improve the strength of embankments. Borrow pits will be carefully

selected for sourcing fill material, ensuring minimal environmental disruption and compliance with regulatory standards.

2.6.2.6 Traffic Safety Features

To ensure the safety of road users, traffic safety features such as guardrails, road markings, and reflective signage will be incorporated throughout the highway. Durable materials will be used for these installations to withstand extreme weather and heavy usage. Crash barriers will also be installed along bridges and steep embankments to minimize the risk of accidents.

2.6.3 Environmental Considerations

Environmental sustainability is a core aspect of the project. Measures will be taken to mitigate the impact of construction activities, including proper disposal of construction waste, minimizing greenhouse gas emissions, and implementing soil erosion control measures. Vegetation will be restored in disturbed areas along the right-of-way (ROW) after construction to stabilize the soil and enhance biodiversity.

CHAPTER THREE: PROJECT DESCRIPTION

3.1 Introduction

This chapter presents the technical description of the proposed Sokoto-Badagry Superhighway (SBS), a 950km Greenfield infrastructure development initiative by the Federal Government of Nigeria. This transformative project is conceived as a solution to address trade, transport, and security (TTS) challenges, enhancing connectivity and economic integration between the Northwest and South-West regions of Nigeria. The superhighway will traverse Sokoto, Kebbi, Niger, Kwara, Oyo, Ogun, and Lagos States, interconnecting two significant Trans-African Highways: TAH 5 (N'Djamena-Dakar) and TAH 7 (Lagos-Dakar).

The Sokoto-Badagry Superhighway corridor is designed to optimize trade routes, reduce transport costs, and improve the overall efficiency of cross-border and regional trade. It starts at Alfala in Sokoto State, a border town between Sokoto and Kebbi states in the north, and traverses major towns, crossing the River Niger at north of Kpatachi in Niger State before culminating at Badagry in Lagos State. Section 2 of the project, covered under this Environmental and Social Impact Assessment (ESIA), spans 323km from Alfala in Sokoto state to Balugu in Kebbi state.

3.2 Proposed Alignment of the Road

The Sokoto–Badagry Superhighway (SBS) is designed as a Trade, Transport, and Security (TTS) Greenfield Corridor. The SBS-2 alignment is a Greenfield project that covers a total length of 323km from Alfala in Sokoto state to Balugu in Kebbi state. It traverses Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri Local Government areas in Kebbi state. This strategic route interconnects two Trans-African Highways: TAH 5 (N'Djamena–Dakar) and TAH 7 (Lagos–Dakar), thereby enhancing regional trade, reducing transport costs, and improving connectivity and economic efficiency. This corridor is designed to optimize economic advantages, boosting trade efficiency and logistical economies of scale.

3.3 Corridor Description:

1. **Starting Point:** The corridor connects with Section 1 (which terminated at Alfala in Sokoto state) and proceeds to Balugu (Bagudo Local Government), Kebbi state.
2. **River Niger Crossing:** It crosses the River Niger at north of Kpatachi, employing a robust bridge system designed for heavy-duty logistics and transport.

3. **Alignment Through the state:** The corridor traverses nine (9) Local Government Areas in Kebbi state and terminates at Balugu (Kebbi-Niger state border).

4. **Auxiliary Spurs:** A 35KM connection to Birnin Kebbi, Kebbi State.

5. **Local Government Areas (LGAs) Covered**

- Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri

This project emphasizes advanced civil engineering practices, including grade-separated interchanges, multi-lane carriageways, structural enhancements for bridges, and geotechnical solutions for challenging terrains. The alignment integrates feeder roads, ensuring seamless interconnectivity and economic stimulation for local communities (Figure 3.1).

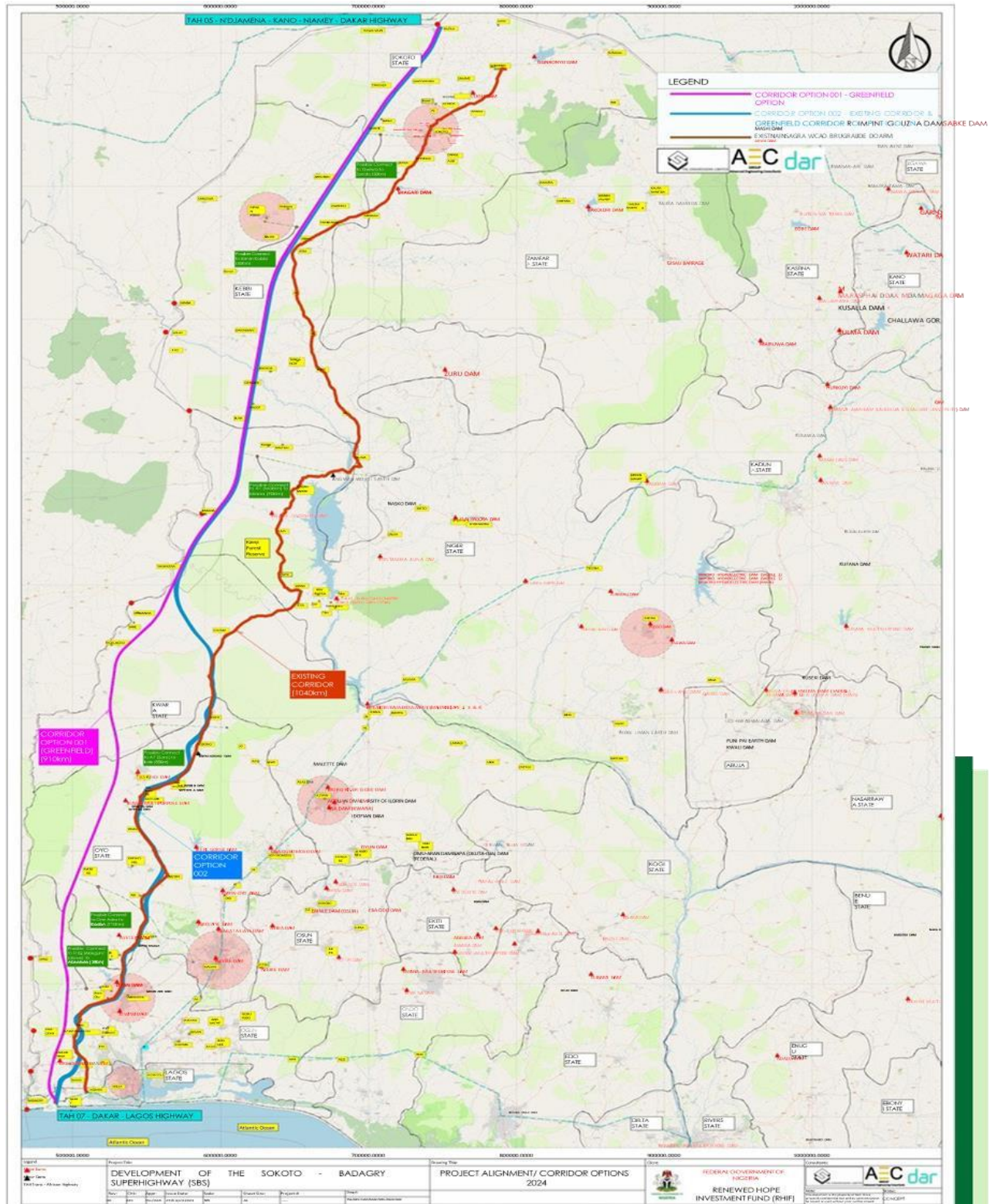


Figure 3.1: Proposed SBS Alignment

3.4 Project Scope

The project involves the development of the proposed SBS-2. The project scope includes the following:

- Site Clearing;
- Earthworks;
- Construction of new bridges;
- Construction of retaining walls;
- Pavement works (CRCP placement);
- Construction of Drainages;
- Construction and installation of culverts.
- Installation of road furniture.
- Installation of railings;
- Road marking.

3.5 Project Design and Features

1. Dual-Carriageway Concrete Road

The superhighway will be a 3-lane, dual-carriageway concrete road with a 100-meter right-of-way corridor. This corridor is planned to accommodate future rail infrastructure and other essential utilities.

2. Utility Corridor

The project includes a dedicated utility corridor for gas pipelines and fiber optic cables. Additionally, truck parks equipped with compressed natural gas (CNG) refilling stations and electric vehicle (EV) charging infrastructure will support the shift to cleaner energy sources for transportation.

3. Bridges and Intersections

Approximately 60 bridges, including a 1.8km bridge across the River Niger, will be constructed. U-turns will be strategically placed at every 5km interval to facilitate efficient traffic management.

4. Livestock Underpasses

Livestock underpasses will be integrated into the design to ensure the safe crossing of herding routes, addressing potential conflicts between vehicular traffic and traditional herding practices.

5. Spur Roads and Economic Zones

The corridor will include spur roads to connect major towns and economic zones. This approach will enhance access to key economic centers, fostering regional development and enabling tourism.

The various component of the dual carriageway was designed with several considerations such as safety, traffic volume, level of service, alignment, grades multimodal and Environmental consideration and cost of the proposed project as seen in Figure 3.2.

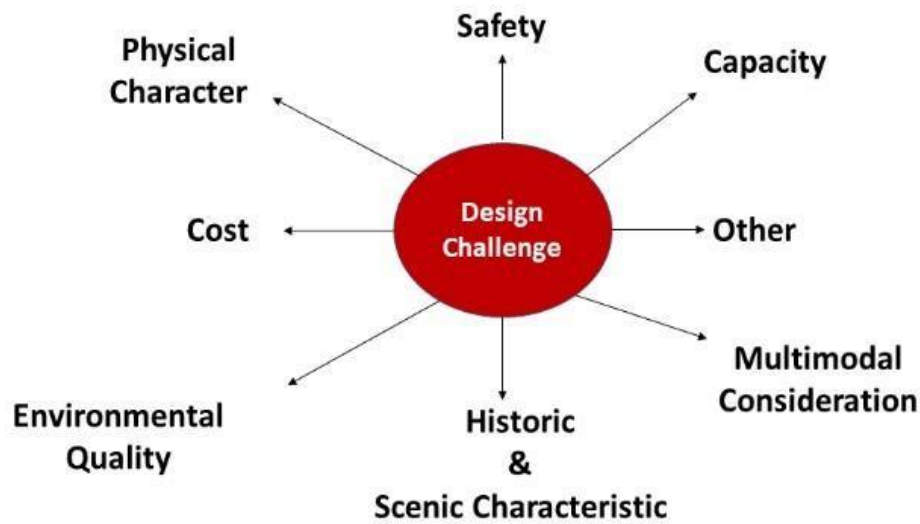


Figure 3.2: Design Consideration

3.5.1 Geometric Designs Standards

The geometric design standards for the cross-sectional elements of SBS-2 shall adhere to the following specifications:

- **Road Width:** Dual carriageway with three lanes in each direction.
 - **Carriageway (each):** 12m
 - **Shoulders (outer):** 2.75m on each side (1.75m paved + 1m unpaved)
 - **Shoulders (inner):** 1.05m on each side
 - **Median Centre:** 6.0m
- **Cross Slope:**
 - **Carriageway:** 2.5%
 - **Shoulder:** 5%

- **Maximum Grade:** 4%

3.5.2 Cross Sections

The cross-section for the proposed SBS-2 will be designed to accommodate the expected traffic volume over the design period. It will ensure safe and convenient traffic operations at speeds appropriate to the terrain and the road's functional classification.

The cross-sectional elements, including lane and shoulder widths, will comply with the standards outlined in the geometric design specifications for the project. These include:

- Dual carriageway configuration with three lanes in each direction.
- **Lane width:** 3.65m
- **Overall Carriageway Width:** 12.0m (On each Side)
- **Shoulder width:**
 - Outer shoulders: 2.75m (1.75m paved + 1m unpaved).
 - Verge: 1.250m
 - Inner shoulders: 1.05m.
- **Median width:** 6.0m.

This design ensures that the road meets safety, capacity, and operational requirements for efficient traffic flow.

Minimum requirements for the design elements

One of the most important considerations in highway design is horizontal alignment. Horizontal as well as vertical alignments are the two primary design control elements.

Horizontal alignment

Taking into account the consideration of the Highway Design Manual of the FMW, the road horizontal alignments shall be in conformity with the following:

- The alignment shall be consistent with the topography and be as direct as possible.
- The horizontal alignment shall consist of a minimum number of curves as much as possible.

- Occurrence of severe breaks in the natural skyline shall be avoided in the embankments and cuttings.
- As much as practicable, short curve lengths and straights shall be avoided while adjacent curves shall be similar in length. Generally, for a central angle of 5 degrees the curve shall be 150m⁶
- Compound curves shall be avoided as much as practicable.
- Adequate tangent length shall be provided to achieve a normal passing sight distance.
- In order to avoid the perspective of a disjointed road, small changes of direction shall not be made.
- In order to stimulate flowing alignments, curves shall be introduced in preference to straight.
- At the top or near the top of a crest curve, care shall be exercised such that sharp horizontal curvature is not allowed in order to prevent the attendant hazardous condition at night.
- On high, long fill, only flat curvature shall be used and for a moderate sight distance flat horizontal and vertical curves shall be adopted at the intersections.

The alignment shall provide good drainage, minimum and balanced earthworks, and avoid swampy and high-water table areas, where this is possible. Straight portions of the road on the horizontal plane shall be connected with horizontal curves which may be circular or transitional. Table 3.1 shows design speed applicable to the proposed project.

Table 3.1: Design Speed

Terrain	Level	Rolling	Hilly
Adopted Design Speed Km/ Hr	100	80	60

The proposed SBS-2, (323km length) is on a relative level terrain, accompanied by some hilly section, thus the adopted design speed range between 60 km/hr and 100km/hr to accommodate the meandering terrain.

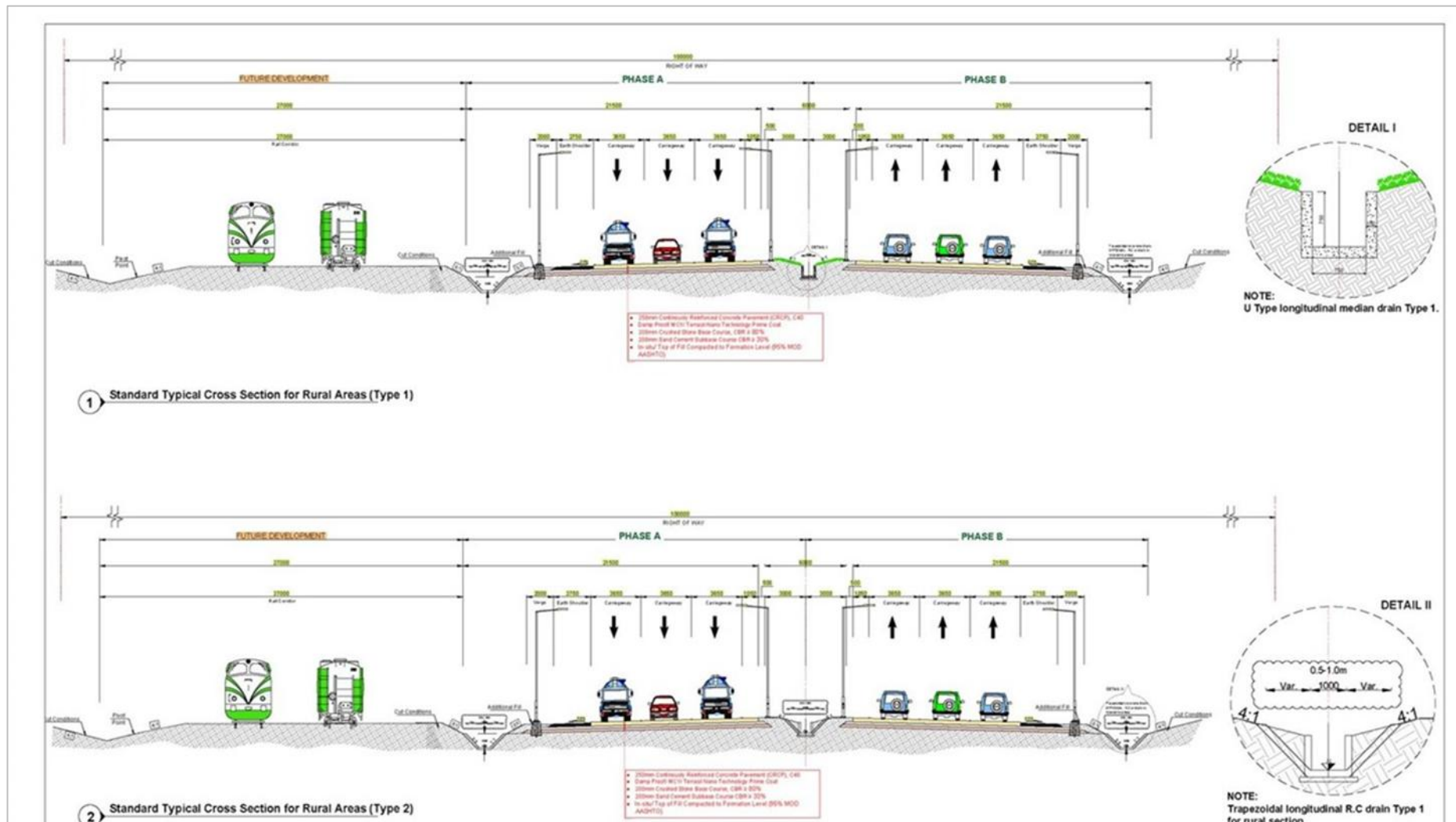


Figure 3.3: SBS Design

3.5.3 Road Right-of-Way

The road right-of-way (ROW) for the proposed SBS-2 shall be 100 metres wide. This is to accommodate the road, shoulders, drainage, and any future expansion or service lanes. This means the horizontal distance from the centre of the median to the boundary of the ROW will be 50 metres on each side of the dual carriageway. Adjustments to the ROW width will only be considered where necessary for economic, financial, social, or environmental reasons.

The applicable standard setback distances from the Centre Line (CL) of highways and roads to the nearest building are as follows:

- Primary highway (federal or state): 90m ROW – 45m from the centre of the road.
- Secondary highway (federal or state): 60m ROW – 30m from the centre of the road.
- Local road (state): Variable ROWs, including 24m, 18m, 15m, 12m, 9m, 7.5m, and 6m. □

Access Road/street: 9m or 6m from the edges of the road.

A schematic representation of a typical ROW for road projects, as depicted in **Figure 3.4**, illustrates the arrangement of the cross-sectional elements and their respective boundaries.

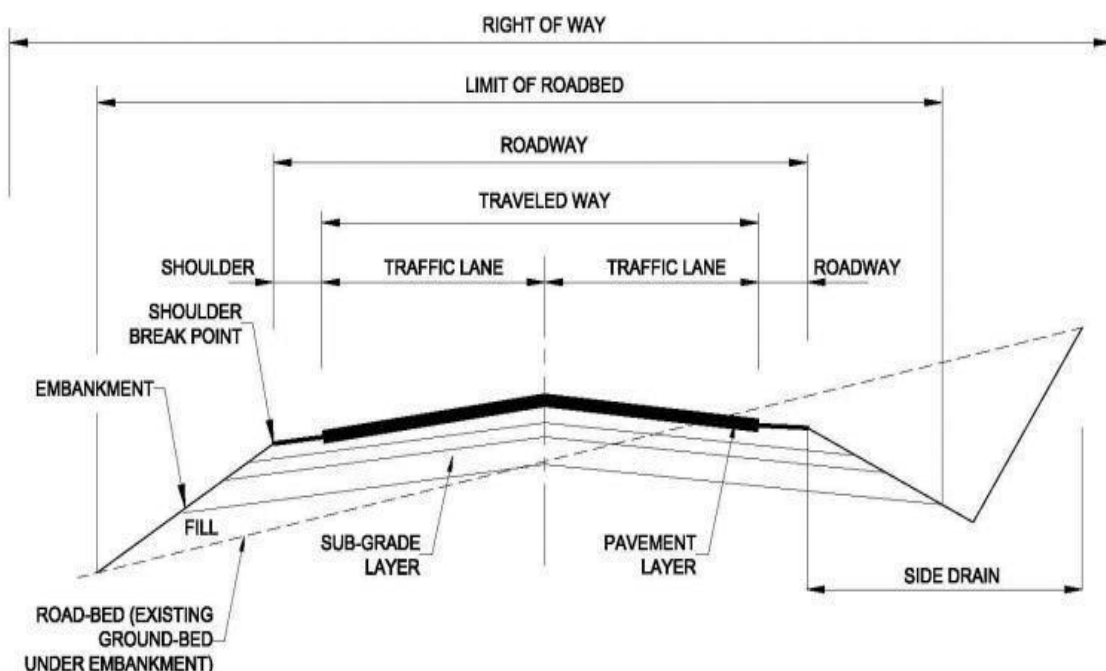


Figure 3.4: Schematic diagram of typical ROW for a Road

3.5.4 Road Pavement

The pavement structural design is based on Federal Ministry of Work's "Federal Highway Manual Part 1 Design". This follows specified pavement structure that depends on defined traffic catalogue (Tn) and subgrade strength catalogue (Sn). The pavement materials shall consist of naturally occurring material subbase, crushed rock base, and the CRCP wearing courses.

The main alignment will be composed of three layers, using 200-mm grade 40 CRCP only in wearing course. 100-mm cement stabilized stone base course, 250-mm stabilized laterite subbase. Coarse grained porous construction of embankments is envisaged from rock and gravel. The lower part of the embankment is envisaged from rock, the maximum size of which shouldn't exceed 2/3 of the compacted layer.

Compaction should proceed in layers, paying special attention to the quality of compaction. The base of the embankment requires strengthening as it is represented by soft soils. Strengthening of embankment base in high embankments, mainly at the approaches to bridges, is envisaged by stone (gravel) columns, whilst in relatively low embankments strengthening is envisaged by high strength geotextile. In both cases, layer of separation geotextile is envisaged between the existing soil and the embankment. Construction of side (drainage) channels is envisaged in the design on both sides of the highway. Design envisages filling of topsoil on the embankment slopes, followed by levelling and seeding of grass.

3.5.5 Bridges

The bridges for the proposed SBS-2 shall be designed in compliance with Section 1-308.00 of the "Highway Manual Part Design" and the "General Specifications (Roads and Bridges) Vol. II" of the Federal Ministry of Works. By adhering to these requirements, the design will ensure that the bridges provide:

- Safe and efficient vehicular and pedestrian movement.
- Adequate load-carrying capacity to handle projected traffic volumes and freight loads.
- Ease of maintenance to minimize lifecycle costs.
- Durability for a reasonable service life under regional conditions.

The engineering design of all bridges will follow the BS5480 (Part 2) standard latest edition, ensuring structural integrity and alignment with international best practices. This approach ensures

the bridges meet the functional, safety, and longevity requirements for the superhighway's operational demands.

3.5.5.1 Cross-section

For dual structures within the proposed SBS-2, each bridge structure shall have a total width of **12m** (excluding the width of bridge railings) and will include the following elements:

- **12m Carriageway width.**
- **1.5m inner Walkway width** between the inner edge of the carriageway and the bridge railing.
- **2.5m outer walkway width** between the outer edge of the carriageway and the bridge railing.

3.5.6 Key Design Considerations:

- Provision of **ducts within the walkway** for service wires and cables.
- Construction of **concrete parapet** along the sides for pedestrian and vehicular safety to prevent vandalization.
- Adequate **drainage systems** to prevent water accumulation.
- Incorporation of a **replaceable riding surface** for the carriageway to facilitate maintenance.

Construction Materials:

- **Concrete** will be the primary construction material for the bridge, ensuring strength and durability.
- **Steel** usage will be limited to reinforcement and pre-stressing strands.

Superstructure:

All bridges will utilize **precast pre-stressed concrete I-beam structures** to enable efficient and rapid construction. The “I” shape precast beams are selected for their cost-efficiency, ease of fabrication, and fast installation. The design will adhere to the standards of the **American Association of State Highway and Transportation Officials (AASHTO)** for I-beams, ensuring compliance with globally recognized engineering benchmarks. Diaphragm Beams will be provided at the supports and intermediate (within the span), where necessary. Table 3.2 provides details on bridge specifications and dimensions.

S/N	Type	H(mm)	A(m ²)	Recommended span lengths (m ²)
1.	AASHTO TYPE I	711	0,18	9.1 – 13.7
2.	AASHTO TYPE II	914	0,24	12.2 – 18.3
3.	AASHTO TYPE III	1143	0,36	16.8 – 24.4
4.	AASHTO TYPE IV	1372	0,51	21.3 – 30.5
5.	AASHTO TYPE V	1600	0,65	27.4 – 36.6
6.	AASHTO TYPE VI	1829	0,70	33.5 – 42.7

Technical drawing of a road cross-section showing Phase A and Phase B. The drawing includes dimensions, material specifications, and a list of materials for the road base.

PHASE A (Right of Way: 17700mm)

- Carriageway: 3650mm (x3)
- Shoulder: 1050mm
- Verge: 2000mm
- Contracted Fill Shoulder

PHASE B (Right of Way: 100000mm)

- Carriageway: 3650mm (x3)
- Shoulder: 1050mm
- Verge: 2000mm

Material Specifications:

- Added 100mm (8M) x 100mm (4) x 20mm (7M) R.C. Slab Form Continuously Laid New Jersey Barrier with 1750mm (20mm) Storage and 1750mm (20mm) Links including plain concrete baying End
- 250mm (40mm) IP 40 (40mm) Intelligent Photocell Solar Street Light to Specification on a 10m Activated Road (Galvanized Steel Pole Fabricated to Shape with minimum 1.5m Outreach Arm Contractor to submit shop drawings for Consultant's approval)

Materials for Road Base:

- 200mm Continuously Reinforced Concrete Pavement (CRCP) (G.O.)
- MCI Prime Coat at 1.1 Litres/m² to be finished with quarry Road
- 100mm Cement Stabilized Stone Base Course (Cement Content 5%)
- 250mm Sub-Base Lateral Sub Base (Cement Content 5%)

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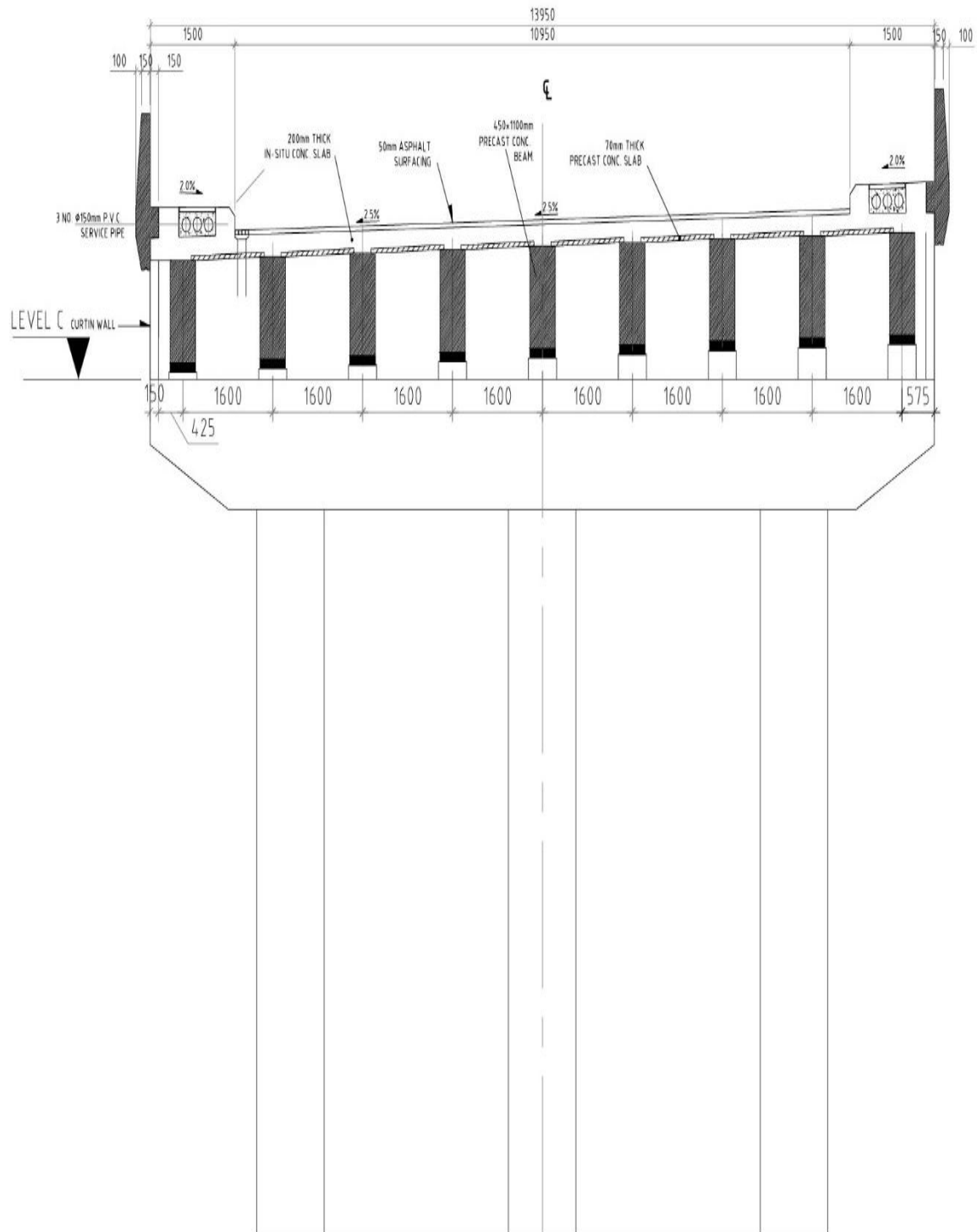


Figure 3.6: Typical cross section of a Bridge

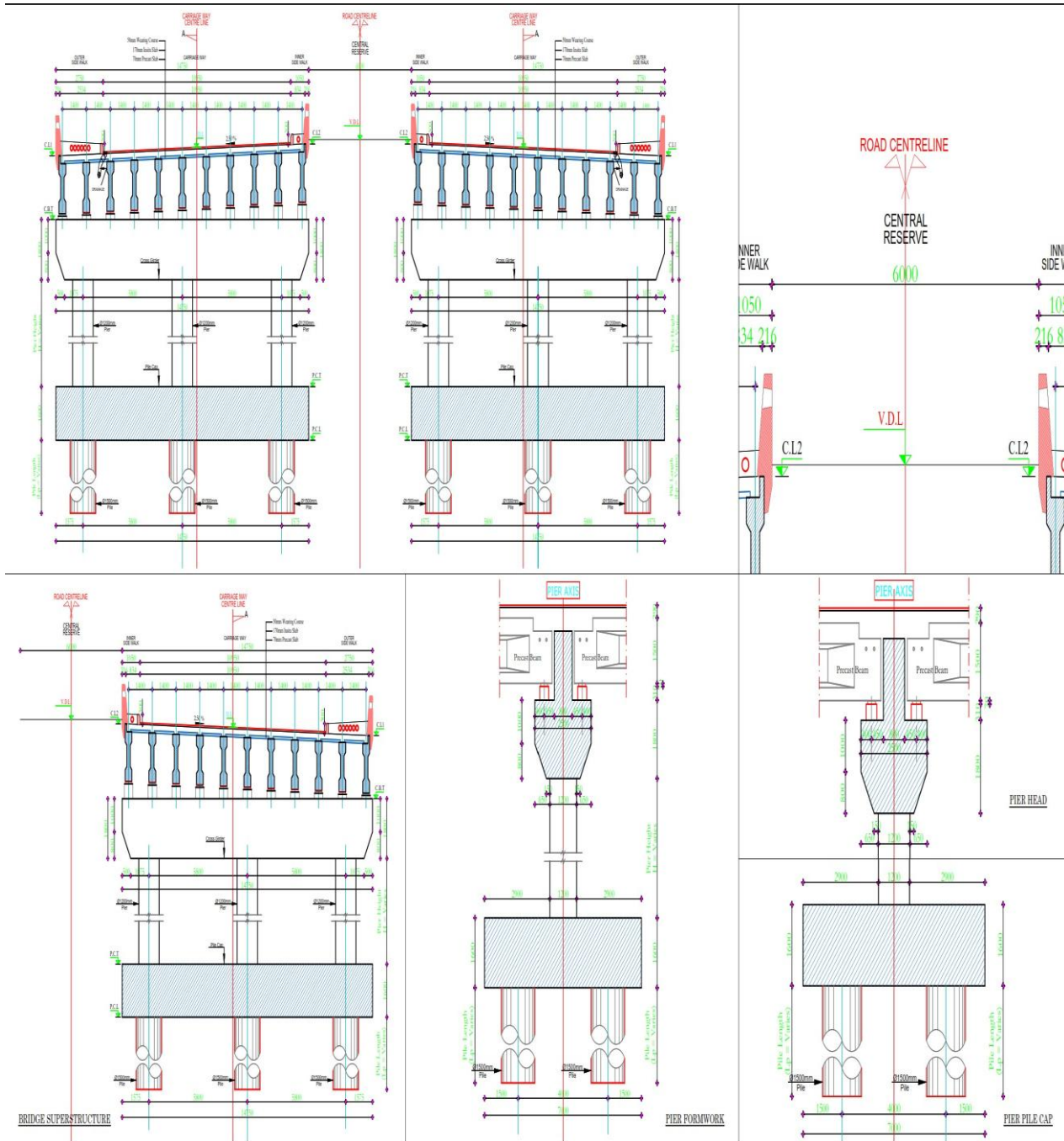


Figure 3.7: Bridge Superstructure, Pile Cap and Pier

3.5.7 Abutments

For all bridges within Section 2 of the Proposed Sokoto-Badagry Superhighway, **slab abutments** will be employed. These abutments will consist of:

- **Stub abutments** positioned at the top of the embankment.
- Support provided by **piles**, ensuring stability on various soil conditions.

- **Two wing walls** on both sides of each abutment to support and retain the roadway approaches.

3.5.8 Piers

The intermediate bents for the bridges will include:

- A pier cap supported by two columns (in certain cases, three columns depending on the structural requirements).
- Piers designed in an oblong shape, with the short axis measuring 1.5m and the long axis measuring 1.8m, to balance structural integrity and aesthetic considerations.

3.5.9 Drainage System

An effective drainage system is a critical component of the design for the proposed SBS-2. The drainage system is designed to:

- Collect storm water runoff from the carriageway and right-of-way.
- Convey storm water efficiently along and through the right-of-way.
- Safely discharge the collected water into a suitable receiving body, ensuring no adverse on-site or off-site impacts.

The design incorporates the following principles:

1. Paved Drains

- Minimum gradient for paved drains will be **0.3%** to facilitate proper flow.
- Paved drains are designed with a **V-profile** to prevent susceptibility to scour and enable **self-cleansing velocities**, even with relatively small flows. This feature minimizes the need for frequent maintenance.

2. Slope Design

- The **maximum slope** for the sides of the drain is set at **1:4**, ensuring safety for road users.
- Both sides of the drain will be designed to conform to this slope or a flatter gradient where required.

The drainage system is designed to align with the **terrain conditions** of the Kebbi section and mitigate any potential flooding or waterlogging issues.

Side Drains

Side drains serve as essential collectors of surface water, specifically targeting areas that typically include the **cut face** and the **road surface**. These drains are typically positioned beyond the **shoulder breakpoint** and run parallel to the **center line of the road**.

The key functions and design considerations for the side drains in the Proposed Sokoto-Badagry Superhighway, Section 2, include:

- **Water Collection:** Side drains are designed to collect and channel water from the road surface and surrounding areas, effectively managing runoff.
- **Diversion of Water:** The drains will direct the water towards a designated point, where it can either be safely diverted away from the **road prism** or directed through it using **culverts**.
- **Drainage Efficiency:** The side drains are positioned to ensure that water is efficiently carried along the **toe of any embankment** or **fill area**, reducing potential erosion and water accumulation around the road structure.

These features ensure the drainage system minimizes road damage, facilitates the safe diversion of runoff, and protects the integrity of the roadway throughout the 323km stretch from **Alfala** in Sokoto state to **Balugu** in Kebbi state (Figure 3.8).

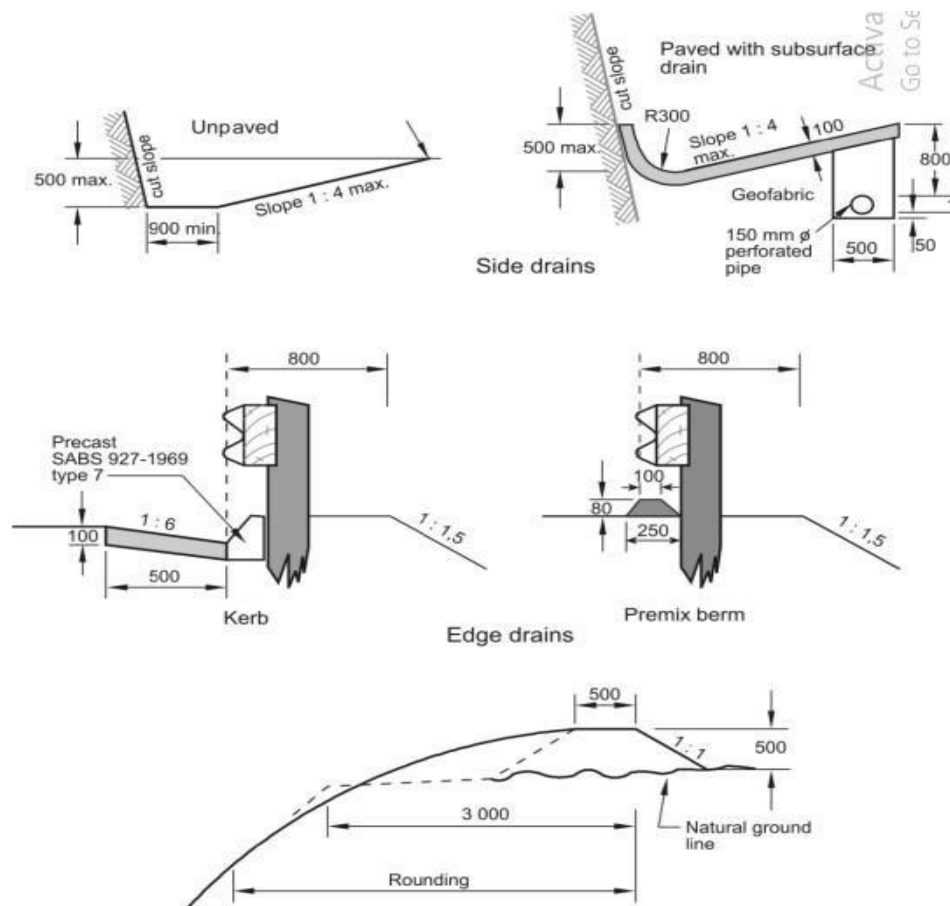


Figure 3.8: Typical Drain Types

3.5.10 Culverts

Culverts are crucial infrastructure elements that facilitate the safe passage of water whether from rivers, streams, tidal inlets, or storm events—beneath the road, without disrupting traffic flow. For the proposed SBS-2, hydrological/hydraulics studies of the catchment area along the route of the alignment will be conducted. These studies will determine the type, location and size of the drainage structures to be designed and constructed. Generally, culverts will play a vital role in managing the movement of surface water and ensuring the durability of the road.

The key considerations and design for the culverts in this section of the highway include:

- **Box Culverts:** These will be used where there is limited **headroom** for pipes or where the available waterway area is constrained. Box culverts are designed to efficiently balance the flow of water on either side of the road.
- **Concrete Box Culverts:** Different sizes and cell configurations of **concrete box culverts** will be implemented, depending on the **magnitude** and **flow rate** of the surface water, including water from **streams** and **rivers** along the route.

- **Culvert Design:** The number of cells and dimensions of each culvert will be determined based on the specific water flow requirements at each location along the highway. Table 3.3 outlines the preferred spacing and dimensions for the culverts along the highway.

Table 3.3: Spacing and Dimensions of Culverts

S/N	Structure	Stagnant	Slow lateral flow	Fast lateral flow
1.	Culvert Spacing	Widely spaced	Mid to widely spaced	Closely spaced
2.	Maximum culvert spacing; permanent road	200 m	150 m	100 m
3.	Maximum culvert spacing; temporary road	250 m	200 m	150 m
4.	Culvert diameter	250 – 500 mm	500 – 800 mm	>500 mm

Source: Partington et al. (2016)

3.5.11 Median

The proposed median for SBS-2 will consist of a combination of raised concrete barriers and low concrete barriers. The raised barriers will be installed primarily along the highway section passing through urban areas, such as townships or city centers, to manage traffic flow and ensure safety. In areas where the road traverses townships or areas with high pedestrian traffic, low concrete barriers will be incorporated, facilitating pedestrian crossing. The design will aim to balance safety, traffic management, and pedestrian access while ensuring the highway's overall efficiency and functionality.

3.5.12 Rest Areas

Rest Areas along the proposed SBS-2 will serve as designated stop-over points for motorists and locations for key highway services. These areas will include facilities such as trailer parks,

ambulance services, lube services, restaurants, and other hospitality offerings. The inclusion of these facilities is designed to provide several key benefits:

- Improved road safety, allowing tired motorists to stop and refresh, reducing the likelihood of accidents due to fatigue.
- Enhanced emergency response efficiency, with ambulance services stationed in rest areas for quick access to the highway in case of an emergency.
- Improved aesthetic quality, creating visually pleasing and functional spaces along the highway.
- Revenue generation and economic development, fostering local business growth and providing services for travellers.

Additionally, the project includes a dedicated utility corridor for gas pipelines and fiber optic cables. This will support essential infrastructure needs along the corridor. Moreover, the project will feature truck parks equipped with compressed natural gas (CNG) refilling stations and electric vehicle (EV) charging infrastructure, facilitating the shift to cleaner energy sources for transportation and supporting sustainable practices in the region.

3.5.13 Utility Relocation and Service Crossings

Some utilities have been identified to fall within the ROW of the SBS project like some buildings and an entire village in Kebbi state. Similarly, some river bodies and swamps, some power lines and some farmlands. Still in Kebbi we have an area where a cemetery also falls within the alignment. Some of these utilities will be avoided by realigning the route. Some of the utilities encountered in the Kebbi section of the alignment are as shown in Table 3.4.

Table 3.4: Some key features to be avoided on the Kebbi alignment

FEATURE	CHAINAGES
Stream	CH. 282+900 - 283+200
Stream	CH. 283+500 - 284+000
Stream	CH. 285+400 - 285+500
Fulani Huts and Some Streams	CH. 289 - 290
Power Lines	CH. 231+000
Cemetery	BETWEEN CH. 238+000 – 239+000
River	CH 279+000 – 280+000
Mountainous Hill	CH 277+000 – 278+000
Buildings	CH 223+000
Abandoned Village Primary School	CH 300+700
Stream	CH 300+200
Farmlands	CH 297 + 298

3.6 Project Development Phase

3.6.1 Preconstruction phase

The preconstruction activities to be carried out before actual construction work commence include the following:

- Right of Way acquisition/compensation.
- Demolition of existing structures /buildings along the Row.
- Acquisition of all relevant permits.
- Preparation of temporary camp sites along the corridor.
- Identification of borrow pits and quarry site as sources of construction materials (stones / aggregates and laterites)
- Selection of temporary disposal sites for construction debris of the highway and materials.
- Selection of temporary sites for separate stockpiling of topsoil and subsoil.
- Developing work camp or construction yard site map.

3.6.2 Construction Phase

The construction phase of the proposed SBS-2 involves a range of key activities aimed at transforming the designed plans into a completed highway. These activities include:

- Mobilization of Workforce and Equipment to Site
- Site Clearance and Removal of Vegetation from the Right-of-Way (RoW)
- Stripping and Stockpiling of Topsoil
- Removal and Stockpiling of Subsoil
- Grading of the Area and Laying of Cross-Drain Pipes/Culverts
- Reinforcement of Soil with Gravel Columns and/or Prefabricated Vertical Drains (PVD)
- Base Course Formation on the Subgrade
- Surface Course Formation
- Concrete Works, Foundations, and Bridge Structures
- Construction of Span Bridges
- Provision of Road Furniture and Markings
- Landscape Harmonization and Tree Planting/Grass Seeding

3.6.2.1 Mobilization

The construction works for the proposed SBS-2 will be executed by Hitech Construction Company Ltd, referred to as "the contractor." Prior to the commencement of construction activities, the contractor will:

- **Specify the Location of Temporary Facilities:** The contractor will identify and designate suitable locations for the construction camp, equipment stationing areas, material stockpiling sites, and other temporary infrastructure essential for the project.
- **Obtain Necessary Permits:** The contractor will ensure the timely acquisition of all required permits from relevant state authorities or landowners for the use of these sites, ensuring the project progresses smoothly without legal or logistical delays.
- **Transport Workforce and Equipment to Site:** The required workforce, machinery, and equipment will be mobilized and transported to the project site along the highway corridor. Mobilization will occur in phases to ensure an organized and efficient deployment of resources for the 323km stretch from Alfala in Sokoto state to Balugu in Kebbi state.

3.6.2.2 *Site Clearing*

The site for the proposed SBS-2 will be cleared of any obstacles or impediments that may obstruct the highway alignment. This will involve the removal of trees, bushes, stumps, makeshift structures, rocks, and other obstructions within the Right of Way (RoW). The clearing process will be carried out using hydraulic excavators, bulldozers, chainsaws, and cutlasses. Site clearing will be strictly confined to the designated RoW for the project, ensuring minimal environmental disturbance and compliance with project guidelines.

3.6.2.3 *Excavation*

All excavation work for the proposed SBS-2 shall be carried out to the lines and levels specified in the project drawings or as directed by the Engineer. The Contractor shall ensure that all permanent excavations are trimmed to the lines and levels indicated on the approved designs. Excavation operations will be executed in such a manner that the side slopes are not endangered by undercutting or instability.

Where feasible, all suitable excavated materials will be reused in embankment construction and backfilling for structures. The Contractor will dispose of any unsuitable or excess excavated material in a location approved by the local community, ensuring that disposal does not interfere with the proper functioning of the project or surrounding environment.

The bottom and side slopes of the excavations, where concrete is to be placed, will be finished accurately according to the specified dimensions in the drawings or as prescribed by the Engineer. The surface will then be moistened with water and tamped or rolled using suitable equipment to ensure a firm and stable foundation for subsequent construction.

3.6.2.4 *Back filling*

Backfilling for the proposed SBS-2 will involve the use of selected materials from excavation or borrow pits sourced from approved locations. In all areas where excavated material is required to be returned as backfill, suitable materials shall be set aside during excavation and kept free from contamination by topsoil, vegetation, or other unsuitable materials.

The backfill will be deposited in horizontal layers not exceeding 150mm in thickness after compaction. Each layer will be compacted to 100% of the maximum dry density as determined by standard compaction tests. The moisture content of the backfill material will be brought to the required level to ensure proper compaction, and it will be uniform throughout each layer.

Where backfill consists of cohesionless granular material, the field dry density must not be less than 1950 kg/m³. Backfilling shall be carried out carefully, especially in the vicinity of any structures, to avoid damaging the structures. The Contractor will ensure that backfilling operations comply with all engineering specifications and do not affect the integrity of the highway.

3.6.2.5 Construction of the gravel layer

The gravel wearing course material for proposed project will be spread in layers not exceeding 150mm thickness per layer. Each layer will be watered and compacted in accordance with the specifications to achieve the final thickness required, ensuring conformance to the designated lines, levels, and road cross-section.

Before spreading the gravel wearing course, the subgrade material will be watered to the required moisture content. Additional water will be applied to the gravel material as needed during the spreading process until the optimum moisture content (OMC) for compaction is achieved. The Contractor will ensure that all gravel layers are properly compacted to meet the required standards for road durability and performance.

3.6.2.6 Rolling

Following the spreading of the coarse aggregate for the proposed SBS-2, the material will be compacted to its full width using a three-wheel power roller with a capacity of 8 to 10 tonnes or an equivalent vibratory roller.

Initially, light rolling will be performed until the aggregate is partially compacted, creating sufficient void space to allow the application of screenings. Rolling shall commence from the edges, moving forward and backward, while simultaneously adding the screenings until the edges are firmly compacted.

The rolling process will then progress gradually from the edges towards the center, running parallel to the center line of the road and overlapping each preceding rear wheel track by half its width. The process will continue until the entire area of the course has been uniformly rolled by the rear wheel, ensuring proper compaction and the longevity of the road surface.

3.6.2.7 Application of Screening

Once the coarse aggregate has been lightly rolled to the required true surface on the proposed SBS-2, screenings shall be gradually applied over the surface to fill the interstices completely.

The application of screenings will be done in a manner that ensures the voids are fully filled, using a slow rate of application (in three or more stages).

Dry rolling shall continue as the screenings are being spread, with the jarring effect of the roller helping to settle the screenings into the voids of the coarse aggregates. Rolling and booming operations will continue as the screenings are being applied to ensure complete compaction.

Mechanical brooms, hand brooms, or both will be used to assist in the spreading and levelling of the screenings, ensuring even coverage and the required surface finish.

3.6.2.8 Application of Binding Material

Following the application of screenings and rolling, a suitable binding material will be applied at a uniform and slow rate in two or more successive thin layers across the proposed SBS-2. After each layer of binding material is applied, the surface will be copiously sprinkled with water to form a slurry. This slurry will be swept into the surface with hand brooms, mechanical brooms, or both, ensuring that the voids are properly filled.

Once the slurry is applied, the surface will be rolled using an 8-10 tonne roller. Water will be applied to the roller wheels to prevent the binding material from sticking. The process of spreading the binding material, sprinkling water, sweeping with brooms, and rolling will continue until the slurry fully fills the voids and forms a wave ahead of the roller wheels.

Rolling will continue until the road metal is thoroughly keyed, with no creeping of metal ahead of the roller. Only slight sprinkling of water will be applied during rolling, as needed. On super elevated curves, rolling will start from the lower edge and progress towards the upper edge of the pavement, ensuring an even distribution of the binding material.

Rolling of the sub-base will be avoided if the subgrade is soft or yielding, or if rolling causes a wave-like motion in the sub-base or subgrade, as this could affect the integrity of the construction.

3.6.2.9 Preparation of Sub-Grade

The formation width, equal to that of the crushed stone path, shall be first cut to a depth below the proposed finished level. This depth will be equal to the thickness of the course of brick aggregate, with due allowance for consolidation. The sub-grade will then be dressed off and levelled to the finished profile as shown in the project design. In areas where made-up soil is encountered, adequate watering will be applied to ensure that the earth settles as much as

possible. Once the soil has settled, it will be rolled using a minimum 3-tonne or light power roller, as directed by the Engineer. This rolling process will help ensure the sub-grade is adequately compacted and stable before the next phase of construction.

3.6.2.10 Sub-base (250-mm)

For the proposed SBS-2, the sub-base will play a critical role in providing structural support, improving drainage, and preventing the intrusion of fines from the sub-grade into the pavement structure. This layer is designed to distribute the wheel loads effectively to the sub-grade, ensuring long term stability and durability of the highway.

Given that the stresses within the sub-base are much lower than those within the base course, the materials used for the sub-base will be stabilized lateritic subbase (5% cement content). The sub-base help to distribute the loads while improving drainage.

3.6.2.11 Stone base Course (100mm)

For the proposed SBS-2, the base will be cementing stabilized stone base course layer (3.5% cement content) will be placed above the sub-base and directly beneath the binder course surface. This base course is a critical structural layer of the pavement system, designed to efficiently distribute the traffic loads and environmental stresses. The base course ensures that the underlying unbound layers are protected from excessive stresses and strains, maintaining the overall integrity of the highway.

The base course will also contribute to the sub-surface drainage system, allowing for proper water flow and reducing the risk of moisture accumulation beneath the pavement structure. The materials used for the base course will include crushed stone, crushed slag, and other suitable untreated or stabilized materials that meet the specifications required for the highway's performance.

Plate 3.1 depicts the process of CRCP laying during road construction, highlighting the application of the surface course as part of the overall pavement structure for proposed SBS-2.



Plate 3.1: Typical CRCP Laying Procedure

3.6.2.12 Continuously Reinforced Concrete Pavement (CRCP) surface course (200-mm)

For the proposed SBS-2 project, the surface course, also known as the wearing course, will be the topmost layer of the pavement structure. Its primary function is to provide a smooth and durable riding surface that can withstand the stresses induced by high traffic volumes and environmental factors, without exhibiting unsatisfactory cracking, rutting, or other forms of deterioration.

The surface course also serves as a water-tight barrier, preventing the infiltration of surface water into the underlying pavement layers. This is crucial for maintaining the long-term stability of the highway. The surface course will be CRCP reinforced for both longitudinal and transverse stresses, designed to meet the specific demands of the project, ensuring a high-quality, weather-resistant finish.

3.6.2.13 Drainage channels

The roadside drainage channels will be implemented to effectively remove surface water from the highway cross-section. These drainage systems will include:

- **Toe of Slope Channels:** These channels will convey surface water from the cut section and adjacent slopes to a natural watercourse, ensuring proper water runoff management.

- Intercepting Channels: These will be placed behind the top of the cut slopes to intercept surface water and redirect it
- away from the road structure to prevent erosion and damage.
- Chutes: Chutes will be used to carry the collected water down steep cut or fill slopes, directing it safely away from the road and minimizing the risk of waterlogging or soil erosion.

In addition to the roadside drainage, median drainage channels will be incorporated into the design. These channels will be shallow depressed areas located near the center of the median, formed by the flat side slopes of the divided roadways. The swale in the median will be sloped longitudinally for efficient drainage, with water being intercepted at intervals by inlets or transverse channels. The collected water will then be discharged from the roadway through storm drains or culverts, ensuring the highway remains functional during heavy rainfall and reducing the risk of flooding.

3.6.2.14 Protective Work

For the proposed SBS-2 project, protective works will be implemented at various locations along the route, as dictated by site-specific requirements. These protective works will include:

- Retaining Walls: Where necessary, retaining walls will be constructed to stabilize slopes, prevent erosion, and ensure the structural integrity of the highway, particularly in areas with steep terrain or potential soil instability.
- Breast Walls: These will be used in areas requiring additional support, especially in zones with challenging geographical features or where space constraints exist.
- New Jersey Crash Barriers: At critical sections of the highway, particularly in high-risk zones such as sharp curves, elevated sections, and near residential areas, W-beam crash barriers will be installed to enhance road safety and reduce the impact of vehicle collisions.

These protective works are designed to safeguard both the structural integrity of the highway and the safety of road users, ensuring the long-term sustainability of the Sokoto-Badagry Superhighway.

3.6.2.15 Traffic control devices

Traffic control devices are essential for regulating, warning, and educating road users. These devices include signs, markings, and signals, which play a crucial role in ensuring safety and smooth traffic flow along the proposed SBS-2.

3.6.2.16 Signs, Markings & Signals

- **Signs:** Regulatory signs will be used to impose legal restrictions applicable to specific locations along the highway, in line with road safety and operational requirements.
- **Markings:** Pavement markings, including lines, patterns, words, colors, and other devices, will be applied to the surface of the road or objects within or adjacent to the roadway. These markings will serve the purpose of regulating, warning, or guiding traffic.
- **Traffic Control Signals:** The installation of traffic signals will be carefully designed and strategically placed, following the guidelines outlined in Section 1-404.00 of the Federal Ministry of Work's "Highway Manual Part 1 Design" for the proposed dual carriageway.

All signs, pavement markings, and traffic signals for the proposed SBS-2 project will meet the requirements of Section 1-403.00 and Section 1-404.00 of the Highway Manual and conform to the Manual on Uniform Traffic Control Devices.

3.6.2.17 Guardrails

Guardrails will be strategically placed at specific locations where the highway alignment or environmental conditions pose a safety risk. The placement and design of these guardrails will meet the requirements of **Section 1-405.00** of the "Highway Manual Part 1 Design" of the Federal Ministry of Works. Guardrails shall be provided at the following locations along the proposed SBS-2:

- At obstructions or sudden reductions in road width.
- At isolated sharp curves on roads built to standard.
- Where embankments or structures exceed 3m in height.
- On side slopes steeper than 4:1.
- Where shoulder width is less than 2.4m.
- At the approaches to bridges and on the bridges themselves.

These measures ensure the safety and protection of road users along the proposed SBS-2, contributing to the overall effectiveness of traffic control and reducing the risk of accidents.

3.6.2.18 Water Requirement / Use

Freshwater, free from contaminants and deleterious impurities, will be required during the construction phase of the proposed SBS-2 project. Water that is high in potassium and sodium is unsuitable for use in construction, as the presence of these salts can promote alkali-aggregate reactions. Therefore, only high-quality freshwater will be used in the production of concrete to ensure the strength and durability of the final structure.

3.6.3 Water Sourcing

Freshwater will be sourced from existing local water bodies, such as rivers, and transported to the construction sites using water tankers. Since the construction sites are located at considerable distances, careful planning will be undertaken to ensure that the water supply is adequate and sustainable. The total volume of water to be used for various construction activities will be monitored to avoid over-extraction of surface water. Water reuse will be promoted to enhance sustainability.

For concrete production, approximately 180 liters of water will be required to produce one cubic meter of concrete. Additionally, water for dust suppression will be sourced from runoff, flood water, or adjacent surface water, without the need for treatment.

3.6.4 Water Monitoring and Conservation

Continuous monitoring of water levels from local rivers and streams will be carried out to prevent over-extraction and ensure that the surrounding communities still have access to sufficient water. To further enhance water availability, a temporary water holding dam may be considered for collecting floodwater or rainfall, which can serve as an alternative water source for construction activities in areas with limited surface water sources.

3.6.5 Water Supply for Workers' Camp

For the workers' camps, water will be sourced from boreholes where there is no access to potable water or where procuring potable water is difficult. In all cases, measures will be taken to ensure that the water used is safe and sufficient to meet the needs of the workers.

3.6.6 Water Use During Operation Phase

During the operation phase of the Sokoto-Badagry Superhighway, water demand is expected to be minimal, primarily for maintenance and operational needs.

3.6.7 Energy Requirement and use

Energy is a crucial component in the construction of the proposed SBS-2. The energy required during the construction phase will support various activities, including the processing of construction materials, hauling of materials and equipment, and operation of the various campsites and construction yards.

3.6.7.1 Energy Sources

The source of energy during the construction phase will be hybrid, combining the use of power generators, solar power systems, and CNG-powered construction vehicles, buses, trucks, and equipment. This hybrid energy solution will ensure a sustainable and reliable power supply for construction operations while minimizing environmental impact. The use of CNG (Compressed Natural Gas) vehicles and equipment will contribute to reducing greenhouse gas emissions and the overall carbon footprint of the project, further supporting sustainable construction practices.

3.6.7.2 Energy Requirements

Energy will be required for various construction activities, including:

- Lighting of the construction campsites and surrounding areas
- Cooling systems to maintain optimal working conditions
- Powering of machines, equipment, and tools used during the construction process
- Other operational needs within the construction yards and work zones

The use of solar systems will reduce the reliance on fossil fuels, contributing to environmental sustainability, while the power generators will ensure an uninterrupted power supply for critical activities.

3.6.8 Borrow pit

Borrow pits provide the source material for the construction of road embankments, which, depending on the local area, may include gravel/aggregates, silica sands, laterite sands, and calcite. A borrow pit is an area created to remove earthen material, which will then be used for filling at another location. Borrow pits will be systematically identified along the road corridor. Where an existing borrow pit that has yet to be closed is found, it will be prioritized for use.

Care will be taken to ensure that borrow pits are sustainably managed to prevent them from evolving into gully erosion sites. Borrow pits will be located at the Bagudo axis, and Dakingari along the proposed SBS-2.

3.6.9 Off-Site Works

Off-site works will include the extraction of construction materials. The purchase of materials from already existing licensed quarries will be preferred over opening new quarries by the contractor. Material purchase will only be allowed from authorized, licensed providers. The contractor will be required to provide copies of the licenses obtained from material providers to the client before the commencement of works.

The inert material in the project area generally meets the requirements for fillers and base materials. Aggregates (both coarse and fine) can be sourced from Yauri and Shanga Local Governments in Kebbi State, where several quarries are located to meet project requirements.

3.7 Operational Phase

The operational phase of the proposed SBS-2 project involves activities such as the maintenance of the pavement and road infrastructure/markings, cleaning and management of roadside waste, desilting of the side drainage system, and clearing of grasses along SBS-2 alignment. These activities will ensure the road's continued functionality, safety, and environmental sustainability throughout its operational lifespan.

3.7.1 Materials Input and Output

The proposed SBS-2 project will involve extensive infrastructural works, leading to the removal of vegetation covers, earth movement, trenching, backfilling, embankment, levelling, compaction, drainage installation, and optimization of natural resources along the SBS-2 alignment in Kebbi state.

3.7.2 Raw Material Supply

Major inputs for the proposed SBS-2 project will include construction equipment and machinery for vegetation (bush) clearing, earth (soil) movement, topographic levelling, alignment and realignment of road segments, creation of the road pavement, coal tarring, bridge works, and construction materials such as bitumen, gravel, and fill material, typically excavated on-site. Aggregates will be sourced from existing licensed quarries in Kebbi, and Zamfara States, while sand can be obtained from accessible riverbanks along the road corridor, especially in areas like Bagudo and Dakingari. Construction workers, particularly unskilled labor, will be sourced from

local communities along the road corridor, while technical and highly skilled workforce may be recruited from outside the locality, based on the availability of such skills in the area.

3.7.3 Process Inputs

The road pavement will primarily consist of lateritic materials stabilized with cement as the subsurface course and crushed stone as the base course, while the surfacing will involve the continuously reinforced concrete.

3.7.4 Project Operation and Maintenance

Optimum highway operation will ensure smooth traffic flow at the designed speed, minimizing frequent acceleration or deceleration, which is environmentally undesirable, and maintaining a high level of safety. Road infrastructure will be regularly maintained through periodic inspections to ensure proper drainage, bridges, and culverts are functional. As necessary, maintenance will include rehabilitation, strengthening the base and sub-bases of deteriorated pavement, improving structural integrity, resurfacing with concrete, clearing road shoulders of bush, and maintaining road furniture in good condition.

3.7.5 Project Life Cycle

The project will follow an envisaged life cycle of 50 years that includes conceptual and design stages, where feedback from the EIA outputs will be used to improve the final design for sustainable development. During the construction and operational phases, any identified negative environmental impacts, as documented in the Environmental Management Plan, will be mitigated. Upon reaching the end of the project lifespan, the decommissioning plan will be activated to ensure environmentally responsible closure of the project.

3.7.6 Workforce / Workers Camp

The construction company will determine the workforce requirements based on the work delivery schedule and capacity, as outlined in the contract terms. The contractor will be responsible for engaging both skilled and unskilled labor. However, the contractor will be encouraged to hire unskilled workers from the surrounding communities.

The workers' camp will consist of temporary structures with essential facilities, including electricity, water, communication systems, sanitary facilities (showers, toilets), a refectory, living or sleeping quarters, laundry facilities, and waste management facilities. The camp will be secured by fencing and monitored by 24-hour security surveillance. The camp will be located

at a reasonable distance from the project site to minimize any disruption to nearby communities. It will accommodate a significant portion of the workforce to reduce pressure on local social amenities. Unskilled workers from the communities will have the option to either reside in the workers' camp or commute from their homes.

3.7.7 Equipment /Machinery to be utilized during construction

Table 3.5 present some equipment and machinery to be used onsite during site preparation and construction phase.

Table 3.5: Equipment and Machinery

Materials	Equipment	Vehicles
- Laterite - Sharp sand - Granite - Steel - Cement - PVC pipes - Water - Wood	- Excavator - Swamp dozer - Wheel loader - Dredger - Grader - Bulldozer - Steel roller - Rubber roller - Tipper truck - Crane - Water truck - Tar boiler - Low bed loader - Shovels - Head pans - Wheelbarrows - Steel tube scaffolds - Hacksaw blade/frame - Communication equipment - Survey equipment	4-Wheel drives - Trucks - Buses - Cars

3.8 Waste Generation

Construction debris, domestic waste and soil would be generated from site preparation and construction activities of the proposed road construction, the waste would require disposal and

removal from the construction site and environ. Sanitary waste from portable toilets used during construction would be removed by commercial vendors and be disposed of in a sanitary sewer system offsite.

The construction wastes are classified as off-cuts, wood chippings, concrete, cement bags, unused sand, oily wastes, solid wastes, domestic and sanitary wastes (sewage, kitchen leftovers, papers, general waste). The waste items that would be generated during the proposed project include solid wastes (used drums, plants, excavated soil, packing materials, waste rags, rubbish/garbage etc.) and liquid wastes (wastewater, used engine oil, etc.).

Most of these wastes are of non-hazardous type of waste. To fully comply with Federal Ministry of Environment policies, a Waste Management Programme would be prepared for the project. The disposal methods for the enumerated wastes have been clearly defined. The sensitivity of the area necessitates designated waste bins to be provided to encourage waste segregation at site for ease of managing the various waste.

All trash will be separated at source in trash bins that will be placed at the accommodation facility. Trash disposal will be carried out daily. Combustible materials (largely paper) shall be segregated and sent to a third-party contractor that has the capacity to handle such category of waste. Biodegradable materials, largely kitchen and mess wastes shall be handled by a third-party contractor. Medical waste largely needles, and syringes and cotton wools shall be handled by a third-party contractor with approved ownership of an incinerator.

During the operational phase of the road, the waste streams include domestic waste (nylon (sachet water), plastic bags, plastic bottles, packs cigarette, food waste, spent oil from vehicle repair among others. Hazardous and radiological waste are not expected to be generated along the road corridor during the operational phase of the road. Table 3.5 shows the anticipated waste streams from the proposed project.

3.8.1 Non-Hazardous Waste

3.8.1.1 Vegetal Waste

This will include cleared vegetation from site clearing activities during the preconstruction phase of the project. These organic wastes will be largely degradable and therefore can be used for composting and will be made available to farmers to boost agricultural production. In addition, cleared woody vegetation will also be made available to inhabitants of nearby communities to be used for domestic purposes including as firewood for cooking.

3.8.1.2 Construction waste

This will consist of sand, concrete and scrap metals, wooden pallets, cement bags, paper, cardboard and other packaging materials. Other non-hazardous waste will be domestic-type solid waste from site office and workers camp operations which may include paper wastes, residual packaging and food wastes, metal cans from food and drinks etc.

There are recycling opportunities for some of these materials, therefore they will be adequately segregated and stored on-site to be provided to local industries for reuse or recycling as appropriate. All waste that cannot be reused or recycled will be placed in appropriate on-site storage containers and evacuated at least once a week by third party waste contractor approved by Kebbi State Environmental Protection Agency (KSEPA) for disposal in a government approved facility.

3.8.2 Hazardous Waste

Hazardous wastes are expected to be generated in limited quantities during construction and will be accumulated in appropriate containers with secondary containment or bunds provided to contain spillages and leakages. Hazardous waste may include bitumen, used nickel, cadmium batteries, chemical containers, used oil, oily rags, and sanitary waste etc. The storage areas shall be properly demarcated and marked as hazardous.

The storage of this category of waste will be brief before being evacuated by registered waste contractor with off-site permitted hazardous waste treatment, storage, or disposal facilities. However, there may be some recovery or recycling opportunities for some hazardous industrial wastes. This will be handled by the waste contractors. Mobile toilets will be used during construction and generated human/sanitary waste will be disposed appropriately daily by the state's Environmental Protection Agencies approved collectors.

3.8.3 Waste Stream

The various waste streams comprise of gaseous emissions, liquid wastes, and solid wastes.

3.8.3.1 Gaseous Emissions

There shall be gaseous emissions resulting primarily from the burning of diesel as fuel for heavy equipment. The resulting air pollutants from diesel engine combustion will include CO, CO₂, NO₂, N₂O, SO₂, CH₄, SPM, and VOC. Although the resulting concentrations of ambient

pollutions are not expected to impact on sensitive receptions since it is not persistence and shall immediately be disposed and dispersed into the ambient air.

3.8.3.2 Liquid Wastes

Liquid wastes shall include sewage, spent lubricants and detergent solution, among others.

3.8.3.3 Solid Wastes

Cut vegetation stumps/ twigs, metal drum, plastic containers, used batteries, cartons and other packaging materials, cement bags, hardened cement concrete etc. constitute some of the solid waste likely to be generated during execution of this project. Environmental impacts shall arise from both quantity of the waste and the volume of their residue if improperly disposed (Table 3.6).

Table 3.6: Anticipated Waste from the Project

S/No.	Waste Types	Proposed Quantity	Classification	Management Options/Methods
1	Domestic wastes	5kg/Month	Non hazardous (offices)	Move to Government-approved dump sites by government approved Public Sector Partnership contractors
		1kg/Month	Hazardous (Batteries, Bulbs etc.)	Move to Government-approved recycling depot by PSP contractors
2	Sanitary waste	5 litres/Week	Grey water	Implement a well-engineered soak-away system at designated project base camps and worker facilities
3	Excavated topsoil & vegetation	6 tons	Clearing spoils	Wash and reuse for filling up borrow pits or other construction related backfill activities along the road corridor
			Concrete mix waste	Re-mix and use for road pavement repair or bridge work maintenance
4	Storm water	10,000 litres/week	Storm water	Channel collected storm water into lined drains or temporary holding ponds before discharge to prevent soil erosion
5	Construction waste	200kg	Off-cuts, metal scraps, etc.	Move to project site scrap yard for segregation and subsequent transfer to approved Metal Recycling Depots

			Welding electrode stumps	Move to site scrap areas for segregation and recycling through approved metal recycling facilities
6	Concrete waste	Variable	Hazardous	Collect and dispose of at approved government-regulated concrete recycling plants or approved hazardous waste sites
7	Vegetation	400kg	Non-Hazardous	Turn into mulch for community use or transport to approved dumpsites for composting. Burning of vegetation is prohibited
8	Paper	5kg/Month	Non-Hazardous	Collect, segregate, and transfer to paper mills for recycling or approved municipal waste dumpsites
9	Recovered Oil	N/A	Hazardous	Move to licensed oil production/recovery companies for reintegration into crude oil production lines
10	Treated mud & soil	N/A	Hazardous	Obtain regulatory approval for treatment and reuse via solidification, backfilling, land farming, or disposal
11	Scrap tires	Variable	Non-Hazardous	Collect and send to recycling facilities for reuse or conversion into other materials like road subbase aggregates
12	Bitumen residue	Variable	Hazardous	Dispose of through government approved hazardous waste facilities or specialized recycling centers
13	Plastic packaging waste	15kg/Month	Non-Hazardous	Segregate and send to recycling centers or approved dumpsites for proper disposal
14	Demolition waste (old bridges/culverts)	Variable	Non-Hazardous	Reuse materials such as concrete for road maintenance, backfilling, or transfer to recycling centers
15	Wood waste	Variable	Non-Hazardous	Repurpose for temporary site works, construction forms, or as mulch; dispose of at approved dumpsites
16	Dust and particulate matter	N/A	Non-Hazardous	Suppress through water sprinkling and dust control measures at project sites and haul routes

3.9 Health Safety and Environment (HSE)

The Health and Safety of construction workers, road users and the public are of utmost importance during road construction activities. This is because road construction exposes human population and the environment to diverse risk of pollution, accident and fatalities. Thus, Health safety and Environmental consideration are a must in any construction site. The HSE component of the project will entails the following:

- i. **Implement Proper Training** - the workers will be subjected to routine training to be aware of the policies in place and the imminent hazards they will encounter in carrying out their task. Daily HSE briefing shall also be carried out by the HSE manager on site. The trainings will include the following:
 - Safety training schedules
 - Traffic control plans
 - Schedules for equipment and materials inspections
 - Known hazards for your worksite and plans to alleviate them
 - Equipment training
 - Emergency and first aid plans.
- ii. **Start Each Workday with a Safety Meeting** - In addition to ensuring that all personnel at the construction site have the proper training required, it is also expedient to hold daily safety briefing / safety meeting before work begins. Since conditions can change greatly from day to day in the work zone, workers should be briefed on the work activity scheduled each day and notified of all potential hazards. This is also a good time to ensure that all workers have and are wearing the proper PPE required for the work being done that day.
- iii. **Use of Personal Protective Equipment** - On workers and visitors shall be required to be properly always kitted. Coverall, Gloves, Hat, Safety boots, goggles, earmuff and noise mask shall be provided onsite and their usage shall be strictly enforced at all times. Figure 3.10 shows some PPE to be deployed for the project.



Figure 3.9: Personal Protective Equipment (PPE)

- iv. ***Properly Control Traffic*** - Traffic signs shall be provided at an ample distance away from the work zone so that drivers can prepare to adjust to changes like slowdowns or reduced lanes. Adequate space shall be provided for motorist to safely transition out of the work zone and back into the regular flow of traffic. Flag Men/Flaggers who are directing vehicles should never turn their backs to oncoming traffic.
- v. ***Increase Worker and Work Site Visibility*** - Workers on site shall be required to wear high-visibility clothing. High-visibility clothing includes things like hats, vests and armbands with reflective or fluorescent materials.
- vi. ***Use Caution When Operating Heavy Machinery*** – Heavy duty machines, such as rollers and excavators, have blind spots and are capable of fatally injuring construction workers. The following measures will be enforced to safely operate heavy equipment on the highway construction site.
 - Use a seatbelt at all times.
 - Apply parking brakes whenever vehicles are not in use.

- Put a block in front or behind of the tires when left on an incline or decline.
 - Use a spotter when moving, unloading and loading equipment.
 - Check that mirrors and other visual aids like taillights are attached and operational.
- v. ***Create Separate Work Areas*** - Road construction work zones are busy areas usually with several work activities taking place at the same time. To avoid accidents, use cones, barrels, and barriers to clearly delineate specific areas of the work zone such as material storage, areas where heavy equipment is being used, vehicle parking, and safe areas for workers on foot to move about.
- vi. Ensure a Competent Person are employed to work on Site.

3.10 Decommissioning

The proposed SBS-2 project has a projected life expectancy of 50 years. However, the road will be designed, constructed, and maintained to operate efficiently and sustainably, with the goal of exceeding the expected lifespan. Periodic maintenance activities, including resurfacing, repairs, and rehabilitation, will be undertaken to ensure the road continues to meet safety, environmental, and operational standards beyond its design life.

3.11 Raw Material Supply

The major raw materials required for the SBS project are sand, lateritic materials, gravels and aggregate stones, cement, water and iron rod. While sand and lateritic materials are abundant in the Sokoto sedimentary basin, cement will be primarily obtained from BUA Cement, Plc Sokoto plant and some Dangote Cement depots across the state. Registered contractors and agents will be screened and licenced to supply these materials as at when needed. Similarly, aggregate stones would be obtained through registered agents from quarries in Yauri and Shanga Local Government areas state while iron rods will be supplied by dealers and agents across the country.

3.12 Labour Requirement

The total labour requirement for all phases (pre-construction, construction and operation/maintenance) of the SBS project is approximately 1850 personnel. Majority of the workers required in the preconstruction and construction phases of the project are semi-skilled and unskilled. These include technicians, survey staff, labourers, drivers, support staff and petty workers who would assist in the execution of works at different capacities. Most of these workers will be sourced from the area as may be available.

Skilled workers such as designers, planners, engineers, environmental and social experts, surveyors, geotechnical staff, accountants, foremen and supervisors would also be required to perform different functions. Skilled workers are primarily staff of TSL or its registered contractors and consultants. A breakdown of labour requirement is presented in Table 3.7.

Table 3.7: Labour Requirements for the Sokoto Section of SBS Project

Project Phase	Job Description	Number Required
Pre-construction Phase	Engineers/designers, Environmental & social experts, Surveyors & geotechnical staff, Administrative/support	250
Construction Phase	Unskilled labourers, Skilled technicians, Equipment operators & drivers, Engineers & supervisors, Health, safety & environment, Security & logistics, Administrative & finance	1450
Operation and Maintenance Phase	Maintenance crew, Toll operation & finance, Environmental monitoring, Security and surveillance personnel	150
	Total	1850

3.13 Project Implementation schedule

In accordance with the project conceptualization, preliminary studies, ESIA studies activities are currently ongoing. However, contract procurement and actual construction work is scheduled to commence by first quarter of 2025. It is estimated that the project construction period will be up to 24 months following receipt of relevant permits and approvals from relevant regulatory authorities. The project implementation schedule for pre-construction and construction phases is shown in Table 3.8.

Table 3.8: Project Schedule

	Activity	2024					2025												2026				
		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Mar	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Mar
1	Planning/preliminary designs																						
2	E.I.A study/ provisional Approval																						
3	Site Preparation (Land clearing, Demolition of Existing structures Levelling)																						
4	Civil works (Bridges, Culverts, Drainage,																						



TSL ENGINEERING LIMITED

ESIA of the Proposed Sokoto-Badagry Superhighway, Section 2 – 323km

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CHAPTER FOUR: DESCRIPTION OF THE PROJECT ENVIRONMENT

4.1 Introduction

This chapter describes the existing biophysical and socio-economic conditions of communities along the alignment. The activities carried out for this EIA include reconnaissance survey of the project affected communities, extensive literature review, stakeholder identification, consultation and engagement, field data gathering, laboratory analyses of the collected samples and socio-economic survey of the selected project affected communities.

4.2 Reconnaissance Survey

Reconnaissance visit was the first major activity undertaken to familiarize with the alignment, identify major stakeholders and logistic routes as well as examine security issues. This exercise was undertaken between Tuesday, 26th of November 2024 and Thursday, 28th November 2024.

4.3 Environmental Data Gathering

Environmental data gathering and other field activities were carried out between 14th December 2024 and 1st January 2025 when the field data collection activities were carried out. Within the report period, data on hydrology (surface and groundwater), ecology (flora, fauna and aquatic), soils and socioeconomic characteristics of communities along the alignment were collected.

4.4 Laboratory Analyses

All water and soil samples were preserved and transported to the Centre for Advance Science Research and Analytical Services (CASRAS) Laboratory, Usmanu Danfodiyo University, Sokoto for analyses (Plate 4.1).



Plate 4.1: CASRAS Laboratory, Usmanu Danfodiyo University, Sokoto

4.5 Political Set up

Kebbi State is in the North-western part of Nigeria, between latitudes $10^{\circ} 5' 37''$ and $13^{\circ} 13' 37''$ N; and longitudes $03^{\circ} 29' 50''$ and $6^{\circ} 1' 57''$ E and covers a total land area of about 37,699 square kilometres. The State shares border with Sokoto State to the North-East, Zamfara State to the East, Niger State to the South, Niger Republic to the North and Benin Republic to the West (Figure 4. 1).

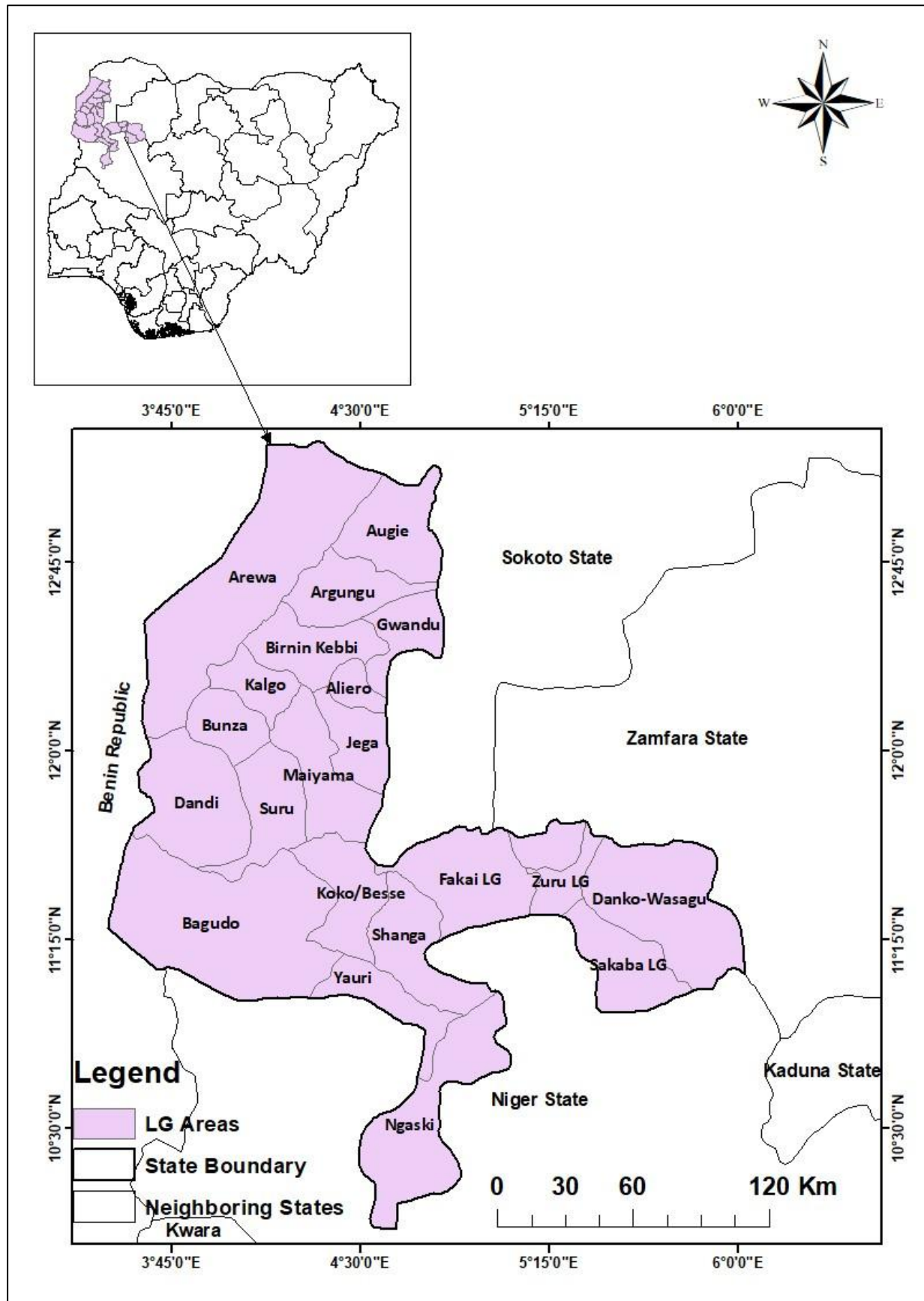


Figure 4.1: Kebbi State and Local Government Areas

4.6 Geology

The geology of Kebbi State is dominated by two formations Precambrian Basement complex in the South to southeast and young sedimentary rocks in the North. The basement complex region is composed of very old volcanic and metamorphic rocks such as granites, schist, gneisses, and quartzite consist of Gwandu, Illo and Rima group whose ages range from cretaceous to the Eocene. The geology of the area was described to contain different lithofacies varying from one location to another. Generally, the litho sequence was described to vary from high energy fluvial deposits of poorly sorted sandstone sitting unconformably on conglomeratic bed.

The sedimentary region consists of the Gwandu, Illo and Rima groups whose ages range from the cretaceous to Tertiary and are composed mostly of interbedded sand, clay, and some limestone; the beds dip gently toward the northwest. The Gwandu group consist of massive clay grits inter bedded with sand stone while the Illo and Rima groups consist of pebbly grits, sand stone and clays mudstone and siltstone respectively. The Rima Group contains an extensive artesian aquifer which is economically important in the Sokoto and Birnin Kebbi areas (Usman, 2019). The sediment dips gently and thickens gradually toward the northwest with maximum thicknesses attainable toward the border with Niger Republic (Adamu et al., 2020).

The sedimentary deposit of the state belongs to Gwandu Formation, with type section and type area in the Gwandu Emirate of north-western Nigeria (Kogbe, 1972). Outcrops of the formation cover a vast area dotted with several prominent ridges and groups of flat-topped, steep-sided hills capped by ironstone. Some of the isolated hills covered with ironstone debris occur in all stages of disintegration due to varying degree of weathering, rising out of the sandy plain over which the products of erosion have been distributed. The hills are flat at the top but steep sided with falloff of ironstone boulders on it and screes at the foot of the hills. The best outcrops of the Gwandu Formation occur around Birnin-Kebbi and Argungu. The sediments consist of massive white clays interbedded with coarse and medium-grained red sandstones and mudstones with occasional peat bands.

The conglomerate is underlain by sandstone, siltstone and carbonaceous shale at the bottom; suggesting downward decrease in grain size and energy of transportation and deposition of the sediments (Ola-Buraimo et al., 2019). According to Ola-Buraimo et al. (2019), the downward sequence indicates varying paleo environment of deposition, suggested to vary from fluvial environment at the top, but prograded into deltaic setting at the bottom (Figure 4.2).

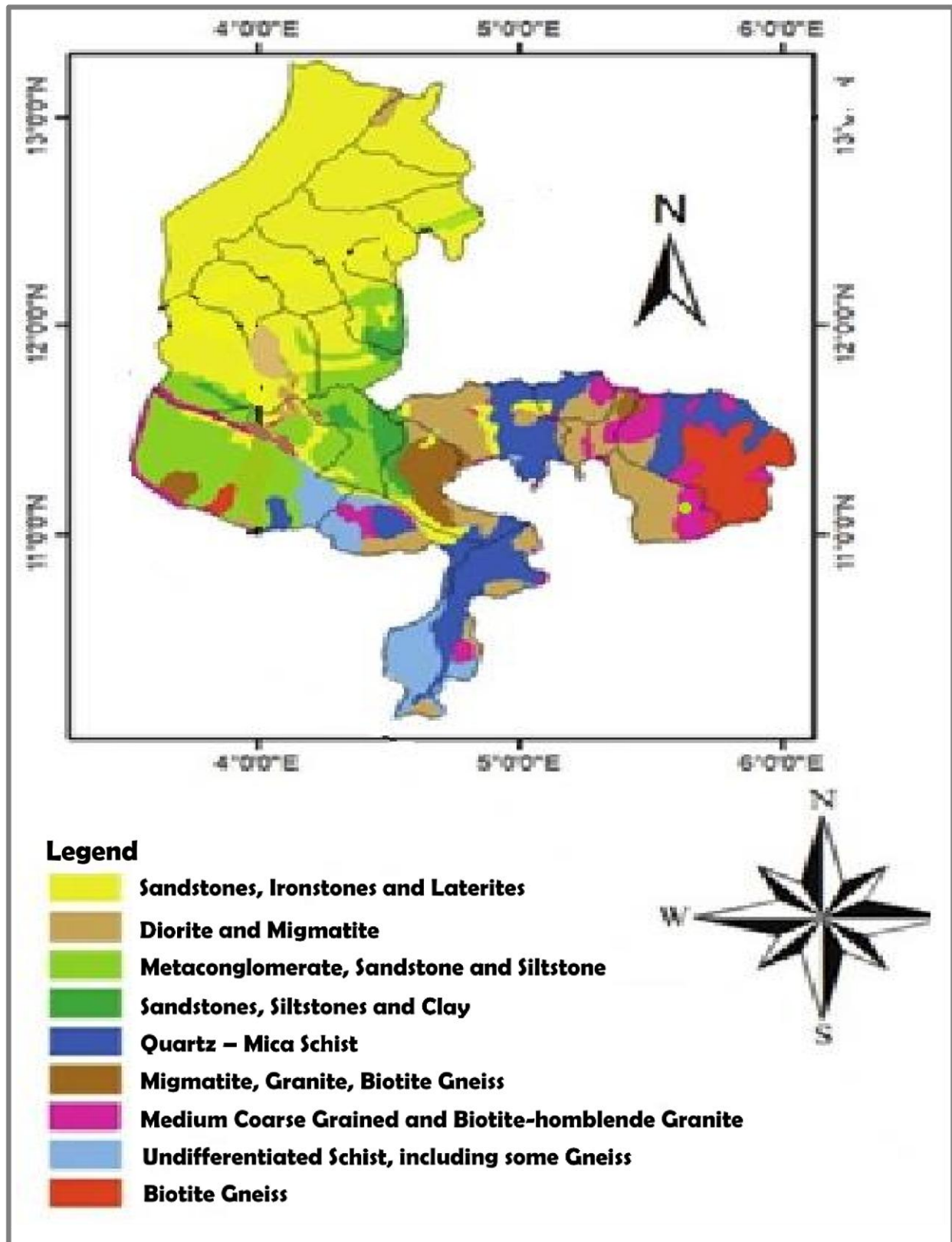


Figure 4.2: Geology of Kebbi State (Adopted from Augie and Ologe, 2020)

4.7 Climate

4.7.1 Rainfall

The climate of Kebbi State is typically tropical continental, with marked dry and wet seasons. The wet season lasts for approximately 6 months (from April to October) while the dry season spans from November to March. Mean annual rainfall in the area ranges between 1025mm and 1050mm per annum, while mean annual temperature varies throughout the year with the highest range of 38°C recorded in the month of April and the lowest range of 31°C recorded in January (Agan et al., 2019).

4.7.1.1 Field Observation of Meteorology data

Table 4.1 presents the meteorological data collected at various sample locations along proposed SBS-2 project. The data includes temperature, dew point, wet bulb temperature, relative humidity, atmospheric pressure, and wind speed for each point, providing insight into the local climate conditions critical for the highway construction and planning.

Table 4.1: Meteorological data obtained during field observation

S/N	Sample Location	Temp. (°C)	Dew Point (°C)	Wet Bulb (°C)	Relative Humidity (% RH)	Atmospheric Pressure (HPA)	Wind Speed (m/s)
1.	Aisha Buhari Hospital	34.1	26.0	24.2	41	1110	3.6
2.	Bayawa Town	33.7	25.8	23.5	43	1125	3.1
3.	Birnin Madi / Gindi	32.4	24.6	22.1	45	1015	2.8
4.	Balugu Town	35.0	26.2	24.8	40	1100	2.9
5.	Dalijan	33.0	25.4	23.0	44	1012	3.0
6.	Giro	34.5	26.8	25.1	41	1098	3.5
7.	Gwamba Town	32.8	25.0	22.6	46	1102	2.7
8.	Hore	33.2	25.5	23.3	44	1018	2.8
9.	Kyarmi/Nassarawa	34.3	26.4	24.3	42	1120	3.2
10.	Sabiyal Town	33.1	25.7	23.4	45	1107	3.0
11.	Wali	32.7	25.0	22.8	44	1015	3.4
12.	Zagga	35.2	26.0	24.5	40	1105	2.6
13.	Control	33.6	25.3	23.1	43	1090	3.3

Source: TSL Fieldwork, 2024 & 2025

In addition to the in-situ measurement of meteorological data, climate data for 30 years (1990 to 2021) was also obtained and analyzed. The mean annual and monthly rainfall of the state are presented in Figure 4.3 and Table 4.2 respectively.

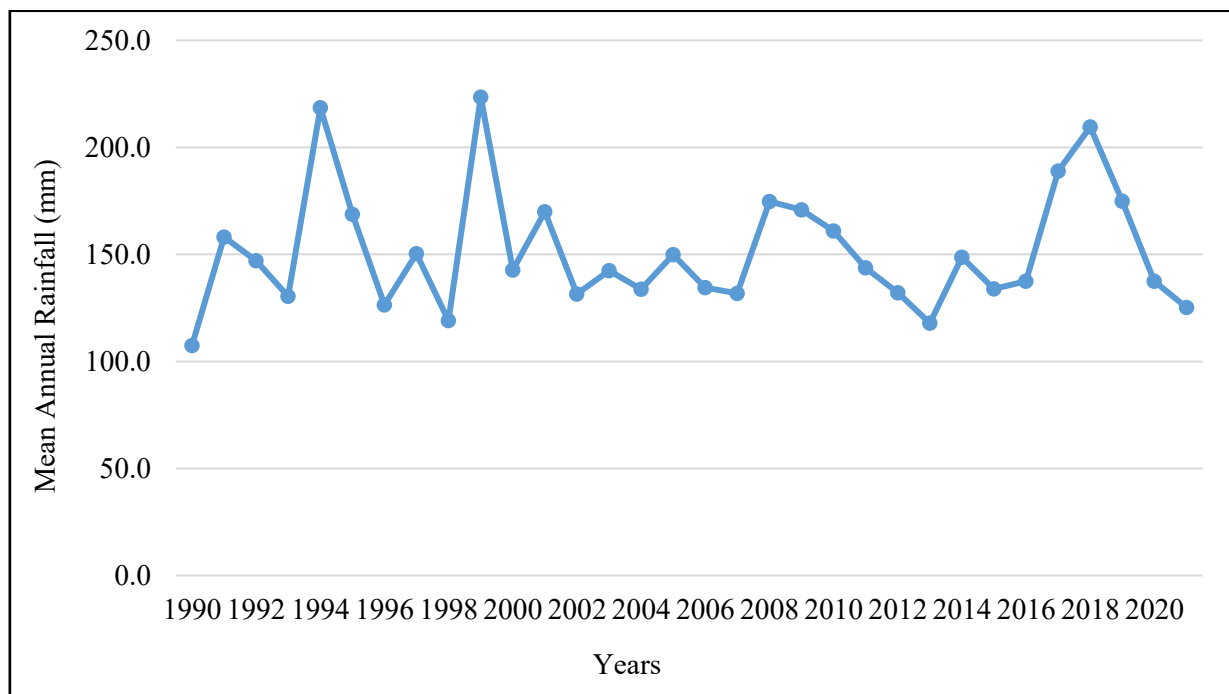


Figure 4.3: Mean Annual Rainfall (mm) in Kebbi State (NiMet, 2022)

Table 4.2: Mean Monthly Rainfall (mm) in Kebbi State (1990 – 2020)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	0	0	0	40.6	76.6	82.6	198.7	157.9	195.1	0.4	0	0
1991	0	0	3.4	84.9	239.3	256.6	216.4	138.8	100.5	70	0	0
1992	0	0	0	0.2	139.5	125.4	206.4	310.4	246.9	0	0	0
1993	0	0	0	0	153.8	126.3	272.6	115.6	153.9	90.6	0	0
1994	0	0	7.5	99.4	52.6	227.8	202.1	467.9	294.1	185.9	0	0
1995	0	0	7.8	114.6	60	145	241.4	246.1	287.9	85.9	0	0
1996	0	0	0	5	121.3	159.4	172.8	200	178	48.7	0	0
1997	0	0	0	59.7	97.7	182.6	177.6	259.1	202.9	72.4	0	0
1998	0	0	0	51.6	82	113.8	103.4	286.5	121.9	73.8	0	0
1999	0	0	0	39.7	54.8	133	231.1	608.3	330.6	167.1	0	0
2000	0	0	0	0	26.5	72.3	361.6	159.8	63.8	48.6	0	0
2001	0	0	0	24.1	60.5	36.8	360.8	141.9	107.5	0	0	0
2002	0	0	0	33.3	30.8	67.4	231.6	183.1	179.2	43.3	0	0
2003	0	0	0	9.2	17.5	71.3	287.9	288.7	108.2	7.4	0	0
2004	0	0	0	30.1	96.4	68.5	133.7	274.4	46.4	TR	0	0
2005	0	0	0	0	104.5	82.5	146.7	171.1	124.3	5.5	0	0
2006	0	0	0	0	19.2	40.6	135.5	304.5	187.3	29.8	0	0
2007	0	0	0	6.6	45.6	65.9	183.4	235.6	99.1	0	0	0
2008	0	0	0	0.7	41.3	94.7	152.2	130.2	93.9	1.6	0	0
2009	0	0	0	0	24.8	64.1	114.6	179.2	98	119.9	0	0
2010	0	0	0	0	24.8	64.1	114.6	146.7	98	119.9	0	0
2011	0	0	0	0.4	128.7	126.1	322.8	357.6	88.2	122.9	0	0
2012	0	0	0	0	92.9	161.2	29.3	174.2	93.2	19.1	0	0
2013	0	0	0	0	54.5	83.2	178.2	140.7	92.4	64.4	0	0
2014	0	0	0	67.4	16.2	61.6	167.8	322.7	41.8	21.7	0	0
2015	4.3	0	0	11.8	72.1	98.3	193.3	129.4	167.8	27.2	0	20
2016	4.1	8.9	26.3	60.3	182.8	51	193.3	322.7	167.8	0	0	0
2017	0	0	1.5	19.3	30.6	33.4	152.7	286.1	134.8	0	0	0
2018	0	0	0	22.6	3.2	118.4	152.9	191.6	156.3	38.8	0	0
2019	0	0	0	0	88.4	54.6	195	249.4	101.8	83.3	0	0
2020	0	0	0	2.2	65.3	112.4	174	238.9	226.14	40.7	0	0

4.7.2 Temperature

Temperature within Kebbi state varies markedly on daily and seasonal scales with the mean daily temperature ranging between 31°C and 38°C but may reach about 44°C during the months of April and May when the area experiences the hot season. Conversely, the mean daily temperature drops to less than 17°C during the months of November to March when the area experiences the cold or harmattan season which is associated with dust-laden and cold winds blowing from the northeast (Paul & Bayode, 2012). The mean annual and mean monthly temperature of the state for 1990 to 2020 are presented in Figure 4.4 and Table 4.3 respectively.

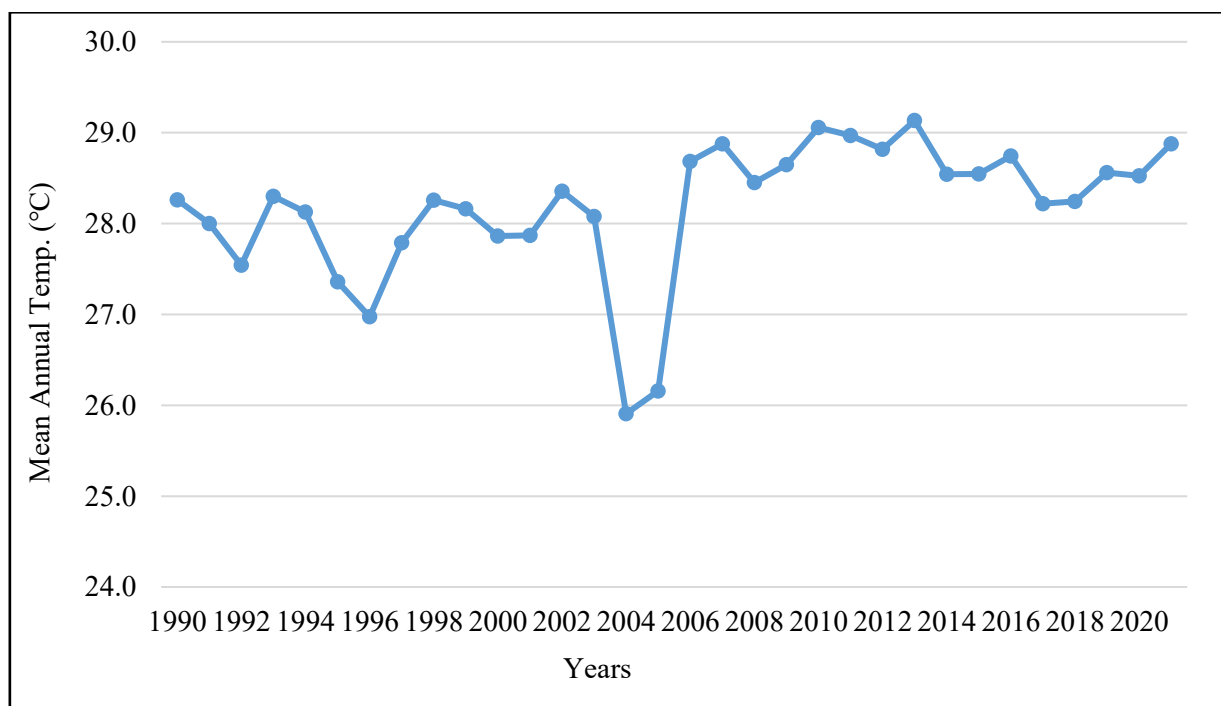


Figure 4.4: Mean Annual Temperature in Kebbi State (2000 – 2020)

Source: NiMet, 2022

Table 4.3: Mean Monthly Temperatures (°C) in Kebbi State (1990 – 2020)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	25.3	27.4	30.4	32.9	29.9	29.3	26.9	26.8	26.8	28.0	27.7	27.8
1991	26.4	30.5	32.0	32.2	28.7	27.6	26.5	26.5	27.1	27.7	26.3	24.6
1992	24.5	27.5	31.7	32.9	29.8	27.5	26.3	25.9	26.0	27.5	26.3	24.7
1993	23.9	27.7	30.9	32.7	31.2	27.9	26.5	26.7	26.9	28.8	29.1	27.4
1994	25.3	26.6	29.9	31.5	30.5	28.9	28.3	27.3	27.9	28.2	28.0	25.1
1995	24.4	25.2	29.4	30.1	29.7	29.3	27.0	27.1	27.5	28.6	25.6	24.5
1996	24.4	24.7	28.9	29.7	29.3	27.7	27.0	26.5	26.2	27.0	26.1	26.2
1997	26.4	26.3	28.5	30.5	28.7	27.4	26.7	26.6	27.1	28.6	28.3	28.6
1998	25.2	30.5	31.0	33.2	30.0	27.8	26.8	26.1	26.6	27.7	27.7	26.4
1999	25.7	28.9	32.5	31.7	30.4	28.6	26.2	25.8	26.1	27.3	28.3	26.5
2000	26.05	24.05	29.3	34.4	34.25	30.75	27.9	27.05	28.1	29.75	28.2	24.55
2001	23.95	25.45	30.95	33.55	33.1	30.65	28.65	27	28	29.55	28.25	26.75
2002	23.25	26.15	31.9	34.3	34.55	31.65	28.4	27.35	28	28.3	28.25	24.45
2003	25.0	28.85	30.25	33.75	33.75	30.7	28.55	26.8	27.8	30.25	29.05	24.95
2004	25.45	27.1	29.7	34.15	31.96	30.25	27.95	27.15	28.65	30.65	29.55	27.3
2005	23.85	31.25	33.65	34.75	33	29.95	28.2	27.2	28.35	29.6	28.95	26.8
2006	27.65	29.45	31.9	33.8	33.1	31.80	29.65	26.95	27.45	29.3	27.2	30.3
2007	22.85	28.05	30.5	34.7	33.7	31.5	28.7	26.85	27.9	30.25	29.85	26.7
2008	22.65	25.6	31.45	33.7	33.25	31.6	27.95	27.3	28.5	30.05	28.75	27.25
2009	26.0	30.5	32.0	34.9	34.0	32.1	29.4	28.25	28.75	30.25	27.95	27.35
2010	26.29	30.96	32.21	35.03	34.11	30.82	27.85	26.94	27.85	29.19	28.70	25.02
2011	24.16	29.71	32.48	33.67	33.69	30.53	29.36	27.38	28.30	30.01	28.04	24.40
2012	23.99	29.03	30.10	34.22	32.93	29.33	26.91	26.55	27.92	29.66	29.89	26.09
2013	25.86	28.48	33.64	33.45	33.62	31.47	28.88	26.26	28.31	29.82	28.54	26.25
2014	26.40	28.00	31.52	33.69	31.99	31.43	29.02	26.95	27.46	29.51	28.93	25.41
2015	22.90	29.27	30.66	32.05	34.12	31.98	28.86	27.35	28.26	31.05	28.82	27.67
2016	24.36	27.44	33.15	34.74	33.51	30.74	28.12	27.28	28.17	30.23	29.47	26.79
2017	25.56	27.19	31.53	34.36	32.99	30.28	28.14	26.77	28.17	29.55	28.37	26.01
2018	23.07	28.44	31.55	33.87	33.49	30.15	27.13	26.35	27.53	29.76	28.05	24.38
2019	25.06	26.60	32.06	34.69	32.91	30.49	27.67	26.93	28.36	28.30	29.06	25.28
2020	24.17	26.15	31.58	34.72	33.47	31.04	27.77	26.34	27.27	28.71	27.46	27.05

4.7.3 Relative Humidity

Relative humidity in Kebbi state is generally low in the dry season but increases with the amount of rainfall received. Hence, relative humidity is usually higher in the months of August and September when the area receives higher rainfall. The mean annual and mean monthly relative humidity of the state are presented in Figure 4.5 and Table 4.4 respectively.

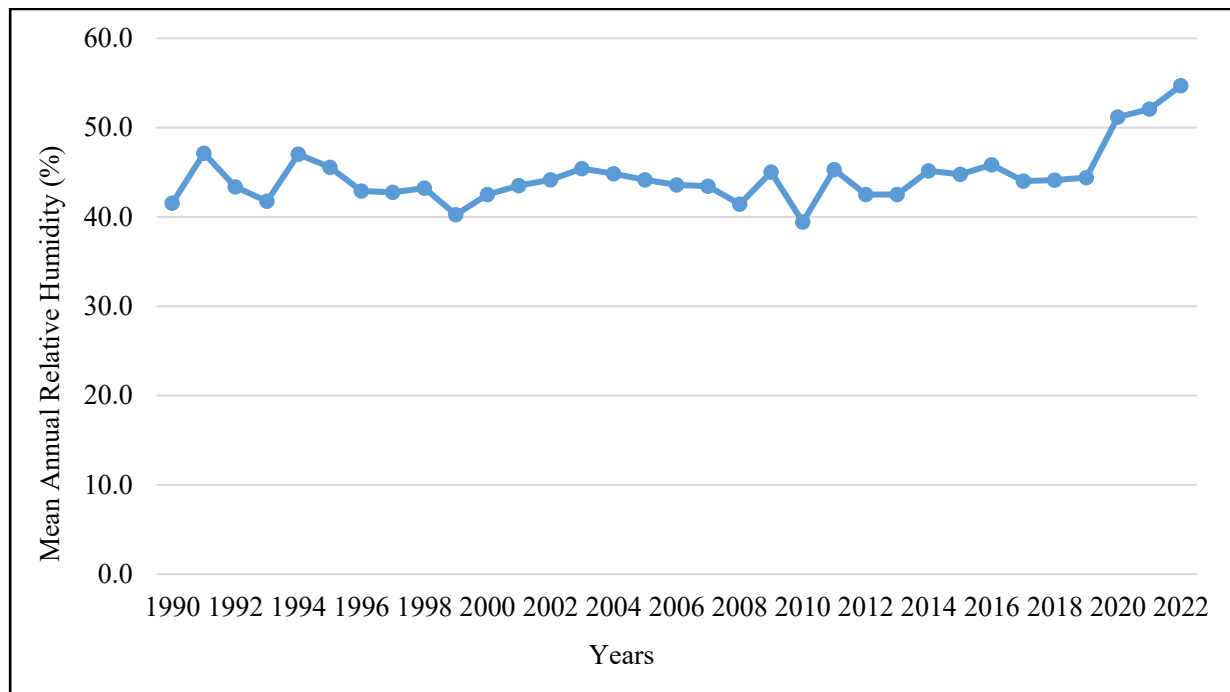


Figure 4.5: Mean Annual Relative Humidity (%) in Kebbi State (1990 – 2022), NiMet, 2022

Table 4.4: Mean Monthly Relative Humidity (%) in Kebbi State (1990 – 2020)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	22.62	15.12	12.44	33.12	50.62	51.62	67.19	73.62	69.19	49.38	29.56	24
1991	19.25	19	22.12	30.44	56.56	59.25	73.81	83	78.81	62.75	33.94	26.5
1992	23.12	15.81	18.75	30.31	47.44	53.88	65.44	77.19	76.75	56.12	31.88	23.56
1993	21.75	16.56	19.31	21.31	42.56	53.06	66.69	76	73.31	55.88	30.69	23.69
1994	21.81	13.19	16.75	31	39.81	52.88	69.81	83.62	82.06	76.44	44.88	32.06
1995	23.88	18.56	22.69	35.88	46.25	54.25	65.5	79	77.62	61.81	34.12	27.19
1996	17.81	18	15.38	25.25	44.31	63.88	66.69	76.06	77.12	59.19	28.12	23
1997	17.12	14.75	25.81	31.44	50.44	59.25	69.19	75.31	68.12	55.06	27.19	19.25
1998	18.62	16.25	10.38	26.38	48.38	54.69	64.62	78.44	79.62	60.94	32.75	27.62
1999	20.88	18.5	15.81	26.31	35.81	44.56	61.88	76.5	78.06	55.38	28.25	21.19
2000	28.0	25.0	15.0	29.0	38.0	57.0	72.0	77.0	68.0	52.0	24.0	25.0
2001	19.0	14.0	18.0	33.0	49.0	59.0	72.0	79.0	75.0	47.0	30.0	27.0
2002	26.0	22.0	22.0	24.0	41.0	51.0	69.0	79.0	77.0	63.0	30.0	26.0
2003	25.0	22.0	21.0	40.0	36.0	58.0	72.0	81.0	76.0	57.0	31.0	26.0
2004	22.0	21.0	20.0	33.0	54.0	62.0	73.0	75.0	72.0	42.0	34.0	30.0
2005	26.0	25.0	17.0	26.0	46.0	62.0	70.0	79.0	75.0	49.0	29.0	26.0
2006	27.0	23.0	18.0	19.0	43.0	50.0	66.0	80.0	74.0	60.0	28.0	35.0
2007	28.0	19.0	22.0	33.0	43.0	53.0	70.0	81.0	72.0	46.0	28.0	26.0
2008	26.0	20.0	16.0	22.0	43.0	53.0	69.0	75.0	71.0	46.0	27.0	29.0
2009	26.0	18.0	18.0	33.0	43.0	52.0	67.0	77.0	75.0	65.0	37.0	29.0
2010	13.0	9.0	13.0	34.0	41.0	61.0	76.0	83.0	72.0	39.0	17.0	15.0
2011	19.2	14.6	14.0	30.4	47.8	58.4	72.0	80.2	74.8	55.6	37.6	39.0
2012	25.0	23.0	11.0	33.0	40.0	62.0	75.0	77.0	69.0	51.0	20.0	24.0
2013	18.0	13.0	13.0	34.0	53.0	62.0	72.0	79.0	73.0	42.0	27.0	24.0
2014	19.0	19.0	40.0	48.0	58.0	74.0	79.0	73.0	59.0	26.0	22.0	25.0
2015	17.0	17.0	44.0	42.0	60.0	73.0	80.0	73.0	58.0	28.0	22.0	23.0
2016	19.0	19.0	47.0	48.0	64.0	75.0	81.0	70.0	55.0	27.0	20.0	25.0
2017	18.0	23.0	15.0	29.0	54.0	65.0	74.0	79.0	73.0	50.0	25.0	23.0
2018	19.3	19.0	28.3	39.0	54.8	68.5	76.8	75.2	64.5	37.3	22.7	24.0
2019	18.4	18.3	31.2	40.0	57.3	69.6	77.1	74.9	63.8	35.1	23.1	24.0
2020	23.0	20.4	27.2	37.3	51.0	61.9	80.2	87.5	83.9	67.1	39.9	34.8

4.7.4 Wind Speed and Direction

Wind in the project area, predominantly blows towards the Southeast direction. The pattern, direction and speed of wind in the area however, varies with the seasons and time of the day. Wind speed is higher from November to July but the average annual wind speed in the area is 81km/h. The mean annual and monthly wind speed in the state for 2000 to 2020 are presented in Figure 4.6 and Table 4.5 respectively, while wind direction is presented in Table 4.6 and Figure 4.7.

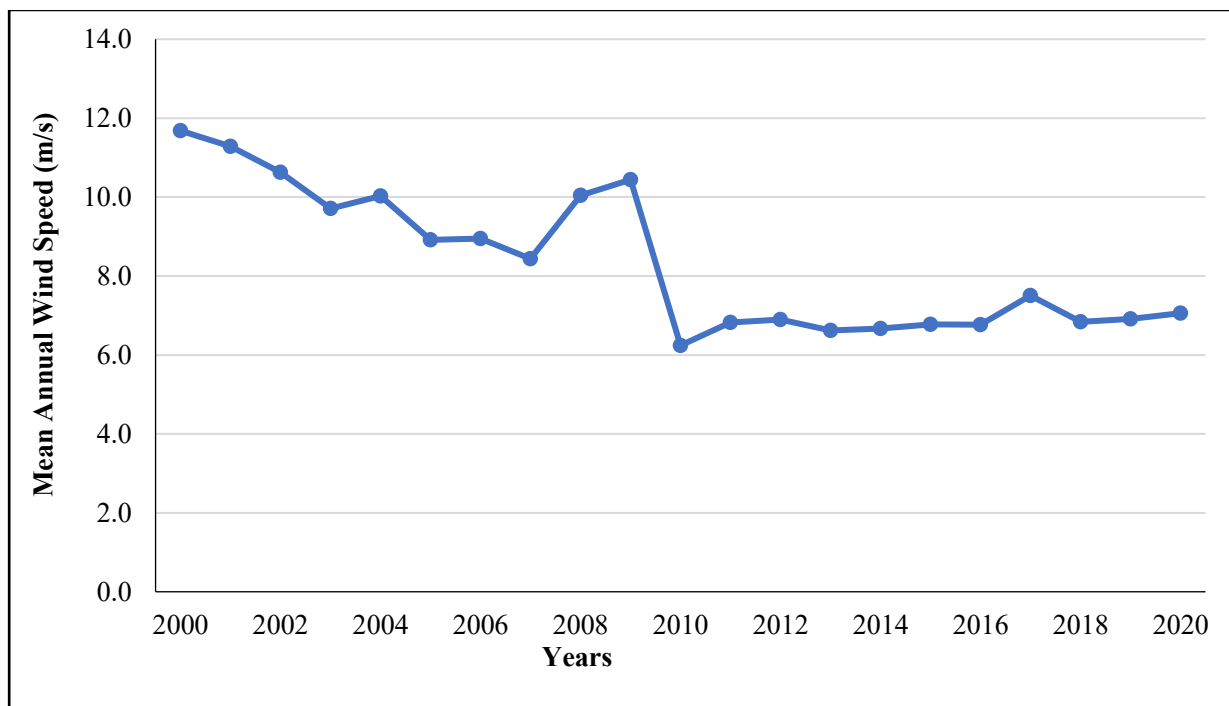


Figure 4.6: Mean Annual Wind Speed (m/s) in Kebbi State (2000 – 2020), NiMet, 2022

Table 4.5: Mean Monthly Wind Speed (Km/Hr) in Kebbi State (2000 – 2020)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2000	13.3	15.7	14.5	10.5	14.4	16.6	13.2	8.6	8.2	6.9	7.6	10.7
2001	12.2	13.3	10.8	15.0	14.7	16.2	12.3	8.7	7.0	6.6	8.0	10.5
2002	15.1	11.2	10.3	10.5	12.7	16.9	13.6	9.1	7.4	5.1	6.5	9.1
2003	8.6	9.1	11.6	11.4	12.2	15.2	12.3	8.8	6.3	5.1	7.6	8.4
2004	8.7	12.0	13.3	9.8	17.0	13.4	10.0	8.3	7.6	5.6	6.9	7.8
2005	10.8	9.2	9.7	11.2	12.0	11.6	9.8	7.2	6.8	5.3	6.1	7.3
2006	7.9	8.5	9.4	10.4	15.9	14.8	12.5	4.5	4.2	3.8	7.9	7.9
2007	8.3	7.9	8.6	10.9	14.0	16.9	6.5	5.6	3.4	4.0	6.7	8.4
2008	10.8	12.0	8.1	8.8	18.3	15.4	12.6	7.9	6.4	5.9	6.3	8.1
2009	6.9	9.5	10.5	12.0	13.8	16.3	13.5	10.1	7.6	8.7	7.8	8.6
2010	5.2	5.5	6.9	9.1	8.7	8	6	5.6	5.7	2.8	3	8.4
2011	6.9	7.2	6.7	8.2	7.8	8.0	7.1	5.4	5.2	5.8	6.8	7.0
2012	6.7	7.2	6.9	8.6	8.2	8.4	7.1	5.5	5.3	5.4	6.4	7.0
2013	6.0	6.8	6.9	8.5	8.1	8.4	6.9	5.2	5.0	5.3	6.0	6.2
2014	6.2	6.7	6.9	8.6	8.2	8.2	6.8	5.4	5.3	4.8	5.6	7.4
2015	6.5	7.0	6.8	8.5	8.1	8.3	6.9	5.4	5.2	5.3	6.2	7.2
2016	6.3	6.9	6.9	8.5	8.2	8.3	6.9	5.4	5.2	5.2	6.1	7.3
2017	7.8	9.1	7.5	8.8	8.5	8.8	7.6	6.1	6.1	5.7	8.2	5.9
2018	7.9	7.8	7.6	6.6	8.2	8.1	7.7	6	5.3	4.4	7.3	5.2
2019	6.8	8.1	7.5	7.6	8.6	7.6	6.1	4.6	5.9	4.9	7.1	8.2
2020	7.1	7.8	7.3	8.0	8.3	8.2	7.1	5.5	5.5	5.1	7.0	7.9

Table 4.6: Wind Direction (Degrees) in Kebbi State (2000 – 2020)

Month	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Jan	170	160	90	90	70	60	90	70	260	90	60	50	130	60	120	90	90	90	150	90	210
Feb	170	200	200	190	150	110	150	150	210	200	110	80	180	110	130	200	190	190	240	100	210
Mar	160	210	220	200	170	190	140	170	210	220	110	160	200	190	170	230	220	200	230	120	260
Apr	160	200	210	190	170	220	180	170	200	210	180	200	190	220	240	210	240	190	240	200	210
May	140	180	210	170	160	210	190	160	200	210	210	210	200	210	270	190	210	170	190	250	210
Jun	190	190	210	190	160	150	180	160	250	210	200	200	160	150	250	180	190	190	250	250	230
Jul	130	160	140	210	190	140	180	190	230	200	210	180	220	140	250	170	160	210	250	350	240
Aug	180	200	190	190	220	190	200	210	240	210	220	190	200	190	230	230	230	190	240	280	240
Sep	180	190	130	180	190	130	170	170	220	210	190	160	150	130	220	140	210	180	230	190	240
Oct	160	200	180	170	200	180	150	150	230	200	200	200	170	180	200	130	230	160	220	200	210
Nov	130	50	100	120	50	100	140	140	230	220	50	80	120	100	130	140	220	130	220	90	240
Dec	130	50	60	100	50	60	120	70	270	140	50	50	100	60	130	70	100	130	180	80	190

Source: NiMet, 2022

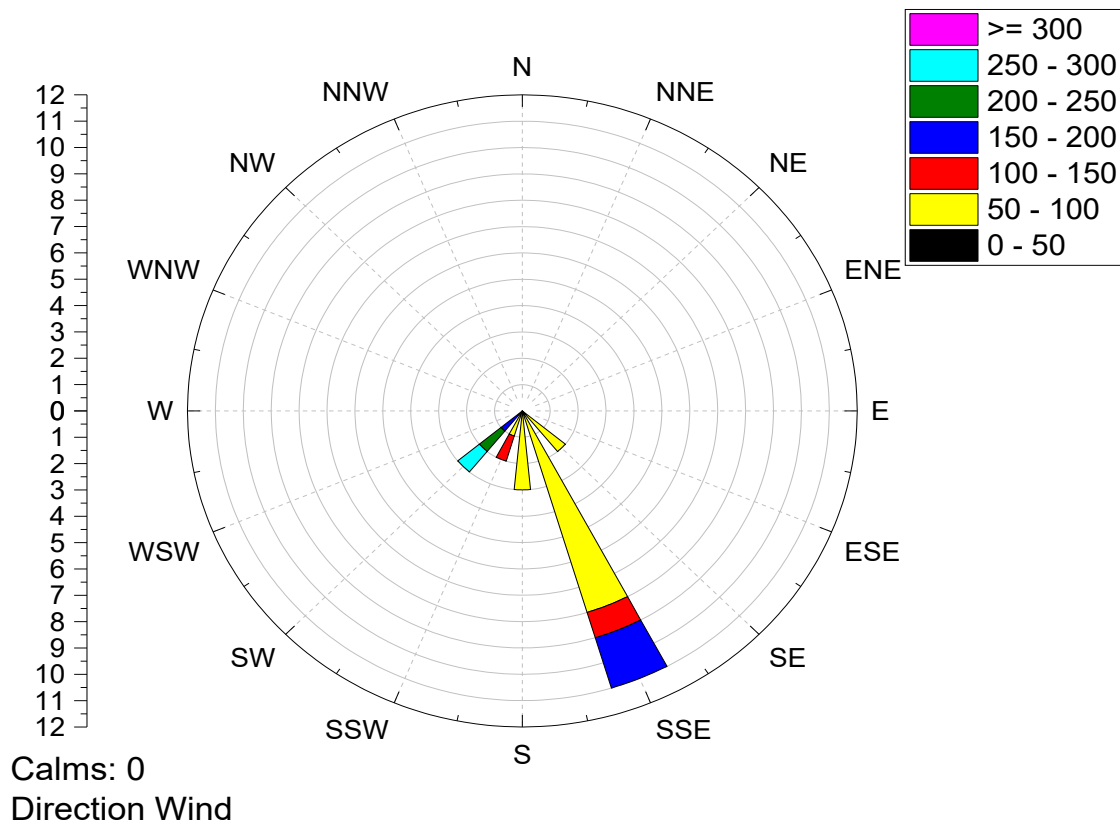


Figure 4.7: Average Wind Direction in Kebbi State (2000 – 2020)

4.8 Air Quality Assessment

Air quality monitoring data was taken at 12 locations and 1 control point between 8 and 24 hours in fulfilment of international lender requirements, specifically the requirement of the IFC for air quality data monitoring. It is also important to note that sampling was undertaken for a single 24-hour period at each location as per the FMEnv guidelines (Plate 4. 2 and Plate 4.3).



Plate 4.2: Air Quality Measurement at Jega and Balugu, Kebbi State



Plate 4.3: Sampling for Soils and Air Quality at Gidiga

Ambient air quality parameters including Ozone (O_3), Carbon monoxide (CO), Carbon dioxide (CO_2), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Formaldehyde (HCHO), Total Volatile Organic Compounds (TVOC), temperature and relative humidity were measured. Similarly, particulate matter of 1.0 microns ($PM_{1.0}$), less than 2.5 microns ($PM_{2.5}$), 10 microns and above (PM_{10}) were monitored using battery operated mini-volume sampler, whereas PM_{10} , $PM_{2.5}$ and gases were monitored using Aeroqual 500 series monitors fixed with sensor heads. The measured

parameters were compared with air quality standards set by NESREA (2014), WHO (2006) and USEPA (2016) (Table 4.7).

Table 4.7: Air Quality Standards

Parameter	Average Time	NESREA ($\mu\text{g}/\text{m}^3$)	WHO ($\mu\text{g}/\text{m}^3$)	USEPA ($\mu\text{g}/\text{m}^3$)
CO	1 hour	11.4	30	40
SO ₂	24 hours	26	20	0.14 (ppm)
NO ₂	8 hours	10	200	100 (ppb)
PM ₁₀	24 hours	250	50	150
PM _{2.5}	1 hour	250	25	35
O ₃	8 hours		60	
CO ₂	8 hours	30 min		7,000
TVOC				0.3 (ppm)
HCHO	30 min		0.21(mg/m ³)	0.3 (ppm)

Source: NESREA (2014), WHO (2006) and USEPA (2016)

Noise levels on the other hand, were measured in dBA and recorded based on average minimum and maximum levels. These were compared with the National permissible limits as provided by FEFA, 1992 (Table 4.8) and guidelines for community noise in specific environments (Table 4.9) as provided by WHO (1999).

Table 4.8: Permissible Noise Exposure Limits for Nigeria

S/N	Duration per Day, Hour	Permissible Exposure Limit dB(A)
1.	8	90
2.	6	92
3.	4	95
4.	3	97
5.	2	100
6.	1.5	102
7.	1	105
8.	0.5	110
9.	0.25 or less	115

Source: FEFA, 1992

Table 4.9: Guideline values for community noise in specific environments.

Specific environment	Critical health effect(s)	LAeq [dB(A)]	Time base [hours]	LAmx fast [dB]
Outdoor living area	Serious annoyance may be experienced in the daytime and evening Moderate annoyance, daytime and	55 50	16 16	- -
Outside bedrooms	Sleep disturbance, window open (Outdoor values)	45	8	60
School, playground outdoor	Annoyance (external source)	55	During play	-
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Outdoors in parkland and conservations areas	Disruption of tranquility	#3		

Source: WHO (1999)

4.8.1 Results and Discussion

The baseline environmental conditions within the study area reveal a diverse range of influences shaped by the natural environment, regional dynamics, and localized pollutant sources. These factors collectively define the air quality and noise levels observed along the proposed SBS-2 project. This section spans a 323 km from Alfala town at the northern border between Sokoto and Kebbi state, to Balugu at the southern border between Kebbi and Niger states. The section traversed semi-arid landscapes with intermittent human settlements and activities. Results from the baseline air quality assessment revealed pollutant concentrations that vary depending on proximity to emission sources (Table 4.10).

Table 4.10: Ambient Air Quality Monitoring Results

S/N	Station/Point	SO ₂ (µg/m ³)	NO ₂ (µg/m ³)	CO (mg/m ³)	H ₂ S (µg/m ³)	CO ₂ (ppm)	VOCs (ppm)	O ₃ (µg/m ³)	PM2.5 (µg/m ³)	PM10 (µg/m ³)	HCHO (µg/m ³)
1.	Aisha Buhari Hospital	0.00	2.00	0.54	0.00	355.00	0.50	5.00	4.00	7.00	0.70
2.	Bayawa Town	0.00	1.00	0.70	0.00	365.00	0.70	4.06	6.00	9.22	0.80
3.	Birnin Madi / Gindi	1.00	6.00	0.90	0.00	270.00	0.07	2.06	7.00	10.00	1.00
4.	Balugu Town	0.00	5.00	1.10	0.00	355.00	0.10	8.00	9.00	12.00	0.90
5.	Dalijan	0.00	3.05	1.30	0.00	360.00	0.15	9.00	7.00	14.00	0.90
6.	Giro	8.00	8.00	0.90	0.00	365.00	0.20	6.16	5.00	8.20	0.90
7.	Gwamba Town	4.00	4.00	0.80	0.00	315.00	0.35	6.00	6.00	9.00	0.80
8.	Hore	0.00	3.00	0.70	0.00	280.00	0.10	7.00	6.00	10.00	0.70
9.	Kyarmi/Nassarawa	0.00	3.50	0.90	0.00	320.00	0.50	2.01	7.00	11.10	0.90
10.	Sabiyal Town	0.00	3.00	0.65	0.00	325.00	0.15	6.00	6.00	10.02	0.70
11.	Wali	2.00	6.00	0.90	0.00	315.00	0.20	9.00	10.00	14.00	0.90
12.	Zagga	0.00	2.50	0.70	0.00	260.00	0.30	4.00	11.00	15.00	0.80
13.	AQ/KB/Control	0.00	4.00	1.20	0.00	315.00	0.30	12.00	12.00	17.00	1.00

AQ/M/N= Air Quality, Meteorology and Noise; **WB AQG**= World Bank Air Quality Guideline Source:

TSL Fieldwork, 2024 & 2025

4.8.1.1 *Suspended Particulate Matter (SPM)*

Suspended particulate matter (SPM), are finely divided solid or liquid particles with diameter 0.01 to 100 μm of organic or inorganic origin. These may include dust, sand, metals, wood particles, diesel exhaust, coal fly ash, etc. Depending on their concentrations in space, they may cause considerable air pollution and health risk such as irritation of the mucous membranes and other respiratory diseases.

The concentration of $\text{PM}_{2.5}$ along the alignment range from 4 – 12 $\mu\text{g}/\text{m}^3$ with a mean of 7.4 $\mu\text{g}/\text{m}^3$. The highest concentration was however found at the control point which is close to a relatively busy road. Other locations with relatively higher concentrations are Balugu (9 $\mu\text{g}/\text{m}^3$), Wali (10 $\mu\text{g}/\text{m}^3$) and Zagga (11 $\mu\text{g}/\text{m}^3$). This may not be unconnected with the transportation and other human activities in the area. However, all the values recorded in both wet and dry seasons were below the permissible limits.

4.8.1.2 *Carbon monoxide*

Carbon monoxide (CO) is a colourless, odourless, tasteless and toxic gas which is naturally formed by photochemical reactions in the troposphere, as well as from volcanoes, brush fires, and other forms of incomplete combustion of carbonaceous materials or fossil fuels. A significant proportion of atmospheric CO comes from fuel combustion engines. At higher concentrations, this gas may constitute adverse health risk such as replacing oxygen in the bloodstream and forming carboxyhaemoglobin (COHb). Other adverse health effects of carbon monoxide exposure include concentration of carboxy-haemoglobin in the blood which may result to headache, dizziness, weakness, nausea, confusion, disorientation and visual disturbance (at 20 - 30 %) as well as other secondary health issues such as convulsions, respiratory arrest and death when concentrations exceed 50% (Fierro et al., 2001).

CO values along the alignment range between 0.5 to 1.3 mg/m^3 . Higher concentrations of CO were recorded in Wali, Gindi and Bayawa towns (0.9 mg/m^3), Balugu (1.1 mg/m^3) and Dalijan (1.3 mg/m^3). These areas are known for high irrigation activities and dense commercial activities which allow for burning of fossil fuels.

4.8.1.3 Carbon dioxide (CO₂)

Carbon dioxide (CO₂) is a colourless, odourless, tasteless and non-flammable toxic gas which is naturally produced in the body and during the burning of fossil fuels as well as during the decay of vegetation and rotting of carbon-containing wastes. CO₂ can exist in both liquid and solid forms, depending on the temperature and pressure. CO₂ is required for all plant and animal life as well as in fire extinguishers, as a coolant in the form of dry ice, and in producing artificial fog used in theatre productions.

Although CO₂ is minimally toxic by inhalation, the primary health effects caused of CO₂ include reduction or displacement of the normal oxygen in breathing air. Longer exposure to higher concentrations may result to rapid breathing, confusion, increased cardiac output, elevated blood pressure and increased arrhythmias may occur. Breathing oxygen depleted air caused by extreme CO₂ concentrations can lead to death by suffocation (Zhang et al., 2017).

The concentrations of CO₂ along the alignment is generally within the permissible limits. The mean concentrations of CO₂ along the alignment ranged from 260 ppm to 365 ppm with a mean value of 323 ppm. However, higher concentrations were detected at Giro and Bayawa towns (365 ppm), Dalijan (360 ppm) and Aisha Buhari Hospital (355 ppm). The higher values recorded in these locations can be attributed to relatively higher population and other CO₂ producing activities and transportation.

4.8.1.4 Sulphur dioxide (SO₂)

Sulphur dioxide (SO₂) is a colourless gas that is produced from volcanoes, oceans, biological decay and forest fires releases and when sulfur-containing fuels, such as coal and oil, are burned. The primary sources of sulfur dioxide emissions are power plants, refineries and copper smelting facilities. SO₂ reacts with moisture in the atmosphere to produce acid rain but can also be released into the atmosphere via fossil fuel combustion, smelting, manufacture of sulphuric acid, incineration of refuse and production of elemental sulphur (Ukpebor et al., 2004). Some of the health risks associated with low concentrations of sulfur dioxide include irritation of the eyes, nose, throat, and respiratory tract, causing coughing and shortness of breath. However, higher concentrations may cause breathing problems, respiratory illness, alterations in pulmonary defences and aggravation of existing cardiovascular disease (Dejmek et al., 2000).

The mean concentrations of SO₂ within the project area are generally below the permissible limits. However, higher concentrations were recorded in Giro (8 µg/m³) and Gwamba town (4 µg/m³) while lower concentrations were recorded in Wali (2 µg/m³) and Birnin Madi/Gindi (1 µg/m³). No concentrations of SO₂ were recorded in all the other communities.

4.8.1.5 Volatile Organic Compounds (VOC)

Volatile Organic Compounds (VOCs) are primarily comprised of hydrogen and carbon atoms. They have high vapor pressure at ordinary room temperature which usually results from a low boiling point, causing large numbers of molecules to evaporate or sublime from the liquid or solid form of the compound and enter the surrounding air.

VOCs include both human-made and naturally occurring chemical compounds and play an important role in communication between plants, and messages from plants to animals. Not much is known about the immediate health effects associated with VOCs. Some VOCs may be harmful but are not acutely toxic. However, long-term exposure to VOCs may pose health risks such as respiratory disorders, allergy, or immune effects especially in infants and children. Others include eye, nose, and throat irritation; headaches, loss of coordination, nausea; and damage to the liver, kidney, and central nervous system (Ernstgard et al., 2007). But the fact is, many organic compounds are known to cause cancer in animals while some are suspected of causing, or are known to cause, cancer in humans.

The concentration of VOCs along the alignment was found to be generally low. Higher concentrations (0.7 ppm) were found in Bayawa, followed by Aisha Buhari Hospital and Kyarmi/Nassarawa (0.5ppm) and Gwamba town (0.35 ppm). The control point also had 0.3 ppm of the VOCs. These are however below the permissible limits set by the Federal Ministry of Environment.

4.8.1.6 Formaldehyde (HCHO)

Formaldehyde is also a colourless but strong-smelling gas often found in aqueous (water-based) solutions. It is a common chemical that can be emitted from a number of products in the home but higher formaldehyde levels are usually found in newer homes or homes with new construction. Formaldehyde levels decrease over time but may increase with increases in temperature and humidity (Hult et al., 2014). Common health risks associated with formaldehyde include irritation of the airways especially for people with known cases of

asthma, bronchitis, or other breathing conditions (Centers for Disease Control and Prevention, 2008).

The concentration of formaldehyde along the alignment range between 0.7 and 1.0 $\mu\text{g}/\text{m}^3$, with a mean value of 0.8 $\mu\text{g}/\text{m}^3$. The highest concentration (1.0 $\mu\text{g}/\text{m}^3$) was recorded in Birnin Madi/Gindi while the lowest (0.7 $\mu\text{g}/\text{m}^3$) was recorded in Sabiyal, Hore and Aisha Buhari Hospital. Other locations had relatively high values of 0.9 $\mu\text{g}/\text{m}^3$ which include Dalijan, Giro, Wali, Balugu and Kyarmi/Nassarawa. This shows that formaldehyde is generally available throughout the project area.

4.9 Noise Levels

Noise monitoring is an essential aspect of the Environmental Impact Assessment (EIA) to establish baseline noise levels at Noise Sensitive Receptors (NSRs) near the project area. Baseline noise data helps assess potential noise impacts from the proposed SBS-2.

The noise monitoring locations were strategically selected to represent NSRs across rural, urban, and control areas along the highway alignment. These locations provide insights into the baseline noise levels under typical conditions.

4.9.1 Noise Monitoring Methodology

- **Equipment Used:** Type 1 precision sound level meters were used to measure the noise levels, calibrated to ensure accuracy before and after the measurements.
- **Sampling Duration:** Each site was monitored over five consecutive days. Measurements were taken during **daytime (07:00 - 22:00 hours)** and **night time (22:00 - 07:00 hours)** to capture variations in noise levels.
- **Control Points:** Two control points were established in areas expected to have minimal influence from the proposed highway to serve as baseline references.

4.9.2 Results Discussion

Average noise levels obtained at day time (07:00 – 22:00hrs) and night time (22:00 – 07hrs) along the alignment are presented in Table 4.11 and Table 4.12.

Table 4.11: Noise Level Measurement along the Alignment in Kebbi State

S/N	Station	Noise Level									
		One-hour LAeq (dBA)									
		25/11/24		26/11/24		27/11/24		28/11/24		29/11/24	
		Day 1		Day 2		Day 3		Day 4		Day 5	
		DT	NT	DT	NT	DT	NT	DT	NT	DT	NT
		07:00 - 22:00	22:00 - 07:00	07:00 - 22:00	22:00 - 07:00	07:00 - 22:00	22:00 - 07:00	07:00 - 22:00	22:00 - 07:00	07:00 - 22:00	22:00 - 07:00
1.	Aisha Buhari Hospital	54	44	50	43	56	42	49	43	55	45
2.	Bayawa Town	55	42	51	42	57	42	49	43	52	44
3.	Birnin Madi/Gindi	55	40	52	42	54	44	55	43	51	44
4.	Balugu Town	56	44	55	44	57	44	54	44	50	43
5.	Dalijan	54	44	54	43	52	45	54	45	52	42
6.	Giro	52	45	50	43	47	43	51	45	52	44
7.	Gwamba Town	48	45	49	45	54	43	51	45	51	43
8.	Hore	49	45	50	42	55	43	52	43	50	49
9.	Kyarmi/Nassarawa	45	42	52	43	56	44	53	43	50	41
10.	Sabiyal Town	46	43	59	44	55	45	50	44	51	40
11.	Wali	49	44	55	42	58	41	56	42	51	42
12.	Zagga	51	41	54	43	51	42	56	43	52	45
13.	NL/KB/Control	52	46	49	45	53	45	55	42	55	44

DT = Day Time; NT = Night Time; NL = Noise Level

Source: TSL Fieldwork, 2024 & 2025

The summary range of noise data recorded on Day 1 to Day 5 is presented on Table 4.12. The overall LAeq levels are the logarithmic average of the LAeq, noise level for the daytime and night-time periods. For this ESIA, the LAeq is the metric that is used to assess project noise impacts since LAeq is referred to in the Nigerian noise regulations and IFC's Guidelines.

Table 4.12: Summary Range of Noise Data

Data	One-hour LAeq (dBA)									
	Day 1		Day 2		Day 3		Day 4		Day 5	
	DTR	NTR	DTR	NTR	DTR	NTR	DTR	NTR	DTR	NTR
MIN	45	40	47	42	47	40	48	40	49	40
MAX	56	51	59	46	59	45	58	46	57	51
AVG	51	44	51	44	54	43	52	44	52	44

MIN: Minimum, MAX: Maximum, AVG: Average, DTR: Day Time Range, NTR: Night Time Range

4.9.2.1 Key Observations from the Noise Monitoring Results:

- The monitored noise levels fluctuate between 40 dBA and 59 dBA during the daytime and night-time periods.
- The highest daytime levels range from 50 dBA to 59 dBA. These were recorded in Balugu, Sabiyal and Wali
- Night time levels show a slight reduction, with most stations recording values between 40 dBA and 50 dBA. Highest night time noise levels were recorded in Hore, Giro, Gwamba, Dalijan and Sabiyal towns.

4.9.2.2 Analysis of the Data and Comparison to IFC Guidelines:

- According to the IFC Noise Level Guidelines for off-site receptors, industrial and commercial zones can tolerate noise up to 70 dBA during the daytime, and residential, institutional, and educational zones should not exceed 55 dBA during the night time (see Table 4.11).
- The noise levels at all monitoring points mostly fall within these acceptable thresholds, indicating that daytime noise is generally within acceptable levels for both residential and industrial zones, while night time noise is largely within the limits for residential and educational institutions.

4.9.2.3 Implications for the ESIA of the Proposed Sokoto-Badagry Superhighway:

□ **Noise Impact Assessment:**

The noise levels recorded are important for evaluating the potential environmental impact of the proposed superhighway, particularly on communities, schools, and hospitals along the route.

- If these levels continue or worsen as construction progresses, there may be significant discomfort or adverse health effects in areas near the highway, especially at night time, where the general guideline for residential zones is 45 dBA.
- The monitored areas with noise levels consistently above 50 dBA during the day (such as Balugu, Sabiyal and Wali) could indicate that further mitigation measures will be required, such as sound barriers, strategic alignment of the road to avoid residential areas, or implementing noise-reducing technologies.

□ **Health and Safety Concerns:**

- Continuous exposure to noise levels above 55 dBA, especially during the night time, can lead to disturbances in sleep, contributing to stress and other health issues such as hypertension and cardiovascular problems. The findings from stations AQ/M/N16 and AQ/M/N12, which have values nearing 55 dBA during the night, suggest a need for noise abatement measures.
- High noise levels could also affect local wildlife in sensitive areas, requiring ecological impact assessments as part of the broader ESIA.

The ambient air quality data collected for the Proposed Sokoto-Badagry Superhighway, Section 2, shows that air quality is currently within acceptable levels, with certain localized pollution hotspots observed near urbanized or traffic-dense areas. Monitoring and mitigation measures will be essential during the construction phase to ensure that air quality remains within acceptable limits and that potential health risks to nearby communities are minimized. Effective traffic management, emission controls, and public awareness can significantly mitigate the impact of the project on local air quality.

4.10 Hydrology and Water Quality Assessment

4.10.1 Sample Collection

Sampling was conducted covering hand dug wells in selected settlements, surface water bodies while notable physical features serve as a guide and reference to the road alignment for the field exercise. Water samples were collected for both surface (where they occur) and groundwater for analysis in the laboratory. Altogether, 23 water samples were collected in the Kebbi section of the alignment (Plate 4.4 and Plate 4.5).



Plate 4.4: Water samples collection at Gindi and Gwamba



Plate 4.5: Water samples collection at Dudduke and Rafin Tofa

4.10.2 In situ Measurements

The In-situ measurement covered most of the physical parameters such as temperature, pH, DO, EC, TDS and Turbidity. The chemical and microbial parameters (Total Bacteriological Count and Total Coliform Count) including the major ions Calcium (Ca), Magnesium (Mg), Carbonates (HCO_3^-), Chlorine (Cl), Nitrates (NO_3^-), Sulphates (SO_4), Ammonia (NH_4) and the heavy metals (Fe, Zn, Cu) were taken to the laboratory for analysis (Plate 4.6 to Plate 4.8).



Plate 4.6: In situ water quality assessment at Giro and Bagudo

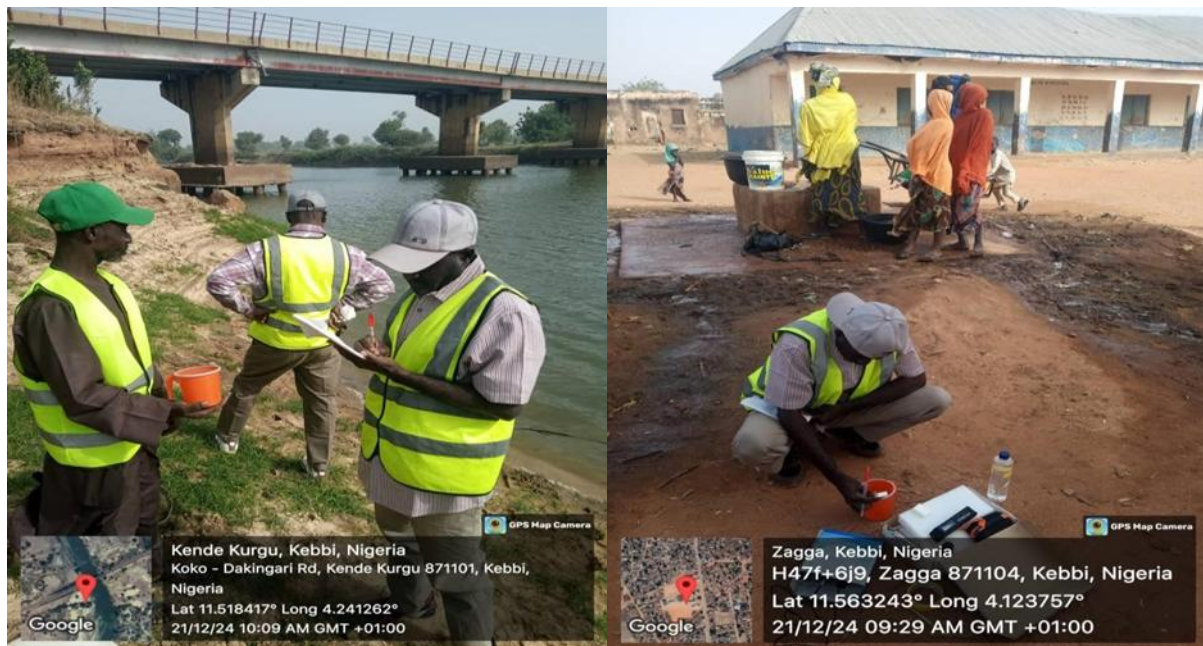


Plate 4.7: In situ water quality assessment at Kende and Zagga



Plate 4.8: In situ water quality assessment at Sabiyal

4.10.3 Results Discussion

4.10.3.1 Physico-chemical properties of water

The Physico-chemical characteristics of water from sampled areas are presented in Table 4.13. From the Table, the mean water temperature obtained was 27.86°C with a maximum value of 33.5°C obtained in a hand dug well at Gwamba town, while a minimum of 22.4°C was obtained in a river water at Kwasara. Generally, surface water samples exhibit lower temperature values (22-27°C) compared to groundwater samples (26-33°C). For pH values, a mean of 6.08 was obtained from the values in Table 4.2 with a maximum of 7.87 obtained in a hand dug well at Aisha Buhari Hospital, while a minimum of 4.4 obtained at Zagga and Balugu towns. The results shows that surface water tends to be more alkaline than groundwater which tends to be more acidic.

The Dissolved Oxygen (DO) is highest in well water sample at Giro with 5.2mg/L, and lowest in groundwater samples at Zagga with 4.1mg/L. The mean value for the study area was 4.71mg/L. The same sample point at Giro also has the highest value of Electrical Conductivity (EC) with 178µS/cm, while river Kwasara sample has the lowest with 46µS/cm. The mean EC values were generally around 108.2 µS/cm (Table 4.13).

The mean values of Total Dissolved Solids (TDS) were 73µS/cm, with highest in surface water sample at Balugu Earth Dam with 234µS/cm and lowest at river Kwasara 23µS/cm. For turbidity, the maximum value was also obtained from the same water sample at Balugu earth dam with 22.0NTU and lowest at Giro hand dug well water sample with 4.9NTU and a mean of 11.99NTU.

Table 4.13: Physico-chemical Properties of Water (in situ)

S/No	Location	Parameters					
		Temp (°C)	pH	DO	EC	TDS	Turbidity
1.	Aisha Buhari	26.7	7.87	4.9	76.7	114	36.1
2.	Bayawa (SW)	25.0	7.12	4.5	174	81.3	65.5
3.	Bayawa Town	26.7	4.76	4.2	136	123	12.8
4.	Birnin Madi / Gindi	25.3	5.4	4.7	75.3	54	36.2
5.	Borai	29.3	5.41	4.6	122	38	12.3
6.	Balugu Earth Dam (SW)	26.7	7.34	4.2	113	234	52
7.	Balugu Town	28.9	4.44	4.4	172	86	12.2
8.	Dalijan	32.7	4.97	5.1	109	29	13.0
9.	Dudduke	25.1	5.7	5.2	87	98	24.8
10.	Giro	33.1	6.06	5.2	178	97	4.9
11.	Gwamba (SW)	24.3	7.62	4.8	86.5	69	14.3
12.	Gwamba Town	33.5	5.91	5.1	166	33	5.3
13.	Hore	29.2	5.23	4.65	137.45	72.5	10.65
14.	Jega (R. Zamfara) SW	26.9	7.5	4.9	94	71	14.8
15.	Kaura Manu / Gidiga	26.4	6.26	5.1	112	46	14
16.	Kulun Koji	32.1	6.30	5.1	79	73	18.2
17.	Kwasara (SW)	22.4	7.10	4.7	046	23	11.4
18.	Kyarmi/Nassarawa	31.3	6.4	4.5	134	57	11.6
19.	Rafin Tofa	26.8	6.3	5.1	61.6	78	31.4
20.	Sabiyal (SW)	25.5	6.15	4.8	85.8	79	16.4
21.	Sabiyal Town	31.4	6.17	4.3	96	37	5.3
22.	Wali	26.1	5.34	4.2	50.4	38.2	14.2
23.	Zagga	25.3	4.40	4.1	96.9	48	16.4

4.10.3.2 Major Ions in Water

The highest values of Ca (Table 4.14) were obtained in a hand dug well at Hore 103.23mg/L, even though a sample in well from Giro also obtained values above 70mg/L. The minimum value of 3.23mg/L was obtained at Borai with an average value of 38.52mg/L. The maximum Mg concentration was also obtained from the same well sample at Hore with 70.46mg/L, while a minimum value of 4.56 was obtained in a well at Gwamba. It has an average concentration of 23.29mg/L. The maximum HCO₃ was however obtained at Kyarmi/Nassarawa with 164.2mg/L, while the lowest was 22.96mg/L obtained at Dalijan, with a mean of 25.86mg/L.

Similarly, the highest Cl concentration was obtained in the same well sample at Hore with 125.6mg/L, while the lowest values were obtained at Wali with 4.63mg/L. For NO₃, a maximum of 106.04mg/L was obtained at the same well point at Hore with a minimum of 19.43mg/L also at Kyarmi/Nassarawa, with an average of 50.64mg/L. The same well at Hore also has a maximum So₄ of 174.3mg/L and a minimum value of 11.49mg/L at Gwamba town, with an average of 27.01mg/L. Finally, the same water sample at Hore gave a maximum of 34.47mg/L NH₄ concentration and a minimum of 9.27mg/L obtained at Kulun Koji, with a mean of 21.18mg/L.

4.10.3.3 Microbial: Total Bacteriological Count (TBC) and Total Coliform Count (TCC)

The surface water at Sabiyal shows a higher concentration of bacterial (TBC) presence in the water sample with 5.10×10^2 Cfu/ml, while the minimal presence was in Bayawa town with 1.22×10^5 Cfu/100ml with. For Coliform count (TCC) however, only 12 out of 23 samples indicate no presence of coliform in the water samples, the remaining 11 samples indicated presence at varying levels of concentration. The highest concentrations obtained at Balugu earth dam (30 Cfu/100ml), Kaura Manu/Gidiga and Bayawa town, each with 20 Cfu/100ml or above as the case may be (Table 1) represents an alarming concern.

Table 4.14: Chemical and Microbial Parameters of Water

S/No	Location	Parameters								
		Ca ²⁺	Mg ²⁺	HCO ₃ ⁻	Cl ⁻	NO ₃ ⁻	SO ₄ ²⁻	NH ₄ ⁺	TBC	TCC
1.	Aisha Buhari	43.72	34.45	73.18	26.04	51.30	28.46	13.38	3.82 × 10 ⁵	0
2.	Bayawa (SW)	38.78	5.34	62.73	10.88	75.13	14.67	15.37	2.56 × 10 ²	0
3.	Bayawa Town	66.67	24.35	33.12	18.31	62.65	11.56	21.22	1.22 × 10 ⁵	20
4.	Birnin Madi / Gindi	6.36	24.28	95.17	28.21	42.65	11.66	14.38	3.04 × 10 ³	0
5.	Borai	3.23	22.43	93.15	23.33	63.95	51.45	12.27	2.82 × 10 ⁴	0
6.	Balugu Earth Dam (SW)	25.22	13.24	75.52	26.44	43.17	19.32	13.49	2.36 × 10 ³	30
7.	Balugu Town	42.13	24.27	102.38	39.55	82.04	34.44	30.26	3.42 × 10 ⁵	0
8.	Dalijan	43.33	12.45	22.96	14.47	54.69	16.33	12.38	2.42 × 10 ⁵	0
9.	Dudduke	15.22	10.37	102.94	18.29	36.78	25.92	29.28	2.34 × 10 ²	10
10.	Giro	74.45	23.23	85.78	15.62	42.43	37.77	21.27	3.63 × 10 ³	10
11.	Gwamba (SW)	39.29	34.23	97.93	11.78	28.73	16.28	16.28	4.00 × 10 ⁵	0
12.	Gwamba Town	26.46	4.56	32.16	18.31	53.65	11.49	24.28	4.10 × 10 ⁴	0
13.	Hore	103.23	70.46	104.32	125.63	106.04	174.34	34.47	3.82 × 10 ⁵	0
14.	Jega (R. Zamfara) SW	20.84	19.34	42.34	16.56	32.30	23.33	25.22	2.10 × 10 ⁴	0
15.	Kaura Manu / Gidiga	48.47	36.26	142.16	10.86	20.92	14.94	15.27	3.00 × 10 ³	20
16.	Kulun Koji	17.48	23.24	34.92	39.24	65.39	12.72	9.27	3.04 × 10 ⁵	0
17.	Kwasara (SW)	19.94	26.23	92.53	11.24	28.86	15.26	34.36	4.82 × 10 ²	10
18.	Kyarmi/Nassarawa	34.22	18.56	164.20	15.32	19.43	17.23	29.26	4.53 × 10 ³	10
19.	Rafin Tofa	11.38	17.23	153.95	14.23	24.08	19.42	27.35	2.82 × 10 ⁵	10
20.	Sabiyal (SW)	47.56	41.23	32.55	28.97	54.52	12.22	14.48	5.10 × 10 ²	10
21.	Sabiyal Town	66.67	14.23	56.17	18.44	67.65	11.68	24.77	3.04 × 10 ⁵	10
22.	Wali	33.84	22.45	78.96	4.63	82.69	26.36	21.36	2.53 × 10 ²	10
23.	Zagga	57.56	13.35	34.62	58.33	25.57	14.47	27.56	3.36 × 10 ³	0

4.10.3.4 Heavy Metals

The maximum values of Fe were obtained at Dalijan with 3.63ppm, while the lowest was 0.05ppm at Kaura Manu/Gidiga with an average of 1.46ppm. For Zn, the maximum was obtained at river Kwasara with 1.61ppm and the minimum was 0.02ppm also at the same water sample at Kaura Manu/Gidiga (Kebbi state). It has an average of 0.70ppm. However, the maximum Cu values were obtained at Wali hand dug well with 2.88ppm, while the minimum was 0.10ppm obtained in a well at Giro with an average of 0.71ppm (Table 4.15).

Table 4.15: Heavy Metal Content

S/No	Location	Fe	Zn	Cu
1.	Aisha Buhari	0.10	0.06	0.16
2.	Bayawa (SW)	0.08	0.30	1.41
3.	Bayawa Town	3.48	1.46	1.24
4.	Birnin Madi / Gindi	2.41	0.32	1.51
5.	Borai	2.67	1.41	0.43
6.	Balugu Earth Dam (SW)	2.18	1.35	1.24
7.	Balugu Town	2.44	0.29	1.20
8.	Dalijan	3.63	1.46	0.43
9.	Dudduke	0.17	0.09	0.16
10.	Giro	0.25	0.05	0.10
11.	Gwamba (SW)	2.23	1.29	0.27
12.	Gwamba Town	2.36	0.17	0.16
13.	Hore	0.18	0.09	0.16
14.	Jega (R. Zamfara) SW	0.33	0.46	0.16
15.	Kaura Manu / Gidiga	0.05	0.02	0.12
16.	Kulun Koji	0.33	0.09	0.16
17.	Kwasara (SW)	2.87	1.61	1.24
18.	Kyarmi/Nassarawa	0.18	0.08	0.16
19.	Rafin Tofa	0.178	0.95	0.42
20.	Sabiyal (SW)	2.36	1.34	1.24
21.	Sabiyal Town	0.08	0.08	0.14
22.	Wali	2.87	1.23	2.88
23.	Zagga	2.18	1.31	1.24

4.10.3.5 Conclusion

The water quality assessment was carried out along the proposed SBS-2. The values obtained shows various levels of concentration of parameters measured. Even though no comparison

were made with any world standards, the results provide an insight into the existing baseline water quality status for any need or purpose that may arise.

4.11 Soils

4.11.1 Soil Sampling and Analysis

The soil characteristics along the proposed SBS-2, are crucial to the engineering and environmental planning of the project. A comprehensive understanding of these soil properties is essential for ensuring the highway's stability, durability, and sustainability, while also considering the potential impacts on surrounding lands and communities.

Soil samples were collected from a total of 26 points across the various communities along the alignment as well as intercepts of the existing road, using soil auger, trowel and polythene bags. At each point, soil samples were collected at 0 – 15cm (top soil) and 15 – 30cm (subsoil/bottom) depth (Plate 4.9 to Plate 4.11).



Plate 4.9: Soil sampling at Bayawa and Basaura, Kebbi State

Soil quality parameters analyzed include physical parameters such as temperature, pH, Electrical Conductivity (EC), bulk density, particle density, texture and porosity. The chemical parameters include Calcium (Ca), Magnesium (Mg), Nitrate (NO₃), Sulfate (SO₄²⁻), Bicarbonate (HCO₃⁻), Chlorine (CL⁻) and Ammonium (NH₄⁺). Others are heavy metals including Iron (Fe), Zinc (Zn) and Copper (Cu).



Plate 4.10: Soil sampling at Dakala and Sabiyal, Kebbi State



Plate 4.11: Soil sampling at Dakin Gari and Jega, Kebbi State

4.11.2 Results

4.11.2.1 Soil Physico-chemical parameters

The physico-chemical parameters of top/surface and bottom/sub-surface soils sampled along the alignment are shown in Table 4.16 and Table 4.17 respectively. The values recorded for all the parameters varied across the state and along the alignment.

Table 4.16: Physical Properties of Top Soil (0 – 15cm) in Kebbi State

S/N	Sampling Location	Texture	Temp. (°C)	pH	EC (μS/cm)	Bulk Density (g/cm ³)	Particle Density (g/cm ³)	Porosity (%)
1	Aisha Buhari Hospital	Fine Sand	26.4	5.5	36.8	1.5	2.63	42.96
2	Birnin Madi	Fine Sand	26	6.8	26.6	1.2	2.8	57.14
3	Bayawa Community	Sandy clay	26.4	5.3	22.3	1.5	2.79	53.41
4	Bayawa Intercept	Fine Sand	25.1	5.5	36	1.6	2.66	39.85
5	Bore	Sandy clay	25.1	5.4	48.9	1.31	2.66	50.75
6	Buya Dam	Coarse sand	26	5.4	26.6	1.6	2.66	39.85
7	Buya Intercept	Coarse Sand	26.4	6.1	10	1.6	2.66	39.85
8	Dalijan	Clayey sand	26.4	5.3	24.5	1.6	2.6	38.46
9	Dudduke Intercept	Fine Sand	24	7.5	26.5	1.42	2.7	47.41
10	Gidiga	Clayey Sand	24	7.5	45.8	1.6	2.68	40.3
11	Giro Community	Coarse sand	25.1	5.5	18	1.45	2.74	47.27
12	Giro Intercept	Clayey Sand	26.3	5.8	34.4	1.3	2.62	38.93
13	Gungu	Sandy Loam	27	5.7	18	1.1	2.83	61.13
14	Gwamba	Coarse Sand	26.4	6.3	38	1.6	2.65	39.62
15	Hore Intercept	Fine Sand	26.4	5.8	30.5	1.3	2.66	51.13
16	Hore	Loamy sand	25.4	5.1	144	1.6	2.65	39.82
17	Kulun Koji Intercept	Clayey sand	26.4	5.2	28	1.6	2.6	38.46
18	Kyarmi	Sand	21	7.5	36.7	1.4	2.8	50
19	Kyarimi/Nassarawa Intercept	Sandy Loam	24	7.5	35.7	1.5	2.62	42.75
20	Nassarawa (Jega)	Sand	24	7.5	26	1.4	2.83	50.53
21	Rafin Tofa	Clayey Sand	24	7.5	37.3	1.5	2.6	42.31
22	Sabiyal Community	Clayey Sand	25.1	5.3	28.5	1.6	2.66	39.85
23	Sabiyal	Clayey Sand	26.4	5.3	28	1.4	2.79	49.82
24	Wali Intercept	Fine Sand	27.1	6.7	14	1.6	2.66	39.85
25	Zagga Kwasara	Fine Sand	25.8	5.7	34.2	1.58	2.6	39.23
26	Zagga	Fine Sand	26.4	5.6	35.9	1.5	2.62	39.69

Table 4.17: Physical Properties of Bottom Soil (15 – 30cm) in Kebbi State

S/N	Sampling Location	Texture	Temp. (°C)	pH	EC (µS/cm)	Bulk Density (g/cm ³)	Particle Density (g/cm ³)	Porosity (%)
1	Aisha Buhari Hospital	Coarse sand	25.4	5.4	44.6	1.6	2.65	39.62
2	Birnin Madi	Fine Sand	28.0	7.5	36.1	1.5	2.65	43.4
3	Bayawa Community	Clayey sand	27.0	6.7	26.5	1.6	2.6	38.46
4	Bayawa Intercept	Fine Sand	27.0	7.4	44.0	1.6	2.65	39.62
5	Bore	Fine Sand	25.6	5.4	28.3	1.29	2.65	51.32
6	Buya Dam	Fine Sand	26.5	6.1	32.3	1.61	2.66	39.85
7	Buya Intercept	Clayey sand	26.4	5.6	19.7	1.33	2.7	50.74
8	Dalijan	Sandy clay	26.4	6.0	48.8	1.62	2.65	38.87
9	Dudduke Intercept	Fine Sand	24.0	6.5	56.0	1.6	2.6	38.46
10	Gidiga	Clay	29.0	6.4	62.5	1.3	2.66	51.13
11	Giro Community	Fine Sand	26.4	6.6	56.5	1.26	2.78	54.68
12	Giro Intercept	Clayey sand	26.4	5.2	16.9	1.61	2.6	38.08
13	Gungu	Loam	27.5	5.5	18.5	1.6	2.62	38.93
14	Gwamba	Sand	26.1	5.4	33.0	1.6	2.6	38.46
15	Hore Intercept	Clayey Sand	26.4	5.8	93.9	1.6	2.66	39.85
16	Hore	Sandy clay	26.3	5.6	30.2	1.28	2.79	54.12
17	Kulun Koji Intercept	Clayey Sand	26.4	4.8	24.5	1.4	2.8	50
18	Kyarmi	Clayey sand	24.0	7.5	26.2	1.6	2.66	39.85
19	Kyarimi/Nassarawa Intercept	Sand	26.0	7.5	45.7	1.58	2.65	40.38
20	Nassarawa (Jega)	Sandy Clay	24.0	7.5	26.0	1.6	2.65	39.62
21	Rafin Tofa	Fine Sand	24.0	6.6	46.5	1.45	2.75	47.27
22	Sabiyal Community	Clayey sand	25.8	5.4	68	1.2	2.83	57.6
23	Sabiyal	Clayey sand	25.8	5.4	24.7	1.6	2.62	38.93
24	Wali Intercept	Fine Sand	26.4	5.9	52.6	1.6	2.64	39.39
25	Zagga Kwasara	Coarse sand	26.4	5.7	25.7	1.6	2.8	46.43
26	Zagga	Fine Sand	25.0	7.4	29.0	1.6	2.6	38.46

▪ **Electrical Conductivity (EC)**

The electrical conductivity values for both topsoil and bottom soil range between 29.293 $\mu\text{S}/\text{cm}$ and 30.420 $\mu\text{S}/\text{cm}$. These values suggest that the soils have low salinity, which is generally favorable for construction, as high salinity can lead to soil instability or corrosion of infrastructure. The consistency in EC across samples indicates that the soil does not exhibit significant variability in salinity, making it more predictable for construction activities.

▪ **pH**

The pH of the topsoil samples ranges from 5.610 to 7.030, while the bottom soil samples range from 5.470 to 7.500. Both topsoil and bottom soil fall within a neutral to slightly acidic range, which is conducive for most types of construction activities. The slightly acidic nature of some of the soils, particularly in areas like TS3, may require some adjustments in soil treatment, but it generally won't pose significant challenges for highway construction.

▪ **Moisture Content**

Moisture content values for the soils vary between 4.442% and 7.493%. These figures indicate moderate moisture content in both the topsoil and bottom soil, suggesting that the soils are not excessively dry nor saturated. This is beneficial for construction, as overly dry soils can be challenging to compact, while high moisture content can lead to waterlogging or erosion. Proper management of moisture during construction will be essential to avoid issues such as instability or shifting during the compaction process.

▪ **Ammonium Levels**

The ammonium concentrations in both topsoil and bottom soil range between 0.312 mg/Kg and 0.485 mg/Kg. These low levels suggest minimal contamination from organic matter breakdown or fertilizers, which is generally positive from an environmental standpoint. The levels are unlikely to cause significant environmental or engineering concerns unless there is a substantial increase due to future activities in the area.

4.11.2.2 Anion Concentrations

- **Cyanide**

Cyanide levels across the soil samples range from 0.011 mg/Kg to 0.035 mg/Kg. These values are relatively low and within acceptable limits, indicating that the soils are not contaminated by industrial pollutants that could be detrimental to the highway's construction or the surrounding environment.

- **Nitrite and Nitrate**

Nitrite concentrations are generally low, ranging from 0.001 mg/Kg to 0.029 mg/Kg, suggesting that there are no significant sources of nitrate pollution in the soils. Nitrate levels, however, show higher variability, with the highest concentration observed in TS6 (4.000 mg/Kg). Elevated nitrate concentrations, especially in agricultural areas, can indicate fertilizer use or contamination from nearby farming practices. In areas with high nitrate levels, proper drainage and soil management will be necessary to prevent leaching into groundwater or further environmental contamination.

- **Phosphate**

Phosphate levels range from 0.801 mg/Kg to 0.965 mg/Kg in the topsoil and from 0.835 mg/Kg to 0.932 mg/Kg in the bottom soil. These are moderate levels that suggest that the soils are not overly enriched with phosphates, which can promote algae growth in nearby water bodies if excessive. However, they are sufficient for supporting plant growth in surrounding agricultural areas, if necessary.

4.11.2.3 Major Ions in Soils

The concentration of major ions in top and bottom soils along the alignment are shown in Table 4.18 and Table 4.19.

Table 4.18: Major Ions of Top Soil (0 – 15cm) in Kebbi State

S/N	Sampling Location	Ca (mg/kg)	Mg (mg/kg)	NO ₃ ⁻ (mg/kg)	SO ₄ ²⁻ (mg/kg)	HCO ₃ ⁻ (mg/kg)	CO ₃ ²⁻ (mg/kg)	Cl ⁻ (mg/kg)	NH ₄ ⁺ (mg/kg)
1	Aisha Buhari Hospital	53.46	90.81	14.39	11.32	123.72	26.05	47.93	14.15
2	Birnin Madi	70.76	40.45	61.32	33.27	74.86	29.75	28.33	69.93
3	Bayawa Community	28.84	61.91	83.0	59.48	128.72	42.67	42.97	22.27
4	Bayawa Intercept	30.76	89.0	26.45	19.44	141.96	10.64	14.63	17.82
5	Bore	64.61	64.81	56.5	42.29	90.95	23.15	30.41	15.71
6	Buya Dam	33.46	70.83	105.07	74.73	160.83	40.82	53.72	27.4
7	Buya Intercept	63.38	58.74	17.3	12.99	107.93	17.02	59.32	44.86
8	Dalijan	23.84	74.1	64.56	77.23	167.88	42.57	56.77	29.68
9	Dudduke Intercept	44.61	64.24	67.83	53.55	109.13	27.77	46.53	69.82
10	Gidiga	63.84	54.29	55.26	42.29	90.91	23.22	40.44	65.69
11	Giro Community	27.69	46.29	22.36	16.82	36.67	29.17	12.4	26.2
12	Giro Intercept	40.76	89.0	18.95	12.95	127.97	37.09	19.58	15.86
13	Gungu	60.76	89.0	81.79	75.71	153.64	41.42	54.69	28.23
14	Gwamba	60.76	40.5	15.6	11.65	125.78	26.33	28.44	48.14
15	Hore Intercept	28.84	87.69	31.33	23.49	150.43	12.81	16.83	18.73
16	Hore	1633.07	90.0	17.33	12.93	27.94	27.05	19.5	24.8
17	Kulun Koji Intercept	65.38	78.53	15.72	11.68	25.79	26.85	18.48	24.2
18	Kyarmi	63.07	70.43	66.37	43.5	103.51	26.49	54.62	87.31
19	Kyarimi/Nassarawa Intercept	54.23	41.36	66.24	50.0	137.94	27.37	65.95	89.62
20	Nassarawa (Jega)	58.84	57.27	60.93	41.5	98.96	24.84	63.79	47.04
21	Rafin Tofa	23.84	64.29	56.52	42.2	170.97	23.17	50.23	75.28
22	Sabiyal Community	63.07	60.39	92.6	76.27	165.32	41.89	55.19	28.53
23	Sabiyal	83.84	84.29	12.42	7.09	109.54	16.92	16.5	9.3
24	Wali Intercept	23.84	64.29	20.48	15.5	123.56	18.54	11.29	5.8
25	Zagga Kwasara	30.76	79.0	57.36	42.99	152.38	23.49	30.9	16.2
26	Zagga	34.23	51.36	47.9	35.82	76.92	19.55	25.85	13.3

Table 4.19: Major Ions of Bottom Soil (15 – 30cm) in Kebbi State

S/N	Sampling Location	Ca (mg/kg)	Mg (mg/kg)	NO ₃ ⁻ (mg/kg)	SO ₄ ²⁻ (mg/kg)	HCO ₃ ⁻ (mg/kg)	CO ₃ ²⁻ (mg/kg)	Cl ⁻ (mg/kg)	NH ₄ ⁺ (mg/kg)
1	Aisha Buhari Hospital	83.84	84.29	45.2	33.89	72.7	18.44	24.35	12.63
2	Birnin Madi	70.76	60.38	50.2	54.86	96.52	24.54	62.48	16.89
3	Bayawa Community	28.84	51.92	46.13	34.47	174.15	18.82	24.84	62.78
4	Bayawa Intercept	13.46	90.83	36.65	27.3	148.7	14.97	19.68	30.2
5	Bore	68.84	77.69	41.74	31.77	127.3	17.23	22.38	11.25
6	Buya Dam	29.61	78.21	42.97	35.87	76.93	19.51	25.84	13.32
7	Buya Intercept	114.61	78.01	60.34	67.88	145.49	36.85	48.5	25.18
8	Dalijan	23.32	80.22	65.29	48.7	104.92	26.62	35.1	18.24
9	Dudduke Intercept	53.46	80.81	61.92	45.56	164.95	25.82	42.56	17.14
10	Gidiga	68.84	37.46	63.57	47.48	102.27	25.66	74.25	78.63
11	Giro Community	33.07	80.57	33.94	25.32	94.53	13.88	18.24	29.33
12	Giro Intercept	23.84	84.29	13.02	9.74	20.972	35.31	37.0	3.63
13	Gungu	68.84	87.69	53.46	24.61	152.14	13.44	17.72	19.21
14	Gwamba	29.61	48.21	16.75	31.3	166.77	18.25	9.97	76.15
15	Hore Intercept	58.84	87.29	73.07	54.53	117.4	29.95	39.2	20.47
16	Hore	15.38	58.53	84.7	70.73	152.44	38.66	50.94	26.39
17	Kulun Koji Intercept	27.69	66.91	32.15	100.0	115.37	54.63	70.94	37.28
18	Kyarmi	53.07	60.22	63.67	46.77	86.77	25.5	63.61	57.67
19	Kyarimi/Nassarawa Intercept	33.21	80.57	41.69	30.2	108.39	17.41	32.02	61.22
20	Nassarawa (Jega)	18.84	67.29	26.23	19.8	140.62	10.34	53.65	26.2
21	Rafin Tofa	68.84	38.2	42.69	26.8	169.74	25.52	63.65	57.36
22	Sabiyal Community	114.61	48.01	15.37	11.03	123.75	16.01	29.47	27.1
23	Sabiyal	18.84	67.69	11.39	18.47	142.94	16.57	18.76	65.4
24	Wali Intercept	23.84	74.29	52.7	38.63	83.95	21.21	28.39	14.52
25	Zagga Kwasara	18.84	67.69	56.8	40.9	88.19	22.38	29.46	15.24
26	Zagga	72.69	36.91	23.92	10.35	62.38	5.67	27.47	23.83

4.11.2.4 Heavy Metals in Soils

The concentrations of heavy metals (iron, Zinc and Cupper) in the top and bottom soils along the alignment are presented in Table 4.20 and Table 4.21 respectively.

- **Iron**

Iron (Fe) content in soils along the alignment range from 10.34 ppm to 42.73 ppm for top soils and from 10.27 ppm to 33.85 ppm for bottom soils. From Table 4.20 (Top Soils), highest concentrations of Fe (42.73 ppm) were recorded in Dalijan while the lowest (10.34 ppm) were recorded in Gwamba. In the same vein, the highest concentration of Fe in bottom soils was recorded in Zagga/Kwasara intercept of the alignment while the lowest concentration was recorded at an intercept at Balugu.

While iron is not likely to pose any major issues in construction, its presence in higher concentrations could cause staining of the road surface, which may be an aesthetic concern. Its low concentration suggests that this is unlikely to be a problem along the route.

- **Zinc**

Except for Hore (6.27 ppm), Balugu (3.98 ppm) and Kulun-Koji (3.24 ppm), concentrations of Zinc in the top soils were very low in all the other areas. However, all samples of the bottom soils exhibited very negligible levels of zinc.

- **Cupper**

Cupper levels in the top soils range from 0.02 ppm to 0.36 ppm. In the bottom soils, the detected concentrations range from 0.02 ppm to 0.87 ppm which is slightly higher than what was obtained in the top soils. This also implies that shallow wells may be contaminated by this metal in especially in Giro town where the highest concentration was recorded.

Table 4.20: Heavy Metals in Top Soil (0 – 15cm) in Kebbi State

S/N	Sampling Location	Fe (ppm)	Zn (ppm)	Cu (ppm)
1	Aisha Buhari Hosp.	17.23	0.23	0.09
2	Bayawa Comm.	11.64	0.87	0.36
3	Bayawa Intercept	20.25	0.54	0.03
4	Bore	21.46	0.35	0.09
5	Buya Dam	15.22	1.21	0.05
6	Buya Intercept	14.54	3.98	0.09
7	Dalijan	42.73	0.28	0.09
8	Duddke Intercept	16.6	0.72	0.06
9	Gidiga	14.62	0.38	0.04
10	Giro Comm.	24.22	0.29	0.05
11	Giro Intercept	18.28	0.22	0.03
12	Gungu	21.12	0.21	0.08
13	Gwamba	10.34	0.89	0.07
14	Hore	32.64	0.23	0.04
15	Hore Intercept	19.22	6.27	0.02
16	Kulun Koji Intercept	16.27	3.24	0.06
17	Kyarimi/Nassarawa Intercept	18.61	0.24	0.32
18	Kyarimo	29.43	1.65	0.07
19	Nassarawa (Jega)	15.34	0.34	0.23
20	Rafin Tofa	20.42	0.26	0.09
21	Sabiyal	24.75	0.38	0.05
22	Sabiyal Comm.	18.53	0.46	0.23
23	B/Madi	20.55	0.64	0.08
24	Wali Intercept	14.38	0.27	0.03
25	Zagga	16.75	0.26	0.03
26	Zagga Kwasara Intercept	18.36	0.98	0.05

Table 4.21: Heavy Metals in Bottom Soil (15 – 30cm) in Kebbi State

S/N	Sampling Location	Fe (ppm)	Zn (ppm)	Cu (ppm)
1	Aisha Buhari Hosp.	22.67	0.34	0.37
2	Bayawa Comm.	19.37	0.29	0.09
3	Bayawa Intercept	23.38	0.57	0.04
4	Bore	22.37	0.68	0.47
5	Buya Dam	16.27	0.23	0.03
6	Buya Intercept	10.27	0.38	0.09
7	Dalijan	12.38	0.14	0.28
8	Duddke Intercept	22.7	0.42	0.21
9	Gidiga	23.41	0.46	0.25
10	Giro Comm.	21.35	0.87	0.87
11	Giro Intercept	15.45	0.62	0.03
12	Gungu	30.55	0.92	0.03
13	Gwaba	24.35	0.28	0.06
14	Hore	25.98	0.59	0.06
15	Hore Intercept	16.27	0.67	0.04
16	Kulun Koji Intercept	17.35	0.34	0.05
17	Kyarimi/Nassarawa Intercept	13.41	0.28	0.08
18	Kyarimo	14.59	0.23	0.67
19	Nassarawa (Jega)	11.32	0.36	0.07
20	Rafin Tofa	17.58	0.24	0.48
21	Sabiyal	32.74	0.27	0.12
22	Sabiyal Comm.	21.62	0.45	0.02
23	B/Madi	15.22	1.13	0.08
24	Wali Intercept	27.53	0.86	0.02
25	Zagga	20.31	0.98	0.04
26	Zagga Kwasara Intercept	33.85	0.22	0.23

4.11.2.5 Microbial Parameters

The total heterotrophic bacteria (THB) concentrations range from 3.04×10^5 cfu/g to 3.74×10^5 cfu/g, and the total heterotrophic fungi (THF) concentrations range from 1.3×10^4 cfu/g to 3.7×10^4 cfu/g. These microbial populations are relatively high, indicating a moderate level of biological activity in the soils. While this is generally positive for soil health, high microbial activity may indicate the presence of organic material that could affect soil stability or fertility in agricultural contexts. *E. coli*, *Salmonella* spp., and *Enterococci* spp. All these pathogenic microorganisms were not detected (NG), which is a positive sign, indicating that the soils are not contaminated by harmful pathogens. This makes the soils more suitable for both construction and agriculture, as the risk of disease transmission from the soil is minimal.

4.11.2.6 Inferences and Implications

- **Soil Composition and Stability**

Inference: The soil along the proposed Sokoto-Badagry Superhighway consists primarily of sandy soils with clay-rich sections. Sandy soils have good drainage but are prone to erosion, while clayey soils retain moisture and are prone to compaction.

Implications: The sandy soils may cause erosion, especially during heavy rainfall or strong winds, requiring the implementation of soil stabilization and erosion control measures. In contrast, the clay soils need to be managed carefully to prevent waterlogging and reduced permeability, which could destabilize the highway if not addressed through proper drainage systems.

- **Fertility and Agricultural Impact**

Inference: The soils along the highway route have low fertility, especially in sandy areas where organic matter is minimal. The fertility levels are consistent across both topsoil and bottom soil, indicating uniform soil quality.

Implications: While the low fertility does not pose immediate challenges to road construction, it may impact local agricultural activities. Farmers may need to use fertilizers and irrigation to maintain crop productivity. Efforts to minimize soil degradation during construction should be implemented to avoid long-term negative impacts on surrounding agricultural land.

▪ **Metal Contamination and Environmental Risks**

Inference: The soil contains trace amounts of metals such as lead, chromium, and cadmium, but these levels are within acceptable limits and do not pose immediate risks for construction.

Implications: Despite being within safe limits for construction, the presence of metals could potentially leach into nearby water sources over time, affecting water quality. Ongoing environmental monitoring is necessary to ensure that metal concentrations remain within safe levels and that any potential contamination is mitigated.

▪ **Microbial Activity and Soil Health**

Inference: The soils show moderate levels of microbial activity, with total heterotrophic bacteria and fungi present. No pathogenic bacteria, such as *E. coli*, *Salmonella* spp., or *Enterococci* spp., were detected in any of the samples.

Implications: The presence of beneficial microbes suggests that the soil is healthy and can support vegetation and organic matter decomposition, which benefits both the ecosystem and agriculture. The absence of pathogens also reduces the risk of disease transmission, making the area safer for both construction and local communities.

▪ **Drainage and Moisture Management**

Inference: The moisture content in the soil ranges from 4.44% to 7.49%, with sandy soils having low water retention and clayey soils retaining more moisture.

Implications: Effective drainage systems, such as culverts and proper grading, will be essential in areas with clayey soils to avoid waterlogging. The moderate moisture content also supports soil compaction during construction, but careful management of moisture levels will be required to prevent issues related to uneven settling or instability.

▪ **Soil pH and Construction Compatibility**

Inference: The soil pH ranges from slightly acidic to neutral, with values between 5.47 and 7.50. This is suitable for most construction activities, though some areas may require pH modification.

Implications: The soils' pH levels are generally conducive to construction processes like compaction and cement stabilization. However, areas with slightly acidic pH may need adjustments to optimize the performance of construction materials and ensure long-term stability of the highway.

4.11.2.7 Conclusion

The soil analysis for the proposed Sokoto-Badagry Superhighway project reveals a relatively stable and suitable soil profile for construction. The low levels of contaminants, such as heavy metals and pathogens, suggest that the soils are not significantly polluted, although localized monitoring of metal concentrations (particularly lead and chromium) will be necessary. The moderately fertile soils may require management to prevent soil degradation, especially in the more fertile topsoil areas. Ensuring proper compaction, moisture management, and drainage during construction will help mitigate any potential challenges posed by soil type variability. Furthermore, the microbial population in the soils indicates healthy biological activity, which is beneficial for long-term environmental sustainability, though it should be considered in relation to the highway's impacts on surrounding ecosystems.

4.12 Biodiversity Assessment

4.12.1 Introduction

Ecological survey of biodiversity (fauna and flora) of both terrestrial and aquatic biota along the proposed SBS-2 project was carried out. The main aim of the survey was to establish the existing biological condition of the area before the actual commencement of the project.

This report therefore represents a detailed survey of biotic components within the ecological zones that define the region. The survey was based on ground survey and rural appraisal interviews. It emphasizes the interplay of natural factors and human activities in shaping the biodiversity and ecological characteristics of these areas.

4.12.2 Sampling

The survey covered nine (9) Local Government Areas in Kebbi State which are Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri. Eleven (11) sampling sites were selected based on vegetation change, presence of a water body, accessibility and security of the area (Table 4.22).

Table 4.22: Biodiversity Sampling Locations and their Coordinates

S/N	Sampling Location	Latitude	Longitude
1.	Bayawa	12.8392°N	4.6989°E
2.	Balugu	11.0776°N	4.0590°E
3.	Dalijan	12.5675°N	4.5049°E
4.	Gwamba	11.4097°N	4.1036°E
5.	Hore	11.9579°N	4.2256°E
6.	Jega	12.2511°N	4.3499°E
7.	Kaoje	11.1709°N	4.0988°E
8.	Rafin Tofa	12.6224°N	4.1622°E
9.	Sabiyal	12.4050°N	4.4402°E
10.	Wali	12.7157°N	4.6317°E
11.	Zagga	11.5129°N	4.1391°E

Plant specimens were randomly collected along the road project corridor within each of the sample quadrats. The plants were tagged, pressed, and labelled. Initial identification of the plant species was done using standard references, such as Flora of West Tropical Africa (Hutchinson and Dalziel, 1954; 1958) and Nigerian Trees (Keay et al., 1960; 1964). The scientific names of the identified plants were recorded, and the specimens were preserved for further study.

During the sampling area selection, emphasis was given to vegetation change and presence of water bodies along the road's alignments. However, some remote areas within the alignment are inaccessible due to security challenges. (Plate 4.12 to Plate 4.16).



Plate 4.12: Aquatic Sampling at Sabiyal



Plate 4.13: Aquatic Sampling at Gwamba

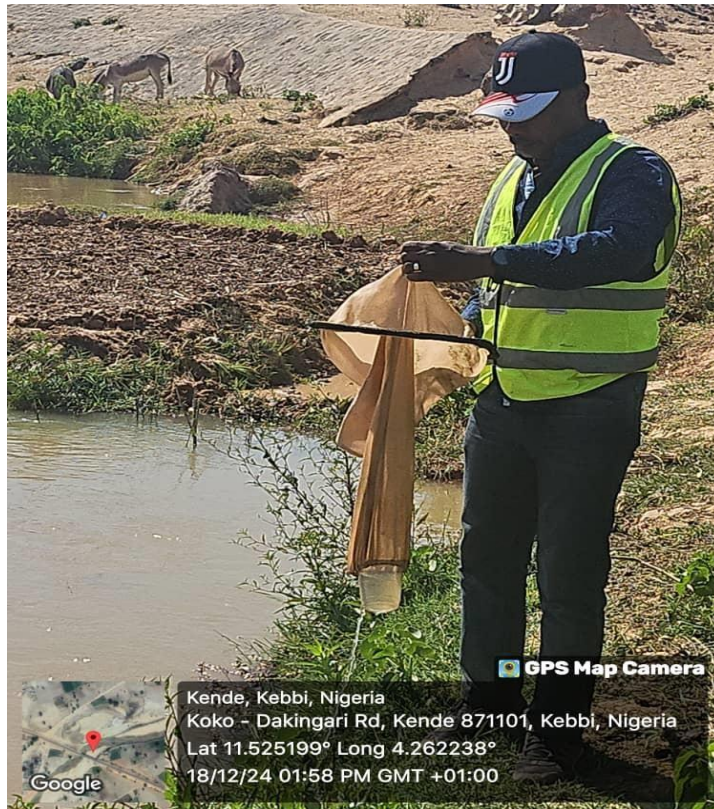


Plate 4.14: Aquatic Sampling at Kende

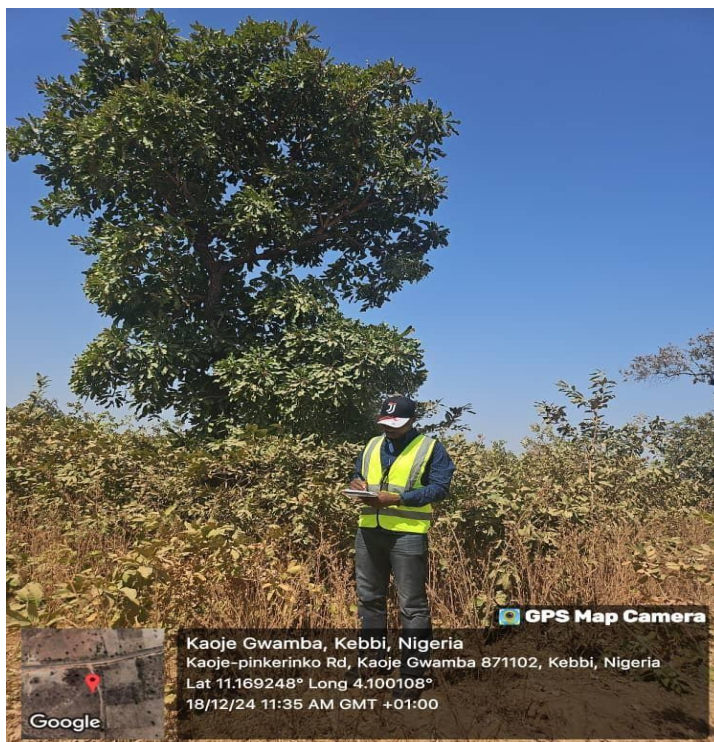


Plate 4.15: Vegetation sampling at Gwamba



Plate 4.16: Vegetation sampling at Dalijan

4.12.3 Field Data Collection

i. Vegetation

Plots were established within the sampling sites, followed by inventory of vegetation within the sites. Diversity indices and enumeration of woody plants were conducted. Samples were collected for identification.

ii. Wildlife

Insects and other macro- invertebrates were collected using nets and aspirators. Reptiles and birds were handpicked and/or observed using binoculars. Additional information was generated through interactions with local people. Samples were collected in sampling bottles containing formaldehyde and taken to the Laboratory for identification.

iii. Aquatic biota

Phyto-plankton and Zoo- plankton were collected by towing plankton net over the surface of the water and transferring the content into sampling bottles containing formaldehyde. Available

fishes were seen with the fishermen while additional information was obtained by interacting with them. Plankton samples were brought to the laboratory for identification.

4.12.4 Results

4.12.4.1 Vegetation Characteristics

In Kebbi State, the vegetation changes slightly from the Sudan Savannah type to the Northern Guinea Savannah type, particularly in Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri LGAs. This zone is characterized by a denser vegetation cover with more woodlands, shrubs, and grasslands than the Sudan Savannah. It is an area where both tree density and species variety increase, creating more complex plant communities.

4.12.4.2 Floristic Composition

The floral diversity of the Kebbi axis of the proposed SBS-2 alignment is presented in Table 4.23 and Table 4.24. A total of 7,458 individual plants, belonging to 26 woody and 18 herbaceous prominent plant species. This suggests that the plant community is diverse with the potential for ongoing regeneration. In Kebbi State therefore, vegetation is varied, with rich biodiversity supporting both wildlife and agricultural activities. Rice cultivation thrives in the riparian zones, especially around the Bagudo LGA, where riverine vegetation and water sources are abundant.

Table 4.23: Woody species encountered in the project area

SN	Species Name	Plants	Frequency	Percentage (%)
1	<i>Adansonia digitata</i>	Kuka (Baobab tree)	18	1.0
2	<i>Azadirachta indica</i>	Neem tree	402	22.0
3	<i>Balanites aegyptiaca</i>	Aduwa (Desert dates)	51	2.8
4	<i>Calotropis procera</i>	Tunfafiya	13	0.7
5	<i>Ceiba pentandra</i>	Kapok Tree	23	1.3
6	<i>Eucalyptus camaldulensis</i>	River Red-gum	13	0.7
7	<i>Euphorbia candelabrum</i>	Candelabra Tree	23	1.3
8	<i>Faidherbia albida</i>	Apple-ring	27	1.5
9	<i>Grewia carpinifolia</i>	African Raisin	36	2.0
10	<i>Guiera senegalensis</i>	Sabara (Bee Sting Bush)	86	4.7
11	<i>Hyphaene thebaica</i>	Kaba (Doum palm)	103	5.6
12	<i>Khaya senegalensis</i>	African Mahogany	22	1.2
13	<i>Mangifera indica</i>	Mango tree	331	18.1
14	<i>Megathyrsus maximus</i>	Guinea grass	42	2.3
15	<i>Moringa oleifera</i>	Zogale Plantation	218	11.9
16	<i>Musa acuminata</i>	Banana	12	0.7
17	<i>Parkia biglobosa</i>	African locust bean	23	1.3
18	<i>Piliostigma thonningii</i>	Kalgo (Camel's foot)	137	7.5
19	<i>Tamarindus indica</i>	Tamarind	32	1.7
20	<i>Terminalia avicennioides</i>	Tamarind Wood	19	1.0
21	<i>Terminalia glaucescens</i>	Grey Terminalia	12	0.7
22	<i>Terminalia macroptera</i>	Umbrella Tree	26	1.4
23	<i>Terminalia sericea</i>	Silver Terminalia	10	0.5
24	<i>Vitellaria paradoxa</i>	Shea nut tree	34	1.9
25	<i>Ziziphus jujuba</i>	Junjube	23	1.3
26	<i>Ziziphus mauritiana</i>	Magarya (Indian jujube)	93	5.1
			1829	100.0

Source: TSL Fieldwork, 2024 & 2025

Table 4.24: Herbaceous species encountered in the project area

SN	Species Name	Plants	Frequency	Percentage (%)
1	<i>Allium cepa</i>	Common Onion Plantation	750	13.3
2	<i>Capsicum annum</i>	Hot Pepper	238	4.2
3	<i>Cenchrus biflorus</i>	Karangiya (Indian sandbur)	37	0.7
4	<i>Cenchrus biflorus</i>	Karangiya (Indian sandbur)	344	6.1
5	<i>Dichrostachys cinerea</i>	Sickle Bush	33	0.6
6	<i>Digitaria longiflora</i>	Harkiya (Indian crabgrass)	27	0.5
7	<i>Ipomoea aquatica</i>	Duman kada	99	1.8
8	<i>Ipomoea batatas</i>	Sweet Potatoes Plantation	420	7.5
9	<i>Manihot esculenta</i>	Cassava Plantation	580	10.3
10	<i>Nymphaea odorata</i>	Water lilly	404	7.2
11	<i>Oryza glaberrima</i>	Rice Plantation	1293	23.0
12	<i>Pennisetum purpureum</i>	Kawari (Elephant Grass)	119	2.1
13	<i>Pistia stratiotes</i>	Water lettuce	424	7.5
14	<i>Prunus Africana</i>	African Cherry	28	0.5
15	<i>Senna occidentalis</i>	Sanga sanga (Coffee senna)	167	3.0
16	<i>Sida cordifolia</i>	Garmani (Flannel Weed)	55	1.0
17	<i>Typha latifolia</i>	Bulrush (Typa grass)	27	0.5
18	<i>Zea mays</i>	Maize	584	10.4
			5629	100.0

Source: TSL Fieldwork, 2024 & 2025

4.12.4.3 Dominant Tree Species in Kebbi State

The most dominant woody species include *Azadirachta indica* (22%), *Mangifera indica* (18%), *Moringa oleifera* (12%) and *Piliostigma thonningii* (7.5%). Most dominant herbaceous species on the other hand include *Oryza glaberrima* (23%), *Allium cepa* (13.3%), *Manihot esculenta* (10.3%), *Pistia stratiotes* (7.5%) which are widely cultivated throughout the state. Other dominant tree species in this region include the following:

- *Vitellaria paradoxa* (Shea Butter Tree): Known for its economic importance, especially in the production of shea butter, this tree thrives in the Guinea Savannah.
- *Khaya senegalensis*: A tall, evergreen tree common in riparian zones and forested regions.
- *Isobertia doka*: A prominent tree species in woodlands, especially in areas where soil fertility supports tree growth.

- *Lannea schimperi*: A tree species known for its role in savannah ecosystems, providing important habitat for various fauna.

The dominant shrub and grass species on the other hand include:

- *Panicum maximum*: A common grass species in this region, favored for grazing by livestock.
- *Dichrostachys glomerata*: A shrub frequently found in the understory of the savannah, providing cover for small fauna.

The predominant food plants in the proposed SBS-2 project area, which spans a 323 km stretch from Alfala to Balugu, are a mix of maize, beans, melon, potatoes (both Irish and sweet potatoes), carrots, cucumber, rice, groundnut, soybeans, tomatoes, among others. These crops are essential to the local agricultural economy, supporting both subsistence farming and commercial agriculture in the region.

The demand for firewood and charcoal has led to extensive tree cutting for domestic and economic purposes. This intense reliance on natural vegetation for fuelwood has contributed to deforestation in some areas, impacting the local plant communities and potentially affecting soil fertility. The preponderance of the Northern Guinea Savannah in Kebbi highlights the ecological sensitivity of the region. This vegetation provides not only critical agricultural resources but also serves as a habitat for various wildlife species. Managing the balance between resource use and conservation is crucial for maintaining the ecological integrity of the area, especially as the Sokoto-Badagry Superhighway development progresses.

4.12.4.4 Floral Species Richness and Population Density

The survey identified a total of 60 species, representing moderate species richness. This diversity reflects the ecological health of vegetation in Kebbi state, showcasing their ability to sustain a variety of flora. Rich biodiversity supports critical ecosystem functions such as nutrient cycling, soil stabilization, and water regulation.

4.12.4.5 Floral Community Structure and Stability

A low dominance value (0.05146) indicates that no single species dominates the ecosystem significantly. This is a positive indicator of ecological balance, where multiple species coexist with

minimal competition. Such a structure promotes biodiversity and enhances the system's resilience to external pressures like environmental changes or invasive species.

The Simpson Index ($1-D = 0.9485$) and Shannon Index ($H = 3.339$) further reinforce the observation of high diversity (Table 36). The Simpson Index reflects even species distribution, which reduces vulnerability to ecological disruptions caused by the loss of specific species. Meanwhile, the Shannon Index captures both species richness and evenness, indicating a complex and well-distributed community that can support various ecological functions (Table 4.25).

4.12.4.6 Floral Evenness and Distribution

The evenness value ($e^H/S = 0.47$) suggests that while the ecosystem is diverse, some species are more abundant than others. This highlights the importance of conservation efforts to ensure that less abundant species are not overshadowed or outcompeted by dominant ones. Such an imbalance, if unchecked, could lead to a decline in species richness and overall ecosystem health.

The Equitability Index ($J = 0.8156$) confirms that species are distributed relatively evenly across the surveyed locations. This balance is critical for sharing available resources equitably, minimizing competition, and fostering coexistence among species (Table 4.25).

4.12.4.7 Floral Indices of Richness and Diversity

The Margalef Index (6.102) and Fisher's Alpha (7.89) highlight the richness and diversity of floral species. High values for these indices emphasize the ecosystem's capacity to support a wide range of species, which is essential for maintaining ecological stability and supporting complex interspecies interactions (Table 4.25).

Similarly, the Brillouin Index (3.327) indicates a well-structured community with significant diversity and balance. The Menhinick Index (0.4769) further complements this by demonstrating a healthy relationship between the number of species and the total population size.

4.12.4.8 Floral Sustainability and Resilience

The Chao-1 Index (60), which aligns perfectly with the observed number of species, suggests that the survey effectively captured the full diversity of the flora (Table 36). This indicates that the

ecosystem's sustainability potential is accurately represented, providing a strong foundation for conservation planning.

The Berger-Parker Index (0.1135) confirms a low level of dominance by any single species, reinforcing the ecosystem's diversity and stability. A balanced ecosystem like this is better equipped to withstand environmental changes, including climate variability, land-use shifts, and other anthropogenic pressures (Table 4.25).

4.12.4.9 Floral Biodiversity Significance

The biodiversity indices underscore the ecological richness of Kebbi state. High values for indices like the Shannon Index and Simpson Index reflect a robust ecosystem with diverse and evenly distributed species. This diversity plays a critical role in sustaining ecosystem functions such as carbon sequestration, water filtration, and soil fertility. Furthermore, biodiversity enhances aesthetic, cultural, and economic values, supporting local communities and promoting sustainable development (Table 4.25).

Table 4.25: Floral community structure and stability

Diversity Index	Status
Taxa_S	60
Individuals	15828
Dominance_D	0.05146
Simpson_1-D	0.9485
Shannon_H	3.339
Evenness_e^H/S	0.47
Brillouin	3.327
Menhinick	0.4769
Margalef	6.102
Equitability_J	0.8156
Fisher_alpha	7.89
Berger-Parker	0.1135
Chao-1	60

4.12.4.10 *Floral Conservation Strategies*

The survey emphasizes the need for targeted floral conservation strategies to protect the diverse floral species in Kebbi State. Conservation measures should include;

1. Preventing habitat loss by protect natural habitats from urbanization, agricultural expansion, and deforestation.
2. Mitigating over-exploitation can be done by regulating the harvesting of plant species to ensure sustainable use.
3. Restoration initiatives by rehabilitating degraded areas to promote the recovery of less abundant species.
4. Community engagement should carry out by involve local communities in conservation efforts to build awareness and foster stewardship.

4.12.4.11 *Floral Sustainability of Species*

The observed richness and high population density support the sustainable coexistence of species. However, moderate evenness highlights potential risks to less abundant species due to competition for resources. Active management is crucial to address these risks, including habitat restoration, the promotion of agro- forestry, and the use of indigenous knowledge in conservation practices.

4.12.4.12 *Floral Resilience and Stability*

The diversity and evenness of flora in Kebbi State contribute significantly to the ecosystems' resilience. This diversity ensures that the ecosystems can adapt to environmental changes, resist invasive species, and recover from disturbances. Conservation initiatives should aim to preserve these attributes to safeguard the ecological integrity of these regions.

The diversity indices reveal a robust and balanced ecosystem in Kebbi state, characterized by high species richness, even distribution, and ecological stability. To sustain these ecosystems, conservation efforts must focus on protecting species richness, enhancing evenness, and mitigating potential threats to less abundant species.

4.12.4.13 *Faunal Diversity*

Africa is renowned for its diverse and well-known savannah fauna, particularly in areas that provide habitats for large mammals. This makes it crucial for projects within these areas, such as the Proposed Sokoto-Badagry Superhighway, to be carefully planned and implemented to minimize potential negative impacts on wildlife.

The savannah ecosystem in this region provides essential habitats for a variety of animals, insects, and birds, many of which play critical ecological roles such as grazing, browsing, pollinating, nutrient cycling, and seed dispersal (Smith, 2023). The International Union for Conservation of Nature's (IUCN) Red List was used to categorize species in the study area according to their conservation status. The IUCN's categories include not evaluated, data deficient, least concern, near threatened, vulnerable, endangered, critically endangered, extinct in the wild, and extinct, and these categories helped identify species at high risk of extinction in the study area.

The results encompass faunal diversity across various locations in Kebbi state. Table 4.26 represents distinct ecological zones, highlighting the species observed, their frequency, and the percentage of their occurrence.

Table 4.26: Faunal Species encountered in the project area

S/N	Species Name	Animals	Frequency	Percentage (%)
1	<i>Agama agama</i>	Lizard	27	1.3
2	<i>Belenois aurota</i>	Brown-Veined Butterfly	1	0.0
	<i>Brachythemis</i>	African Emperor	2	0.1
3	<i>leucosticta</i>	Dragonfly		
4	<i>Bubulcus ibis</i>	Bel bela (Cattle Egret)	96	4.7
5	<i>Camelini camelus</i>	Camel	2	0.1
6	<i>Canis familiaris</i>	Domesticated dog	1	0.0
7	<i>Capra hircus</i>	African Pygmy Goat	58	2.8
8	<i>Chloroce bussabaeus</i>	Western Green Monkey	23	1.1
9	<i>Clarias gariepinus</i>	Cat fish	40	2.0
10	<i>Corvus albus</i>	Pied Crow	3	0.1
11	<i>Corvus corone</i>	Black Bird	5	0.2
12	<i>Cricetomys gambianus</i>	Giant African Rat	7	0.3
13	<i>Danaus chrysippus</i>	Brown Tiger	12	0.6
	<i>Dendro aspispolylepis</i>	Black Mamba (African Black Snake)	3	0.1
14	<i>Dorylus wilverthi</i>	Army Ants (Biting ants)	128	6.3
15	<i>Equus asinus</i>	African donkey	2	0.1
16	<i>Formica fusca</i>	Black ants	250	12.3
17	<i>Geopelia striata</i>	Zebra Dove	29	1.4
18	<i>Gerris lacustris</i>	Aquatic insects	29	1.4
19	<i>Junonia atlites</i>	Brown-white butterfly	13	0.6
20	<i>Leptidea sinapis</i>	White butterfly	1	0.0
21	<i>Macrotermes bellicosus</i>	Termite	164	8.0
	<i>Manduca</i>			
22	<i>quinquemaculata</i>	Green Grass worm	12	0.6
23	<i>Musca domestica</i>	Housefly	338	16.6
	<i>Odontotermes</i>	Termite	266	13.0
24	<i>transvaalensis</i>			
25	<i>Oreochromis niloticus</i>	Tilapia fish	246	12.1
26	<i>Ovis arie</i>	Sheep	28	1.4
27	<i>Panicum maximum</i>	Guinea Grass	21	1.0
28	<i>Passer domesticus</i>	House Sparrow	3	0.1
29	<i>Pieris rapae</i>	Brow-white butterfly	3	0.1
30	<i>Rattus rattus</i>	Black Rat	157	7.7
31	<i>Schistocerca gregaria</i>	Green Desert Locust	37	1.8
32	<i>Schistocerca gregaria</i>	Brow Desert Locust	8	0.4
33	<i>Spilopelia senegalensi</i>	Laughing Dove	3	0.1
34	<i>Tchagra senegalus</i>	Black-crowned Tchagra	3	0.1
35	<i>Vanessa atalanta</i>	Red Butterfly	19	0.9
36			2040	100.0

Source: TSL Fieldwork, 2024 & 2025

Faunal Diversity at Bayawa

At Bayawa water body, the faunal composition is heavily dominated by aquatic species, with *Oreochromis niloticus* (Nile Tilapia) accounting for a staggering 83.91% of the recorded fauna. This shows the importance of aquatic habitats in this area. *Clarias gariepinus* (African Catfish) also plays a significant role with 8.81%, further emphasizing the prominence of fish species in the ecosystem. The remaining species, such as desert locusts and butterflies, are less frequent but add to the area's biodiversity. The high frequency of fish species suggests that this location is an aquatic-focused ecosystem, likely related to local wetlands or water bodies. The following zooplanktons were encountered at Bayawa: *Daphnia*, *Moina*, *Asplanchna*, *Filinia* and *Keratella tropica*.

Faunal Diversity at Dalijan

Dalijan is dominated by termite species, especially *Odontotermes transvaalensis* (54.51%) and *Macrotermes bellicosus* (27.91%), reflecting a strong insect-driven ecosystem. This large termite population points to a dry or semi-arid environment where such insects thrive, contributing to the decomposition of organic matter. Other species include army ants (*Dorylus wilverthi*, 26.23%) and black ants (*Formica fusca*, 7.79%), emphasizing the prevalence of ant species in this ecosystem. The dominance of ants and termites indicates a habitat rich in decomposing organic matter, with fewer larger fauna present.

Faunal Diversity at Jega

The faunal diversity at Jega is heavily dominated by black ants (*Formica fusca*), which represent 75.00% of the observed fauna. This overwhelming presence of ants indicates a thriving ant community within the ecosystem. Other species such as African pygmy goats (*Capra hircus*, 10.32%) and houseflies (*Musca domestica*, 10.71%) are present but in much lower frequencies. This suggests a region where ants play a crucial role in the local ecology, with other species being less abundant.

Faunal Diversity at Sabiyal

At Sabiyal, the faunal composition includes a mixture of both aquatic and terrestrial species. Aquatic insects like *Gerris lacustris* (13.94%) and catfish (*Clarias gariepinus*, 8.17%) represent the semi-aquatic nature of the area, showing the presence of both water and land-based ecosystems. Bird species, such as cattle egrets (*Bubulcus ibis*, 12.50%) and zebra doves (*Geopelia striata*, 11.54%), further highlight the area's diverse birdlife. This mixture of aquatic

insects, fish, and birds suggests a well-balanced environment with both wetland and terrestrial components. *Filinia* and *Diaptomus* are the only zooplanktons identified.

Faunal Diversity at Balugu Forest Reserve

At Balugu Forest reserve, houseflies (*Musca domestica*) make up a dominant 65.97% of the observed fauna, pointing to a high level of human activity and settlements in the region. Black rats (*Rattus rattus*, 11.34%) and cows (*Bos taurus*, 5.37%) are also present, further reflecting the agricultural or pastoral influence on the ecosystem. The high number of houseflies indicates proximity to human habitation or livestock, while the presence of cows emphasizes the location's agricultural context.

Faunal Diversity at Balugu Earth Dam

Like the previous location, Balugu Earth Dam is heavily influenced by human activities. Houseflies (*Musca domestica*) dominate the fauna with 61.45%, followed by domesticated cows (*Bos taurus*, 15.08%). This high concentration of houseflies suggests an environment influenced by agriculture or human habitation. In addition to these species, there are also small populations of lizards, black rats, and even a minimal presence of black mambas, further diversifying the ecosystem and reflecting the complexity of interactions between human and wildlife populations in the area. Only *Asplanchna* was encountered at the Dam.

Faunal Diversity at Zagga

Zagga is another location dominated by aquatic species, with *Oreochromis niloticus* (Nile Tilapia) being the most common species, accounting for 83.91% of the recorded fauna. This reinforces the importance of aquatic ecosystems in the area. Additionally, *Clarias gariepinus* (African Catfish) contributes 8.81%, further supporting the prominence of fish species. The concentration of aquatic life suggests that this is a key water-based ecosystem where fish play a dominant role in the food web. The water samples collected from Zagga had *Diaptomus* and *Filinia spp.*

4.12.4.14 Diversity Indices of Faunal Species Surveyed in Kebbi State

The faunal diversity indices for Kebbi State provided a rich diverse ecosystems and ecological health in these regions. These indices not only measure species richness and population density but also offer insights into the stability, evenness, and distribution of species across the surveyed areas.

Faunal Species Richness and Population Density

Species richness, a key indicator of biodiversity, reflects the variety of species present within an ecosystem. In the present survey across Kebbi state, 58 species were recorded, comprising a total of 4,965 individuals. The relatively high number of species and individuals suggests a diverse and dynamic ecosystem, supporting various ecological processes and species interactions. Population density, measured in terms of individual species per area, provides further understanding of how these species were distributed within the habitats. Higher species richness generally correlates with a greater ecological variety, supporting the resilience of the ecosystem and its ability to recover from disturbances.

Faunal Community Structure and Stability

The community structure of an ecosystem defines the arrangement and relationships among species, which can provide insights into its stability and health. One critical aspect of community structure is the concept of dominance whether a few species out-compete others for resources. In this survey, the Dominance Index (D) was low, with a value of 0.07451, which indicated a relatively even distribution of resources among species. A low dominance value is a positive sign of ecological balance, as it suggests that no single species is overly competitive, preventing the loss of biodiversity and ensuring long-term ecosystem stability.

The Simpson Index (1-D) further supports this observation, with a value of 0.9255, indicating high diversity and a low level of dominance. This suggests that species were well represented across the ecosystem, promoting stability and resilience in the face of environmental changes. A high diversity of species reduces the likelihood of ecological collapse by ensuring that the ecosystem remains functional even if some species are affected by external pressures (Table 4.27).

Faunal Evenness and Distribution

Evenness is a measure of how evenly individuals are distributed across species in an ecosystem. An evenly distributed community promotes ecological balance and prevents the dominance of a few species over others. The Shannon Index (H), which recorded a value of 2.949, indicates a moderate level of species evenness and diversity. This suggests that while the ecosystem supports a variety of species, some may still be more dominant than others. Evenness was quantified at 0.329, suggesting moderate equitability. While this value indicates that some

species may be more abundant, there remains a balance in species representation, which is crucial for maintaining ecosystem stability (Table 4.27).

The Brillouin Index, which was recorded at 2.922, further confirms the diversity of the ecosystem, especially highlighting the presence of rare or less common species. This is critical for maintaining the integrity of the ecosystem, as it suggests that the region is not dominated by just a few widespread species but also supports the survival of rarer taxa, which are often more vulnerable to ecological changes.

Faunal Indices of Richness and Diversity

Several indices were used to measure the richness and diversity of species for the present survey; Menhinick Index (0.8231) indicates a moderate level of species richness relative to the number of individuals surveyed. This highlights that there is a reasonable balance between the number of species and individuals present, suggesting that the ecosystem is not overcrowded by any one species group (Table 4.27).

The Margalef Index (6.698) reflects relatively high species richness, which is vital for the overall resilience of the ecosystem. Higher species richness typically correlates with greater ecosystem stability, as more species contribute to the functional diversity of the environment.

The Fisher's Alpha value of 9.22 was another important indicator of species richness, reinforcing the notion that the ecosystem supports a wide range of species, which is essential for ecological function and long-term sustainability. These indices collectively point to a diverse and balanced community structure that is fundamental to the stability and resilience of the ecosystem.

Faunal Sustainability and Resilience

The sustainability and resilience of an ecosystem are tightly linked to its biodiversity. In this survey, the Berger-Parker Index (0.1434) demonstrates low dominance, suggesting that no single species is overly abundant, which promotes sustainability. Ecosystems that support diverse species with relatively even population distributions tend to be more resilient, meaning they can better withstand environmental disturbances such as climate change, disease outbreaks, or habitat destruction.

The Chao-1 Index (61.33) provides an estimate of the total species richness, accounting for rare and undetected species. This implies that the actual biodiversity in the region may be even higher than recorded, suggesting that the ecosystems in Kebbi state could be more bio-diverse than initially thought. This potential for undiscovered species highlights the importance of continued monitoring and research to ensure comprehensive conservation strategies (Table 4.27).

Table 4.27: Analyzed faunal diversity indices of surveyed species in Kebbi State

Diversity Index	Status
Taxa_S	58
Individuals	4965
Dominance_D	0.07451
Simpson_1-D	0.9255
Shannon_H	2.949
Evenness_e^H/S	0.329
Brillouin	2.922
Menhinick	0.8231
Margalef	6.698
Equitability_J	0.7262
Fisher_alpha	9.22
Berger-Parker	0.1434
Chao-1	61.33

Biodiversity Significance and Conservation Implications

The findings for the present survey revealed significant biodiversity in Kebbi ecosystems, highlighting the importance of these regions for broader conservation efforts. The relatively high species richness, moderate evenness, and low dominance suggest that the ecosystems are in a healthy state, capable of supporting a diverse range of species. This is crucial, as ecosystems with high biodiversity provide critical ecosystem services such as pollination, soil fertility, and carbon sequestration.

Given the potential presence of rare or under-recorded species, as indicated by the Chao-1 Index, it is essential that conservation efforts prioritize the protection of habitats that support these species. Additionally, maintaining balanced species populations will help ensure the sustainability of the ecosystem, as imbalances in species distributions can lead to ecosystem degradation.

Faunal Sustainability of Species and Resilience

For the long-term sustainability of the species and their habitats in Kebbi State, conservation efforts should focus on maintaining the delicate balance of species richness and evenness. This includes the following;

1. Protecting rare and vulnerable species by focusing not only on the most abundant species but also on those that are rare or threatened. Efforts should include habitat preservation, anti-poaching measures, and sustainable land-use practices.
2. Preventing over-dominance of species, thereby monitoring and managing the populations of dominant species.
3. Enhancing habitat connectivity by ensuring that habitats are interconnected, which will allow species to move and adapt, increasing their chances of survival in changing environmental conditions.

4.12.4.15 Conclusion

This EIA survey of floral and faunal diversity across Kebbi State reveals distinct ecological zones, influenced by both natural factors and human activity. From wetlands with abundant aquatic plants and fish species to dry, semi-arid environments rich in drought-resistant flora and fauna, the data highlights the resilience and adaptation of species in diverse habitats. Agricultural practices, such as the cultivation of rice, cassava, tobacco, and maize, are evident in many locations, influencing both plant and animal populations. In contrast, aquatic and wetland areas, with species such as bulrush, water lilies, and various fish, reflect the ecological importance of water bodies in sustaining biodiversity. Understanding these patterns offers valuable insights into local ecosystems, helping inform conservation strategies and sustainable management of natural resources.

The biodiversity indices suggest that Kebbi State maintain diverse, resilient ecosystems that can continue to provide vital ecological functions. However, conservation efforts are needed to protect this biodiversity and enhance the sustainability of these ecosystems in the face of environmental pressures. Conservation strategies should focus on preserving this balance by protecting both abundant and rare species, preventing the dominance of any single species, and safeguarding habitats from degradation. These measures will ensure the long-term survival of the species in these regions and promote the overall stability of the ecosystem. It is hoped that

this survey will provide the project with all the necessary information that can help in successfully achieving the goals of the project at the same time minimizing adverse effects on the environment.

4.12.4.16 Recommendations

At the end of this survey, the survey team proposed the following recommendations;

1. The government and implementation agencies should ensure complete compliance with all regulatory EIA requirements particularly, those related wildlife, as set out by the local, national and international environmental regulations.
2. The government and implementation agencies should ensure that wildlife corridors were included in the design and execution of the project to allow safe passage for local wildlife.
3. The government should ensure that implementation agencies conduct a similar EIA survey during rainy season to establish the complete biotic community (including the migratory and dormant species) in the project area.
4. Relevant government agencies (Ministry of Environment, Ministry of Works, etc.) and the communities around the project should continuously monitor the biotic community around the area even after the project and adapt strategies based on environmental feedback.

The government and implementation agencies should ensure that post-EIA monitoring of biotic community is included to establish environmental impacts identified and update mitigation measures to reduce the unavoidable negative effects of the project

4.13 Socio-economic Survey

4.13.1 Introduction

Socioeconomic survey of the communities along the alignment was also carried out. The focus was to establish baseline condition of the people in terms of population and gender, education and health facilities, commerce, housing, transport as well as peoples' awareness, perception and apprehensions about the proposed project.

4.13.2 Stakeholders Engagement

Individual interviews, Focused Group Discussion (FGD) and enlightenment discussions were conducted with several stakeholders in the state. The various individuals and groups were selected in terms of their knowledge of relevant issues within the study area (i.e. Leadership position, age, education, health). The exercise focused on acquiring general and specific knowledge of the stakeholders with reference to the proposed project area.

4.13.2.1 Stakeholders

There exist two (2) classes of impact stakeholders- Primary and Secondary stakeholders. The Primary impact stakeholders include the proximal communities, businesses and the 9 Local Government Areas (Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri Local Government Areas). These local governments are responsible for the welfare of the communities around the proposed road corridor. The secondary impact stakeholders are naturalists, the conservationist and the environmental NGO groups all over Nigeria.

4.13.2.2 Institutional Consultation

The Primary regulatory authorities are Federal Ministry of Environment while the secondary regulatory authorities are the various state environmental bodies and the Local Government councils. The information regarding the proposed project was communicated to the Federal Ministry of Environment and the scope of work/ terms of reference for the ESIA study were also sent for details and preparedness to fully participate.

4.13.2.3 Parties Consulted

Consultations to intimate the stakeholders of the proposed project were held with the under listed stakeholders/ regulatory bodies:

- Federal Ministry of Environment (FMEnv);
- Federal Ministry of Works
- Road Sector Development Team (RSDT);
- Kebbi State Government
- Kebbi State Ministry of Environment
- Kebbi State Ministry of Works

- National Environmental Standards and Regulations Enforcement Agency (NESREA) Kebbi Office
- Federal Road Safety Corps, Kebbi State Command
- Vehicle Inspectorate Office (VIO), Birnin Kebbi
- The Nine Local Government Areas of Argungu, Augie, Birnin Kebbi, Jega, Koko-Besse, Maiyama, Ngaski, Shanga and Yauri
- Traditional Institutions including District Heads of various Communities / Settlements
- Religious Organizations
- NURTW, Kebbi State Chapter
- RTEAN
- NULGE
- Non-Government Organizations.

4.13.2.4 Future Consultation

The Federal Ministry of Works, as the project proponent, remains committed to continuous consultation with all relevant stakeholders who may be directly or indirectly affected by the proposed SBS-2. Engagement will be maintained throughout all phases of project development, including planning, construction, operation, and maintenance.

In alignment with the Ministry's policy of promoting environmental sustainability and safeguarding the well-being of affected communities, the proponent will actively encourage stakeholder participation, ensuring that concerns and suggestions are duly considered in the decision-making process. Regular consultations will be conducted with federal, state, and local government agencies, traditional rulers, community representatives, civil society organizations, and other interest groups.

To further enhance transparency and build trust, the Federal Ministry of Works will implement a robust stakeholder engagement framework that includes public hearings, focus group discussions, town hall meetings, and the dissemination of relevant project information through various media channels. These efforts will help to keep all concerned parties informed about the project's progress, potential impacts, and mitigation measures.

Furthermore, in accordance with best environmental and social management practices, the proponent will initiate comprehensive awareness and educational programs to enlighten communities within the project corridor about the risks and hazards associated with the superhighway. These programs will cover topics such as road safety, environmental conservation, health implications, and potential socio-economic benefits.

Maintaining open communication channels and fostering collaborative relationships with all stakeholders, the Federal Ministry of Works aims to achieve a balanced and sustainable development outcome for the Proposed Sokoto-Badagry Superhighway, Section 2.

4.13.3 Household Surveys

Household survey (HHS) was conducted in the proximal communities adjacent to the road corridor, where focus groups interviews were also held. Household in this study refers to an extended family, led by a head, which forms an economic unit living in the same compound, working/ farming the same communal land and eating together. Questionnaires were administered to each family head. A total of Four Hundred and Seventy (470) questionnaires were administered across the route using structured interview approach. This approach is to ensure adequate reach to respondents and to obtain maximum responses. Out of these, 445 were filled, while 25 copies of the questionnaire could not be retrieved from the sampling population. The 445 filled questionnaires were analysed and presented in descriptive statistics.

4.13.4 Oral Interview Sessions conducted along the Alignment

Among the people interviewed and visited were the Village Head of Wali (Argungu Local Government), the Head of Borgu, Sarkin Borgun Ka'oje as well as the Village Heads of Balugu and Gwamba in Bagudo Local Government area. As required by statutory laws guiding the conduct of Environmental Impact Assessments (EIA), the EIA socio-economic experts conducted interviews and paid courtesy visits to key stakeholders along the proposed SBS-2 in Kebbi state, traversing critical communities in the region.

The visit was to brief them and their Councils of Chiefs on the proposed SBS project. The briefings covered the modalities for assessing the socio-economic and health status of the locality and sought their permission/approval, which were granted.

4.13.5 Focus Group Discussion with the Men Group

The Focus Group Discussions (FGD) were carried out between the 2nd and 6th day of the Baseline Data Gathering Exercise across the major communities proximal to the corridor of the proposed SBS-2. The objective of the engagements was to educate the men on the proposed Sokoto-Badagry Superhighway of this section of the highway, its potential impacts on adjacent settlements and communities, their livelihoods, and to document their fears and concerns regarding the project while addressing them appropriately.

The men's group was pre-informed of the exercise to create an opportunity for most participants to return from their farms and workplaces, ensuring robust participation in the discussions. The socio-economic team moderated the process, posing strategic questions to the group to gather vital information about the entire study area. Sufficient time was allotted for each participant to share their perspectives on the topics raised.

Participants were encouraged to feel free to express their fears, concerns, and suggestions regarding the project. This approach fostered open dialogue and enabled the collection of meaningful contributions that will be critical in shaping the socio-economic and environmental considerations of the project. Stakeholder engagements with men groups in the Kebbi section of the alignment are shown in Plate 4.17 to Plate 4.22.



Plate 4.17: Community Consultation at Wali, Argungu Local Government



Plate 4.18: Community Consultation at Gwamba



Plate 4.19: Community Consultation at Balugu



Plate 4.20: Community Consultation at the Palace of Sarkin Bargu Ka'oje, Bagudo Local Govt.



Plate 4.21: Community Consultation at Rafin Guzuma, Maiyama Local Govt.



Plate 4.22: Community Consultation at Emir's Palace, Koko, Koko-Besse Local Govt.

4.13.5.1 Outcomes of the Focused Group Discussion with the Men Group

The following observations were noted during the meeting with the men's group regarding the proposed SBS-2:

- a) **Support for the Project:** The people expressed strong support for the proposed road project, emphasizing that it was long overdue for intervention by the Federal Government. However, they voiced concerns about issues related to compensation, particularly regarding potential corruption. They feared that those affected might not receive fair and adequate compensation aligned with prevailing realities and market values for their properties.
- b) **Employment and Contracting Opportunities:** The men highlighted their interest in employment and contracting opportunities that often accompany such developmental projects. They appealed for prioritization of local men in job placements and contracting opportunities during the construction phase of the project.
- c) **Concerns About Social Amenities:** The group raised concerns about the inadequate availability of social amenities such as water supply and healthcare facilities in their

communities. They appealed for intervention in the provision of additional water supply infrastructure and improved healthcare facilities to meet the needs of the growing population.

The men's group was assured that during the construction and implementation phases of the project:

- Unskilled labor would be sourced from the local communities.
- Qualified individuals would be considered for job placements where they meet the required competence.
- Compensation would be paid in accordance with statutory laws applicable in each state, ensuring beneficiaries could access it before the commencement of road construction.

4.13.6 Focus Group Discussions with the Women Group

The Focus Group Discussions (FGD) with the women group were conducted during the baseline data gathering exercise in key communities along the corridor of the proposed SBS-2. The primary objective of these discussions was to provide the women with comprehensive information about the proposed project, including its potential impacts on their communities, livelihoods, and overall well-being. Additionally, the engagements aimed to document their concerns and fears while addressing them effectively. The women were also sensitized on the Environmental Impact Assessment (EIA) process and the various project-induced impacts on their socio-economic activities, health, and environment (Plate 4. 23).



Plate 4.23: Interaction with Women Group in Zagga

4.13.6.1 Outcomes of the Focus Group Discussion with the Women Group

The following observations were noted during the meetings:

- a) **Optimism and Safety Concerns:** The women expressed optimism about the proposed SBS-2 project, highlighting the benefits it would bring to the communities and commuters.
- b) **Compensation for Affected Women:** The women appealed to the Federal Government, through the Federal Ministry of Works, to ensure that adequate compensation is paid to those affected by the ROW Acquisition.
- c) **Employment Opportunities:** The group expressed disappointment over the high levels of unemployment and poverty in their communities. They emphasized that despite their

children being graduates, many lack good jobs to support their families. They requested that employment opportunities be provided for both the women and their children, particularly those skilled in construction activities, during the road construction phase to enable them to earn a living.

- d) **Economic Concerns:** The women were deeply concerned about the impacts of the fuel subsidy removal policy and the rising costs of food and inflation on their survival. They appealed to the government to intervene and take measures to reduce the prices of essential commodities, especially food items.
- e) **Social Empowerment and Infrastructure Needs:** The women urged the project proponent to undertake social empowerment schemes, including financial support for women to grow their businesses. They also requested the provision of additional water supply infrastructure, noting the significant challenge of trekking long distances to fetch water for their households.
- f) **Security Concerns in Communities:** The women in some communities, such as Riyom, expressed concerns about the ongoing farmer-herder conflicts and resultant attacks on residents, especially women. They called for government intervention to address the marauding herders and ensure the safety of the communities.

4.13.7 Focus Group Discussion with the Youth Groups

The Focus Group Discussions (FGDs) with youth groups were conducted over a five-day period. These engagements took place across the key communities located along the corridor of the proposed SBS-2. The primary objective of the FGDs was to create awareness among the youth population regarding the proposed highway project, its potential impacts on adjacent settlements and communities, and its possible effects on their socioeconomic activities and overall livelihoods.

In preparation for the discussions, various youth groups within the project corridor were duly informed ahead of time to facilitate adequate participation and representation. This proactive approach ensured a substantial turnout of youths from different communities, thereby providing a diverse range of perspectives and insights regarding the proposed development. The FGDs were designed to serve as an interactive platform where the youth could voice their opinions,

express their concerns, and seek clarifications on aspects of the project that could directly or indirectly affect them.

During the discussions, several key themes emerged, reflecting the collective sentiments of the youth groups. These included concerns regarding potential displacement of local businesses, the environmental implications of the highway construction, opportunities for employment and skill acquisition, and the long-term sustainability of their communities. The youth also raised questions about the project's timeline, compensation mechanisms for affected individuals, and strategies to mitigate any adverse impacts on their daily lives.

In response to these concerns, the project team provided detailed explanations, highlighting the measures put in place to minimize disruptions and maximize the benefits of the superhighway. Specific attention was given to the project's commitment to environmental sustainability, local employment generation, and the overall economic growth that the highway is expected to bring to the region. The discussions also emphasized the importance of youth involvement in the project implementation phase to foster a sense of ownership and partnership.

Furthermore, the FGDs created an opportunity to explore potential avenues for collaboration between the project developers and the youth groups. Suggestions were made regarding capacity-building programs, entrepreneurship opportunities, and initiatives aimed at leveraging the highway project for the socio-economic advancement of the local communities.

Overall, the Focus Group Discussions proved to be an essential component of the baseline data gathering exercise, as they provided invaluable insights into the expectations, apprehensions, and aspirations of the youth population. The feedback obtained from these engagements will be instrumental in shaping the project's implementation strategies to align with the needs and aspirations of the local communities.

4.13.8 Results

4.13.8.1 Demographic Composition of respondents

Majority (87%) of the respondents in Kebbi state were male, while only about 13% were females. The respondents are predominantly Muslims and Hausa/Fulani by tribe. These respondents also range in age 25 to 45 years (48.7%), 46 to 55 years (23.3%), 56 – 70 years (16.7%) while respondents above 70 years of age constitute 11.3% (Figure 4.22)

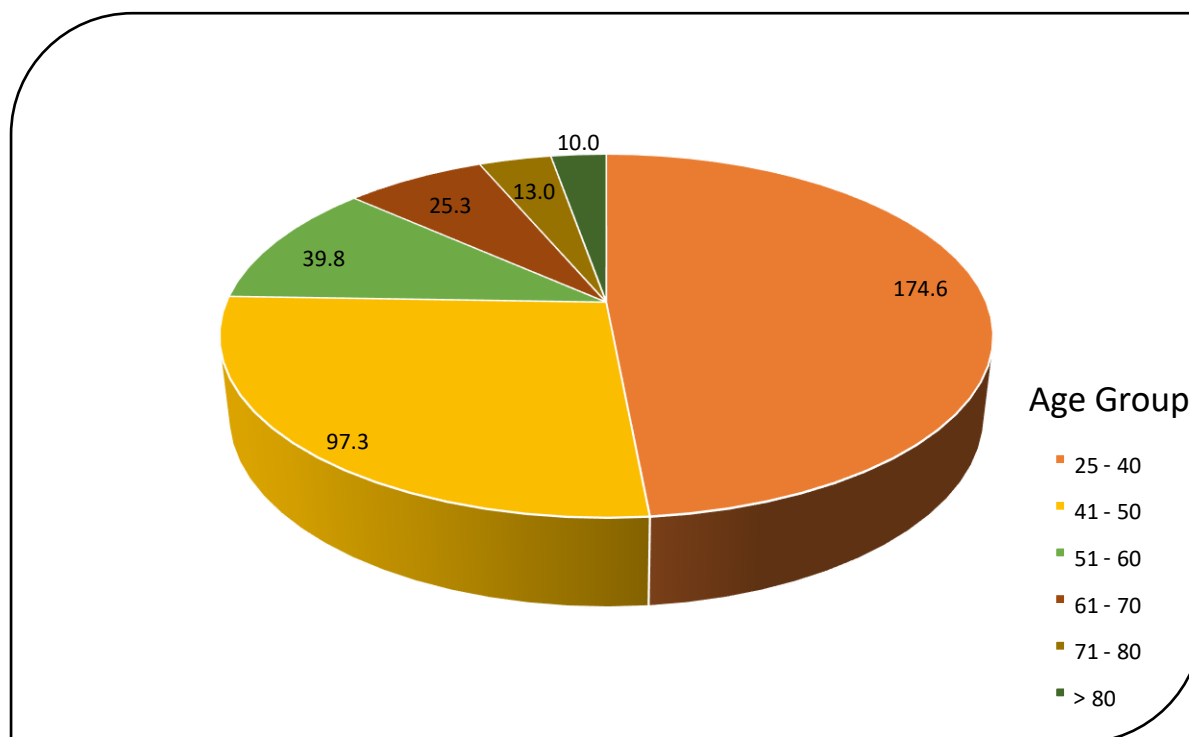


Figure 4.8: Age Group of Respondents

4.13.8.2 Educational Facilities

Kebbi state is endowed with many educational institutions ranging from primary, secondary and tertiary institutions to Islamiyya schools which are fairly distributed across the state. School enrolment in the state is considerably high though some areas have very low turnout of pupils/students in schools.

Along the alignment also, there is an appreciable number of educational facilities including primary schools which are provided in almost all major villages and towns as well as junior and secondary schools such as Government Day Secondary School Bayawa, Junoir Secondary School Ambursa, Government Day Secondary School Dalijan, Government Girls Secondary School Zagga, Government Secondary School Kende, Kebbi State Polytechnic Dakin Gari and School of Health Technology, Jega among others (Plate 4.24 and Plate 4.25).



Plate 4.24: Government Day Secondary School Bayawa and Dalijan, Kebbi state



Plate 4.25: Government Girls Secondary School Zagga and GDSS Balugu, Kebbi state

Respondents' educational attainment is shown in Figure 4.9. From the data collected, about 42% of the respondents have attended secondary schools though some of them dropped out before completion. Thus, only about 35% (141) of the respondents completed secondary education. It could be deduced that the rate of school dropout along the alignment is alarming. In the same vein, only about 13% (61) of the respondents attained tertiary level of education. This includes National

Diplomas, Higher National Diplomas, National Certificate of Education (NCE) and various certificates from School of Health Technology. The remaining 52% (244) respondents have either primary certificates or Quranic education (Figure 4. 9).

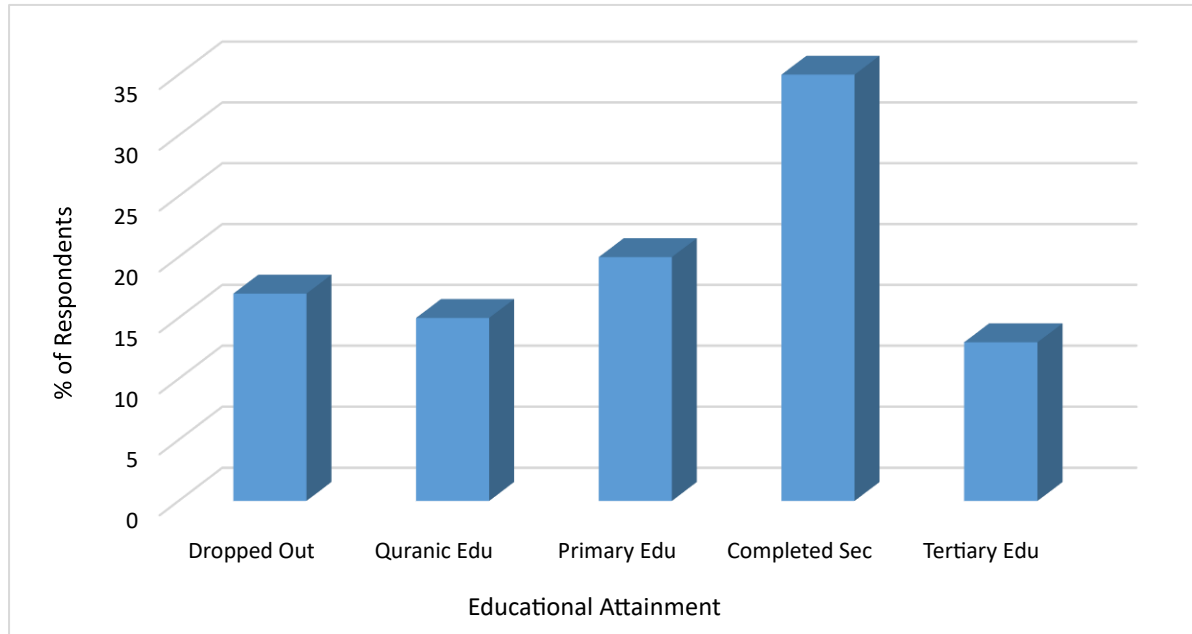


Figure 4.9: Educational Attainment of Respondents

4.13.8.3 Occupation and Income of Respondents

The major occupation for people in Kebbi state is farming. In particular, rice cultivation during both the wet and dry seasons is a major source of food and domestic income in many parts of the state. Similarly, vegetables such as onions, tomatoes, pepper, spinach and lettuce are widely cultivated. Other crops produced along with rice include guinea corn, millet, beans, as well as watermelon, sugar cane, cassava and sweet potatoes. There are, however, a handful of people who are civil servants (16.7%), artisans (11%) and traders (25%). The occupation distribution of respondents is shown in Figure 4.10.

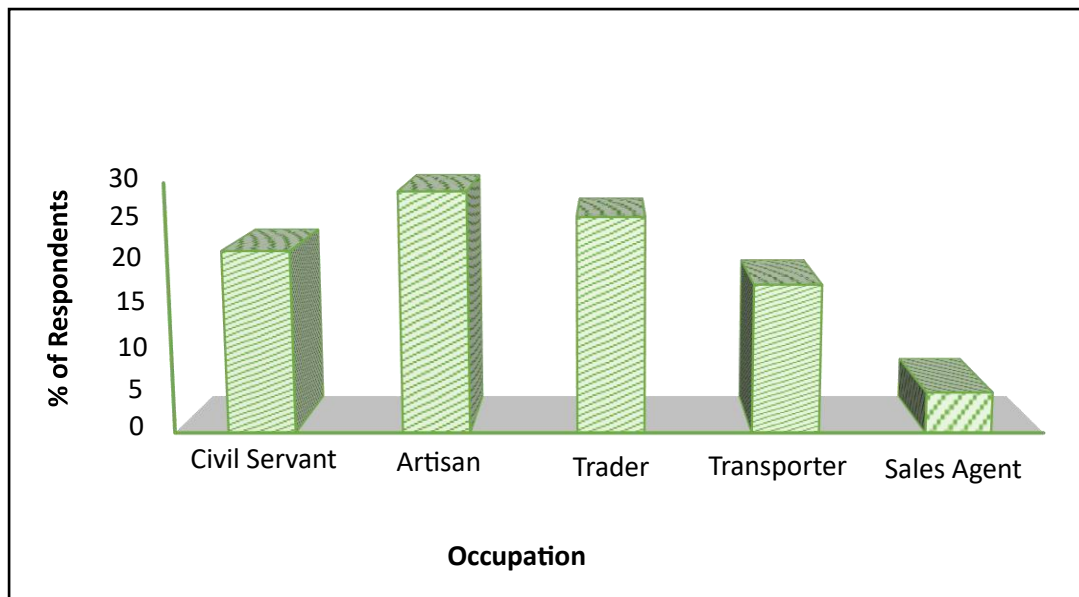


Figure 4.10: Occupation of Respondents

The monthly income of respondents is shown in Figure 4.11. From the data collected and analyzed, most of the respondents (64%) have a monthly income of more than ₦50,000.00 and above. This may not be unconnected with the fact that many people in the state are engaged in rice and other vegetables farming which earns them higher monthly incomes. In the same vein, about 22% (103) respondents have a monthly income of between ₦50,000 to ₦200,000. From the data also, 71 respondents (15%) have monthly incomes of ₦200,000 to ₦500,000, 47 respondents (10%) have monthly incomes of ₦500,000 to ₦1,000,000 while only 24 respondents (5%) have incomes of ₦1,000,000 and above (Figure 4.11).

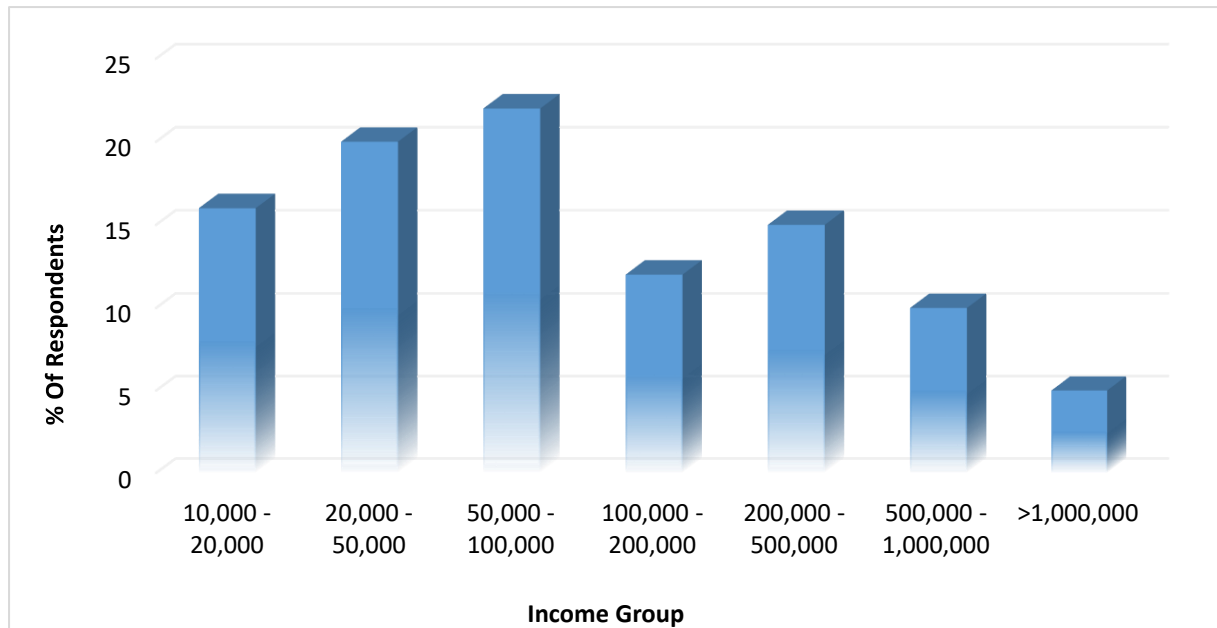


Figure 4.11: Income Distribution of Respondents

4.13.8.4 Health Facilities

There are a number of health facilities, of different grades along the alignment. Many of the health facilities have been rehabilitated/upgraded with solar energy but many also need some improvement to facilitate enhanced health service provision (Plate 4.26 to Plate 4.29).



Plate 4.26: Bayawa Town Dispensary



Plate 4.27: Kyarimi Town Dispensary



Plate 4.28: Primary Health Centre Wali



Plate 4.29: Primary Health Centre Sabiyal

4.13.8.5 Water Supply

Water supply in the communities along the alignment is presented in Plate 4.16. The major source of water for drinking and other domestic uses in the communities is hand dug well which provides water to more than half of the people. In many places located along or close to surface water sources, rivers and ponds serve as formidable sources of water for both domestic and irrigation activities. Similarly, there are several motorized and solar boreholes, provided by state and local governments as well as some individuals and NGOs that also supply water to the people (Plate 4.30).



Plate 4.30: Various sources water supply along the alignment in Kebbi State

4.13.8.6 Agriculture

In Kebbi state, agriculture provides employment, income and family subsistence for more than 80% of the population. In particular, rice farming during both the wet and dry season is a prominent activity in many settlements along the alignment. These include Argungu, Dakin Gari, Bunza, Zagga, Suru and Kaurar Manu. Similarly, onion is extensively cultivated in most of the towns, especially Aliero, Jega, Bayawa, Sabiyal, Kulun Koji, Gindi, Gidiga, and Rafin Tofa among others. Other crops grown in the state include maize, guinea corn, millet, beans, sweet potatoes and cassava. In addition, vegetables such as tomatoes, pepper, spinach, watermelon and lettuce are widely cultivated in the state. Often, these activities are complimented with animals rearing such as cattle, sheep, goats and poultry birds (Plate 4. 31).

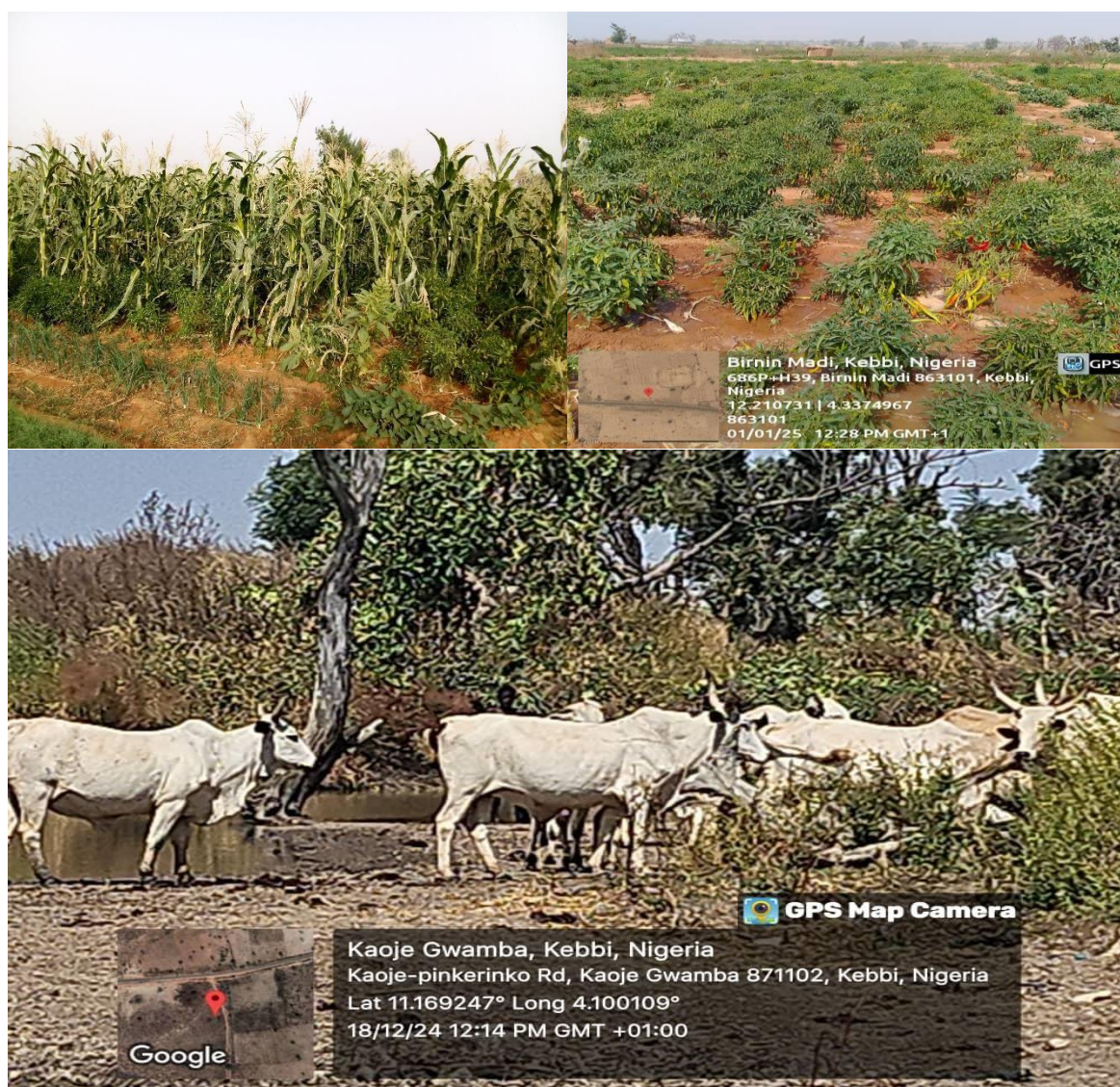


Plate 4.31: Agricultural Activities along the SBS alignment, Kebbi State

4.13.8.7 Housing Type

Many houses along the SBS alignment in Kebbi state were built with concrete blocks and roofed with zinc and in some case, aluminium roofing sheets. Some of the houses, however, were plastered built with mud and thatch roof while some are plastered with cement and roofed with zinc. Others are completely built with thatch or other crops residue (Plate 4.32).



Plate 4.32: Housing types along the alignment in Kebbi State

4.13.8.8 Vulnerable Population: Social Inclusiveness & Poverty Reduction

In line with the World Bank Environmental and Social Standards (ESS) 4, the study recognizes that the various project activities, equipment, operations, and infrastructure associated with the proposed SBS-2, may increase the potential for exposure to risks and impacts for communities in proximity to the project. Specifically, the health, safety, and security risk and impacts on project-affected

communities may arise due to potential air, soil, and water pollution if mitigative measures are not strictly implemented. Sensitive businesses, such as poultry farms, could be significantly affected by pollution, while the disposal of construction waste during the construction phase is of particular concern.

Despite accounting for only 17% of Nigeria's total road network, federal roads handle over 80% of the nation's vehicular and freight traffic (NIIMP, 2020). However, approximately 40% of these roads are in poor condition and require urgent rehabilitation. The Sokoto-Badagry Superhighway is a critical component of the Federal Government's strategic efforts to bridge the infrastructure gap and enhance national connectivity. With funding support from the Renewed Hope Infrastructure Development Fund (RHIDF), which provides an annual budget of \$25 billion over the next eight years, the SBS is poised to improve mobility, enhance safety, and support industrial and socioeconomic reforms.

The SBS project presents an opportunity to incorporate unemployed youth and women into unskilled positions during the construction phase, providing immediate economic benefits to the host communities. The project is also expected to spur commercial activities along the corridor, given the anticipated increase in traffic and improved logistics efficiency. Additionally, the highway will serve as a unifying force, integrating Northern culture with Southern commerce, fostering national cohesion, and driving economic prosperity.

The primary objective of the project is to improve transportation and the movement of people, goods, and services across Nigeria, enhancing regional connectivity and economic growth. From an ESIA perspective, the focus is to ensure social acceptance and environmental sustainability by fostering job creation, supporting livelihoods, and leveraging social, traditional, and religious institutions to strengthen environmental steward.

CHAPTER FIVE: ASSOCIATED AND POTENTIAL IMPACTS

5.1 Introduction

The activities associated with the different phases involved in the proposed SBS-2 are capable of resulting in varying degrees of impacts on the bio-physical and social environment. In this Chapter, the potential impacts that may arise from the proposed road construction project are identified and assessed to determine their significance.

To achieve this, all the potential environmental and social resources and/or receptors in the project area that may be affected (adversely or beneficially) by the project were identified. The identification was based on the review of existing information and comprehensive field-based studies. Consequently, three high-level categories of project receptors were identified:

- Physical: essentially non-living environmental components, including air, water bodies, groundwater, landscapes, soils (also sediments) and geology.
- Biological: including aquatic and terrestrial ecology (i.e., habitat, flora and fauna); and
- Human: including landowners and residents of local communities, local economy, cultural heritage, community health etc.

Essentially, impact identification was based on the project interaction with individual receptors within these broad groups while the value, sensitivity and importance of these receptors form the bases upon which the impacts were assessed to determine their significance.

5.2 Impact Assessment Approach and Methods

The broad approach (and methods) adopted for assessing the impacts of the proposed SBS-2 project on the physical, biological and social environment is based on the International Organization for Standardization (ISO) 14001 requirements for risk and impact assessment, IFC Performance Standards on Environmental and Social Sustainability (IFC 2012) and international best practice principles.

Furthermore, the primary information obtained during field data gathering in the project area (including information gathered from members of affected communities and other stakeholders during consultations), secondary information from existing relevant literatures as well as professional experience and judgment of the multidisciplinary ESIA team formed the bedrock upon which the potential impacts were identified and assessed. Consequently, impact assessment was carried out in three stages as follows:

- **Impact Identification:** entails prediction of changes to the environment that could result from the road construction project. The prediction of these changes will be based on the identification of potential interactions between the project and the physical, biological and social resources/receptors.
- **Impact Characterization:** entails characterizing/forecasting the nature, magnitude, extent, duration, frequency and scale of the impacts. Characterization will essentially help determine the magnitude of impacts and degree of change the impact is likely to have on the receptor.
- **Impact Evaluation:** entails determination of the significance of impacts based on the magnitude of impacts and the value, sensitivity/fragility and recoverability of the affected receptors. This requires an in-depth appraisal of the attributes of potential receptors which has been carried out in the baseline studies and documented in Chapter 4.

5.3 Impact Identification

The environmental and social impacts were identified in the context of the project area of influence and were based on the existing environmental and social baseline data. A logical and systematic approach was used in order to capture all projects - environment interactions capable of resulting in impacts (Table 5.1).

The impact identification process began during the reconnaissance survey and continued throughout the stakeholder's engagement process where significant issues and impacts were identified. Essentially, information obtained through this process was matched with all environmental aspects of the proposed project as well as existing description of the proposed project environment to develop a checklist of associated and potential impacts of the project on the biophysical and social environment.

The development of the checklist was carried out using the FMEnv EIA Sectoral Guidelines for infrastructure, IFC Performance Standards on Environmental and Social Sustainability (IFC 2012), and the World Bank Environmental, Health and Safety (EHS) Guidelines for construction and other relevant international standard codes for infrastructure.

Table 5.1: Project Implementation Phases and Associated Activities

S/N	Project Phases	Activities
1	Preconstruction Phase	• Land acquisition • Installation of site camp structures and facilities • Mobilization of equipment, materials and workers • Site clearing including grubbing and demolition of structures
2	Construction Phase	• Earthworks including excavation and grading • Construction of structures including culverts • Paving and concrete laying
3	Operation Phase	• Road usage • Maintenance and Repairs • Scheduled and unscheduled integrity checks for bridges and culverts • Maintenance and replacement of wearing/ faulty/ damaged components • Repairs of cracks and potholes • Maintaining road markings and traffic signs • Cleaning and vegetation control along the shoulders

The potential environmental and social impacts likely to result from the interaction between the project activities in each phase and the environment are presented in Table 5.2.

Table 5.2: Potential Environmental and Social Impacts

Project Phase	Proposed Project Activities	Associated and Potential Impacts
Preconstruction Phase	Land acquisition (acquisition of land that falls within the RoW)	• Loss of farmland and land-based livelihood. • Reduction in food production and consumption due to loss of farmland • Loss of economic trees including medicinal herbs. • Grievances and conflicts over land and property resettlement & compensation.
	Installation of site camp structures and facilities	• Noise and vibration disturbances in surrounding communities from the use of machineries and motorized equipment. • Risks of occupational accident and injuries to workers • Security risks
	Mobilization of equipment, materials and workers	• Deterioration of local air quality due to the release of fugitive dusts and gaseous pollutant from heavy duty vehicles. • Noise and vibration disturbances from heavy equipment and truck traffic. • Disturbance and displacement of terrestrial wildlife as a result of noise and vibration from heavy duty vehicles • Compaction of soil and predisposition to erosion as a result of use and stationary positioning of heavy-duty vehicles. • Landscape disruption and visual intrusion due to presence of equipment, vehicles and trucks. • Increased security risks due to storage of materials and equipment on site • Threat to community culture, safety and security associated with presence of construction workers and business opportunists. • Increased demand on existing community health and sanitation infrastructure due to influx of temporary workers and camp followers. • Employment of local labour

	Site clearing including grubbing and demolition of structures within the Row	• Deterioration of local air quality due to the release of fugitive dusts from land clearing activities and gaseous emission from heavy duty vehicles. • Noise and vibration disturbances from operation of heavy-duty vehicles. • Loss of vegetation and habitat destruction • Wildlife disturbances and destruction • Loss of ecosystem provisions e.g., fuel wood and economic trees. • Predisposition of soil to erosion due to the removal of vegetal cover and exposure of soil surfaces to rain and wind. • Soil contamination from oil spills associated with heavy equipment operation and fueling activities. • Waste generation from accumulation of cleared vegetal materials. • Siltation of surface water from eroded top soil • Respiratory and eye related problems from exposure to fugitive dusts and gaseous emissions. • Occupational related accidents and injuries to workers including struck by, exposure to dangerous animals, noise exposure etc
Construction Phase	General construction, Earthworks including excavation and grading	• Deterioration of local air quality due to the release of dust from exposed soil surfaces and exhaust emissions from heavy equipment and vehicles.
	Construction of structures including bridges and culverts	• Noise and vibration disturbances. • Soil erosion from exposure soil surfaces. • Soil contamination from accidental leakage/spillage of fuel, oil and lubricants • Generation of spoils and other excavated materials. • Generation of construction waste and debris • Surface water contamination as a result of sediment/pollutants run off from spoils and exposed soil surfaces. • Groundwater contamination from accidental spillages and leakages of oils and other chemicals. • Risk of communicable diseases such as sexually transmitted diseases (STDs) including HIV/AIDS, COVID 19 from influx of temporary construction workers. • Risks of occupational accidents and injuries to workers. • Loss of employment for temporary workers after construction.
	Paving and concrete laying	• Generation of hazardous waste • Noise and vibration disturbances in the adjoining settlements from use of machineries and motorized equipment. • Risks of occupational accidents and injuries to workers.

Operation Phase	Road usage	• Increased traffic & risk of road traffic accidents and injuries especially for the vulnerable groups (old, and children) • Increased vehicular emission of GHGs due to increased transportation. • Noise disturbances, disrupting wildlife movement • Reduction in ecosystems connectivity. • Waste generation, leading to soil and water contamination. • Changes in livelihood and equity. • Public health concerns, such as open defecation, risk of HIV and other STDs • Improved rural access accessibility and mobility in the project area; • Stimulation of local and regional economic activities due to improved road network. • Improvement in agricultural productivity, economic empowerment and sociocultural wellbeing of the benefiting communities through easy access to inputs, extension services, primary and secondary markets. • Improved communication and socioeconomic integration amongst adjoining communities. • Reduction in travel time and transport operating cost due to improvement in the riding quality of the road.
	Maintenance and Repairs	• Deterioration of local air quality due to the release of dust from exposed soil surfaces and exhaust emissions from heavy equipment and vehicles. • Waste generation from repairs (such as cement) • Noise and vibration disturbances. • Risks of occupational accidents and injuries to workers.

5.3.1 Impact Characterization

In order to further qualify the impacts of the various proposed project activities on the environment and the people, all identified impacts were characterised based on the nature, duration and reversibility of impacts as shown in Table 5.3.

Table 5.3: Impact Characterization Parameters and Definition

Beneficial Impacts	Impacts with positive and beneficial effects.
Adverse Impacts	Impacts with negative and untoward effects.
Direct Impacts	Impacts that are most obvious, result solely and are directly related to the proposed project and can be connected to the action that caused them.
Indirect Impacts	Secondary impacts that do not occur directly from a project activity but occur as a consequence of the project as a result of some intermediate step or processes.
Cumulative Impacts	Impacts that typically occur from the incremental impact of an action when combined with impacts from projects that have been undertaken recently or would be carried out in the near future.
Reversible Impacts	Impacts over which the components involved have the ability to recover after the disturbances caused by the impact.
Irreversible Impacts	Impacts whose effects are such that the affected environmental/socioeconomic component cannot be returned to its original state even after adequate mitigation measures are applied.
Residual Impacts	Impacts whose effects remain after mitigation measures have been applied.
Short Term Impacts	Impacts which last only within the period of a specific project activity.
Long Term Impacts	Impacts which have their effects remain after a specific project activity.

5.3.2 Impact Evaluation

The third stage in the assessment procedure involved the evaluation of the impacts identified in order to determine their significance. This was based on the methodological framework set by (ISO) 14001 – Environmental Management System (EMS). The evaluation of impact significance was based on the following clearly defined criteria:

- Legal/Regulatory requirement (L)
- Risk posed by impact (R)
- Frequency of occurrence of environmental impact (F)
- Importance of affected environmental component and impact (I)
- Public interest/concern & perception (P)

The above criteria and the rating adopted for the evaluation are described below:

- ❖ **Legal/Regulatory Requirement (L)** – Is there a legal/regulatory requirement? In the evaluation process, project activities that could result in impacts were weighed against existing legal/regulatory requirements to determine if the issue is affected by legislation or whether permits are required prior to the execution of such activities. Such legal/regulatory requirements were identified from the laws/guidelines, which have been reviewed in Chapter One of this report as well as those guidelines in the source references relating to the proposed project activity. The rating used for this criterion is as shown in Table 5.4.

Table 5.4: Legal/Regulatory Requirement Criteria

Legal/Regulatory Requirement	Rating	Condition
Low	1	No legal/ regulatory requirement for carrying out project activity
Medium	3	Legal/regulatory requirement exist for carrying out project activity
High	5	A permit is required prior to carrying out project activity

Risk Posed by Impact (R) – What is the risk/hazard rating based on Risk Assessment Matrix (RAM)?

Risk is a measure of the likelihood and magnitude of an adverse effect. For the proposed project, associated risks with aspects of project activities were evaluated in terms of: Risk to human health; Risk to asset (commercial and economic risk); Risk to the biophysical environment; and Risk to the client's reputation.

Risks posed by potential impacts were evaluated based on the Risk Assessment Matrix (RAM) shown in Figure 5.2. Three criteria, namely: Consequence (C), Probability of occurrence (P) and Severity (S) were used as basis for ranking the risk.

Consequence (C): This was used to determine the severity which was then summed with the probability of occurrence to determine the level of risk as illustrated below:

- Low Risk where $S + P$ is $2 \leq 5$
- Medium Risk is where $S + P$ is $6 \leq 7$
- High Risk is where $S + P$ is $8 \leq 10$

Probability (P): The probability is further explained for clarity as the measure of the likeliness that an event will occur. For the purpose of this Report, the probability factor is quantified as

whole numbers between 1 and 5 (where 1 indicates impossibility and 5 indicates absolute certainty). The higher the probability of an event within the scale, the more certain that the event will occur as described in Table 5.5.

Table 5.5: Description of Probability

S/N	Likelihood	Description
1	Never heard of in industry	An event which has never occurred or is unheard of in the construction industry
2	Heard of in industry	An event which rarely occurs in the industry, although it may have occurred before, but it is uncommon.
3	Incident has occurred in our company	An event which is likely going to occur
4	Happens several times per year	An event which the industry is familiar with and may occur more than once within a project
5	Happens several times per year in a location	An event which occurs frequently in the industry and may likely occur almost every day during the project.

Using the RAM in Figure 5.2, risk posed by potential impacts were assessed and ranked as presented in Table 5.6:

Table 5.6: Risk Criteria

Risk	Rating	Attribute – Environmental, Human Health, Safety and Reputation
Low	1	This means that no further mitigation action may be required
Medium	3	The impact can be mitigated with additional controls and modifications
High	5	This means that the impact requires avoidance or major control/mitigation

- **Frequency of Impact (F)** – What is the frequency rating of impact?

Evaluation of the frequency of occurrence was carried out and rated as “high”, “medium” or “low” based on the outcome of the RAM, consultation with project proponent, experts and professional judgment. The weighing scale used for this criterion is presented in Table 5.7.

Table 5.7: Frequency Criteria

Importance	Rating	Attribute – Environmental, Human Health and Safety
Low	1	• Minor degradation in quality in terms of scale (<0.1% of study area), appearance and duration (e.g., only a few days). • Rapid reversibility (change lasting only a few weeks before recovery, no lasting residual impact of significance) • No potential for cumulative impact • Very localized geographic extent of impact (e.g., not more than a few meters from impact source point) • Low frequency of impact (occur in just about one occasion during the project execution period) • Immeasurable change in social, cultural, economic activity of affected communities (e.g., a few jobs lost, etc.)
Medium	3	• Degradation in quality in terms of scale (>0.1% of study area), appearance and duration (e.g., a few months). • Slow reversibility (change lasting only a few months before recovery, lasting residual impact of significance)
		• Potential for cumulative impact • Limited geographic extent of impact • Intermittent frequency of impact (occur in only a few occasions during the project execution period) • Measurable change in social, cultural, economic activity of affected communities (e.g., percent of jobs losses, etc.)
High	5	• Major degradation in quality in terms of scale (>1% of study area), appearance and duration (beyond duration of project). • Irreversible or only slowly recoverable (change lasting more than one year, degradation of environmental ecosystem level (population, abundance, diversity, productivity) • Existing cumulative impact • Geographic extent of impact (Encompassing areas up to half the area of project coverage) • High frequency of impact (occur continuously and almost and almost throughout the project execution period (about 12 months) • Major change in social, cultural, economic activity of affected communities (e.g., percent of jobs losses, etc.)

- **Importance of Impact (I) – What is the rating of importance based on consensus of opinions?**

The importance of target environmental component in respect of identified potential impact was determined and rated as “high”, “medium” or “low”. The ratings were based on consensus of opinions among consulted experts including project engineers and other stakeholders on the proposed project. The rating used for the criterion is outlined in Table 5.8.

Table 5.8: Importance Criteria

Importance	Rating	Attribute – Environmental, Human Health and Safety
Low	1	• Low Imperceptible outcome • Insignificant alteration in value, function or service of impacted resource • Within the compliance of regulations, no controls required
Medium	3	• Negative outcome • Measurable reduction or disruption in value, function or service of impacted resource • Potential for noncompliance with regulations
High	5	• Highly undesirable outcome (e.g., impairment of endangered, protected habitat, species) • Detrimental and extended flora and fauna behavioural change (breeding, spawning, molting) • Major reduction or disruption in value, function or service of impacted resource • Impact during environmentally sensitive period • Continuous noncompliance with regulations

Public Interest/Concern & Perception (P) – What is the rating of public perception and interest regarding the project and impacts based on consultation with stakeholders? The opinions, views and concerns of interested parties including affected communities were

solicited through consultations and questionnaire administration. The criteria used to assign the ratings are outlined in Table 5.9.

Table 5.9: Public Interest/Concern & Perception Criteria

Public Interest &Concern Perception	Rating	Attribute – Environmental, Human Health & Safety
Low	1	• No risk of accident and/or death • No risk to human health, acute and/or chronic • No negative effect on means of livelihood • No possibility of life endangered for on-site personnel • Minor reduction in social, cultural, economic value
Medium	3	• Limited incremental risk to accidents and death • Minimal report on risk to human health, acute or chronic • Unlikely life endangered for on-site personnel • Some reduction in social, cultural, economic value • Possibility of adverse perception among population in the project area • Potential for non-compliance
High	5	• Elevated incremental risk to accidents and death • Increased risk to human health, acute and / or chronic • Possibility of life endangered for on-site personnel • Possibility of fuelling inter-communal conflict • Major reduction in social, cultural, economic value • Major public concern among population in the project area • Continuance non-compliance with statutes

5.3.3 Overall Significance Ranking

Following the evaluation of each impact using the criteria discussed above, the significance of each impact was then rated as “Low”, “Medium” or “High” using the criteria in Table 5.10.

Table 5.10: Classification of Impact Significance

Significance	Criteria	Notes
Low	(L+R+F+I+P) 0 - 8:	That is the sum of weight of Legal Requirement, Risk Factor, Frequency of Occurrence of Impact, Importance & Public Perception ranges between 0 and 8.
Medium	(L+R+F+I+P) 9 - 14	That is the sum of weight of Legal Requirement, Risk Factor, Frequency of Occurrence of Impact, Importance & Public Perception ranges between 9 and 14.
High	(L+R+F+I+P)	That is the sum of weight of Legal Requirement, Risk Factor, Frequency of Occurrence of Impact, Importance & Public Perception is greater or equal to 15
	(F+I) 6	That is sum of weight of Frequency of Occurrence of Environmental Impact and Importance of affected Environmental Component is greater than the benchmark of 6.
	P = 5:	That is the weight of public interest and perception of the potential impact is the benchmark of 5.

* L= Legal, R = Risk, F = Frequency, I = Importance, P = Public Interest

The result of the impact characterization and evaluation exercise is presented in Table 5.11

Table 5.11: Evaluation of Associated and Potential Impacts of Proposed Project

PROJECT ACTIVITIES	ENVIRONMENTAL AND SOCIAL IMPACTS	Impact Evaluation					Total Score		Impact Significance	
		Assessment Criteria								
		L	R	F	I	P	F+I	L+R+F+I+P		
PRECONSTRUCTION PHASE										
○ Land acquisition	○ Loss of farmland and land-based livelihood	3	5	3	3	5	6	19	HIGH	
	○ Loss of economic trees including medicinal herbs.	3	1	1	3	3	4	11	MEDIUM	
	○ Grievance and conflicts over land and Property resettlement & compensation.	3	5	3	3	5	6	19	HIGH	
	○ Reduction in food production and consumption	3	1	1	1	1	2	7	LOW	
○ Installation of Site Camp Structures and Facilities	○ Noise and vibration disturbances from the use of machineries & equipment.	0	1	3	3	1	6	8	LOW	
	○ Generation of hazardous and non-hazardous wastes	0	1	3	3	1	6	8	LOW	
	○ Soil contamination from indiscriminate dumping of hazardous wastes.	0	1	3	3	1	6	8	LOW	
	○ Security risks	0	3	3	3	3	6	12	MEDIUM	
	○ Risks of occupational accident and injuries to workers	0	3	3	3	3	6	12	MEDIUM	
○ Mobilization of Equipment,	○ Deterioration of local air quality due to the release of fugitive dusts & gases.	0	1	3	3	1	6	8	LOW	

Materials and Workers	○ Noise and vibration disturbances from equipment & truck traffic.	0	1	3	3	1	6	8	LOW
	○ Disturbance & displacement of wildlife as a result of noise and vibration.	0	1	3	3	1	6	8	LOW
	○ Compaction of soil and predisposition to erosion as a result of use and stationary positioning of heavy-duty vehicles.	0	1	3	3	1	6	8	LOW
	○ Landscape disruption and visual intrusion	0	3	1	1	1	2	6	LOW
	○ Increased security risks due to storage of materials and equipment on site	0	3	3	3	3	6	12	MEDIUM
	○ Threat to community culture, safety and security due to presence of workers and business opportunists.	0	5	3	3	3	6	14	MEDIUM
	○ Increase demand on existing community health and sanitation infrastructure due to influx of temporary workers and camp followers.	0	5	3	3	3	6	14	MEDIUM
	○ Employment of local labour.	3	3	3	3	5	6	17	POSITIVE
	○ Respiratory and eye related problems from exposure to dusts and gases.	0	1	3	3	1	6	8	LOW

PROJECT ACTIVITIES	ENVIRONMENTAL AND SOCIAL IMPACTS	Impact Evaluation					Total Score		Impact Significance
		Assessment Criteria							
		L	R	F	I	P	F+I	L+R+F+I+P	
	○ Traffic congestions and risks of road traffic accidents and injuries.	0	1	3	3	1	6	8	LOW
	○ Occupational related accidents and injuries	0	1	3	3	1	6	8	MEDIUM
○ Site Preparation and Clearing	○ Deterioration of local air quality due to the emission of dusts & gases	0	3	3	3	3	6	12	MEDIUM
	○ Noise and vibration disturbances from operation of heavy-duty vehicles.	0	3	3	3	3	6	12	MEDIUM
	○ Loss of vegetation and habitat destruction	0	5	3	3	3	6	14	MEDIUM
	○ Wildlife disturbances and destruction	0	3	3	3	3	6	12	MEDIUM
	○ Loss of ecosystem provisions e.g., fuel wood & economic trees	0	5	3	3	3	6	14	MEDIUM
	○ Predisposition to soil erosion due to the removal of vegetal cover.	0	5	3	3	3	6	14	MEDIUM

	○ Soil contamination from the spill of fuels/oils from heavy equipment	0	1	3	3	1	6	8	LOW
	○ Waste generation from accumulation of cleared vegetal materials.	0	1	3	3	1	6	8	LOW
	○ Siltation of surface water from eroded topsoil	0	5	3	3	3	6	14	MEDIUM
	○ Respiratory and eye related problems for workers due to exposure to fugitive dusts and gaseous emissions.	0	3	3	3	3	6	12	MEDIUM
	○ Occupational related accidents and injuries to workers	0	3	3	3	3	6	12	MEDIUM
CONSTRUCTION PHASE									
○ Earthworks and Grading ○ Construction of culverts	○ Deterioration of local air quality due to the release of dust & exhaust gases.	0	5	3	3	3	6	14	MEDIUM
	○ Noise and vibration disturbances.	0	5	3	3	3	6	14	MEDIUM
	○ Predisposition of soil to erosion.	0	3	3	3	3	6	12	MEDIUM
	○ Soil contamination from leakage/spillage of fuel from equipment & vehicles.	0	3	3	3	3	6	12	MEDIUM
	○ Generation of spoils and other excavated materials.	0	3	3	3	3	6	12	MEDIUM

	○ Generation of construction waste and debris	0	3	3	3	3	6	12	MEDIUM
	○ Surface water contamination as a result of sediment/pollutants run off from spoils and exposed soil surfaces.	3	5	3	3	5	6	19	HIGH
	○ Groundwater contamination from accidental spillages and leakages of oils and other chemicals.	0	1	3	3	1	6	8	LOW
	○ Direct and indirect job creation.	3	3	3	5	5	8	19	POSITIVE
	○ Improved livelihood and poverty reduction.	3	3	3	5	5	8	19	POSITIVE
	○ Stimulation of socioeconomic activities arising from employment creation.	3	3	3	5	5	8	19	POSITIVE
	○ Increased revenue generation to government through permits and taxes.	3	3	3	5	5	8	19	POSITIVE
	○ Risk of communicable diseases such as sexually transmitted diseases (STDs) including HIV/AIDS from influx of temporary construction workers.	0	3	3	3	3	6	12	MEDIUM
	○ Risks of occupational accidents and injuries to workers.	0	3	3	3	3	6	12	MEDIUM

PROJECT ACTIVITIES	ENVIRONMENTAL AND SOCIAL IMPACTS	Impact Evaluation					Total Score		Impact Significance
		Assessment Criteria							
		L	R	F	I	P	F+I	L+R+F+I+P	
○ Paving and bitumen concrete laying	○ Generation of hazardous waste	0	1	3	3	1	6	8	HIGH
	○ Noise and vibration disturbances in the adjoining settlements from use of machineries and motorized equipment.	0	3	3	3	3	6	12	MEDIUM
	○ Risk to community health and safety	0	3	3	3	3	6	12	
	○ Loss of employment for temporary workers after construction	0	3	3	3	3	6	12	
	○ Risks of occupational accidents and injuries to workers.	0	3	3	3	3	6	12	
OPERATION PHASE									
○ Road Usage	○ Increased traffic & risk of road traffic accidents and injuries.	3	3	1	3	3	4	13	MEDIUM
	○ Traffic noise disturbances	3	3	1	1	1	2	6	LOW
	○ Improved rural access accessibility and mobility in the project area;	3	3	3	5	5	8	19	POSITIVE
	○ Stimulation of local and regional economic activities due to improved road network in the region.		3	3	5	5	8	19	

		3							POSITIVE
	○ Improvement in agricultural productivity, economic empowerment and sociocultural wellbeing of the benefiting communities.	3	3	3	5	5	8	19	
	○ Improved accessibility to communities, markets, farms and agro processing centres.	3	3	3	5	5	8	19	
	○ Increased agricultural production by facilitating easy access to inputs, extension services, primary and secondary (urban) markets.	3	3	3	5	5	8	19	POSITIVE
	○ Improved communication and socioeconomic integration amongst adjoining communities.	3	3	3	5	5	8	19	
	○ Reduction in travel time and transport operating cost due to improvement in the riding quality of the road.	3	3	3	5	5	8	19	
○ Maintenance and Repairs	○ Deterioration of local air quality due to the release of dust from exposed soil surfaces and exhaust emissions from heavy equipment and vehicles.	0	3	1	1	3	2	8	LOW
	○ Noise and vibration disturbances.	0	3	1	1	1	2	6	LOW
	○ Generation of construction waste and debris	0	3	3	3	3	6	12	MEDIUM
	○ Risks of occupational accidents and injuries to workers.	0	5	3	3	3	6	14	MEDIUM
	○ Direct and indirect job creation.	3	3	3	5	5	8	19	POSITIVE

5.4 Discussion of Environmental and Social Impacts

The proposed SBS-2 is expected to have highly positive socioeconomic impacts, especially on the affected communities and people of Kebbi State. This road project will significantly enhance the road network between communities, towns, and cities, while connecting rural to semi-urban communities, thereby stimulating both local and regional economic activities. The new road network will also promote integration and improve accessibility to communities, markets, farms, and agro-processing centers in the region.

Given that the majority of the population in the affected 9 LGAs are engaged in farming and trade, the provision of an improved road network will lead to an increase in agricultural output by facilitating easier access to farm inputs, extension services, and primary and secondary (urban) markets. The enhanced agricultural productivity will translate to economic empowerment, poverty reduction, and socio-cultural wellbeing for the benefiting communities.

Additionally, the proposed superhighway project will contribute to the overall socioeconomic wellbeing of the region by creating employment opportunities. A significant number of locals are expected to be directly engaged, particularly as semi-skilled workers (e.g., masons, carpenters, electrical technicians, welders, etc.) and unskilled laborers (e.g., for site clearance, loading and offloading of materials, security services, etc.). Furthermore, the project will generate indirect opportunities for local contractors, businesses, and food vendors, among others. This impact will be highly beneficial, given the high unemployment rate in Nigeria and in the project's host communities.

However, the project will inevitably have some adverse impacts on the biophysical and social environment. These impacts are expected to be more pronounced during the construction phase of the project. Such adverse effects are anticipated to be largely localized in spatial extent, short term in duration, and manageable through the application of appropriate mitigation measures, sound design, good construction practices, effective maintenance, and adequate supervision and enforcement during project implementation.

The potential environmental and social impacts that may arise from activities to be undertaken during the preconstruction, construction, operation, and maintenance phases of the proposed superhighway project are discussed in the following sections.

5.4.1 Adverse Environmental Impacts

5.4.1.1 Impact on Air Quality

❖ Deterioration of Local Air Quality

The construction of the proposed SBS-2, is expected to result in significant air quality deterioration within and around the project corridor. Air pollution will primarily result from the generation of dust and gaseous emissions caused by construction activities and vehicular movements. Specific sources of air pollutants will include site preparation activities, such as clearing vegetation and topsoil, extensive road earthworks, and the operation of heavy-duty machinery. Additionally, the transportation of construction materials, including aggregates, sand, and concrete, using trucks on unpaved surfaces, will lead to substantial dust emissions and vehicular exhaust pollution.

Road earthworks, which involve excavation, grading, and levelling, will particularly contribute to dust emissions. This will be compounded by the operation of diesel-powered construction equipment and vehicles, which emit a variety of pollutants. The arid climatic conditions and flat terrain characteristic of the Sokoto and Kebbi regions could exacerbate the spread of dust, particularly during dry and windy periods.

5.4.1.2 Potential Impacts

The deterioration of air quality during the construction of the superhighway is likely to have several adverse effects. Increased concentrations of particulate matter, especially PM₁₀ and PM_{2.5}, can pose significant health risks to workers and nearby communities, including respiratory and cardiovascular issues. Dust emissions can also reduce visibility along the construction corridor, increasing the risk of accidents. Gaseous emissions, such as CO, NO_x, and SO₂, could exacerbate health problems, particularly for vulnerable populations, including children, the elderly, and those with pre-existing conditions.

In addition to human health concerns, the deposition of dust on surrounding vegetation can impede photosynthesis, reduce crop yields, and harm local ecosystems. Wildlife in the area may also be affected by increased airborne pollutants and dust deposition on habitats. Furthermore, the arid climate and flat terrain of Kebbi state may facilitate the wide dispersal of pollutants, potentially affecting areas beyond the immediate project zone.

❖ Noise and Vibration

Noise is an inevitable consequence of construction activities, particularly for large-scale infrastructure projects such as the proposed SBS-2. The primary sources of noise during the pre-construction and construction phases will include the operation of heavy duty vehicles, motorized equipment, and machinery. Key contributors to noise will be earthmoving and excavation equipment, concrete mixers, and other machinery required for road earthworks and material handling.

During the pre-construction phase, noise and vibrations will also arise from the movement of heavy-duty vehicles transporting personnel, construction plants, equipment, and materials to the site. The operation of excavation and grading machinery during road earthworks will further contribute to noise levels and vibration disturbances, especially in areas close to settlements or sensitive receptors.

The impacts of noise and vibration from these activities are unavoidable and may pose significant risks to construction workers and create a nuisance for members of adjoining communities. Prolonged exposure to high noise levels can lead to auditory health issues for workers if adequate protection is not provided, while vibrations may cause discomfort or damage to nearby structures depending on their intensity and proximity.

However, these impacts are considered to be of medium significance because noise-generating activities will primarily occur during the daytime when noise is more tolerable due to the masking effect of ambient background noise. Additionally, the duration of construction-related noise is expected to be short-term and localized, as it will be limited to the project's construction period and specific work zones along the road corridor.

5.4.1.3 *Impact on Soil/Land*

The construction of the proposed SBS-2 is expected to have significant impacts on soil and land resources. Key concerns include soil compaction, erosion, contamination, and waste generation, which may vary in severity depending on the project phase and specific activities.

5.4.1.3.1 Soil Erosion

Ground-disturbing activities during the pre-construction and construction phases of the proposed SBS-2, will significantly contribute to soil erosion. The clearing of vegetation, excavation, and removal of topsoil expose the underlying soil to the elements, reducing its natural protective cover and increasing its vulnerability to erosion. Additionally, the side tipping

of spoil materials and the use of heavy machinery further destabilize the soil, compounding the erosion risk.

This impact is expected to be particularly severe during the wet season, as the increased rainfall accelerates soil displacement, washes away topsoil, and leads to the loss of soil structure and fertility. The region's soils, along the alignment are prone to erosion due to their high silt-clay content, low structural stability, and low organic matter, which reduce their porosity and water retention capacity. These soil characteristics make the area more susceptible to flooding and erosion, further enhancing the risk of sediment transport into nearby water bodies and disrupting local ecosystems.

The consequences of soil erosion could extend beyond the construction zone, affecting water quality, aquatic life, and surrounding vegetation. The erosion process could lead to the silting of rivers and streams, further degrading the environment. Given these factors, the potential impact of soil erosion is considered of **moderate to major significance** during both the preconstruction and construction phases, highlighting the need for careful management to mitigate erosion risks and preserve soil health.

5.4.1.3.2 Soil Contamination

The Potential Environmental Impacts of soil contamination during the construction of the Proposed Sokoto-Badagry Superhighway, Section 2, are significant, albeit localized, and can have long-term consequences for both the immediate area and surrounding ecosystems. Contaminants such as fuels, oils, and lubricants, when spilled or improperly disposed of, can lead to toxicity in the soil, harming vital soil organisms like earthworms and microbes that are essential for maintaining soil health and fertility. This disruption to soil life can degrade the soil's capacity to support vegetation and crops, potentially reducing agricultural productivity in the region.

Furthermore, these contaminants can leach into groundwater, causing contamination of water supplies and impacting local communities' access to safe water. The presence of hazardous substances in the soil can also affect the broader ecosystem, disrupt the local flora and fauna and leading to a loss of biodiversity, especially in sensitive environments along the highway route. In the long term, soil contamination could hinder the regeneration of vegetation in the affected areas, delaying the restoration of ecological balance.

While the impact is localized to the construction area and is generally reversible over time, the persistence of contaminants, particularly in areas with limited natural recovery processes, can lead to prolonged environmental damage. The severity of these impacts underscores the importance of proper management practices to prevent contamination and facilitate effective clean up, ensuring that the environmental health of the region is protected.

5.4.1.4 *Waste Impact*

Road construction is a resource-intensive activity that generates substantial amounts of waste, both biodegradable and non-biodegradable. The types and quantities of waste produced vary across the project phases, with each phase contributing to potential environmental challenges.

5.4.1.4.1 Pre-Construction Waste

During the pre-construction phase, significant waste generation is expected from land preparation activities. This includes:

- **Cleared Vegetative Materials:** Trees, shrubs, grasses, and other organic matter removed to clear the road corridor.
- **Excavated Soil and Spoil:** The removal of topsoil and subsoil during site grading and levelling produces excess soil material.
- **Demolition Waste:** If existing structures, such as old culverts or temporary installations, are dismantled, these will also contribute to pre-construction waste.

These materials, while mostly biodegradable or inert, require proper handling to prevent pileup, obstruction of drainage channels, or encroachment into adjacent ecosystems.

5.4.1.4.2 Construction Waste

The construction phase generates a more diverse array of waste types due to the intensive civil engineering activities involved. Key waste streams include:

- **Rubble and Debris:** Excavation and scarification activities produce rubble and discarded rock or concrete fragments.
- **Construction Debris:** Materials such as metal offcuts, wood, and plastic from drainage and bridge construction, scaffolding, or temporary installations.

- **Packaging Waste:** Bags, containers, and wraps from construction materials like cement, bitumen, and chemicals.
- **Hazardous Waste:** Used oils, lubricants, and chemical residues from equipment maintenance and operation.

Improper handling of these wastes can lead to contamination of soil and water bodies, especially during the wet season when runoff can spread pollutants beyond the immediate project area.

5.4.1.4.3 Workers' Camps Waste

Temporary workers' camps established for the duration of the project also contribute to waste generation. These camps are likely to produce:

- **Domestic Waste:** Food waste, organic matter, and sanitary waste.
- **Non-Biodegradable Waste:** Packaging materials, plastics, and cans from daily activities.
- **Discarded Equipment and Parts:** Broken tools, damaged machinery parts, and worn out personal protective equipment (PPE).

Without proper waste management systems, the accumulation of such waste could create environmental and health hazards for the workers and nearby communities.

5.4.1.4.4 Post-Construction Waste

The completion of construction activities is accompanied by site cleanup, which often generates additional waste. This includes:

- **Wet Concrete and Construction Residues:** Leftover concrete and materials used in construction may be improperly disposed of.
- **Damaged or Used Equipment:** Discarded containers, empty drums, and damaged construction tools.
- **Temporary Structures:** Removal of temporary storage units, scaffolding, and other installations can generate large quantities of waste.

5.4.1.5 *Environmental Significance*

Improper handling, storage, or disposal of these wastes has the potential to result in soil contamination, particularly through leaching of hazardous materials into the soil profile. This can negatively impact soil fertility, disrupt local ecosystems, and pose risks to groundwater quality. Although these impacts are considered localized, they are of medium significance due to their cumulative effects on the surrounding environment.

5.4.1.5.1 Impact on Water Resources

The proposed SBS-2, passes through areas that are home to several streams and rivers, including the Sokoto River, Rima River, and Goronyo River, which feeds into the Rima River. Construction activities along the highway route have the potential to impact both surface water and groundwater resources in the area.

▪ **Sedimentation of Surface Water**

The road construction will involve extensive earthworks, such as site clearing and excavation, which are likely to result in high sediment-laden runoff. This runoff can carry silt and debris from exposed soil surfaces into the surrounding rivers and streams, leading to increased turbidity and nutrient levels in the surface water. Activities like road earthworks, drainage, and bridge construction will exacerbate sedimentation during both the pre-construction and construction phases. The risk of significant siltation is particularly high, especially given the scale of earth-moving activities required for the project.

Such sedimentation poses serious risks to the quality of surface water, as it can lead to the deterioration of water quality in the Sokoto, Rima, and Goronyo Rivers. This increased sediment load could result in the loss of aquatic life, as suspended particles in the water reduce light penetration, impacting photosynthesis and the health of aquatic plants. Moreover, sedimentation can lead to eutrophication, which depletes oxygen levels in the water and further disrupts aquatic ecosystems.

While the potential impacts on surface water resources are expected to be of **high significance**, the effects on groundwater resources are likely to be **insignificant**, given the nature of the project and its distance from groundwater sources. However, the importance of mitigating surface water contamination remains critical due to the potential long-term impacts on water quality and local ecosystems.

▪ Receptor Sensitivity

Surface water resources and drainage systems within the proposed SBS-2 are highly sensitive to disruptions caused by construction activities. The region is home to critical water bodies such as the Sokoto River, Rima River, and Goronyo River, which provide essential ecological and socio-economic services to surrounding communities. Disturbances to these water resources, such as sedimentation, alteration of flow patterns, and water quality degradation, can significantly impact aquatic habitats, agricultural practices, and water availability for both domestic and industrial use. The sensitivity of these systems to construction-related changes underscores the importance of addressing potential impacts on surface water and drainage.

Construction activities, particularly during the preconstruction and construction phases, are likely to generate significant sediment-laden runoff from earthworks, road clearing, and other excavation activities. This runoff can lead to increased turbidity and sedimentation in key water bodies such as the Sokoto and Rima Rivers, which could adversely affect water quality, aquatic life, and surrounding ecosystems. The alteration of natural drainage patterns could exacerbate flooding or erosion issues, impacting agricultural lands and local communities' access to water resources.

5.4.1.5.2 Impact on Ecology and Biodiversity

The proposed SBS-2, has the potential to significantly impact the local ecology and biodiversity through various construction activities. Key threats include vegetation clearing, habitat destruction, and disturbance to wildlife.

Vegetation Clearing and Habitat Alteration

One of the most significant environmental impacts associated with road construction projects is the destruction of natural habitats due to vegetation clearing. During the preconstruction phase, the route for the proposed SBS-2, will need to be cleared, which will involve removing trees, shrubs, and other vegetation that exist along the existing single carriageway. The clearing will create a disturbance within the local ecosystem, removing both plant life and the habitats they provide for local fauna. While some parts of the existing vegetation will remain untouched, areas within the designated Right of Way (ROW) will be cleared to accommodate the expansion of the road, which includes a 7.3-meter road width and 2.5-meter shoulders on each side. As the ROW passes through diverse ecological zones, the impact on these ecosystems will vary depending on the area's specific vegetation type and biodiversity.

The loss of natural vegetation will reduce the availability of essential ecological services, such as carbon sequestration, soil stabilization, and the provision of habitats for various species. The affected ecosystems may also experience an altered hydrological cycle due to changes in water retention and runoff patterns, which could exacerbate soil erosion in some areas. The extent of this habitat alteration is substantial but localized to areas directly impacted by the construction activities.

Loss of Economic Trees and Ecosystem Provisioning Services

The removal of vegetation during road construction will also lead to the loss of economically valuable tree species, which are important for the local communities. These trees provide various ecosystem services, such as the provision of timber, fuelwood, medicinal plants, and other plant species used in food, shelter, and construction. The loss of these resources could result in adverse socio-economic consequences for the affected communities, particularly those who rely heavily on these resources for their livelihoods.

The impact on ecosystem provisioning services is expected to be of **medium significance** due to the relatively small scale of land clearing and the fact that compensatory measures will be put in place for affected landowners. However, the cumulative loss of these resources could reduce the overall well-being of local communities, particularly in rural areas that depend on the natural environment for sustenance and income. It should be noted that the impact is anticipated to be localized to areas where the road expansion occurs, and mitigation strategies such as tree planting and compensatory land access for affected communities may help alleviate the long-term effects.

Wildlife Disturbances and Displacement

Wildlife in the project area is likely to be disturbed due to the noise, movement of construction vehicles, and general human activity during the construction phases. The noise generated by heavy machinery, vehicles, and workers is a major disturbance to wildlife, which can lead to changes in animal behavior and habitat displacement. Species that are sensitive to human presence or sound, such as small mammals, birds, and amphibians, may be forced to abandon their territories or migrate to less disturbed areas.

Fauna that are less mobile or more vulnerable to disturbances, such as ground-dwelling species or those with limited home ranges, may face direct threats. In extreme cases, animals could be injured or killed during the construction process, particularly during site clearing and

excavation activities. These impacts are expected to be localized, affecting areas immediately adjacent to the construction zone.

Although road construction typically causes temporary disruptions, the continuous noise, vibrations, and activity during construction can have lasting impacts on sensitive wildlife species. The disturbance is expected to be **medium in significance** as it will be temporary and confined to the areas around the construction site, but the long-term ecological effects could lead to changes in local wildlife populations and species composition. It is important to note that road projects can fragment habitats, making it more difficult for wildlife to move freely, especially if the highway is not designed with wildlife corridors or crossings.

Alteration of Ecosystem Functions and Services

Beyond the direct loss of vegetation and wildlife, the road construction project may also alter important ecosystem functions and services in the area. The fragmentation of habitats can disrupt migration patterns, breeding cycles, and the overall ecological balance in the affected areas. Furthermore, the removal of trees and vegetation can reduce the ability of the land to naturally purify air and water, mitigate climate change impacts, and support biodiversity.

For example, in the areas near the Sokoto and Rima rivers, the clearing of vegetation along riparian zones can impact the stability of riverbanks and increase the likelihood of soil erosion and sedimentation. This, in turn, can affect the quality of water resources, degrade aquatic habitats, and harm fish and other species dependent on these ecosystems.

The reduction of these vital ecosystem services is particularly concerning in areas that rely on natural resources for economic and social sustenance. Although these impacts are likely to be temporary and localized, they could have broader implications for biodiversity and the local communities, particularly those whose livelihoods depend on the health of the surrounding ecosystems.

In conclusion, the impacts on ecology and biodiversity from the proposed Sokoto-Badagry Superhighway, Section 2, are expected to be significant but manageable. While the primary threats include habitat destruction, loss of economic trees, and wildlife disturbances, mitigation measures such as proper planning, compensation for affected communities, and restoration of disturbed areas can reduce these impacts. However, the project will still result in some loss of biodiversity, and the disruption of natural ecosystems will require careful management to minimize long-term environmental consequences.

Receptor Sensitivity

The ecological and biodiversity resources along the proposed SBS-2 are highly sensitive to disturbances caused by construction activities. This stretch of road passes through a range of terrestrial and aquatic habitats, which support a variety of flora and fauna. The region is home to significant biodiversity, including both terrestrial species and aquatic life in the Sokoto River, Rima River, and Goronyo River. Any alteration of these habitats, through vegetation clearing, habitat destruction, or disturbance of wildlife, poses a potential threat to local biodiversity. The removal of vegetation and disruption to habitats can lead to a loss of species diversity, including the potential displacement of sensitive species, and affect ecosystem services provided by these areas. The ecological sensitivity of the area requires careful consideration of potential impacts to ensure the long-term preservation of these resources.

Construction activities, particularly during the preconstruction and construction phases, are likely to cause significant disturbances to local ecosystems. Vegetation removal and habitat alteration, which are inevitable during the route clearing and earthworks, will directly impact plant species and wildlife that rely on these ecosystems. This impact is expected to be most significant in areas with high biodiversity, as the clearing of vegetation could lead to the destruction of critical habitats for both terrestrial and aquatic species. Disturbances caused by noise, human activity, and construction machinery will also contribute to wildlife displacement and potential mortality, particularly for species with limited mobility.

5.4.2 Adverse Social Impacts

5.4.2.1 *Impacts of Land Acquisition*

The land acquisition for the proposed SBS-2 will primarily lead to economic displacement, particularly in areas where the existing road may not have the required width of 7.3m for the carriageway and 2.75m shoulders on both sides. In these locations, land acquisition will be necessary from farmers and the removal of structures along the right-of-way (ROW). The acquisition of land and property will affect livelihoods and may cause displacement for people reliant on farming or other land-based activities.

The project-related land acquisition may lead to significant socio-economic consequences such as the loss of farmland, which may reduce food production and income, and the loss of economic trees. The impact on land-based livelihoods may result in grievances and conflicts over resettlement and compensation processes. The economic displacement from land acquisition is considered to be of **High significance**, as it will directly affect people's means of

livelihood and may cause long-term disruption for farmers and local communities along the route.

5.4.2.2 Grievance and Conflicts

The land acquisition process, including the payment of compensation for acquired farmlands and properties, could give rise to grievances and conflicts in the project area. Concerns may arise from inadequate or delayed compensation payments, disagreements over land resettlement, and perceived unfairness in the implementation of compensation schemes. Given the significant amount of land that will be acquired along the project route, this issue is considered to be of **High significance**. Effective compensation and resettlement plans will be necessary to mitigate potential conflicts and ensure that affected individuals and communities are adequately supported.

5.4.2.3 Loss of Employment

During the construction phase, local unskilled workers may gain temporary employment on the road project. However, upon completion, these workers may lose their jobs, leading to economic hardship for some individuals and their families. The loss of employment, while significant in the short term, is considered to be of **medium significance**, given that the employment opportunities are temporary and will be terminated after project completion. There is an expectation that workers will seek alternative employment, though the transition may create challenges for some.

5.4.2.4 Threat to Community Culture, Safety, and Security

The influx of migrant workers, business opportunists, and other individuals from outside the region to work or engage in business activities related to the project could have cultural and social implications for the host communities. This influx may introduce external influences that could dilute or alter the traditional values and practices of the communities along the route. Additionally, the increased population and presence of transient workers may lead to an increase in social vices, including illicit drug use and petty crime, posing a threat to the safety and security of the local population. This impact is considered to be of **medium significance**, as it is expected to be temporary and reversible, limited to the construction phase. However, it is essential to consider the protection of local cultural heritage, including notable sites along the route.

Mitigation measures will be implemented to protect cultural heritage, particularly for any significant sites, in line with IFC Performance Standard 8 on Cultural Heritage Protection. These measures will aim to minimize the impact on cultural practices and safeguard important historical or sacred sites that may be located within the project area. Specific attention will be given to communities along the Sokoto-Badagry route, ensuring that their cultural identity remains intact while minimizing the social challenges posed by the project.

5.4.2.5 Pressure on Existing Infrastructures in Host Communities

The arrival of construction workers, along with the influx of camp followers and business opportunists, may put significant pressure on the existing healthcare, sanitary, and other infrastructure in host communities along the proposed SBS-2. The demand for healthcare services and sanitation facilities could overwhelm existing systems, especially if the local infrastructure is already under strain. However, this impact is considered to be of medium significance, as the worker's camp will be equipped with a clinic to meet the healthcare needs of workers. Additionally, temporary sanitary facilities, such as toilets and bathrooms, will be erected to cater to the workers' sanitary needs. While some of the business opportunists are likely to be residents of nearby communities, reducing the strain on facilities, it is still essential to plan for any potential impacts on local resources.

5.4.2.6 Risk of Sexually Transmitted Diseases (STDs)

The influx of a large, diverse group of people, including construction workers, migrant settlers, and camp followers, during the preconstruction and construction phases of the project, may increase the spread of sexually transmitted diseases (STDs), including HIV/AIDS and COVID19. This risk arises due to the interactions between high and low prevalence groups in the host communities and the transient population. Behavioral changes linked to poor living standards and economic pressure in the project area may also exacerbate this risk. Given the significant number of migrant workers expected and the potential for increased vulnerability due to poverty, this impact is considered to be of medium significance.

5.4.2.7 Labor Influx

The arrival of construction workers and associated migrant populations could lead to various social risks, such as workers' sexual relations with minors, unwanted pregnancies, and the presence of sex workers in the project communities. Other potential risks include the spread of HIV/AIDS, sexual harassment of female workers, child labor, school dropouts, poor labor

practices, and inadequate road safety measures. These risks require proactive management, with a focus on ensuring that appropriate labor policies are adhered to and that local communities are protected from negative social impacts.

5.4.2.8 *Gender-Based Violence (GBV)*

Gender-based violence (GBV) risks may arise due to the influx of construction workers and associated populations, with potential impacts including intimate partner violence (IPV), public harassment, physical abuse, rape, harmful widowhood practices, and trafficking of women and children. Nigeria's commitment to combating GBV is reflected in its ratification of various international human rights instruments, such as the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and the Maputo Protocol. The project must adhere to these international obligations, ensuring effective prevention, protection, punishment, and reparations for acts of violence against women and children. The development and implementation of specific GBV risk prevention and mitigation strategies, tailored to the local context, will be essential to address these issues effectively.

5.4.2.9 *Security Challenges*

The storage of equipment and materials at the project site during the preconstruction and construction phases could attract thieves, hoodlums, and other criminal elements. This may pose a risk to the security of lives and property in the area. Given the nature of the project and the volume of materials stored, the potential security risks are considered to be of medium significance. Measures to ensure the security of materials and personnel will be critical to prevent theft and other security-related incidents.

5.4.2.10 *Impact on Occupational Health and Safety*

Occupational health and safety (OHS) concerns are likely to arise during the preconstruction, construction, and decommissioning phases of the project. The mobilization of equipment and materials, site clearing, demolition, road construction, drainage and bridge construction, and installation of road furniture may expose workers to various health and safety hazards, such as:

- **Physical Hazards:** Exposure to excessive noise and vibration from machinery, extreme weather conditions, and accidents.
- **Chemical Hazards:** Exposure to fugitive dusts (e.g., cement dust) and exhaust emissions from machinery.

- Biological Hazards: Exposure to poisonous plants, dangerous animals (e.g., snakes and insects), and communicable diseases like STDs and COVID-19.
- Ergonomic Hazards: Poor manual handling, overexertion, and awkward posture.
- Electrical Hazards: Exposure to live wires and machinery accidents.
- Demolition Hazards: Risk of falls, struck-by injuries, and exposure to hazardous materials, electrical shock, fire, and explosions.

Other potential risks include injuries from the use of tools and machinery, accidents due to heavy vehicles and equipment, trips and falls during installation, and fire outbreaks caused by electrical failures. Although these hazards could be fatal, the significance of the impacts is considered to range from Minor to Major, depending on the specific activities being undertaken and the level of exposure of workers.

To address these risks, a robust Occupational Health and Safety Plan (OHSP) will be developed and implemented by the contractors. This plan will outline the safety procedures, emergency response protocols, and safety equipment required to protect workers. Rigorous enforcement of the OHSP will be essential to minimize accidents, injuries, and fatalities on the project site.

Table 5.12: Health Risk Assessment

Stressor/ Exposure	Impact on health	Population at risk	Probability of occurrence	Impact Rating	Environment/biological indicator (monitoring)
Emissions	- Climatic change (Injuries, deaths)	- Worldwide	- Low	Low	- Geoclimatic data and weather phenomena
	- Carboxyhaemoglobin globinemia (cHB)	- Public	- Very rare	Low	- Level of blood cHB
	- Irritation of respiratory tract	- Vicinity	- Rare	Low	- Atmospheric NO ₂ level
	- Respiratory problems (asthma, bronchitis, etc.)	- Vicinity	- Rare	Low	- Epidemiology of respiratory ailments
	- Respiratory irritations	- Vicinity	- Very rare	Low	- Epidemiology of respiratory ailments
	- Sleep disturbance, stress	- Vicinity	- Rare	Low	- Noise levels L (8 hrs), 45 dB, nighttime
	- Quality of life	- Vicinity	- Rare	Low	- Perception studies - Focus groups
Road Accidents	- Environmental allergy	- Vicinity	- Rare	Low	- Perception studies - Accident records
Fire	- Traumas, injuries, deaths	- Workers, vicinity and community	- Occasional	Low	- Morbidity and mortality reports, fire department reports - Storage of chemicals, and other flammable substrates.
Bridge Collapse	Damage to humans and vehicle/ equipment Accidents	- Workers, passengers - Pedestrian and possibly other passers-by	- Rare	Low	- Property assessment
Indirect impacts or other exposure	Individual and collective stress, conflicts, economic losses	Community	Occasional	Low	- General health of community members - Focus group, property assessment

5.4.3 Potential Negative Impacts during Decommissioning Phase

The decommissioning phase of the project may result in a variety of environmental, social, and safety-related challenges. These include:

1. Physical Disturbance

Removal of entrenched equipment and demolition of temporary structures can lead to physical alterations in the landscape, affecting the natural terrain and stability.

2. Soil Erosion

Improper reinstatement or compaction of excavated soil could result in soil erosion, potentially leading to sedimentation in nearby waterways and degradation of land quality.

3. Air Quality Degradation and Noise Generation

Excavation activities to remove buried infrastructure, demolition of structures, and the use of heavy machinery are likely to generate dust and particulate emissions. Additionally, noise pollution from equipment operation and transport activities could impact nearby communities and wildlife.

4. Occupational Hazards and Accidents

Risks to workers' safety may arise due to the use of heavy equipment, dismantling of structures, and handling of hazardous materials. This phase might expose workers to:

- Falls, trips, and injuries.
- Accidents involving vehicles and machinery.
- Exposure to hazardous substances, such as residual fuels or construction chemicals.

5. Waste Management Challenges

The dismantling of road infrastructure and associated facilities is likely to generate a large volume of construction and demolition waste, including:

- Concrete, and metal debris.
- Hazardous waste such as fuel residues, oils, and contaminated soil.

- General waste from the workforce and temporary facilities.

6. Social Misfits and Security Issues

Abandoned project sites might attract miscreants or serve as a hub for unauthorized activities. This could lead to increased crime or antisocial behavior within host communities.

7. Degradation of Roads and Adjacent Lands

Excavation and removal of materials may damage existing access roads and disturb adjacent agricultural lands or natural habitats, resulting in long-term environmental degradation.

5.4.4 Cumulative Impacts

Cumulative impacts in this report refer to the changes to the environment (both biophysical and social) that may arise from the proposed project activities in combination with other past, present, and future human activities. The concept of cumulative effects holds that while individual impacts may seem minor, their combined effect could significantly influence environmental and social receptors. When a resource or ecosystem is nearing its tolerance threshold, even a small additional change can result in substantial negative consequences.

The primary objective of the cumulative impact assessment is to identify the environmental and socio-economic factors that may not constitute significant impacts individually but, when combined with impacts from past, present, or reasonably foreseeable future activities, result in larger and more pronounced effects.

For the proposed SBS-2, the envisaged cumulative or secondary impacts are expected to be moderate to significant and warrant consideration for long-term planning and mitigation. Key potential cumulative impacts include:

1. Growth-Inducing Potential

The development of a major transportation corridor such as the proposed SBS-2 has the potential to stimulate substantial growth in the region. As the superhighway improves connectivity between states, it is likely to attract:

- New settlements in areas along the corridor as accessibility increases.
- Increased commercial activities in nodal communities near interchanges or entry/exit points.

- Investment in supporting infrastructure, such as service stations, markets, and logistics hubs.

This growth-inducing potential, while beneficial for economic development, could place additional stress on local ecosystems and infrastructure if not properly managed.

2. Spin-Off Activities and Secondary Impacts

The superhighway may trigger "spin-off" actions that contribute to cumulative impacts, including:

- *Agricultural Expansion:* Easier access to remote areas may lead to land clearing for farming, potentially contributing to deforestation and habitat loss.
- *Industrial Development:* Increased transportation efficiency could attract industries to the region, resulting in additional emissions, resource extraction, and waste generation.
- *Urbanization:* Towns and villages along the highway corridor may experience rapid, unplanned urbanization, straining existing services such as water supply, waste management, and electricity.

These secondary impacts, when combined with the initial impacts of the superhighway construction and operation, could intensify pressures on the environment and communities along the corridor.

3. Ecosystem Fragmentation and Biodiversity Loss

The construction and operation of the highway may fragment ecosystems along its route. Over time, cumulative effects may include:

- Reduced migration and dispersal of species due to habitat fragmentation.
- Loss of vegetation cover, leading to decreased biodiversity and ecosystem services.
- Increased human-wildlife conflict as natural habitats is encroached upon.

When combined with other land-use changes in the region, the highway's effects could contribute to long-term ecological imbalances.

4. Increased Pressure on Infrastructure and Resources

The superhighway will enhance accessibility to previously less-developed areas, potentially increasing demand for:

- Housing, schools, and healthcare facilities in nodal communities.
- Water resources, especially in arid or semi-arid zones.
- Roadside facilities, leading to possible haphazard development along the corridor.

These pressures, when combined with those from other ongoing or future developments, could overburden existing infrastructure and natural resources.

5. Social and Cultural Impacts

The influx of workers, businesses, and migrants to the area may lead to:

- Changes in community dynamics and cultural practices.
- Increased social inequalities if benefits are not equitably distributed.
- Risk of disputes over land ownership and use, particularly in communities where formal land tenure systems are weak.

5.4.5 Climate Change Impact

Africa's climate is expected to experience significant changes due to various climate scenarios, as highlighted by the World Bank (2018). These changes could profoundly affect infrastructure, particularly roads, by causing disruptions to supply chains, economic activities, and access to essential services. For high-traffic corridors like the proposed SBS-2, even moderate climate related impacts—such as increased rainfall, flooding, or temperature extremes—could substantially disrupt socio-economic activities, emphasizing the critical need for adaptation measures.

The World Bank Environmental and Social Standards (ESS) stress the importance of addressing climate risks in infrastructure projects. ESS1 calls for integrating climate risk assessments into project planning, while ESS3 focuses on resource efficiency and climate-adaptive designs to enhance sustainability. Additionally, ESS6 advocates for measures to mitigate climate pressures on biodiversity and promote ecosystem resilience.

Similarly, the IFC Performance Standards (PS) provide a framework for managing climate risks. PS1 emphasizes comprehensive risk assessments to incorporate climate adaptation strategies, PS4 highlights the need to ensure community safety in the face of climate-induced vulnerabilities, and PS6 underscores the importance of preserving ecological integrity amidst climate shifts.

To align with these standards, adaptation measures for the superhighway should include climate-resilient designs, such as durable materials and advanced engineering solutions, along with enhanced drainage systems to manage increased rainfall and mitigate flooding. Ecosystem based adaptations, like protecting surrounding vegetation, and the development of alternative routes for redundancy, are essential to safeguard the highway's functionality and regional connectivity.

5.5 Vulnerability of the Superhighway to Climate Stressors

The Sokoto-Badagry Superhighway is expected to enhance regional connectivity, stimulate economic growth, and serve as a critical transportation corridor. However, it will also face significant vulnerabilities to climate stressors, including:

1. Increased Temperatures:

- Higher temperatures can degrade road surfaces, particularly concrete, leading to faster wear and tear, rutting, and cracking.
- Expansion and contraction due to temperature fluctuations can compromise the integrity of bridges and other critical infrastructure along the highway.

2. Increased Precipitation and Flooding:

- Heavy rainfall and flooding, common in parts of Sokoto state during certain seasons, could inundate the road, erode embankments, and damage drainage systems.
- Poorly designed culverts and drains could exacerbate waterlogging and lead to prolonged road closures.

3. Drought and Dust Storms:

- Extended dry periods could weaken the structural stability of road embankments, especially in areas with loose soils.
- Dust storms could reduce visibility and increase maintenance costs due to the accumulation of debris on the roadway.

5.6 Quantifying Broader Impacts

When climate events reduce or disrupt the capacity of the Sokoto-Badagry Superhighway, the ripple effects on communities and economies along the corridor could be severe:

- **Economic Output:** Reduced road accessibility may delay the movement of goods, disrupt supply chains, and increase transportation costs.
- **Access to Services:** Climate-induced disruptions may hinder access to healthcare, education, and markets, particularly for rural communities along the route.
- **Agricultural Dependence:** Sokoto is an agricultural hub; road closures could delay the transportation of produce, leading to post-harvest losses and economic hardships for farmers.

5.7 Adaptation and Resilience Measures

To address the vulnerability of the **proposed SBS-2** to climate change, the following adaptation strategies are recommended:

1. Use of Climate-Resilient Materials:

- Employ heat-resistant cement and concrete that can withstand higher temperatures.
- Incorporate geotextiles and soil stabilization techniques to prevent erosion and improve road durability.

2. Improved Drainage Systems:

- Design and construct efficient drainage systems to handle high-intensity rainfall and reduce flooding risks.

- Regular maintenance of culverts, gutters, and embankments to ensure proper water flow and prevent waterlogging.

3. Increased Vegetation and Greening:

- Establish green buffers along the highway to reduce soil erosion and dust accumulation.
- Promote afforestation in nearby areas to combat desertification and enhance carbon sequestration.

4. Frequent Maintenance and Rehabilitation:

- Schedule periodic inspections to identify and address vulnerabilities before they escalate.
- Upgrade Road infrastructure based on climate projections to extend the lifespan of the highway.

5. Alternative Routes and Contingency Planning:

- Develop bypass roads or alternative routes to ensure continued connectivity during extreme weather events.
- Implement emergency response systems to minimize the impacts of road closures on communities and businesses.

CHAPTER SIX: MITIGATION MEASURES

6.1 Introduction

This Chapter describes mitigation measures to avoid, reduce or compensate for all significant impacts of the proposed SBS-2 identified in Chapter Five of this Report. The mitigation measures recommended are commensurate with the nature and magnitude of the potential impacts taking into cognizance the peculiarity of the proposed project and associated activities as well as environmental setting of the project area.

This Chapter also include measures to expand or enhance the benefits of the project especially as it relates to the socioeconomic well-being of the members of local communities and the project region.

6.2 Mitigation Approach

The approach adopted for selecting appropriate mitigation measures followed a hierarchy that favors the avoidance of impacts over minimization, and where residual impacts remain, compensate/offset for impacts to workers, affected communities and the environment, wherever technically and financially feasible to do so.

- **Avoidance:** To avoid the impact altogether by not using certain type of resources, or areas considered to be environmentally sensitive nor taking certain actions or parts of an action that could result in negative impacts. This is the most acceptable form of mitigation.
- **Minimization:** To minimize impacts by limiting or reducing the degree, extent, magnitude or duration of adverse impacts. Negative impacts can be minimized through environmental and social measures/treatments/design. Available options to minimize negative impacts include abate, rectify, repair, and/or restore impacts.

The mitigation (and enhancement measures) recommended are described in the following sections and presented in Table 6.1. Certain measures to enhance the potential positive impacts of the proposed project are also included.

6.3 Site Specific Impact Management

6.3.1 Air Quality Management

Managing ambient air quality during the implementation of the Proposed Sokoto-Badagry Superhighway project is essential for mitigating dust and gaseous emissions, which can affect both the environment and nearby communities. The Federal Ministry of Works (FMW) will implement the following air quality management strategies:

○ **Dust Suppression Techniques**

- **Wetting of Exposed Surfaces:** Regular application of water on exposed construction sites, unpaved roads, and other dusty surfaces will be carried out to reduce airborne dust particles. This will be especially effective during dry weather and high-wind conditions to prevent dust dispersion.
- **Traffic Optimization:** Optimizing the movement of vehicles and construction equipment within the work area will minimize the unnecessary stirring up of dust. Specific routes will be designated for trucks and heavy machinery, reducing dust generation.
- **Speed Reduction:** Speed limits will be enforced within the construction zones, particularly in areas where dust is likely to be raised due to vehicle movement. Lowering vehicle speeds reduces dust emissions and improves road safety.

○ **Revegetation and Soil Stabilization**

- **Prompt Revegetation:** Exposed soils and construction areas will be promptly revegetated with appropriate plant species or covered with erosion control materials (e.g., mulching or geotextiles) to prevent soil erosion and reduce dust. This will stabilize the soil and reduce the amount of dust carried by wind.
- **Temporary Covering:** In cases where immediate revegetation is not feasible, temporary cover materials such as tarpaulins or plastic sheeting will be used to contain dust until vegetation is established.

○ **Storage and Handling of Dust-Producing Materials**

- **Enclosed Storage Facilities:** Construction materials such as sand, gravel, cement, and other dry materials will be stored in enclosed or covered spaces to prevent dust from escaping into the air.

- **Dust Suppression in Storage Areas:** Dust suppression systems, including water misting systems or dust barriers, will be installed in areas where materials are handled or stockpiled. These measures will reduce the amount of dust released during the loading, unloading, and transportation of materials.
- **Covered Transport Vehicles:** All vehicles transporting dusty materials will be fully covered to prevent dust from dispersing during transit, especially along open stretches of the superhighway.
- **Vehicle and Equipment Emission Control**
 - **Regular Maintenance:** All vehicles and equipment used in the project will undergo regular maintenance to ensure they are running efficiently and not emitting excessive levels of exhaust gases, which contribute to air pollution.
 - **Anti-Idling Measures:** An anti-idling policy will be implemented for construction vehicles and equipment to reduce unnecessary emissions. Drivers will be trained to turn off engines when not in use for extended periods, reducing both air pollution and fuel consumption.
 - **Fuel Efficiency Training:** Operators will be trained on best practices for maintaining fuel efficiency, such as driving at optimal speeds, avoiding sudden acceleration or braking, and reducing idle times. This will help minimize emissions and conserve fuel.
- **Air Quality Monitoring**
 - **Continuous Monitoring:** Air quality monitoring stations will be installed at strategic locations along the project route to measure the levels of particulate matter (PM10 and PM2.5), nitrogen oxides (NOx), sulfur oxides (SOx), and carbon monoxide (CO). These stations will provide real-time data to track air quality and ensure compliance with environmental standards.
 - **Data-Driven Adjustments:** The air quality data collected will be analyzed regularly, and any spikes in pollutant levels will trigger immediate adjustments in mitigation measures, such as enhanced dust suppression or vehicle restrictions.

- **Community Engagement and Grievance Mechanism**

- **Community Awareness Programs:** Nearby communities will be informed about the air quality management measures in place and educated on the importance of minimizing exposure to construction dust.
- **Grievance Mechanism:** A formal grievance mechanism will be established to allow residents and local stakeholders to report any concerns related to air quality. This will ensure prompt responses to community concerns and the resolution of issues related to dust and emissions.

6.3.2 Noise and Vibrations

To minimize the potential impacts of noise and vibrations during the construction and operational phases of the proposed SBS-2, the Federal Ministry of Works (FMW) will implement the following best practices and management strategies based on the prevailing land use, proximity to sensitive receptors such as adjoining communities, and compliance with the FMEnv noise threshold of 90dB(A) for the nearest sensitive receptors:

- **Installation of Noise Control Measures**

- **Mufflers and Noise-Reducing Equipment:** Suitable mufflers will be installed on all engine exhausts and compressor components to reduce the amount of noise generated by construction equipment and vehicles. This includes the installation of noise dampening systems in high noise generating machinery, such as generators, bulldozers, and excavators.
- **Low-Noise Equipment:** Where possible, low-noise equipment with reduced sound power levels will be used in the construction and maintenance phases. This will help to minimize the noise footprint in areas close to sensitive receptors, particularly near residential areas or sensitive environmental zones.

- **Traffic and Vehicle Noise Management**

- **Speed Limit Enforcement:** Speed limits will be strictly enforced within the construction zones to reduce vehicle noise. Lower speeds reduce the impact of tire-road noise and minimize noise generated by sudden acceleration and braking.

- **Controlled Traffic Flow:** Optimizing traffic flow and avoiding unnecessary idling of construction vehicles and machinery will help reduce the overall noise emissions from these sources.
- **Noise Monitoring and Complaint Response**
 - **Monitoring of Noise Levels:** Noise levels will be continuously monitored at key locations, especially near sensitive receptors such as nearby communities, schools, and hospitals. This will ensure compliance with the FMEnv threshold of 90dB(A). In case of any exceedances, immediate corrective measures will be implemented.
 - **Prompt Response to Noise Complaints:** A grievance mechanism will be established to allow the community to report noise-related concerns. These complaints will be responded to promptly, and the necessary adjustments will be made to mitigate noise impacts. Measures may include adjusting work schedules or further noise attenuation strategies.
- **Personal Protective Equipment (PPE) for Workers**
 - **Hearing Protection:** All workers in areas with high noise levels will be required to wear appropriate hearing protection devices, such as earplugs or earmuffs. This will protect workers from potential hearing damage and ensure compliance with workplace safety standards.
 - **Training on PPE Use:** Workers will be trained on the proper use and maintenance of hearing protection devices, ensuring that they are worn consistently in designated high noise areas.
- **Work Schedule Optimization**
 - **Limiting Construction Activities during Sensitive Hours:** Construction activities that generate high levels of noise will be scheduled to avoid sensitive hours, such as early mornings, evenings, and weekends. This will help reduce disturbance to nearby residents and businesses.
 - **Phasing Construction Activities:** Work activities will be phased to concentrate high noise tasks in specific sections of the project, minimizing the spatial extent of noise disturbance.

- **Public Engagement and Awareness**

- **Community Awareness Programs:** Communities near the construction site will be informed about the noise mitigation measures in place and the expected duration of construction activities. This will help manage public expectations and reduce concerns about noise pollution.
- **Ongoing Dialogue with Communities:** Regular consultation with local communities will be conducted to keep them informed of any changes to the construction schedule or the introduction of new high-noise activities.

6.3.3 Biodiversity (Flora and Fauna) Management

The protection and conservation of biodiversity are key priorities for ensuring the sustainability of the proposed SBS-2. The Federal Ministry of Works (FMW) will implement the following strategies to safeguard the flora and fauna along the construction route, ensuring that land use needs are balanced with the conservation of local ecosystems:

- **Minimizing Vegetation and Tree Removal**

- **Area-Specific Vegetation Removal:** The removal of vegetation and trees will be strictly limited to areas that are necessary for construction, such as the actual road alignment and construction zones. This approach will ensure that other surrounding ecosystems and habitats are left intact.
- **Adherence to the Approved Vegetation Clearance Plan:** A detailed vegetation clearance plan will be developed and followed to minimize disturbances to non-target vegetation and to ensure that clearing is carried out in an environmentally responsible manner.

- **Phased Vegetation Clearing**

- **Scheduling in Phases:** Vegetation clearing will be done in phases, rather than clearing the entire project area at once. This will allow for better management of biodiversity and minimize habitat disruption. By clearing in stages, wildlife can gradually adjust to the changes, and sensitive areas can be protected.
- **Avoiding Peak Wildlife Seasons:** Clearing activities will be scheduled to avoid critical seasons for local wildlife, such as breeding or migration periods, reducing the impact on fauna during sensitive times.

- **Protection of Non-Cleared Vegetation**

- **Buffer Zones:** Vegetation that does not need to be removed will be carefully protected through the establishment of buffer zones around the construction areas. Measures will include fencing or physical barriers to prevent accidental damage by machinery or human activity.
- **Signage and Awareness:** Areas designated for protection will be marked with clear signage to prevent encroachment and disturbance by workers or equipment.
- **Revegetation and Habitat Restoration**
 - **Indigenous Planting for Revegetation:** After construction is completed in certain areas, exposed soils will be quickly revegetated using indigenous plant species. This will help restore the natural habitat and improve biodiversity by ensuring that native flora is reintroduced, fostering the return of local wildlife.
 - **Erosion Control through Vegetation:** Revegetation will also serve as an erosion control measure, stabilizing the soil and reducing the risk of sediment runoff into nearby water bodies.
- **Erosion and Sediment Control**
 - **Effective Drainage System:** The project will implement an effective drainage system to control surface water runoff and prevent soil erosion, which can negatively affect nearby ecosystems. Proper drainage will direct water flow away from sensitive areas, reducing soil degradation and potential harm to flora and fauna.
 - **Erosion Protection Structures:** Erosion control structures, including sediment traps, riprap, and gabions, will be used to prevent soil loss during and after construction. These structures will help stabilize exposed soils and prevent sedimentation from entering watercourses, which could harm aquatic biodiversity.
- **Monitoring and Adaptive Management**
 - **Biodiversity Monitoring:** Ongoing monitoring of the biodiversity impacts will be conducted during and after construction. This includes the monitoring of flora and fauna populations, particularly those that are rare or endangered.
 - **Adaptive Management:** Based on monitoring results, adaptive management measures will be taken to address any unforeseen biodiversity impacts. This may

include additional vegetation restoration efforts, adjustments to construction practices, or mitigation measures for wildlife corridors.

- **Wildlife Protection and Movement**

- **Wildlife Corridors:** Where feasible, wildlife corridors will be incorporated into the design to allow for the safe movement of animals across the highway route. This may involve the creation of underpasses or overpasses specifically designed for wildlife.
- **Wildlife Monitoring:** The presence of wildlife along the highway route will be monitored, and if necessary, relocation efforts may be made for species that are significantly impacted by construction activities.

6.3.4 Soil, Land and Landscape

Effective management of soil, land, and landscape resources is crucial to the sustainability of the proposed SBS-2 project. The Federal Ministry of Works (FMW) will implement the following strategies to prevent soil contamination, degradation, and to protect landscape resources during the construction and operational phases:

- **Hazardous Waste Management**

- **Proper Storage of Hazardous Materials:** Hazardous wastes, such as oils, chemicals, and other potentially toxic materials, will be stored in properly labelled, closed containers. To further prevent spills, storage areas will be equipped with bunds designed to hold 110% of the volume of the containers. This ensures that any leakage or spillage can be contained and cleaned up promptly, preventing contamination of surrounding soil and water bodies.
- **Waste Segregation and Disposal:** Wastes will be segregated according to their type, and hazardous waste will be disposed of in compliance with environmental regulations. The project will prioritize the use of certified waste disposal companies to handle hazardous materials safely.

- **Vehicle Maintenance to Prevent Oil Leaks**

- **Regular Maintenance and Inspections:** All construction vehicles and machinery will undergo regular maintenance and inspections to detect and prevent leaks of

oil, fuel, and other fluids. The maintenance program will ensure that machinery is kept in optimal condition, minimizing the risk of accidental spills.

- **Oil Spill Prevention:** In addition to maintenance, the construction site will have oil spill kits readily available for prompt containment and clean up in case of any leaks. This will prevent contamination of the soil and surrounding environment.
- **Emergency Response Plan for Spill Incidents**
 - **Preparedness and Quick Response:** An **Emergency Response Plan (ERP)** will be developed and implemented to address potential incidents of spillage or contamination. The ERP will outline clear procedures for identifying, containing, and cleaning up spills, as well as mitigating their environmental impact.
 - **Staff Training:** All staff and workers will be trained on the proper response to spills, including the use of spill containment materials, emergency contact procedures, and the need for immediate notification to environmental authorities. Regular drills will be conducted to ensure preparedness.
- **Construction of Erosion Control and Water Management Structures**
 - **Gabion Walls and Garland Drains:** To manage erosion and prevent soil degradation, **gabion walls** will be constructed along vulnerable sections of the road, particularly in areas prone to heavy rainfall or flooding. These structures will help stabilize the soil, preventing erosion and protecting the surrounding landscape.
 - **Siltation Ponds:** **Siltation ponds** will be constructed at strategic points along the project route to capture and filter runoff water. These ponds will trap sediment and prevent it from contaminating nearby water bodies and surrounding lands. Regular maintenance of these ponds will be carried out to ensure their continued effectiveness.
 - **Drainage Systems:** **Garland drains** will be installed to control surface water runoff and divert it safely away from the construction site. The drains will be designed to prevent water from carrying sediments and contaminants into nearby ecosystems, reducing the risk of water and soil pollution.

○ **Topsoil Management and Rehabilitation**

- **Topsoil Salvage and Storage:** During site preparation and excavation, topsoil will be carefully removed, stored, and preserved. This topsoil will be used later in the rehabilitation process to restore vegetation and stabilize the land after construction. This practice helps maintain soil fertility and promotes quick revegetation.
- **Rehabilitation and Land Restoration:** After construction, disturbed land will be rehabilitated, and any degraded or disturbed areas will be replanted with native vegetation to restore ecological balance and prevent soil erosion. The rehabilitation process will focus on restoring the landscape to its original or an improved condition.

○ **Monitoring and Environmental Audits**

- **Soil and Land Quality Monitoring:** Ongoing monitoring of soil quality and land conditions will be conducted throughout the construction phase. Soil samples will be tested for contamination, and any degradation of the land will be addressed through corrective actions.
- **Environmental Audits:** Regular environmental audits will be conducted to assess the effectiveness of the soil, land, and landscape management measures. Adjustments will be made as needed to ensure the protection of the environment and compliance with relevant environmental standards.

6.3.5 Waste Management

Effective management of construction waste is essential to protect human health, safety, and the environment throughout the preconstruction and construction phases of the proposed SBS-2 project. The Federal Ministry of Works (FMW) will implement the following waste management strategies to ensure the responsible handling, disposal, and minimization of waste:

○ **Hazardous Waste Management**

- **Proper Storage:** Hazardous wastes such as oils, chemicals, solvents, and other toxic substances will be stored in properly labeled, closed containers. These containers will be stored in designated areas that are protected from direct sunlight, rain, and

wind, minimizing the risk of exposure and contamination of the surrounding environment.

- **Secondary Containment:** In addition to primary containment, a secondary containment system will be provided for hazardous waste storage. This will consist of containment structures that can hold at least 110% of the volume of the stored hazardous materials. This precautionary measure ensures that in case of a leak or spill, any released material is contained, preventing environmental contamination.

- **Non-Hazardous Waste Management**

- **Segregation and Sorting:** Non-hazardous wastes such as construction debris (e.g., wood, metal, plastic), packaging materials, and general refuse will be segregated at the source. Proper sorting of waste will help reduce landfill impact and allow for recycling or reuse where possible.
- **Recycling and Reuse:** Materials that are reusable or recyclable (e.g., scrap metal, concrete, wood) will be separated and stored for recycling or repurposing. The project will work with certified recycling vendors to ensure that waste is processed in an environmentally friendly manner.

- **Approved Waste Vendors for Waste Evacuation**

- **Utilizing Approved Waste Contractors:** The project will ensure that only licensed and approved waste disposal vendors are employed to evacuate waste from the site. These vendors will be responsible for ensuring that all waste is removed and disposed of in compliance with local environmental regulations.
- **Waste Disposal Compliance:** Waste disposal practices will be monitored to ensure that waste is being sent to appropriate, certified disposal sites. Regular audits and checks will be conducted to ensure the compliance of all waste disposal activities with national environmental standards.

- **On-Site Waste Management Facilities**

- **Waste Collection Points:** Clearly labelled waste collection points will be established at the construction site to facilitate easy segregation and collection of different waste types. These collection points will be regularly monitored to ensure cleanliness and prevent unauthorized disposal of hazardous materials.

- **Regular Waste Collection:** Waste will be collected and transported off-site at regular intervals to prevent accumulation, reduce the risk of environmental contamination, and maintain a clean working environment.
- **Training and Awareness for Workers**
 - **Worker Education on Waste Management:** Workers will be trained on the proper handling, segregation, and disposal of waste materials. The training will cover the safe management of hazardous and non-hazardous waste, the importance of waste minimization, and the proper use of waste storage facilities.
 - **Ongoing Awareness Campaigns:** Continuous awareness campaigns will be conducted to remind workers of the importance of proper waste management and the environmental impacts of improper waste disposal.
- **Waste Reduction Strategies**
 - **Minimizing Waste Generation:** Efforts will be made to minimize the generation of waste during construction activities by promoting efficient use of materials and reducing the amount of packaging.
 - **Reusable and Sustainable Materials:** Where possible, reusable and sustainable materials will be used in construction to minimize the volume of waste generated.
- **Monitoring and Reporting**
 - **Regular Waste Audits:** The project will conduct regular waste audits to assess the effectiveness of waste management strategies. These audits will identify opportunities for improvement and ensure that waste disposal activities are compliant with relevant environmental regulations.
 - **Reporting:** Waste management reports will be prepared and submitted to relevant regulatory authorities, ensuring transparency and accountability in the waste management process.

6.3.6 Water Use and Quality

The Federal Ministry of Works (FMW) shall adopt and implement the following water use and quality management practices to protect surface water and maintain water quality during the construction phase of the Proposed Sokoto-Badagry Superhighway project. These measures are aimed at preventing contamination, reducing erosion, and ensuring responsible water use:

- **Proper Management of Hazardous Waste**
 - **Storage and Containment of Hazardous Waste:** Hazardous wastes, including chemicals, oils, and solvents, will be stored in properly labelled, closed containers. These containers will be equipped with bunds or containment areas capable of holding 110% of the volume of the stored materials. This will prevent hazardous substances from being accidentally released into the environment and contaminating nearby surface water bodies.
- **Vegetation and Tree Removal Management**
 - **Limiting Vegetation Removal:** The removal of vegetation and trees will be strictly limited to areas that are essential for the construction activities. By minimizing land disturbance, the project aims to reduce the risk of surface runoff, which can lead to soil erosion and the sedimentation of surface water.
 - **Maintaining Natural Buffers:** Efforts will be made to maintain natural vegetation buffers along water bodies and slopes, further reducing the risk of sedimentation and runoff into nearby streams and rivers.
- **Revegetation of Exposed Soils**
 - **Timely Revegetation:** In areas where active construction has been completed, exposed soils will be quickly revegetated with indigenous plant species. This practice will help stabilize the soil, reduce the risk of erosion, and prevent sediment from entering surface water systems. Revegetation will also contribute to the overall ecosystem restoration along the highway corridor.
 - **Selection of Suitable Plant Species:** Indigenous plant species that are well-adapted to the local climate and environment will be selected for revegetation to enhance soil stability and promote biodiversity.
- **Effective Drainage Systems and Erosion Control**
 - **Construction of Efficient Drainage Systems:** The project will include the construction of a well-designed drainage system to manage surface water runoff during construction. This system will be designed to direct storm water away from construction areas and prevent flooding, erosion, and sedimentation in surrounding areas.

- **Erosion Protection Structures:** To minimize soil erosion and water quality degradation, the construction of erosion protection structures will be implemented where necessary. These structures may include sediment traps, riprap (stone installations to prevent erosion), and gabions (wire mesh baskets filled with stones) to control water flow and stabilize areas prone to erosion.
 - **Sediment Control:** In areas where construction is taking place near water bodies, sediment control measures such as silt fences and sedimentation ponds will be installed to prevent sediment from being carried into nearby rivers, streams, or wetlands.
- **Water Usage and Conservation**
- **Minimizing Water Consumption:** The project will aim to use water efficiently by employing best practices in water management. Measures will be taken to minimize water usage for construction activities, such as controlling water consumption for dust suppression and concrete mixing.
 - **Reuse and Recycling of Water:** Whenever feasible, water used during construction activities will be recycled or reused to reduce the overall demand for fresh water. This will help in conserving local water resources and minimizing the impact on nearby water bodies.
- **Monitoring of Water Quality**
- **Regular Water Quality Monitoring:** Water quality in nearby water bodies will be regularly monitored to ensure compliance with environmental standards. Monitoring will include parameters such as pH, turbidity, suspended solids, and the presence of hazardous substances, to assess any potential impacts from construction activities.
 - **Early Detection of Contamination:** In case of any signs of water contamination, prompt remedial actions will be taken to address the issue and prevent further degradation of water quality.

6.3.7 Occupational Health and Safety

The Federal Ministry of Works (FMW) is committed to ensuring a safe and healthy working environment during the construction of the proposed SBS-2. Given the potential risks and hazards associated with road construction, a comprehensive Occupational Health and Safety

Plan (OHSP) will be developed and implemented to proactively manage these risks. The OHSP will focus on the following key aspects to protect the workforce and promote a safe working environment:

○ **Project-Specific Occupational Health and Safety Plan (OHSP)**

The OHSP will be tailored to the specific needs of the construction project, considering the nature of the work and associated hazards. Key components of the OHSP include:

- **Prohibition of Drugs and Alcohol:** The use of drugs and alcohol will be strictly prohibited by workers while on the job site to ensure that their physical and mental capabilities are not impaired. Random drug and alcohol testing may be conducted to enforce compliance.
- **Provision of Personal Protective Equipment (PPE):** Workers will be provided with appropriate PPE such as helmets, high-visibility vests, gloves, safety boots, and hearing protection based on the type of work they are engaged in. Regular inspections will be carried out to ensure that PPE is in good condition and properly worn.
- **First Aid Facilities and Personnel:** Adequate first aid facilities will be available at the construction site, with designated first aiders trained to handle emergency medical situations. The provision of first aid kits will be ensured at key work areas.
- **Clear Signage and Engineering Barriers:** Signage will be prominently displayed in English and local languages to communicate potential hazards and safety instructions. High-risk areas, such as excavation zones and machinery operation zones, will be fenced or secured with engineering barriers to prevent unauthorized access.
- **Restricted Access to High-Risk Areas:** Access to high-risk construction areas will be strictly controlled. Only authorized and trained personnel will be allowed to enter these zones to prevent accidents and injuries.
- **Establishment of “No Approach” Zones:** Areas where rock blasting, heavy machinery, or high-risk activities are taking place will have clearly defined “No Approach” zones to protect workers from potential hazards such as flying debris or machinery malfunctions.

6.3.7.1 *Emergency Response Plans*

An Emergency Response Plan (ERP) will be prepared specifically for the construction activities. The ERP will outline the procedures to be followed in the event of emergencies such as accidents, fires, explosions, or environmental spills. The plan will include:

- **Emergency Contact Information:** A list of emergency contacts, including medical facilities, fire departments, and local authorities, will be provided to all workers and management.
- **Evacuation Routes and Procedures:** Safe evacuation routes and procedures will be established and clearly marked to ensure that workers can quickly and safely exit the construction site in case of an emergency.
- **First Aid and Medical Response:** A detailed protocol for the provision of first aid and emergency medical treatment will be outlined, with designated personnel responsible for coordinating emergency medical services.
- **Regular Drills and Practice:** Emergency response drills will be conducted periodically to ensure that all workers are familiar with the procedures and can act swiftly in case of an actual emergency.

6.3.7.2 *Health and Safety Training*

The FMW will ensure that all workers receive appropriate training on occupational health and safety management, focusing on hazard identification, risk assessment, and safe work practices. Key components of the training program will include:

- **Induction Training:** All new employees will undergo an induction training program that covers site-specific health and safety protocols, including hazard identification, emergency procedures, and the correct use of PPE.
- **Ongoing Safety Training:** Refresher courses and ongoing safety training sessions will be conducted to ensure that all workers remain updated on best practices and any changes to health and safety regulations.
- **Communication of Health and Safety Commitment:** The FMW will maintain a clear and consistent communication program to promote a culture of safety. This will include regular safety meetings, distribution of safety materials, and visible displays of management's commitment to health and safety.

- **Engagement of Local Communities:** Where appropriate, local communities will be engaged in safety awareness programs to ensure they are informed about construction activities and understand how to protect themselves from potential hazards.

6.3.7.3 *Monitoring and Reporting*

Regular monitoring and reporting on occupational health and safety will be carried out to identify and address any safety concerns. This will include:

- **Routine Site Inspections:** Site safety officers will conduct daily inspections of the worksite to identify hazards and ensure that safety measures are being followed. Immediate corrective actions will be taken where necessary.
- **Incident Reporting and Investigation:** Any incidents or accidents will be reported promptly, investigated thoroughly, and corrective actions will be implemented to prevent recurrence.
- **Health Surveillance:** Health surveillance programs will be established to monitor workers' health, particularly for those involved in activities with potential long-term health impacts (e.g., exposure to dust, noise, or chemicals). Regular medical checkups will be conducted to identify any health issues early.

6.3.8 Community Health and Safety Management

The Federal Ministry of Works (FMW) acknowledges the importance of addressing community health and safety issues that may arise as a result of the proposed SBS-2 project. The project will implement the following community health and safety management measures to protect both workers and local communities, focusing on disease prevention, infrastructural support, cultural preservation, and security:

○ **Health Awareness and Disease Prevention**

- **HIV and STD Prevention Programs:** The FMW will institute HIV prevention initiatives, such as peer education programs and the distribution of condoms to both workers and local community members. These programs will be supported by collaborations with local and international health-focused NGOs to educate and raise awareness about sexually transmitted diseases (STDs) and other communicable diseases, including COVID-19.

- **Vector-Borne and Water-Related Disease Control:** Best international practices for solid waste management, surface water drainage, and sanitary wastewater management will be implemented to prevent the spread of vector-borne diseases (e.g., malaria) and water-related communicable diseases in both the construction site and surrounding communities. These measures will include regular cleaning of drainage systems and proper disposal of waste to mitigate the risk of disease outbreaks.
- **Health Awareness Campaigns:** In addition to disease prevention, health awareness campaigns will be organized within nearby communities to provide information on healthy living, sanitation, and hygiene practices.
- **Protection of Existing Community Infrastructure**
 - **Corporate Social Responsibility (CSR) Program:** As part of the commitment to community well-being, the FMW will develop a CSR program to support the development and enhancement of infrastructure in host communities. This may include improvements to local roads, water supply systems, and health facilities, with a focus on meeting the needs of the affected communities.
 - **Establishment of Worker's Camp:** A well-equipped worker's camp will be established to house construction workers during the project. The camp will include basic amenities such as clean water, sanitation facilities, and waste management systems to ensure the health and comfort of workers while minimizing the potential strain on local resources. This will also reduce the impact of transient labor on local communities.
- **Cultural Preservation and Community Security**
 - **Induction Program and Code of Conduct:** A comprehensive induction program will be developed for all workers, emphasizing respect for local culture and the protection of community values. A Code of Conduct will be established, which will outline acceptable behaviors and responsibilities for workers in the local community. Key provisions of the Code of Conduct include:
 - *Respect for Local Residents:* Workers will be required to respect local customs and residents, fostering good relations with host communities.

- *Protection of Local Wildlife and Resources:* Workers will be prohibited from hunting, fishing, or taking livestock and other natural resources without authorization, preventing undue strain on the local environment.
 - *Zero Tolerance for Illegal Activities:* The Code of Conduct will explicitly prohibit illegal activities such as child sexual exploitation, underage sex, prostitution, harassment of women, gender-based violence, and the use of illegal drugs. Any worker found engaging in such activities will face disciplinary measures, including potential dismissal from the project.
 - *Cooperation with Law Enforcement:* The FMW will commit to cooperating with local law enforcement agencies in investigating any incidents of gender-based violence or other illegal activities. This will include providing support for investigations and taking appropriate actions to address such issues.
 - **Community Engagement:** The FMW will regularly engage with local community leaders and stakeholders to ensure that community concerns related to security, cultural preservation, and health are addressed. Community liaison officers will be appointed to facilitate communication and resolve issues as they arise.
- **Monitoring and Reporting**
- **Monitoring of Health and Safety:** Regular monitoring will be conducted to ensure that health and safety practices are adhered to by both workers and local communities. This includes the evaluation of the effectiveness of health awareness programs, disease prevention initiatives, and the CSR activities in the local communities.
 - **Feedback Mechanisms:** A community feedback mechanism will be set up to allow residents to voice concerns about potential health and safety issues related to the project. This will provide an avenue for the prompt resolution of any community grievances.

6.3.7.4 Land Acquisition and Associated Issues

The Federal Ministry of Works (FMW) recognizes that the construction of the proposed SBS-2, may lead to land acquisition and associated socio-economic impacts. A comprehensive approach will be taken to manage these impacts in a way that ensures fairness, transparency,

and the protection of the rights and livelihoods of affected individuals and communities. The following strategies will be implemented:

○ **Development and Implementation of a Livelihood Restoration Plan (LRP)**

A Livelihood Restoration Plan (LRP) will be developed to address the economic displacement caused by the acquisition of land, assets, and loss of economic crops. This plan will ensure that affected land and asset owners receive appropriate compensation, as well as assistance to restore their livelihoods and economic wellbeing. The LRP will outline the support measures for displaced individuals, including training programs, alternative livelihood options, and support for new businesses. ○ *Economic Support*: The plan will also include compensation for income loss resulting from land acquisition, considering local agricultural and business practices. The focus will be on restoring and, where possible, enhancing the living standards of those affected by the project.

○ **Transparent, Consistent, and Equitable Compensation**

- The FMW will ensure that all compensation for land, assets, and crops is carried out in a transparent, consistent, and equitable manner. This will be done in consultation with the affected communities to ensure fair valuation and compensation that meets the expectations of the local people. An independent, third-party valuation expert may be engaged to ensure impartiality in assessing compensation amounts.
- *Displacement and Compensation Process*: The compensation process will be well documented, and all affected individuals will be informed of their entitlements. Clear communication about the compensation process will be provided to mitigate confusion and ensure all stakeholders are adequately informed.

○ **Provision of Employment Opportunities**

Employment Opportunities for Affected Persons: The FMW will prioritize the provision of employment opportunities to individuals and communities directly impacted by land acquisition. These opportunities will be aimed at mitigating the socio-economic impacts of displacement, and where possible, employment will be offered to those whose land has been taken for the construction of the highway.

Training and Capacity Building: In addition to employment, training programs will be offered to help displaced individuals acquire skills for new forms of employment. The FMW will work with local institutions to provide vocational training, apprenticeships, and entrepreneurship support to help individuals transition to alternative livelihoods.

○ **Establishment of a Grievance Mechanism**

- A grievance mechanism will be established to address and resolve concerns or disputes regarding compensation. This system will provide affected individuals and communities with an accessible and effective way to voice concerns, submit complaints, and seek resolution.
- *Transparency and Accountability:* The grievance mechanism will ensure that any issues raised are handled in a transparent and accountable manner. Local community representatives will be included in the grievance process to ensure the concerns of residents are heard and addressed promptly.
- *Follow-up and Resolution:* A follow-up process will be established to ensure that any compensation or other issues raised through the grievance mechanism are resolved in a timely manner. This will include regular updates to stakeholders on the status of complaints and their resolution.

○ **Community Engagement and Consultation**

- *Ongoing Dialogue with Affected Communities:* Continuous consultation and communication with local communities will be maintained throughout the land acquisition and compensation process. The FMW will ensure that all affected persons are informed and engaged in discussions about land acquisition, compensation, and alternative livelihood options.
- *Social Support Programs:* In addition to economic support, social programs will be developed to provide community support and ensure the well-being of affected populations. These may include healthcare services, educational programs, and social safety nets to support vulnerable groups within affected communities.

Through the effective implementation of these strategies, the FMW will manage the impacts of land acquisition and ensure that affected individuals and communities are compensated fairly and adequately, with their livelihoods and socio-economic well-being supported throughout the duration of the project. The aim is to minimize the negative impacts of land acquisition while

providing opportunities for sustainable development and long-term improvement in the affected areas.

6.4 Enhancement Measures

The proposed SBS-2 offers substantial opportunities to enhance the socio-economic development of the surrounding communities and the region at large. The project provides an opportunity to generate direct and indirect employment, which can have far-reaching impacts, including poverty alleviation, the reduction of unemployment, and a general boost to the local and regional economy. The Federal Ministry of Works (FMW) aims to expand these benefits and strengthen the relationship with host communities through the following enhancement measures:

6.4.1 Local Employment and Capacity Building

- *Local Employment Opportunities:* Prioritize hiring local labor for both skilled and unskilled positions during the construction phase of the project. This will provide direct income to the local population, reducing poverty and supporting local families.
- *Skills Development and Training:* Implement training programs for local workers in construction, project management, and related fields. These programs should focus on both technical and soft skills that can be used long after the project's completion, thereby improving the employability and income-generating potential of local individuals.
- *Apprenticeships and Internships:* Provide apprenticeships and internships for local youth to gain on-the-job experience, preparing them for future employment in the construction and infrastructure sectors.

6.4.2 Support for Local Businesses

- *Local Procurement of Goods and Services:* Encourage the use of local suppliers for construction materials and services. This approach will support local businesses and ensure that a significant portion of the project's expenditure benefits the local economy.
- *Business Capacity Building:* Provide support to local businesses to meet the procurement requirements of the project. This can include training, access to financing, and technical assistance, which will enable small businesses to grow and compete for contracts related to the project.

6.4.3 Infrastructure Development in Host Communities

- *Improvement of Community Infrastructure:* Enhance local infrastructure, such as roads, water supply, sanitation, and electricity, using project-generated resources. These improvements will not only support the construction project but also provide lasting benefits to the communities.
- *Community Development Programs:* In collaboration with local authorities, develop community development programs that address the specific needs of host communities, including the provision of healthcare, education, and other social amenities.

6.4.4 Environmental and Social Responsibility Initiatives

- *Sustainability and Environmental Protection:* Foster good environmental stewardship by ensuring that the project aligns with sustainable development practices. The use of eco-friendly technologies, waste management practices, and environmental conservation efforts will ensure that the surrounding environment benefits from the project.
- *Social Support Programs:* Implement social programs that address the needs of vulnerable groups in the host communities, such as women, children, and the elderly. These programs may include access to healthcare, educational scholarships, and microfinance opportunities.

6.4.5 Enhanced Community Engagement and Participation

- *Community Consultation and Participation:* Ensure ongoing, transparent communication with affected communities, allowing them to contribute their perspectives and concerns regarding the project. This will help foster a sense of ownership and ensure that the project aligns with the needs and priorities of residents.
- *Grievance Redress Mechanism:* Develop and maintain a grievance redress mechanism to promptly address any concerns or disputes arising during the construction phase. This will ensure that affected communities feel their issues are heard and resolved effectively.

6.4.6 Post-construction benefits

- *Maintenance of Road and Infrastructure:* After completion of the road, the FMW should ensure that local labor is employed to maintain the road infrastructure. This will provide long-term employment and ensure the road's quality and usability.
- *Creation of New Economic Opportunities:* The completed dualized road will enhance access to markets, trade routes, and tourism destinations, thereby opening new economic opportunities for local businesses and the broader region. Efforts should be made to ensure that these opportunities are capitalized upon by local entrepreneurs and communities.

6.4.6.1 Direct Employment

The Federal Ministry of Works (FMW) aims to ensure that the construction of the proposed SBS-2 maximizes local employment and enhances the socioeconomic benefits for the surrounding communities. The following measures will be implemented to improve the impact of direct employment during the construction phase of the project:

- **Development and Implementation of a Labour and Employment Plan (LEMP)**
 - *Alignment with International Standards:* The LEMP will be developed in accordance with international employment standards, such as the World Bank Environmental and Social Standard 2 (ESS2): Labour and Working Conditions. This will ensure that the project adheres to globally recognized labor standards.
 - *Workforce Sourcing:* The LEMP will specify the percentages and numbers of workers to be sourced from local communities and other demographic groups. The project will prioritize the employment of people in Kebbi state and neighboring Local Government Areas, ensuring that local workforce needs are met.
 - *Notification of Job Opportunities:* Affected communities and representatives from Local Government Areas in Kebbi, and the surrounding states will be notified about the available job opportunities and required skills. This will occur prior to recruitment to ensure transparency and inclusivity in the hiring process.

○ **Training and Skills Development**

- *Pre-construction Training Programs:* Training and skills development programs will be launched before construction begins. These programs will target unskilled local workers and equip them with the skills necessary for employment on the project or in other industrial developments in the region.
- *Workforce Readiness:* By providing training on construction techniques, safety protocols, and equipment operation, the project will increase the employability of local workers, empowering them to secure long-term jobs within the infrastructure and construction sectors.

○ **Targeted Local Employment**

- *Prioritization of Local Labor:* Construction jobs will be specifically targeted to local communities to maximize the economic impact within the project region. This will help reduce unemployment rates and provide local workers with valuable job opportunities.
- *Diversity in Recruitment:* Efforts will be made to promote diversity in the workforce, ensuring equal opportunities for men, women, and individuals from marginalized groups.

○ **Fair Treatment and Equal Opportunities**

- *Promotion of Fair Treatment:* The project will enforce non-discrimination policies to promote fair treatment and equal opportunity in recruitment and employment. This will ensure a respectful and inclusive working environment for all employees.
- *Protection of Vulnerable Workers:* Special attention will be given to protecting vulnerable categories of workers, such as women, migrant workers, and those with special needs, ensuring they are treated with dignity and respect and are not subject to exploitation.

○ **Safe and Healthy Working Conditions**

- *Health and Safety of Workers:* A comprehensive health and safety management plan will be implemented to promote safe working conditions. This will include provision of personal protective equipment (PPE), regular safety training, and proper maintenance of equipment and work environments.

- *Hygiene and Medical Support:* On-site health services, including first aid and emergency medical care, will be available to ensure the well-being of the workforce.
- **Grievance Mechanism for Workers**
 - *Establishment of a Grievance Mechanism:* A robust grievance mechanism will be established to allow workers to raise workplace concerns freely. This will ensure that issues related to working conditions, treatment, and any form of harassment are addressed promptly and effectively.
- **Prohibition of Child Labour and Forced Labour**
 - *Zero Tolerance for Child Labour:* The project will strictly prohibit the employment of minors in any capacity. All workers must meet the legal working age requirements.
 - *No Forced Labour:* The use of forced labor, including under duress or coercion, will be strictly forbidden. All employees will be hired voluntarily, and their rights will be respected throughout the employment period.

6.4.6.2 Procurement and Indirect Employment

The proposed SBS-2 project will not only create direct employment opportunities for local communities but also stimulate the local economy through indirect employment and procurement activities. The construction activities will generate significant business opportunities, benefiting a wide range of local suppliers, service providers, and small-scale traders. The following enhancement measures will be implemented to ensure that the potential economic benefits from procurement and indirect employment are fully realized:

- **Local and Regional Procurement Targets**
 - **Inclusion in Labour and Employment Plan (LEMP):** The project will include specific local and regional procurement targets in the LEMP. This will ensure that a significant portion of the required goods and services is sourced from local suppliers, including construction materials (e.g., cement, gravel, steel), tools, and equipment, as well as logistics services. By prioritizing local suppliers, the project will contribute to the growth of local businesses and enhance regional economic development.
 - **Promotion of Local Businesses:** The project will actively encourage the participation of local businesses by offering procurement opportunities in line with project

requirements. This will include materials for construction, labor services, and general supply services (e.g., food, catering, sanitation, transport).

○ **Contractual Requirements for Local Employment**

- **Local Employment Requirements in Contractor Contracts:** All contractors engaged in the project will be required to recruit workers from the local communities in line with the LEMP. This ensures that local workers benefit from the job opportunities created by the project and that local employment goals are met. Contractors will be incentivized to hire from surrounding communities and be held accountable for meeting these requirements.
- **Incorporation of Local Employment in Request for Proposal (RFP) Documents:** Local employment requirements will be clearly outlined in the Request for Proposal (RFP) documents. This ensures that potential contractors understand the expectations regarding local hiring before submitting their bids, making local employment a key criterion in the selection process.

○ **Support for Small-Scale Traders and Service Providers**

- **Opportunities for Local Vendors:** The construction activities will generate indirect employment opportunities for small-scale traders, including food vendors, caterers, and other service providers around the worker camps. The project will create demand for everyday goods and services, providing a platform for local entrepreneurs to supply food, beverages, clothing, and other essentials to the workers and project staff.
- **Support for Local SMEs:** Efforts will be made to include local small- and medium sized enterprises (SMEs) in the supply chain. This will not only support local businesses but also promote the development of skills and capacity within the local economy.

○ **Capacity Building for Local Suppliers**

- **Training for Local Suppliers:** To maximize the benefits from procurement opportunities, the project will include capacity-building programs for local suppliers. This will ensure that local businesses are well-prepared to meet the standards required for supplying goods and services to the project. Workshops and training sessions on quality control, procurement processes, and contract management will be provided to equip local suppliers with the necessary skills.

○ **Monitoring and Reporting**

- **Tracking Procurement and Employment Impact:** The project will include regular monitoring and reporting mechanisms to track the effectiveness of local procurement and employment initiatives. This will ensure that the project is achieving its objectives in terms of local economic development and employment generation.
- **Transparency in Procurement:** A transparent procurement process will be followed to ensure fair competition among local suppliers and service providers. This will foster trust within the local communities and ensure that the benefits from the project are distributed equitably.

Table 6.1: Mitigation and Enhancement Measures

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
A	PRE-CONSTRUCTION PHASE				
A1	Land acquisition	Loss of farmland as well as land-based livelihood	HIGH	The FMW shall: - Develop and implement a Livelihood Restoration Plan (LRP) to ensure affected land and asset owners are adequately compensated for loss of land, assets and economic crops. - Ensure all issues relating to compensation are handled in a transparent, consistent and equitable manner. - Provide employment opportunities to affected persons and local communities. - Establish a grievance mechanism to receive and address specific concerns about compensation.	MEDIUM
A2		Loss of economic trees including medicinal herbs	MEDIUM		LOW
A3		Grievance and conflicts over land resettlement & compensation.	HIGH		MEDIUM
A4	Installation of Site Structures and Facilities	Security risks	MEDIUM	The FMW shall: - Deploy competent security personnel to secure project site. - Provide adequate training of security personnel.	LOW

A5		Risks of occupational accident and injuries to workers	MEDIUM	FMW shall: • Develop a project specific Occupational Health and Safety Plan (OHSP) commensurate to construction activities. OHSP to include but not limited to: • Prohibition of drug and alcohol use by workers while on the job. • Provision of adequate first aid, first aiders, PPE, signages (English and Hausa languages), engineering barriers e.g fencing. • Restrict unauthorized access to all areas of high-risk activities • Implementation of specific personnel training on worksite OHS management • Disclose site security arrangements to the Police and host communities	LOW
A6	Mobilization of personnel, equipment and materials to site	Increased security risks due to storage of materials and equipment on site	MEDIUM	Same as A4	LOW
A7		Threat to community culture, safety and security due to presence of workers and business opportunists.	MEDIUM	FMW shall: • Develop an induction program including a code of conduct for all workers. The code of conduct will address the following aspect: Respect for local residents; No hunting or unauthorized taking of products or livestock; Zero tolerance of illegal activities such as child sexual exploitation and	LOW

				underage sex, prostitution, harassment of women, gender based violence, purchase or use of illegal drugs, illegal fighting; Disciplinary measures and sanctions (e.g. dismissal) for infringement of the code of conduct and/or company rules; Commitment / policy to cooperate with law enforcement agencies investigating perpetrators of gender-based violence. • Provide cultural sensitization training to improve awareness of and sensitivity of workers to local cultures, traditions and life styles. • Prohibit child and forced labour. • Implement community-based Grievance Redress Mechanism Limit the number of migrant workers by engaging local workers. • Engage competent security personnel.	LOW
A8		Increase demand on existing community health and sanitation infrastructure due to influx of temporary workers and camp followers.	MEDIUM	The FMW shall: • Develop a CSR program to support infrastructural development in host communities. • Establish worker's camp and provide all basic amenities (water, sanitation etc).	

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
A9		Employment of local labour.	POSITIVE	FMW shall: • Ensure construction jobs are targeted to members of local communities • Develop and implement of a Labour and Employment Plan (LEMP) • Ensure prompt notification of representatives from Host LGAs as well as affected communities of the specific jobs and skills required for the project prior to commencement of recruitment. • Ensure due diligence and adherence to the required local content policy. • Ensure priority engagement and training of locals throughout project implementation. • Prohibit child and forced labour	POSITIVE

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
A10		Occupational related accidents and injuries	MEDIUM	Same as A5	LOW
A11	Site Clearing	Deterioration of local air quality due to the emission of dusts & gases	MEDIUM	The FMW shall: • Use water to wet ground for dust suppression.	LOW
A12		Respiratory and eye related problems for workers due to exposure to fugitive dusts and gaseous emissions.	MEDIUM	• Conduct regular visual inspection of dust pollution and ensure appropriate intervention if dust levels are high. • Train drivers/ workers on proper operation of vehicles and equipment to include fuel efficiency and anti-idling techniques. • Provide and enforce the usage of appropriate PPE	LOW
A13		Noise and vibration disturbances from operation of heavy-duty vehicles.	MEDIUM	The FMW shall: • Select and use vehicles/equipment with lower sound levels. • Install suitable mufflers on engine exhausts and compressor components. • Enforce appropriate speed limit to reduce vehicle noise levels. • Respond promptly to noise complaints. • Provide and enforce the usage of hearing protection devices (ear plugs/muffs) for workers as part of OHSP.	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
A14		Loss of vegetation and habitat destruction	MEDIUM	The FMW shall: • Implement a post-project reforestation plan using native plant species to restore the affected areas. • Establish buffer zones around ecologically sensitive areas to minimize habitat encroachment. • Restrict land clearing to the smallest possible footprint needed for the project. • Carefully remove and store topsoil during clearing to enable revegetation efforts after project • Engage in biodiversity offset programs to compensate for habitat loss by conserving or creating habitats elsewhere. • Schedule project activities to avoid sensitive periods such as breeding, nesting, or migration seasons for local wildlife. • Create and maintain wildlife corridors to ensure safe animal passage and reduce habitat fragmentation.	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
A15		Wildlife disturbances and destruction	MEDIUM	- Reduce noise and artificial lighting during construction and operational phases to minimize stress on wildlife. - Establish monitoring systems to track wildlife movements and enforce protective measures to avoid unnecessary disturbances.	LOW
A16		Loss of ecosystem provisions e.g. fuel wood & economic trees	MEDIUM	- Schedule vegetation clearing to occur in phases so that the entire area is not cleared at once. - Protect all vegetation not required to be removed against damage; - Undertake quick re vegetation of exposed soils with indigenous plant species in areas where active construction is completed. - Ensure construction of effective drainage system and use erosion protection structures such as sediment traps, riprap, gabions etc.	LOW
A17		Predisposition to soil erosion due to the removal of vegetal cover.	MEDIUM		LOW
A18		Siltation of surface water from eroded top soil	MEDIUM		LOW
A19		Occupational related accidents and injuries to workers	MEDIUM	Same as A5	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
B	CONSTRUCTION PHASE				
B1	Earthworks and Grading	Deterioration of local air quality due to the release of dust & exhaust gases.	MEDIUM	The FMW shall: • Use water to wet ground for dust suppression. • Conduct regular visual inspection of dust pollution and ensure appropriate intervention if dust levels are high. • Train drivers/ workers on proper operation of vehicles and equipment to include fuel efficiency and anti-idling techniques.	LOW
B2	Construction of bridges and culverts	Noise and vibration disturbances from operation of heavy-duty vehicles and equipment.	MEDIUM	The FMW shall: • Select and use vehicles/equipment with lower sound power levels. • Install suitable mufflers on engine exhausts and compressor components. • Enforce appropriate speed limit to reduce vehicle noise levels. • Respond promptly to noise complaints. • Provide and enforce the usage of hearing protection devices (ear plugs/muffs) for workers as part of OHSP. • Civil engineering structures and bio-engineering measures used.	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
B3		Surface water contamination as a result of sediment/pollutants run off from spoils and exposed soil surfaces.	HIGH	FMW&H shall ensure construction of effective drainage system and use erosion protection structures such as sediment traps, riprap, gabions etc.	LOW
B4		Soil contamination from leakage/spillage of fuel or oil from equipment and vehicles.	MEDIUM	The FMW shall: • Prepare and implement an Emergency Response Plan to respond to incident of spillage. • Ensure fuel storage tanks are installed in a bonded area and checked daily. • Ensure regular maintenance of vehicles to avoid leaks of oil. • Prevent unregulated dumping of fuel waste.	LOW
B5		Generation of spoils and other excavated materials.	MEDIUM	The FMW shall: Ensure stockpile and disposal areas are stable and protected against erosion and not interfere with run off or subsequent construction activities. Stockpile to be covered and stored in a sealed and bonded area in order to divert storm water away. Reuse stockpile as fill materials on the site or another construction site	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
B6		Generation of construction waste and debris	MEDIUM	The FMW shall: • Ensure that hazardous wastes are stored in properly labelled closed containers placed away from direct sunlight, wind and rain. • Provide secondary containment with 110% of storage containers for hazardous waste. • Ensure usage of approved waste vendor for waste evacuation, processing & disposal.	LOW
B7		Direct and indirect job creation.		The FMW shall: • Ensure due diligence and adherence to the required local content policy. Ensure priority engagement and training of locals throughout project implementation. • Prohibit child and forced labour	LOW
B8		Improved livelihood and poverty reduction.			
B9		Stimulation of socioeconomic activities arising from employment creation.			

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
B10		Increased revenue generation to government through permits and taxes.	POSITIVE	The FMW shall: • Strengthening Tax Compliance and Enforcement • Issuance of Local and Environmental Permits • Establish a clear and transparent mechanism for collecting fees from companies and contractors applying for permits. • Implementation of Vehicle and Transport Taxation • Local Business Taxes and Levies	LOW
B11		Risk of communicable diseases such as sexually transmitted diseases (STDs) including HIV/AIDS from influx of temporary construction workers	MEDIUM	The FMW shall: • Institute HIV prevention programs (peer education, condom distribution etc) • Liaise with appropriate health focused NGOs to undertaking health awareness and education initiatives on STDs amongst workers and in nearby communities. • Provide opportunities for workers to regularly return to their families. • Implement community-based Grievance Redress Mechanism (GRM)	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
B12		Risks of occupational accidents and injuries to workers.	MEDIUM	See A5	LOW
B13	Paving and bitumen concrete laying	Generation of hazardous waste	HIGH	The FMW shall: • Ensure that hazardous wastes are stored in properly labelled closed containers placed away from direct sunlight, wind and rain. • Provide secondary containment with 110% of storage containers for hazardous waste. • Ensure usage of approved waste vendor for waste evacuation, processing & disposal.	LOW
B14		Noise and vibration disturbances in the adjoining settlements from	MEDIUM	The FMW shall: Restrict all noise generating activities to working hours during the day	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
		use of machineries and motorized equipment.		• Install suitable mufflers on engine exhausts and compressor components. • Enforce appropriate speed limit to reduce vehicle noise . • FMW shall provide and enforce the usage of hearing protection devices for workers.	LOW
B15		Risk to community health and safety	MEDIUM	The FMW shall: • Provide adequate first aid, first aiders, PPE, signages (English and Hausa languages), engineering barriers e.g., fencing • Restrict unauthorized access to all areas of high-risk activities	
B16		Loss of employment for temporary workers after construction	MEDIUM	The FMW shall: • Ensure compliance with all legal and contractual agreements with workers. • Ensure all workers receive notice of dismissal and severance payments mandated by law and collective agreements in a timely manner. • Provide a grievance mechanism for workers to raise workplace concerns	

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
B18		Risks of occupational accidents and injuries to workers.	MEDIUM	Same as A5	LOW
C	OPERATION PHASE				
C1	Road Usage	Increased traffic & risk of road traffic accidents and injuries especially for the vulnerable groups (old, and children)	MEDIUM	The FMW shall: - Warning signs to be provided at junctions, town entries, schools and market places. - Enforcement of speed limits of ≤ 30 km/h for vehicles moving within communities.	LOW
C2		Increased vehicular emission of GHGs due to increased transportation.		- Use of low-sulfur diesel or alternative cleaner fuels to be encouraged. - A buffer of tree plantation to be provided along the alignment to absorb CO produced.	LOW
C3		Noise disturbances, disrupting wildlife movement		- Signages to be provided at strategic areas to warn of animal sensitive areas. - Wildlife underpasses or overpasses will be constructed at sensitive locations.	LOW
C4		Reduction in ecosystems connectivity.		- Shade and native trees species to be replanted along road shoulders. - Roadside green belts will be established to replace degraded vegetation. - Annual monitoring of roadside biodiversity.	LOW

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
C5		Waste generation, leading to soil and water contamination.		- Establishment of Waste Management Plan - Demolition waste will be sorted at source into recyclable, reusable, and hazardous fractions. - Recyclable materials (steel, aggregates etc.) will be sold to licensed recycling handlers. - Non-recyclable waste will be disposed of at approved government-designated dumpsites.	LOW
C6		Changes in livelihood and equity.		Financial incentives and poverty reduction packages	LOW
C7		Public health concerns, such as open defecation, risk of HIV and other STDs		- Periodic public awareness campaigns on HIV/Aids, and other STDs as well as on sanitation and proper hygiene. - Provision of public latrines at designated places.	LOW
C8		Improved rural access accessibility and mobility in the project area;	POSITIVE	Same as A5	POSITIVE
C9		Stimulation of local and regional economic activities due to improved road network in the region.			
C10		Improvement in agricultural productivity, economic empowerment and socio-cultural wellbeing of the benefiting communities.			

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
C11		- Improved accessibility to communities, markets, farms and agro-processing centres. - Increased agricultural production by facilitating easy access to inputs, extension services, primary and secondary (urban) markets.		Conduct gender study to assess the challenges and opportunities for the mainstreaming of gender concerns in the use of, access to and maintenance of roads	
C12		Improved communication and socioeconomic integration amongst adjoining communities.	MEDIUM	The FMW shall: Ensure installation of appropriate traffic signs and markings to warn drivers.	LOW
C13		Reduction in travel time and transport operating cost due to improvement in the riding quality of the road.			
C14		Increased traffic & risk of road traffic accidents and injuries.			

	Project Activities	Associated and Potential Impacts	Impact Rating before Mitigation	Mitigation/Enhancement Measures	Residual Impact Rating
C15	Maintenance and Repairs	Generation of construction waste and debris	MEDIUM	The FMW shall: • Ensure usage of approved waste vendor for waste evacuation, processing & disposal. • Clean out culverts and side channels and runouts when they begin to fill with sediment and lose their effectiveness	LOW
C16		Risks of occupational accidents and injuries to workers.	MEDIUM	Same as A5	LOW
C17		Direct and indirect job creation.	MEDIUM	The FMW shall: Ensure priority engagement of locals for maintenance works.	LOW

6.5 Residual Impacts

Effective application of the mitigation measures related to emergency response and environmental management will be crucial to maintaining the overall impact of the proposed Sokoto-Badagry Superhighway project at a tolerable level. Ensuring that measures and controls are consistently applied throughout all applicable phases of the project will be key to achieving the low levels of impacts predicted after mitigation. Below are the residual impacts associated with this road project:

6.5.1 Environmental Impact

The construction and operation of the Sokoto-Badagry Superhighway, Section 2 may lead to habitat disruption, soil erosion, deforestation, and alterations in hydrology, which could impact local ecosystems along the SBS-2 alignment in Kebbi state.

- **Residual Impact:** The lasting effect of these disturbances on the ecosystem and wildlife may remain if mitigation measures such as reforestation, erosion control, and water management are not fully implemented.
- **Mitigation Measures:** Careful planning and implementation of environmental restoration programs, including soil stabilization, forest management, and wildlife corridors, will help reduce the long-term environmental impact.

6.5.2 Air and Noise Pollution

The proposed SBS-2 may lead to increased traffic and heightened levels of air pollution and noise pollution, particularly in residential and densely populated areas along the highway.

- **Residual Impact:** Despite mitigation efforts, the increased traffic load could lead to elevated pollution levels, negatively impacting the health and well-being of nearby communities.
- **Mitigation Measures:** Vehicle emission standards, construction of noise barriers, and the promotion of alternative transport options will help minimize these impacts.

6.5.3 Land Use Changes

The proposed SBS-2 could trigger changes in land use, including urban sprawl and the encroachment on agricultural land along the highway corridor.

- **Residual Impact:** While some land conversion may be necessary for the road, the unintended consequences could lead to loss of farmland, urban congestion, and a strain on local natural resources.
- **Mitigation Measures:** The project should include land-use planning and zoning measures to control urban sprawl, and efforts should be made to minimize land acquisition in agricultural areas.

6.5.4 Social Disruption

Communities in the corridor from Sokoto to Kebbi may experience social disruption due to land acquisition, displacement, and changes in local economic activities.

- **Residual Impact:** Even after compensation and resettlement, there may be lingering social tension and disruption within affected communities.
- **Mitigation Measures:** A robust resettlement and livelihood restoration plan, along with continuous community engagement, will help address the social impacts and foster positive relations with local populations.

6.5.5 Maintenance and Infrastructure Costs

While the proposed SBS-2 state will significantly improve connectivity and facilitate economic growth, there will be ongoing costs related to road maintenance and infrastructure repair.

- **Residual Impact:** These ongoing costs may become a burden on government resources over time if proper budgeting for long-term maintenance is not ensured.
- **Mitigation Measures:** The establishment of a comprehensive road maintenance fund and ensuring that funds are allocated for future repairs and upgrades will ensure the infrastructure remains viable.

6.5.6 Induced Traffic

The improved road infrastructure might encourage more people to use the road, leading to increased traffic volumes and potential congestion in certain areas.

- **Residual Impact:** Over time, this could create traffic bottlenecks, particularly near key junctions or urban areas, despite the road's improved capacity.
- **Mitigation Measures:** The development of bypasses, additional lanes, and effective traffic management systems will help accommodate the additional traffic demand and reduce congestion.

6.6 Mitigation Measures for Climate Change Impact

6.6.1 Increased Temperatures

- Use temperature-resistant cement and high-durability concrete in road construction to minimize surface degradation caused by heat.
- Install thermal expansion joints in bridges and other critical structures to prevent cracking due to expansion and contraction.
- Apply light-coloured or reflective coatings on road surfaces to reduce heat absorption and mitigate thermal stress.

6.6.2 Increased Precipitation and Flooding

- Design robust drainage systems, including larger culverts and storm water channels, to manage high-intensity rainfall effectively.
- Elevate roadbeds and use flood-resistant embankments in flood-prone areas.
- Integrate green infrastructure such as bios wales and vegetative strips along the highway to absorb and slow down surface runoff.

6.6.3 Drought and Dust Storms

- Employ geotextiles, soil binders, and other stabilization methods to enhance embankment strength and prevent erosion during dry periods.
- Plant vegetation along the highway to act as windbreaks, reducing dust accumulation and improving visibility during storms.
- Implement routine water spraying and dust palliative applications on unpaved areas to control dust dispersion.

6.6.4 Economic, Social, and Agricultural Impacts

- Develop bypass roads to ensure uninterrupted transportation and connectivity during road closures caused by climate events.

- Create contingency plans and storage facilities to mitigate supply chain disruptions, particularly for perishable goods like agricultural produce.
- Involve local communities in climate resilience planning and provide access to alternative transport modes during disruptions.

6.6.5 General Adaptation and Resilience Measures

- Conduct frequent inspections and proactive repairs to address vulnerabilities caused by climate stressors.
- Launch large-scale tree planting and greening initiatives around the highway to enhance ecosystem resilience and combat desertification.
- Establish emergency response units equipped to handle road closures and assist communities during extreme weather events.
- Use climate projection models and GIS tools to predict high-risk zones and incorporate adaptive measures into the highway's design.

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Introduction

This chapter presents the Environmental and Social Management Plan (ESMP) for the proposed SBS-2. ESMP is a proactive tool that will ensure seamless integration of action plans and programmes for overall management of all identified and unidentified impacts of the proposed road construction project.

The overarching objective of the ESMP is to ensure that all impacts of the project are contained and brought to an acceptable level to guarantee economic, environmental and social sustainability of the project.

Other objectives of ESMP include the following:

- To ensure compliance with national and international environmental legislation, standards and procedures.
- To ensure the adoption and application of best practice environmental management principles during project implementation.
- To ensure that all action plans, mitigation measures and other management plans recommended for all impacts of the proposed road construction are implemented and integrated into the entire implantation phases of the project.
- To monitor the effectiveness and efficacy of the recommended mitigation measures and promptly respond to unforeseen events.
- To ensure that there is sufficient allocation of resources to effectively carry out the proposed mitigation measures; and
- To provide feedback for continual improvement in environmental performance during the road construction.

The ESMP has been developed to meet international and national standards on environmental and social management performance and covers the project implementation phases – Preconstruction, construction and operation phases of the project. Furthermore, it details the mitigation, and enhancement measures the Contractor has committed to implement throughout

the implementation of the project as well as desired outcomes; performance indicators; monitoring; and timing for actions and responsibilities.

FMW will have principal responsibility for all measures outlined in the ESMP but will delegate the responsibility to its contractors. Such delegation of responsibility shall be adequately documented as part of contractual agreements to guarantee absolute compliance and commitment on the part of the contractor to implement the ESMP.

It is instructive to note that Most of the mitigation measures are the obligation of the Contractor during all phases of the project. Consequently, the contractor will have to prepare its proposals considering the measures as well as the detailed general environmental management conditions during civil works. For easy administration and implementation, this ESMP is designed using the model of Environmental Management System (EMS) established management process of “plan, do, check and act” like the ISO 14001 EMS model.

7.2 Environmental and Social Impact and Mitigation

The significant associated and potential environmental and social impacts for which management actions are required have been identified in Chapter 5 of this Report. The feasible, practical and cost-effective measures and actions to avoid, minimize, mitigate the potentially significant negative environmental and social impacts of the project to acceptable levels and enhance positive impacts are described in Chapter 6 of this Report and summarized in Table 6.1. The Table outlines the measures to be implemented for each identified significant environmental and social impact.

The mitigation measures mainly relate to the adoption of environmentally friendly designs and the application of environmentally sound construction and operations management practices. All the management measures will be included in the bid documents for the successful enterprise to implement. The performance measures to enhance the desired environmental and social outcome are discussed in the following sections.

7.3 Environmental and Social Management Programme

The FMW shall be committed to providing resources required for the implementation and control of the ESMP including engaging dedicated personnel competent based on appropriate education, training, and experience to manage and oversee the HSE aspects of the project. The HSE personnel shall ensure that all workers and contractors operate in accordance with the applicable national and international regulatory HSE requirements and plans. The HSE

personnel shall also monitor implementation of environmental and social protection measures contained in this ESMP.

7.3.1 Training and Awareness

The FMW shall ensure that all workers engaged throughout the construction lifecycle whose work may have a significant adverse impact upon the environmental or social conditions are adequately trained. It is important that workers at each relevant function and level are aware of the potential impacts of their activities; and roles and responsibilities in achieving conformance with the ESMP, environmental legislation, policies, standards and procedures.

Employee training will include awareness and competency with respect to:

- Environmental and social impacts that could potentially arise from their activities (including dust, noise, soil contamination etc.).
- Necessity of conforming to the requirements of the ESIA and ESMP, in order to avoid or reduce those impacts.
- Roles and responsibilities to achieve the required conformity, including those in respect of change management and emergency response.
- Other training may be organized as at when required and based on formally identified needs.
- All contractors training program will be subject to approval by the FMW, and it will be audited to ensure that: training programs are adequate; all personnel requiring training have been trained; and competency be verified.

7.3.2 Communication, Information and Monitoring

It is important that good relations be maintained with potentially affected local community throughout the duration of project. Community members should be informed of the intended scope and duration of the project and associated activities well in advance and this has been started and reinforced during this ESIA preparation. They should be kept informed of any changes to scheduling throughout the duration of the different aspect of the phases of the project.

All site contractors, including sub-contractors shall be made familiar with this plan prior to the commencement of any site works.

The FMW shall maintain a formal procedure for communication with the regulatory authorities and affected communities through its representatives or dedicated Community Liaison Officer (CLO). Meetings will be held, as required, between FMW, appropriate regulatory agencies and community representatives to review environmental performance, areas of concern and emerging issues. Dealings will be transparent, and stakeholders will have access to personnel and information to address concerns raised.

7.3.3 Grievance Redress Mechanism

This is designed to address situations of conflicts or disagreements about some of the project activities during construction and operation in the following order:

- All complains will go to the contractor directly at the first instance.
- Where issues are not addressed, complaints shall be scaled to the project manager.
- Where it is perceived that no satisfactory attention was given then the complainant shall have access to the project owner
- Informing the relevant government authorities is considered the next step if Management is seen not to have resolved the arising issues satisfactorily.
- The last but undesirable is reaching the court by settlement of any issues that are not addressed at the previous levels.
- This grievance redress process shall be provided to any person who has complaints or grievances during the phases of the project

Any environmental or social incidents shall be documented. The report shall be transmitted to the relevant authority where necessary/applicable. The reporting shall be with a view to taking appropriate mitigation measures. All complaints received would be investigated and a response (even if pending further investigation) is to be given to the complainant within 5 days.

The following information must be provided:

- Time, date and nature of the incident/report.
- Type of communication (e.g., telephone, personal meeting).
- Name, house location and contact telephone number of person making the complaint.
- If this person wishes to remain anonymous then —not identified is to be recorded.

- Details of response and investigation undertaken as a result of the incident/complaint.
- Name of person undertaking investigation of the incident/complaint; □ Corrective action taken because of the incident/complaint.

7.3.4 Documentation

The FMW will control HSE documentation, including management plans; associated procedures; and checklists, forms and reports, through a formal procedure. All records will be kept on site and will be backed up at several offsite locations (including secure cloud storage facilities as may be required). Records will be kept in both hard copy and soft copy formats. And all records will be archived for future purpose.

In addition, the document control procedure will describe the processes that the FMW will employ for official communication of both hardcopy and electronic document deliverables. Also, it will describe the requirement for electronic filing and posting and for assignment of document tracking and control numbers.

In the same manner, Contractor will be required to develop a system for maintaining and controlling its own HSE documentation and describe these systems in their respective HSE plans.

7.3.5 Operational Control Procedures

Each potentially significant impact identified in this ESIA will have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement and record keeping for avoiding or reducing impacts. Operational controls are monitored for compliance and effectiveness on a regular basis through a monitoring and auditing procedure described in the ESMP.

Operational control procedures shall be reviewed and, where appropriate, amended to include instructions for planning and minimizing impacts, or to at least reference relevant documents that address impact avoidance and mitigation. Operational control shall be undertaken by the Contractor with supervision from the FMW.

7.3.6 Emergency Preparedness and Response Plan

Emergency Preparedness and Response Plan is essential to address unplanned situations that may result in risks to human health, properties or the environment, either along the road corridor or nearby local communities. The Contractor shall prepare plans and procedures for preventing and mitigating unplanned potentially adverse environmental and social events that may occur during project implementation and operation.

Specifically, the Plan shall:

- Identify areas where accidents and emergency situations may occur and individuals that may be affected e.g., fire emergency and hazardous material spill.
- Provide and install relevant emergency equipment such as firefighting/extinguishing equipment and detection system, including alarm bells and visual alarms for communication to alert workers to an emergency.
- Ensure regular servicing and testing of emergency equipment.
- Provide first aid attendants as well as suitable medical equipment.
- Liaise or collaborate with the local communities that may be affected by the project and relevant local agencies in preparation to respond effectively to emergency situations.
- Provide relevant local authorities, emergency services, affected communities and other stakeholders with information on the nature and extent of environmental and human health effects that may result from construction activities.

The project-specific emergency plan shall address amongst others the following aspects of emergency preparedness and response:

- Emergency procedures
- Emergency contacts and communication
- Evacuation routes and meeting points
- Roles and responsibilities
- Education and Training
- Emergency Drills

The Emergency Preparedness and Response Plan shall be reviewed, revised and updated periodically to reflect changing conditions in the plan and emerging emergency issues.

7.3.7 Facilities Surveillance

This is a salient system maintenance requirement for the environmental sustainability of the project. The Contractor shall carry out constant equipment and facilities surveillance to detect on time, the malfunctioning or deterioration of equipment and/or facilities. The surveillance shall aim at taking prompt corrective/repair measures on detected faults.

7.3.7 Emerging Issues and Management

There may be changes to the original project implementation plans or project activities due to unanticipated situations. Adaptive changes may also occur during final design, commissioning or even operations. The contractor will implement a formal procedure to manage changes in the project that will apply to all project activities.

The objective of the procedure is to ensure that the impact of changes on the community and workers health and safety and the environment are identified and assessed prior to changes being implemented.

7.3.8 Facilities Surveillance

This is a salient system maintenance requirement for the environmental sustainability of the project. The Contractor shall carry out constant equipment and facilities surveillance to detect on time, the malfunctioning or deterioration of equipment and/or facilities. The surveillance shall aim at taking prompt corrective/repair measures on detected faults.

7.3.9 Additional Management Plans

Additional detailed policies and plans shall be developed to support the implementation of this ESMP. The timing of the development of the plans may be staged, ensuring that the appropriate focus and level of detail is provided for the proposed SBS-2 project. Additional Management Plans will be developed by the Contractor, where appropriate in consultation with the Federal and State Ministries of Environment, and the host LGAs and other key stakeholders. The Contractor shall ensure Regulators also participate in monitoring of Socio- economic/ Health and safety issues.

Additional management plans for this project may include the following:

- Waste Management Plan.
- Spill Prevention and Emergency Response Plan.
- Emergency Response Plan.
- Traffic Management Plan.
- Drainage and Erosion Control Plan.
- Occupational Health and Safety Plan.
- Security Plan.
- Local Employment and Procurement Policy; □ Integrated Vegetation Management Plan

7.3.10 Checking and Corrective Actions

Checking is crucial to the overall success of this ESMP, and it includes inspections and monitoring. Corrective actions include response to out-of-control situations, non-compliances, and non-conformances. Actions also include those intended to improve performance.

7.3.10.1 Inspection

Health, Safety and Environment inspections shall be conducted weekly on a specific basis and formally at least once every month by the FMW's HSE Officer. The results of the inspection activities shall be reported and addressed appropriately. Outcome of inspection activities shall be communicated to the Contractor through their HSE officers for appropriate action.

7.3.10.2 Monitoring

Environmental Monitoring Plan is the systematic schedule for collection of environmental data through a series of repetitive measurements. UNEP (1996) describes three known types of environmental monitoring within the conceptual ESIA framework as follows:

- **Baseline Monitoring:** Refers to the measurements of environmental parameters during the pre-project period.
- **Effects Monitoring:** Involves the measurements of environmental parameters during construction to detect changes in these parameters which can be attributed to the project.
- **Compliance Monitoring:** Is the periodic or continuous measurement of environmental parameters of discharges to ensure that regulatory requirements and standards are met. Compliance monitoring can either be Mitigation Measures Monitoring which relates to the prescribed mitigation measures put in place by the pre-project ESIA to the existing

operational structure of the project, or Regulatory Compliance Monitoring, which compares the regulatory monitoring requirements to the existing operational, occupational and environmental parameters.

FMW shall adopt a systematic monitoring schedule that will comprise both effects and compliance monitoring plans for the implementation of the project. Baseline requirements are already embodied in Chapter Four of this Report and are such not covered in this Chapter. Monitoring shall be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the ESMP.

The FMEnv guidelines require an environmental monitoring plan as part of an ESIA. The aim of the monitoring programme is to ensure that the negative environmental impacts identified in this ESIA Report are effectively mitigated especially during the preconstruction and construction phases.

Specifically, the objectives of instituting a monitoring programme for this project are to:

- Ensure that regulatory standards/limits for parameters of concerns are not exceeded.
- Monitor changes in existing physical, chemical and biological characteristics of the ancillary environment of the project area. Early warning of environmental damage is thus provided so that urgent action may be taken if needed, to reduce in earnest the unwanted impact.
- Determine whether any detected changes in environmental components are caused by the Project or by other factors.
- Determine the effectiveness of the mitigation measures as well as check mitigation measures are correctly implemented.
- Highlight areas of concern undetected during the ESIA study and provide a basis for recommending additional mitigation measures.
- Auditing (Internal and External)

Audit shall be carried out periodically to confirm proper implementation of checking systems as well as effectiveness of mitigations measures. In addition to routine inspection and

monitoring activities, audits will be carried out internally by the Contractor to ensure compliance with regulatory requirements as well as their HSE standards and policies. Audits to be conducted will also cover all contractors' activities. The audit shall be performed by qualified staff and the results shall be reported to the contractor to be addressed.

The audit will include a review of compliance with the requirements of the ESIA and ESMP and include, at a minimum, the following:

- Completeness of HSE documentation, planning documents and inspection records.
- Conformance with monitoring requirements.
- Efficacy of activities to address any non-conformance with monitoring requirements.

There may be a cycle of audits into specific areas of the project such as waste management. The frequency of audits will be risk based and will vary with the stage of the project and will depend on the results of previous audits.

7.3.10.3 Corrective Action

Investigating a near miss or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future. The contractor will implement a formal non-compliance and corrective action tracking procedure for investigating the causes of, and identifying corrective actions to, accidents or environmental or social non-compliances.

7.3.10.4 Reporting

Internal Reporting: The FMW shall keep the regulatory authorities informed of the project performance with respect to HSE matters through reports that will be made available to the regulators when required. The Contractor shall provide appropriate documentation of HSE related activities, including internal inspection records, training records, and reports to the FMW who will liaise with relevant authorities. Contractors shall also be required to provide HSE performance reporting to FMW on a regular basis through weekly and monthly reports.

External (Governmental Agencies) Reporting: Environmental Assessment report summarizing the status of the environment during construction may be required by regulatory bodies.

7.3.11 Institutional Arrangement

The roles and responsibilities of the various institutions in the implementation of this ESMP as outlined in the previous sections is summarized in Table 7.1. The proposed institutional arrangement is shown in Figure 7.1.

Table 7.1: Summary of Roles and Responsibilities of Relevant Institutions in the Implementation of Project ESMP

S/N	Institution	Roles & Responsibilities
1.	Federal Ministry of Works (FMW) / Senior Engineer/HSE Coordinator /Environmental Liaison Officer/Quality Assurance Engineers	- Ensure integration of ESMP requirements in tender documents and contracts and compliance of same during project implementation. - Liaise with environmental and social regulators at federal and state levels. - Undertake monitoring and report periodically to relevant authority and financial institutions.
2.	Federal Ministry of Environment (in collaboration with NESREA, SMEnv & other relevant agencies)	- Lead environmental regulator and compliance overseer at federal level. - Receive comments from stakeholders on draft ESIA, undertake public hearing of project proposal, convene technical panel for decision-making on environmental and social sustainability of project, and grant approval. - Undertake environmental and social liability investigations, periodic monitoring and supervision.
3.	State Government MDAs (Including Ministries of Lands)	- Compliance overseer at state level on matters of land acquisition and compensation and other resettlement issues. - Other MDAs come in as and when relevant areas or resources under their jurisdiction or management are likely to be affected by or implicated projects. - Participate in the ESIA processes and in project decision making that helps prevent or minimize impacts and to mitigate them. - Undertake monitoring or supervisory oversight as assigned in ESMP.
4.	Construction/O&M Contractor	- Compliance to BOQ specification in procurement of material and construction. - Compliance with and implement ESMP

5.	Host LGAs	- Provide oversight function in LGAs for ESMP compliance. - Monitor activities related to public health, sanitation, waste management, amongst others.
6.	Project Affected Communities	- Promote environmental awareness. - Review environmental and social performance reports. - Provide comments and/or advice on complaints or issues of nonconformity. - Attend public meetings organized to disseminate information and receive feedback.
7.	CDAs	Ensure community participation by mobilizing sensitizing community members;
8.	Others/General Public	Identify issues that could derail the project and support project mitigation and management

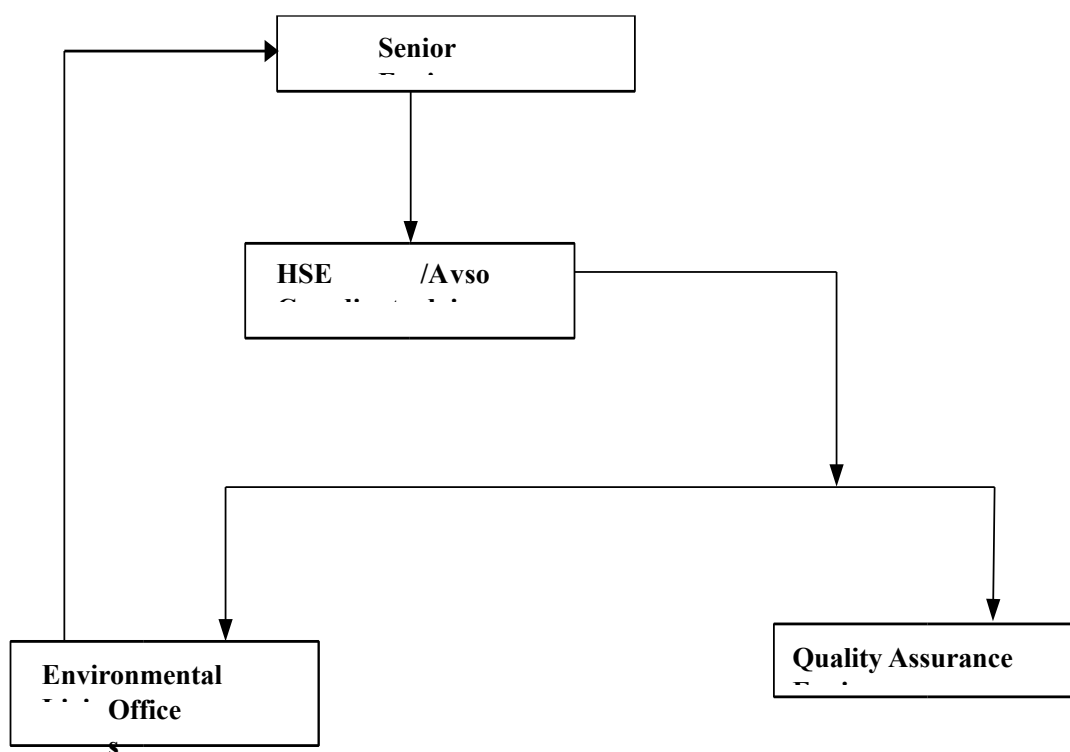


Figure 7.1: ESMP Implementation Organogram

Table 7.2: Environmental Management and Monitoring Plan

	Associated Potential Impacts	& Mitigation Measures	Parameters to be Measured	Method Measurement	Performance Indicator	Sampling Location	Frequency of Monitoring	Responsible Personnel	Monitoring
A	PRECONSTRUCTION PHASE								
	LAND ACQUISITION								
1	Loss of shelter, assets, farmland and land based livelihood	- Develop and implement a Livelihood Restoration Plan (RALRP) to ensure affected landowners are adequately compensated for loss of houses, land and economic crops. - Ensure all issues relating to compensation	- RAP & LRP - Evidence of engagement with land owners. - No of employed locals - Grievances and conflicts	- Visual Observation - Survey - Attendance/minute meetings	Level of satisfaction by landowners	Host communities	Once before construction	FMW	FMEnv Sokoto & Kebbi States Min. of Lands Host LGAs
2	Loss of economic trees including medicinal herbs								

	Associated Potential Impacts	& Mitigation Measures	Parameters to be Measured	Method of Measurement	Performance Indicator	Sampling Location	Responsible Personnel	Monitoring		
3	Grievance and conflicts over land resettlement & compensation									
4	Security risks	- Deploy competent security personnel to secure project site. - Provide adequate training of security personnel - Disclose site	No of security personnel engaged	Records and Interviews	No of security incidents	Construction site	FMW Local Vigilante Police			

		security arrangements to the Police and host communities								
5	Risks of occupational accident and injuries to workers	- Develop a project specific - Occupational Health and Safety Plan (OHSP) commensurate to construction activities. - OHSP to include but not limited to:	OHSP developed	Visual observation	Compliance with Factory Act, 1990	Construction Site	Weekly		FMW	FMW/HSE Coordinator

		• Prohibition of drug and alcohol use by workers while on the job. • Provision of adequate first aid, first aiders, PPE, signages (English and Hausa languages), engineering barriers e. g fencing • Restrict unauthorized access to all areas of high-risk activities • Implementation of specific personnel training on worksite OHS management	Usage of appropriate PPE Usage of signages and demarcations						
MOBILIZATION OF PERSONNEL, EQUIPMENT AND MATERIALS TO SITE									
6	Increased security risks due to storage of materials and equipment on site	Same as A4							

7	Threat to community culture, safety and security due to presence of workers and business opportunists.	workers. The code of conduct will address the following aspect: Respect for residents; No hunting or unauthorized taking of products or livestock's; Zero tolerance of illegal activities such as child sexual exploitation and underage sex, prostitution, harassment of women, gender-based violence, purchase or use of illegal drugs,	Worker's manual, employment codes etc Level of awareness of local culture by migrant workers. Grievance Redress System Ratio of local to foreign workers Presence of security personnel's	Visual observation and interviews	Community perception and level of satisfaction.	Construction site	Weekly	FMW	Host LGAs Police
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		illegal fighting; Disciplinary measures and sanctions (e.g. dismissal) for infringement of the code of conduct and/or company rules; Commitment / policy to cooperate with law enforcement agencies Provide cultural sensitization training to improve awareness of and sensitivity of workers to local							
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		cultures, traditions and lifestyles. • Prohibit child and forced labour. • Implement community-based Grievance Redress Mechanism • Limit the number of migrant workers by engaging local workers. • Engage competent security personnel.						
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8	Increase demand on existing community health and sanitation infrastructure due to influx of temporary workers and camp followers	Develop a CSR program to support infrastructural development in host communities. Establish worker's camp and provide all basic amenities (water, sanitation etc).	Visual inspection	Public perception	Affected communities	Weekly	FMW	Host LGAs
9	Occupational related accidents and injuries	Same as A5						
10	Deterioration of local air quality due to the emission of dusts & gases	Use water to wet ground for dust suppression. Conduct regular visual inspection of dust pollution and	<i>In-situ</i> measurement	FMEnv permissible limit	Construction Site	Weekly	FMW	FMEnv/SMEnv/LGAs

11	Respiratory and eye related problems for	ensure appropriate intervention if dust levels are high.	<i>Visual observation of records & interviews</i>					
	workers due to exposure to fugitive dusts and gaseous emissions.	• Train drivers/workers on proper operation of vehicles and equipment to include fuel efficiency and anti-idling techniques • Provide and enforce the usage of appropriate PPE.	Training records					

12	Noise and vibration disturbances from operation of heavy-duty vehicles.	- Select and use vehicles/ equipment with lower sound power levels. - Install suitable mufflers on engine exhausts and compressor components. - Enforce appropriate speed limit to reduce vehicle noise levels. - Respond promptly to noise complaints. - Provide & enforce the usage of hearing protection devices (ear plugs/muffs) for workers as part of OHSP.	Noise level	<i>In situ measurement</i>	Noise level at sensitive receptors not to exceed FMEnv recommended level (90 dBA) for an 8-hour period	Construction site and nearby communities	Daily	FMW	FMEnv /SMEnv/LGAs
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13	Loss of vegetation and biodiversity	- Restrict removal of vegetation and trees to the boundary of construction site only. - Schedule vegetation clearing to occur in phases so that the entire area is not cleared at once. - Protect all vegetation not required to be removed against damage. - Undertake quick re vegetation of exposed soils with indigenous	Clearly defined boundaries of protected areas Evidence of re-vegetation Evidence of Erosion menace	<i>Visual observation; and</i> <i>Biodiversity survey</i>	Available number and diversity of plant species within baseline conditions	Construction areas	Weekly	FMW	FMEnv/SMEnv/LGAs
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14	Wildlife disturbances and destruction	Restrict of construction site only	-	Visual observation; and Biodiversity survey	Available number and Wildlife abundance within baseline conditions	Construction areas	Weekly	FMW	FMEnv/SMEnv/LGAs
15		• Protect all vegetation not required to be removed against damage		Visual observation; and Biodiversity survey	Available number and diversity of plant species within baseline conditions	Construction areas	Weekly	FMW	FMEnv/SMEnv/LGAs
16	Plant species in areas where active construction is completed. Ensure construction of effective drainage system and use erosion protection	Control measures and drainage system		Visual observation	Erosion menace	Construction areas	Weekly	FMW	FMEnv/SMEnv /LGAs

	structures such as sediment traps, riprap, gabions etc.								
17	Siltation of surface water from eroded topsoil	plant species in areas where active construction is completed. Ensure construction of effective drainage system and use erosion protection structures such as sediment traps, riprap, gabions etc.	control measures and drainage system			Construction areas	Weekly	FMW	FMEnv SME/LGAs

18	Occupational related accidents and injuries to workers	Same as A5							
B	CONSTRUCTION PHASE								
	EARTHWORKS AND GRADING								
	CONSTRUCTION OF BRIDGES AND CULVERTS								
B1	Deterioration of local air quality due to the release of dust & exhaust gases.	Same A10 above							
B2	Noise and vibration disturbances from operation of heavy-duty vehicles and equipment.	Same A10 above							

B3	Predisposition of soil to erosion.	Ensure construction of effective drainage system and use erosion protection structures such as sediment traps, riprap, gabions etc.	Evidence of erosion protection structures	Visual observation	Erosion incidents	Project site	Weekly	FMW	FMEnv SMEnv
B4	Surface water contamination as a result of sediment/pollutants run off from spoils and exposed soil surfaces.								

B5	Soil contamination from leakage/spillage of fuel or oil from equipment and vehicles.	Prepare and implement an Emergency Response Plan to respond to incident of spillage. Ensure fuel storage tanks are installed in a bunded area and checked daily. Ensure regular maintenance of vehicles to avoid leaks of oil. Prevent unregulated dumping of fuel waste	Emergency Response Plan developed Soil quality parameters	Visual observation Laboratory testing	FMEnv Soil Quality Standards	Project site	Weekly	Contractor	FMEnv SMEnv
B6	Generation of spoils and other excavated materials	Ensure stockpile and disposal areas are stable and protected against erosion and not interfere with run	Evidence of stockpile protection	Visual observation	Compliance with Mitigation	Project site	Weekly	FMW	FMEnv SMEnv

		off or subsequent construction activities.							SEPA
		Stockpile to be covered and stored in a sealed and bonded area to divert storm water away. Reuse stockpile as fill materials on the site or another construction site	Evidence of spoil reuse						

B7	Generation of construction waste and debris	Ensure waste is evacuated from site by approved waste contractors to prevent unregulated dumping.	Waste vendor licenses Waste documentation	Visual observation	National Environmental Protection (Management of Solid and Hazardous Wastes) Regulation 1991.	Project site	Weekly	FMW	FMEnv SMEnv SEPA
B8	Diseases (STDs) including HIV/AIDS from influx of temporary construction workers.	Institute HIV prevention programs (peer education, condom distribution etc)	Evidence of awareness among construction	Interview	No of incidents/cases	Project site and affected communities	Monthly	FMW	FMH
B9	Risks of occupational accidents and injuries to workers.	Workers and members of affected communities GRM							

B10	Generation of hazardous waste	• Ensure that hazardous wastes are stored in properly labelled closed containers placed away from direct sunlight, wind and rain. • Provide secondary containment with 110% of storage containers for hazardous waste. • Ensure usage of approved waste vendor for waste evacuation, • processing & disposal	Waste vendor licenses Waste documentation	Visual observation	National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations of 1991.	Project site	Weekly	FMW	FMEnv SMEEnv
B11	Noise and vibration disturbances in the adjoining settlements from use of machineries	Restrict all noise generating activities to working hours during the day	Noise level	<i>In situ</i> measurement	Noise level at sensitive receptors not to exceed FMEnv recommended level (90 dBA)	Construction site and nearby communities	Daily	FMW	FMEnv SME

	and motorized equipment.	• Install suitable mufflers on engine exhausts and compressor components. • Enforce appropriate speed limit to reduce vehicle noise levels. • Provide and enforce the usage of hearing protection devices for workers.			for an 8-hour period				
B12	Risk to community health and safety	Provide adequate first aid, first aiders, PPE, signages (English and Hausa languages),	Appropriate signages in local languages	<i>Visual observation</i>	Zero injuries to community members	Project site	Daily during concreting	FMW	FMH Host LGAs

		engineering barriers e. g fencing Restrict unauthorized access to all areas of high- risk activities	Restrictions						
B13	Loss of employment for temporary workers after construction	- Ensure compliance with all legal and contractual agreement with workers. - Ensure all workers receive notice of dismissal and severance payments mandated by law and collective agreements in a timely manner.	Compliance with workers contract of employment Timely payment of workers dues	<i>Records</i> <i>Interviews</i>	Nigerian Labour Law No of grievances	Site Office	Once	FMW	FMW

		□ Provide a grievance mechanism for workers to raise workplace concerns.							
B14	Risks of occupational accidents and injuries to workers.	See A5							
C	OPERATION PHASE								
	ROAD USAGE MAINTENANCE AND REPAIRS								
C1	Increased traffic & risk of road traffic accidents and injuries.	Ensure installation of appropriate traffic signs and markings to warn drivers.	Traffic signs and markings	Visual observation	No of accidents	Project site	Weekly	FMW	FRSC Police
C2	Generation of construction waste and debris	• Ensure hazardous wastes are stored in properly labelled closed containers	Compliance with WMP Waste vendor licenses Waste documentation	Visual observation	National Environmental Protection	Project site	Weekly	FMW	FMEnv SMEnv

		Placed away from direct sunlight, wind and rain. • Provide secondary containment with of storage containers for hazardous waste			(Management of Solid and Hazardous Wastes) Regulations of 1991.				
		• Ensure usage of approved waste vendor for waste evacuation, & disposal.							
C3	Risks of occupational accidents and injuries to workers.	• Same as A5							

7.4 Biodiversity Management Plan

The biodiversity management plan among other things, have the following objectives:

- Minimize Vegetation clearance, and replanted native trees. These will be allowed to grow along the RoW.
- Prohibit construction workers from hunting, trapping, or disturbing wildlife.
- Incorporate wildlife crossing points and culverts to reduce fauna-vehicle collisions.
- Minimize night works and direct lighting downward to avoid disturbing nocturnal species and reduce photoperiodism.
- Rehabilitate disturbed areas with native species post-construction

Other components of the plan include

Vegetation and Tree Removal Management

- **Limiting Vegetation Removal:** The removal of vegetation and trees will be strictly limited to areas that are essential for the construction activities. By minimizing land disturbance, the project aims to reduce the risk of surface runoff, which can lead to soil erosion and the sedimentation of surface water.
- **Maintaining Natural Buffers:** Efforts will be made to maintain natural vegetation buffers along water bodies and slopes, further reducing the risk of sedimentation and runoff into nearby streams and rivers.

Revegetation of Exposed Soils

- **Timely Revegetation:** In areas where active construction has been completed, exposed soils will be quickly revegetated with indigenous plant species. This practice will help stabilize the soil, reduce the risk of erosion, and prevent sediment from entering surface water systems. Revegetation will also contribute to the overall ecosystem restoration along the highway corridor.
- **Selection of Suitable Plant Species:** Indigenous plant species that are well-adapted to the local climate and environment will be selected for revegetation to enhance soil stability and promote biodiversity.
- **Biodiversity offset program** (e.g., reforestation or conservation funding) will be implemented if unavoidable habitat loss occurs.
- **Long-term ecological monitoring** to track species recovery and vegetation regrowth.

7.5 Waste Management Plan

It is crucial to develop a site-specific Waste Management Plan (WMP) for both hazardous and non-hazardous waste for effective and holistic waste management to prevent environmental contamination and promote resource efficiency. The WMP shall be based on an integrated approach which involves using a combination of techniques and programs to manage wastes adopting the principle of Reduce, Repair, Reuse, Recycle, Recover and Disposal.

The WMP shall include details and classification (type, source and quantity) of all waste anticipated to be generated during the project life cycle as well as handling, storage, and disposal methods for each class of waste. WMP shall also include details of waste contractor who MUST be licensed by State Environmental Protection Agencies and details of documents and records to be kept regarding waste transfer, disposal etc.

During the various phases of the project (construction, operation and maintenance), it is inevitable that discharges of materials described here as waste to the environment will occur. If these are not controlled, they may act as a source of environmental and social disturbance or nuisance. The construction activities could yield a variety of waste in the form of construction materials, scrap metal, municipal wastes, etc.

For effective management, the waste management plan during construction and operation phases will ensure that all the waste must be properly identified, minimized, segregated, properly stored, reused, tracked, monitored and audited. Wastes generated during the proposed project shall be handled, stored, treated, recycled, and disposed based on the nature of each waste stream. The project-specific waste management guidelines shall take into consideration the nature of each waste stream to be generated during the lifetime of the proposed project.

All the wastes that cannot be re-used will be safely managed and disposed of in a manner that meets regulatory requirements. This implies that the waste should be properly handled since the consequences are detrimental. Poor waste handling could lead to the following:

Environmental consequences

- Unsightliness
- Air pollution, especially when waste is burnt
- Blockage of water runoff channels
- Increased amount of waste
- Waste management disposal problem

Economic consequences

- Loss / waste of resources that can be recycled for re-use
- Opportunities for recycling industries and employment lost
- Ozone depletion has led to unpredictable weather conditions. Prolonged droughts and floods demand the use of resources which should be deployed for growth and development in other sectors

Social consequences

- Substantial public spending on health care • Improperly managed waste affects people's health.
- Growth of informal waste disposal centres in the neighbourhood

Responsible waste management is accomplished through hierarchical application of the practices of source reduction, reuse and recycling as well as incineration and landfill. This shall be the guiding principle of waste management in the proposed project. All wastes, which cannot be reused, will be managed and disposed of as the least option in accordance with regulatory standards. The integration of this efficient and effective waste management plan would help to reduce or minimize risk and environmental disturbance.

7.5.1 Waste Generation

The bulk of waste generation is envisaged during construction and demolition phase. During operation, the project is not expected to generate significant quantity of waste, other than the

routine waste generated by passengers who ply the route and from the normal maintenance of the road. For a start, the expected waste types that shall be generated include cement and concrete, landscape debris, Scrap metal, wood and pallets, Garbage/trash and Cardboard/papers. (Table 7.3). The table 7.4 shows the Waste Management Plans generated in Phases.

Table 7.3: Estimated Waste Generation

S/No	Waste	Estimated Waste Quantity (tons/day)	Handling
1	Cement and Concrete	30	Concrete debris can be sized and recycled on-site as pipe bedding or road base
2	Scrap metals	20	Scrap metal can be recycled off-site
3	Wood	20	Wood debris can be chipped
4	Debris/ Landscape Materials	40	recycled on-site as pipe bedding or road base
5	Garbage/Trash	10	Landfill
6	Spent/used oil Caterpillar Dump Truck Crane	7.87 1.68 1.25	Used oil and hydraulic fluid generated on the construction sites will be collected and stored temporarily in a safe place before they are sent to a recycling depot.
7	Paper	0.5	Give others to second hand users and dispose others in landfill
8	Plastic	<1	Send to recycling plants
9	Metal scrap	0.8	Give to second hand users
10	Drums and containers Chemical Wastes	1	All vessels (drums, containers, etc.) containing hazardous chemicals shall be banded to contain spillage.

Table 7.4: Waste Management Plan in Phases

S/N	Potential Source/Activity	Waste Type	Potential Waste Streams	Waste Management
PRE-CONSTRUCTION PHASE				
1	Site clearing including vegetation clearance	Non-Hazardous	Vegetal wastes (organic spoils)	- Recycle as mulch or compost for agricultural or landscaping purposes. - Reuse wood debris and slash as fuel wood for cooking. - Stockpile and reuse spoils during construction
CONSTRUCTION PHASE				
2	Road Earthworks	Non-Hazardous	Spoils	- Minimize amount of spoil/unsuitable rock aggregates generated through proper design. - Re-use/recycle suitable spoil to the extent possible. - Re-usable spoils should be stored on-site in designated stockpile areas. - Unsuitable spoils should be transferred offsite by registered waste contractor.
3	Movement of heavy-duty vehicles for construction activities and transportation of road building materials	Emissions	CO ₂ , SO _x , NO _x , CO, Dust	- Use water suppression to prevent dust emissions. - Maintain vehicles and machineries to reduce emissions - Maintain low speed to reduce dust and gaseous emissions - Allow aerial dispersal over a large area.

4	Bridge and Culvert Construction	Non-Hazardous	Excavated aggregates, spoils and other construction waste	- Minimize amount of spoil generated through proper design. - Re-use/recycle suitable spoil to the extent possible. - Re-usable spoils should be stored on-site in designated stockpile areas. - Unsuitable spoils should be transferred offsite by registered waste contractor
		Non-Hazardous	Cement bags, metal scraps, wooden pallets, paper, cardboard, packaging materials,	Cement bags and used metals should be collected in appropriate bins and transported off site by a registered waste contractor for re-use and recycle.
		Non-Hazardous	Waste water from concrete production and equipment washing.	Discharge to ground as its expected to be non-hazardous
		Hazardous	Bitumen, concrete, used nickel cadmium batteries, chemical containers, used oil, oily rags,	Store on site in closed containers with secondary containment and transfer to a registered waste contractor with off-site permitted hazardous waste treatment, storage, or disposal facilities
5	Worker's camp and Site office operations	Non-Hazardous (Domestic & Sanitary Wastes)	Paper wastes, packaging and food wastes, metal cans of drinks, sanitary wastes	- Segregate, reuse and recycle as appropriate. - Organic wastes can be transferred to locals for use as compost and animal feed. - Plastic and other packaging to be recycled through licensed recycling third parties - non-recyclables to be removed by approved States Environmental

				Protection Agencies waste contractor for onward disposal at approved sites.
6	Spills of oil and fuels from vehicles and equipment	Hazardous	Spent oil, oily rags, etc.	Store on site in closed containers with secondary containment and transfer to a registered waste contractor with off-site permitted hazardous waste treatment, storage, or disposal facilities
7	Movement of heavy-duty vehicles for construction activities.	Emissions	CO ₂ , SO _x , NO _x , CO, Dust	- Use water suppression to prevent dust emissions. - Maintain vehicles and machineries to reduce emissions - Maintain low speed to reduce dust and gaseous emissions - Allow aerial dispersal over a large area
OPERATION PHASE				
8	Maintenance of road and ancillary facilities	Non-Hazardous	Road pavement waste, vegetation waste, sediments/sludges, waste water	- Segregate in appropriate containers as appropriate for collection by a registered waste contractor. - Recycle or reuse as appropriate
		Hazardous	Spent oils, oil rags	Store in closed containers with secondary containment and transfer to a registered waste contractor with off-site permitted hazardous waste treatment, storage, or disposal facilities.

7.5.2 Waste Handling

Waste handling and disposal procedures shall be well defined at source and a waste inventory register kept. The general information required, as minimum, for adequate definition of wastes include:

- Waste stream identification

- Proper waste categorization
- Waste segregation
- Appropriate handling and disposal practice; and □ Recommended Management practices.

Waste management issues shall be part of the agenda for HSE meetings and shall be included in routine HSE Inspections. The findings from such inspections shall be included in the Environmental Audit Tracking System.

a) **Waste Minimization Guidelines**

The four principles of waste minimization process; reduce, recycle, reuse and recovery shall be adopted as applicable, to ensure reduction to the possible extent, of the volume or relative toxicity of liquid or solid wastes.

b) **Waste Segregation Guidelines**

All wastes to be generated from the project shall be segregated at source, into clearly designated bins at strategic locations. Construction debris would be separated on-site into material-specific containers to facilitate reuse and recycling and to increase the efficiency of waste reclamation and/or would be collected by a contracted waste hauler and separated at the points of generation. Source separation of materials at the construction site is essential to

- Ensure appropriate waste diversion rate,
- Minimize costs associated with transportation and disposal, and
- Facilitate compliance with the relevant regulations.

c) **Waste Disposal Guidelines**

All debris, spoilt materials, rubbish and other waste, shall be cleared from the site during construction and disposed of accordingly at Government designated sites for such wastes. Some of the procedures for the treatment and/or disposal of waste envisaged are summarized in the Table 7.5.

Table 7.5: Waste Disposal Options

S/N	Type of waste	Storage Medium	Reuse/Recycle Option.
1.	Chemical wastes	To be stored in separate container and labelled with their contents	Unused and surplus chemicals shall be returned to the supplier whenever possible.
2.	Hazardous substances: - Waste oil - Solvents	To be stored in separate designated containers/ drums and in area designed to control and contain	Residuals of hazardous waste. Waste oil shall be taken for recycling whenever possible or given to second users.
3.	Hydrocarbon based detergents	- Spills and leaks. - Containers shall be labelled with their contents.	
4.	Medical waste	To be stored in separate container and labelled with the contents.	Incinerated
5.	Consumption waste	Closed container for storage	Garbage and trash shall be stored and moved away to appropriate disposal site frequently to avoid smell.
6.	Scrap metals and batteries	Designated container (basket) for storage and transportation.	Reuse/disposal. Specialized disposal for hazardous metal contaminants (e.g., Pb, Hg).
7.	Paper	To be stored in container or sacks	Destroy confidential ones and give others to second hand users
8.	Plastic	To be stored in designated area.	Give to second hand users or send to recycling plants
9.	Wood scrap	To be stored in designated area	Give to second hand users
10.	Drums and containers	To be stored in designated storage areas.	If delivered to the disposal site, they shall be cleaned properly first.

All wastes in transit shall be tracked by waste consignment note. The waste consignment note records shall be kept and would include as a minimum with the information in Table 7.6:

Table 7.6: Waste Consignment Record Template

S/N	Item				
1.	Location				
2.	Date of dispatch				
3.	Description of Waste				
4.	Summary of Waste quantity/container type				
5.	Designated disposal site and method				
6.	Consignee/driver name and means of transportation				
7.	Confirmation of actual disposal (time and date)				
8.	Waste and/or Recyclable Materials		Reuse and Recycling		Disposal
9.	Possible Materials Generated	estimated volume (m3) or Area (m2) or weight (t)	On-site (How will materials be reused and/or recycled on-site?)	Off-site (Specify the contractor and recycling facility)	contractor and/or landfill site
10.	How will materials be stored on-site for reuse and recycling? e.g., in skip bins.				
11.	How will site operations be managed to ensure minimal waste creation and maximum reuse and recycling? e.g., staff training, feedback from waste management service provider, ongoing checks by site supervisors, separate area set aside for sorted wastes, clear signage for waste areas etc.				
12.	How will this plan be evaluated, and who is responsible for the evaluation? e.g., feedback from staff collected by the site supervisor.				

7.6 Climate Risk Management

The contextual site physical factors of the geographical location shows that hydrology, soil, slopes, etc. and artificial factors such as land use, urban development, etc. are of relevance. The climate factors likely to affect the road infrastructure is extreme weather event relating to rain, majorly. This is an intrinsic risk source for soil erosions. This could also be enhanced through artificial changes (e.g., soil waterproofing due to urban development or deforestation).

To reduce climate-related risks there is need to mitigate vulnerabilities and minimise consequences with adaption measures (Figure 7.2). For the road adaptation measures are considered more vital and so the following have been suggested:

- Alter maintenance regimes to target vulnerable sections
- Retrofit existing storm water infrastructure (e.g., culvert crossings, bridges) to accommodate increasing flow patterns)
- Harden or stabilize slopes subject to increased run off from extreme weather events
- Elevate mechanical and electrical equipment in operations or maintenance facilities (e.g., traffic signals)
- Use waterproof materials
- Utilize permeable pavements for heavy traffic areas, the use of permeable pavement shoulder can be beneficial, especially in highly urbanized areas as provides an alternative for areas that cannot integrate bio-retention areas or temporary water storage and serves as a durable and ecological solution to minimize the risk of flooding.

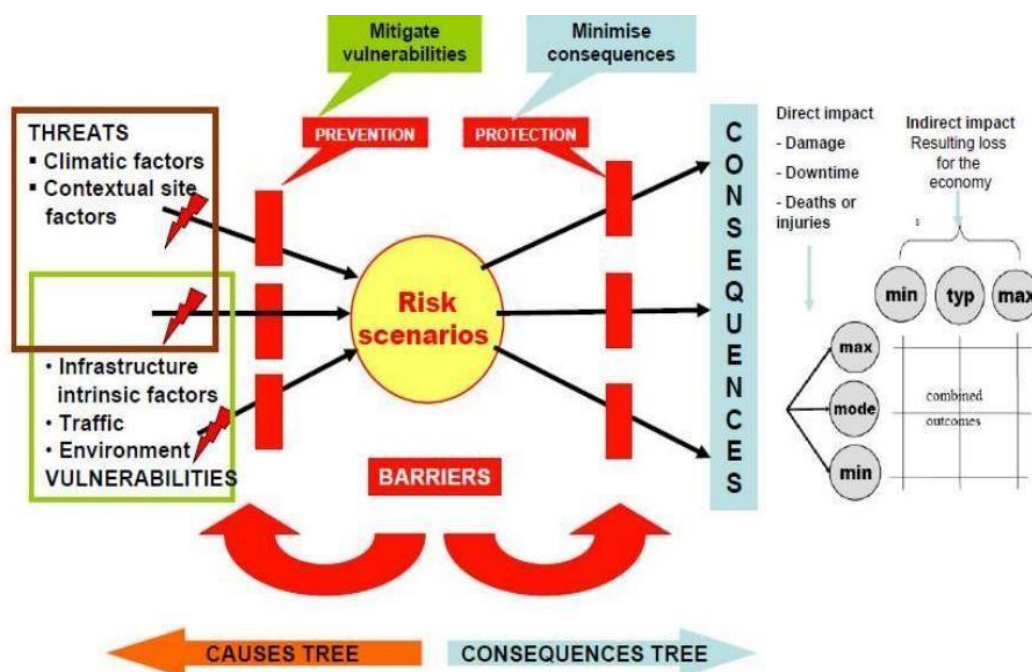


Figure 7.2: Ways to mitigate vulnerabilities and minimize consequences of Climate Risk

7.7 Integrating into project design and tender documents

The mitigation measures developed should be integrated into the project design and tender documents. Using this approach, the mitigation measures will automatically become part of the project construction and operation phase. By including mitigation measures in the contract or in specific items in the Bill of Quantities, monitoring and supervision, mitigation measure implementation could be covered under the normal engineering supervision provisions of the contract. Examples of clauses that should be incorporated into contracts with construction companies include:

1. Construction contracts should:

- Select or develop guidelines and procedures to be applied to each facet of road construction or rehabilitation—site clearing, bed and surface construction, drainage, fuel and material usage, quarry site management, construction camp and work site operating procedures, including worker safety
- Include incentives for adhering to guidelines and penalties for violating them

2. Maintenance agreements should ensure:

- Finalization of maintenance agreements with local communities before beginning construction.
- A combined approach, with a private contractor performing mechanized maintenance and subcontracting labour-intensive maintenance to the communities.
- Maintenance contracts that is performance-based with penalties in case of noncompliance with the agreed standards (e.g., flouting safety rules, number of potholes per km of roads). All parties must clearly understand and be committed to terms of the agreement, such as who will do what work, when, how frequently, for what compensation, and within what limits.

7.8 Budgets for the ESMP

To effectively implement the environmental and social management measures suggested as part of the ESMP, necessary budgetary provisions shall be made by FMW for the project components.

Tentative budget for each of the project shall include the environmental management costs other than the good engineering practices, cost of environmental monitoring. All administrative costs for implementing the ESMP shall be budgeted for as part of the costing.

7.9 Implementation Schedule

The provisional time schedule for preparing contract documents, awarding of tenders and start of construction must be taken into consideration in the implementation schedule for the ESMP.

The contractor is expected to prepare and submit a plan of action covering how the construction related environmental and social mitigation measures recommended in the ESMP will be implemented once a notice to proceed is received.

The contractor shall strictly follow the Action plan, mitigation action required at the preconstruction phase which would have been implemented.

The key elements of the implementation schedule plan which are shown in Table 7.7 are as listed below:

- Preparation and submission of the Action plan.
- Nominating Environmental Management Representative.
- Finalizing site and layout plans for construction camps/temporary yards incorporating environmental requirements and ROW for superhighway project.
- Preparation and submission of construction schedule.
- Implementation of mitigation and enhancement measures.
- Environmental auditing (Federal Ministry of Works, Consultant /FMEnv).
- Monitoring and reporting on ESMP implementation (Federal Ministry of Works, FMEnv & consultant).

Table 7.7: ESMP Implementation Schedule

S/ N	Activity Description	Responsibility	Pre-Construction	Construct on								Post Construction (Operation)
1.	Disclosure of Environmental Assessment Report	FMW										
2.	Allocating Budget for ESMP	FMW										
3.	Appointing Support Staff for ESMP	FMW										
4.	Review and Approval of Contractor's ESMP and Safety Plan	FMW										
5.	Finalizing site and layout plan of construction plan	FMW										
6.	Implementation of Mitigation Measures	FMW, Environmental Consultant & FMEEnv										

7.	Supervising ESMP Implementation	FMW Environmental consultant											
8.	Environmental Auditing	FMW, Environmental Consultant & FMEnv											
9.	Monitoring & Reporting on ESMP Implementation	FMW, Environmental Consultant & FMEnv											
10.	Environmental Training	FMW, Environmental Consultant											

7.10 Review and Revision of the ESMP

This management plan will be reviewed and revised in the event of changes to the project description or new requirements/legislation coming into effect during the project execution. A copy of the revised version will be sent to relevant regulatory authorities as the case maybe.

CHAPTER EIGHT: DECOMMISSIONING AND RESTORATION

8.1 Introduction

The operation life span of the SBS-2 project is anticipated to be 50 years. Typically, road projects are upgraded or constructed and as such it is therefore unlikely that the road infrastructure would be decommissioned and abandoned. In the unlikely event that the FMW decides to decommission and abandon the road, the Contractor engaged shall develop a comprehensive decommissioning, abandonment and remediation plan that is specific to the project.

The Plan shall consider the most cost-effective and practicable methods, environmental considerations, legal requirements and Global International Industry Practice (GIIP) applicable at the time. In addition, the plan shall contain an adaptive management component that allows for the incorporation of lessons learned from monitoring data during the operation of the facility.

This plan will be submitted to the FMEnv and other relevant regulatory agencies for approval, at least 6 months prior to scheduled decommissioning and abandonment. Decommissioning shall only commence after the approval of the plan by the regulatory Agencies.

Prior to the decommissioning and abandonment of the road, an assessment of the existing road infrastructure shall be undertaken, and specific decommissioning requirements shall be determined. This process would involve stock taking of existing infrastructure along the road. Due consideration would be given to structures along the road which have improved the natural drainage patterns or ecological processes of the area which might be left undisturbed. On completion of the assessment an appropriate and systematic decommissioning plan shall be designed.

The decommissioning plan shall specify all activities that will be undertaken during the decommissioning and abandonment of the project. An effective WMP shall be developed as part of the decommissioning plan to ensure proper waste management and protection of the environment. The WMP shall adopt the waste hierarchy specified in this Report i.e., reduce, reuse, recycle, recover and disposal.

8.2 Decommissioning and Abandonment Programme

The activities that will be undertaken during decommissioning and abandonment of the project shall include the following:

- Stakeholders Consultation
- Dismantling of removal of road components such as road furniture, bridge components, etc.
- Scarification of road pavements.
- Site reclamation including ground stabilization and levelling.
- Restoration of natural environment and resources including remediation of soil and water resources where necessary and
- Re-vegetation to restore the environment back to pre-project state as practicable possible.
- Assessment of residual impacts, if any.
- Monitoring

8.3 Site Remediation and Restoration/Re-vegetation after Construction

Following actual decommissioning activities and evacuation of all equipment, rubbles and waste from the camp site, remediation and restoration including re-vegetation shall commence as soon as practicable.

For the road, after pavement removal, the roadway soil would be stabilized and levelled back to its original state as much as possible to enhance drainage.

Site restoration activities shall also include the following as appropriate:

- Re-contouring and grading of roadway to blend with natural topography.
- Planting of native plant species that are dominant within the plant communities in adjacent areas with similar soil conditions to re-establish vegetation. The cover, species composition, and diversity of the re-established plant community shall be like those present on-site prior to project development and in the vicinity of the site. The baseline

data of existing ecological biodiversity of the project site contained in Chapter 4 of this Report shall be a benchmark for selecting the appropriate plant species for revegetation.

- Installation of erosion protection structures such as sediment traps, riprap, gabions, etc. wherever possible to capture run-off sediments and protect the new vegetation.

CHAPTER NINE: CONCLUSION AND RECOMMENDATIONS

9.1 Introduction

The Environmental and Social Impact Assessment (ESIA) for the proposed SBS-2 (323km from Alfala in Sokoto state to Balugu in Kebbi state), highlights significant economic and socio-cultural benefits for local, state, and national economies. The project will enhance connectivity, boost agricultural productivity, create jobs, and foster community development. However, it may also cause environmental and social impacts, such as biodiversity loss, drainage disruption, and resettlement challenges, which can be mitigated through strict adherence to the Environmental and Social Management Plan (ESMP).

9.2 Key Recommendations

1. **Prioritize Avoidance:** Minimize resettlement and disruptions; fully implement Resettlement Action Plan (RAP) where needed.
2. **Engage Local Workforce:** Employ local labor to reduce community impacts and stimulate the local economy.
3. **Community Grievance Mechanisms:** Establish systems to address and resolve community concerns promptly.
4. **Active Monitoring:** Ensure FMW oversees ESMP adherence during project execution.
5. **Community Engagement:** Foster relationships with local communities to promote project ownership and sustainability.
6. **Institutional Capacity Building:** Strengthen implementing bodies to address environmental and social challenges effectively.
7. **Address Key Issues:** Emphasize gender inclusion, occupational health, and environmental safety during all project phases.

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APPENDICES