ENVIRONMENTAL, SOCIAL AND HEALTH IMPACT ASSESSMENT (ESHIA) OF THE THE SIERRA RUTILE SEMBEHUN HAUL ROAD, BRIDGE AND TRANSMISSION LINE PROJECT

ENVIRONMENTAL, SOCIAL AND HEALTH IMPACT ASSESSMENT (ESHIA)

Prepared by

CEMMATS Group Ltd

Freetown, Sierra Leone

For

Sierra Rutile Ltd (Iluka)

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LIST OF ACRONYMS

%	Percentage
″	Inch
^{0}C	Degrees Celsius
AC	Affected Community
AfDB	African Development Bank
CBD	Convention on Biological Diversity
CBO	Community-based Organisation
CC	Conservation Concern
CDAP	Community Development Action Plan
CDMC	Community Development Management Committee
CEMMATS	Construction Engineering Maintenance, Manufacturing and Technical Services
CI	Corrugated Iron
CITES	Convention on International Trade in Endangered Species on wild flora and fauna
cm	Centimetre
cm^2	Square centimetre
CP	Closure Plan
dB	Decibels
DO	Dissolved Oxygen
EBA	Endemic Bird Area
EC	Electrical Conductivity
EDA	Edward Davies and Associates
EDSA	Electricity Distribution and Supply Authority
EEZ	Exclusive Economic Zone
EGTC	Electricity Generation and Transmission Company
EMF	Electro Magnetic Fields
EMP	Environmental Monitoring Plan
EPA-SL	Environment Protection Agency Sierra Leone
ERP	Emergency Response Plan
ESHIA	Environmental, Social and Health Impact Assessment
ESMP	Environmental, Social and Health Management Plan
EU	European Union
FC	Faecal Coliforms

GDP	Gross Domestic Product
GIS	Geographic Information Systems
GoSL	Government of Sierra Leone
GPS	Global Positioning System
ha	Hectare
HCB	Hexa-chlorobenzene
HCV	High Conservation Value
HDI	Human Development Index
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
HH	Household Head
HMC	Heavy Mineral Concentrate
IEZ	Inshore Exclusive Zone
IFC	International Finance Corporation
ILI	International Lending Institutions
IMR	Infant Mortality Rate
IOTA	Indigenous Transport Owners Association
IUCN	International Union for Conservation of Nature
IVS	Inland Valley Swamp
JSS	Junior Secondary School
km	Kilometre
km^2	Square kilometre
kVA	Kilovolt-Ampere
Le	Leones
m	Metre
MAFFS	Ministry of Agriculture, Forestry and Food Security
mamsl	Metres Above Mean Sea Level
mbgl	Metres Below Ground Level
MCH	Maternal and Child Health
MDA	Ministries, Departments and Agencies
MLA	Mine Lease Area
MLPCE	Ministry of Lands, Country Planning and the Environment
mm	Millimetre
MoE	Ministry of Energy (MoE)
MoTA	Ministry of Transport and Aviation

MOWHI	Ministry of Works, Housing and Infrastructure
MSP	Mineral Separation Plant
N	North
NGO	Non-Governmental Organisation
NPA	National Power Authority
NTU	Nepthielometric Turbidity Unit
OHS	Occupational Health and Safety
PAPs	Project Affected Persons
PCBs	Polychlorinated Biphenyls
PCDP	Public Consultation and Disclosure Plan
pH	Power of Hydrogen (measure of acidity)
PM_{10}	Particulate Matter (10 microns)
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PRSP	Poverty Reduction Strategy Paper
PS	Performance Standard
RAMSAR	Convention on wetlands of international importance
RMFA	Road Maintenance Fund Administration
RPF	Resettlement Policy Framework
SIA	Social Impact Assessment
SL	Sierra Leone
SLEPAA, 2008	Sierra Leone Environmental Protection Agency Act, 2008
SLIEPA	Sierra Leone Import and Export Promotion Agency
SLP	Sierra Leone Police
SLRSA	Sierra Leone Roads Safety Authority
SLRTC	Sierra Leone Road Transport Corporation
SPSS	Statistical Package for Social Scientist
SRL	Sierra Rutile Limited
SSL	Statistics Sierra Leone
SSS	Senior Secondary School
STDs	Sexually Transmitted Diseases
TDS	Total Dissolved Solids
ToR	Terms of Reference
Turb.	Turbidity

UMU	United Mine Workers Union
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
Vu	Vulnerable
WHO	World Health Organisations
WMP	Waste Management Plan

GLOSSARY

Avifauna	Birds of a particular region, habitat, or geological period
Board of EPA-SL	Board of Directors that form the governing body of the EPA-SL; is headed by the Executive Chairperson; and consists of representatives from a number of line Ministries and three additional members of society.
Client	A person or organization using the services or advice of another professional person or company.
Communities	A group of interacting people, living in some proximity (i.e. in space, time, or relationship) that shares common values and has social cohesion.
Community Development Action Plan (CDAP)	A CDAP is a plan of action to address key community issues that are based on the expressed needs and aspirations of the local residents of the community Project area. These issues are deemed as basic developmental needs in the Project area.
Conservation	The planning, management, and implementation of an activity with the objective of protecting the essential physical, chemical, and biological characteristics of the environment against degradation. The process of managing biological resources (e.g., timber, fish) to ensure replacement by re-growth or reproduction of the part harvested before another harvest occurs. A balance between economic growth and environmental and natural resource protection.
Ecosystem	A community of interdependent organisms together with the environment they inhabit and with which they interact.
Environmental, Social and Health Impact Assessment (ESHIA)	The process of predicting and evaluating the social, health and environmental impacts and risks of a proposed project and identifying mitigation measures that will enable the project to meet the requirements of stakeholders, applicable laws and regulations, and any additional requirements for social or environmental performance identified by the Project, and so that impacts are as low as technically and financially feasible.
Environmental, Social and Health Management Plan (ESHMP)	A plan setting out all the proposed mitigation measures that the proponent of a project will take to prevent, reduce, remedy and compensate for adverse effects, and to maximise the benefits of the project. Also, the plan for monitoring and auditing that will be undertaken to confirm compliance with the ESMP.
EPA-SL “checklist”	A list of procedures developed and provided by the EPA-SL to be systematically followed by a client to conduct the ESHIA process required for the issuance of an EIA licence.
Framework	An organized structure of policies, legislation, programs and tasks created to achieve a specific outcome. There can be frameworks for broad policies and strategic initiatives at various scales (*e.g.* provincial, regional, sector, media); programs and program delivery; and short-term tasks and projects.

Hazardous Waste	Substances classified as hazardous wastes possess at least one of four characteristics: ignitability, corrosivity, reactivity or toxicity – or appear on special lists.
Human Development Index	The Human Development Index (HDI) is a composite statistic used to rank countries by level of "human development", taken as a synonym of the older terms (the standard of living and/or quality of life), and distinguishing "very high human development"; "high human development"; "medium human development"; and "low human development" countries.
Hydrogeology	Hydro (meaning water), and geology (meaning the study of the Earth) is the area of geology that deals with the distribution and movement of groundwater in the soil and rocks of the Earth's crust (commonly in aquifers).
Hydrology	The study of the movement, distribution, and quality of water.
International Finance Corporation	An international financial institution that offers investment, advisory, and asset-management services to encourage private-sector development in developing countries. The IFC is a member of the World Bank Group.
Invertebrates	Animal species that do not develop a vertebral column. This in effect includes all animals apart from the subphylum Vertebrata.
Mammals	Members of class Mammalia, air-breathing vertebrate animals characterised by the possession of endothermy, hair, three middle ear bones, and mammary glands functional in mothers with young. Most mammals also possess sweat glands and specialised teeth.
Mitigation measures	Designs, and methods for construction, operation and closure of a project that are introduced into the plans for a project, to prevent adverse impacts, where impacts cannot be prevented altogether, to reduce them as low as is technically and financially feasible, and to remedy, offset or compensate for adverse effects, and measures to provide and enhance the positive benefits from a project.
pH	A measure (unit) expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, lower values are more acid and higher values more alkaline. The pH is equal to $-\log_{10} c$, where c is the hydrogen ion concentration in moles per litre. pH in surface water is regulated by the geology and geochemistry of an area and is affected by biological activity. The distribution of aquatic organisms and the toxicity of some common pollutants are strongly affected by pH.
Pollution	Refers to both hazardous and non-hazardous pollutants in the solid, liquid or gaseous forms, and is intended to include other forms such as nuisance odours, noise, vibration, radiation, electromagnetic energy and the creation of potential visual impacts including light.
Potable Water	Water that is used for drinking, cooking, dishwashing, or other domestic purposes requiring water that is suitable for human consumption without the risk of health problems.

Project Interested and Affected Parties (IAP's)	Any person, group of persons, or organization interested in; affected by; concerned about; or with jurisdiction over an activity; development; project; policy; or action and who need to be consulted during the process of decision making.
Project Proponent	An individual, group or organization responsible for a project; creating a detailed project description; and submitting it to stakeholders for analysis, review and acceptance.
Socio-economic data / study	Social science that studies how economic activity affects and is shaped by social processes. In general, it analyzes how societies progress, stagnate, or regress because of their local or regional economy, or the global economy.
Social Indicators	A "direct and valid statistical measure which monitors levels and changes over time in a fundamental social concern." Such as economic growth, values or goals. Social indicators are numerical measures that describe the well-being of individuals or communities. Indicators are comprised of one variable or several components combined into an index. They are used to describe and evaluate community well-being in terms of social, economic, and psychological welfare.
Stakeholders	Any and all individuals, groups, organizations, and institutions interested in and/or potentially affected by a project, and/or having the ability to influence a project.
Water Quality	The chemical, physical, biological, and radiological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.
World Bank	The World Bank is an intergovernmental pillar supporting the structure of the world's economic and financial order, it is an organization whose focus is on foreign exchange reserves and the balance of trade.

EXECUTIVE SUMMARY

Introduction

Sierra Rutile Limited (SRL) (Iluka) is one of the world's largest rutile producing companies, generating high quality rutile, ilmenite and zircon rich concentrate. SRL's Mine Lease Areas (MLAs) are located approximately 135 kilometres (km) southeast of the Sierra Leone capital city, Freetown, and approximately 30 km east of the Atlantic Ocean.

The current SRL operation (MLA 1), has an existing Environmental Licence (reference number EPA-SL030) and has undertaken two previous Environmental and Social Impact Assessment (ESIA) studies for their operations in 2001 and an update in 2012 respectively. When these studies where undertaken, the primary mining process was dredge mining (referred to as wet mining). During 2013 SRL commenced a distinct open cast mining operation (referred to as dry mining) as an auxiliary method of ore extraction in conjunction with wet mining. In 2016 a second dry mining operation was commissioned. It is anticipated that, over time, dredge mining will cease, and dry mining would be the primary mining method employed.

SRL plans to start mining the Sembehun deposits (the Sembehun Mine / DM3) in the Northern half of its MLA (Area 5), which is located in the Bagruwa Chiefdom, some 30 km north of the Area 1 which is located close to Mogbwemo (Bonthe District). The inception of mining in the Sembehun deposits will require extensive preparation, including the construction of a haul road (including bridge infrastructure) and power linkages with Area 1.

This project requires an Environmental, Social and Health Impact Assessment (ESHIA) and Environmental, Social and Health Management Plan (ESHMP) for the haul road, bridge and power transmission line, in order to obtain an Environmental Impact Assessment (EIA) Licence in line with requirements of the Environment Protection Agency of Sierra Leone (EPA-SL). ESHIA studies are concurrently being conducted for both the current operational site (Area 1) and the new Sembehun mine site (Area 5). SRL contracted the execution of the ESHIA study for the Haul Road, Bridge Infrastructure and Power Transmission Line Construction to CEMMATS Group Ltd. (CEMMATS).

The Project area falls within the Bagruwa and Lower Banta Chiefdoms of Moyamba District, with a small footprint in the Bonthe District where the transmission line connects to the transformer in Area 1.

This report presents the results and outcomes of data and information collected and consultations carried out by a team of environmentalists and socio-economists during October and November 2017.

Summary of Scope of Work

In summary, the scope of work comprised:

- Collection of primary and secondary environmental, health, social and cultural data from relevant literature on the project region;

- Undertaking field visits to obtain baseline data of prevailing environmental and social conditions, and
- Preparation of a Scoping Report (submitted on 16 October 2017, and approved by the EPA-SL on 25th October);
- Preparation of an ESHIA report, including an ESHMP.

Assumptions and Limitations

- The ESHIA / ESHMP study has been undertaken to meet the national requirements for securing the EIA Licence. Relevant international guidelines, consistent with Iluka's Corporate Policies have also been incorporated into the ESHIA and ESHMP;
- The timeframe within which the study was undertaken did not allow for seasonal variations to be taken into consideration. However, desktop studies were undertaken to obtain historical climatic data and other records obtained at various times during previous years, and
- At the time of compilation of this report, various types of technical investigative work and options analysis was underway and/or being planned. The consultant and SRL have done their utmost to collect relevant information from the studies. Where there may be insufficient information or non-resolution of issues related to design and location of facilities, general advice and guidance have been provided.

Notwithstanding the aforementioned assumptions and limitations, the ESHIA team employed an evidence-based approach and included scientific information relevant to the Project area. Where possible the ESHIA team sought data and information from other sources at a level of detail adequate to conduct the ESHIA study.

Project Description

Introduction

The Project involves the development of a haul road to transport Heavy Minerals Concentrate (HMC) from SRL's Sembehun Mine site to the MSP in Area 1 at Mogbwemo, which is located approximately 30 km southeast, for further processing. A bridge of approximately 150 m in span will be constructed over the Gbangbaia River near the town of Moselolo.

The Project also involves the installation of a power transmission line, starting at the SRL power station at Area 1 and terminating at a transformer which will be located on the MLA at Sembehun.

Summary of Scope of Work

In summary, the scope of work comprised:

- Collection of primary and secondary environmental, health, social and cultural data from relevant literature on the project region;

- Undertaking field visits to obtain baseline data of prevailing environmental and social conditions, and
- Preparation of a Scoping Report (submitted on 16 October 2017, and approved by the EPA-SL on 25th October);
- Preparation of an ESHIA report, including an ESHMP.

Assumptions and Limitations

- The ESHIA / ESHMP study has been undertaken to meet the national requirements for securing the EIA Licence. Relevant international guidelines, consistent with Iluka's Corporate Policies have also been incorporated into the ESHIA and ESHMP;
- The timeframe within which the study was undertaken did not allow for seasonal variations to be taken into consideration. However, desktop studies were undertaken to obtain historical climatic data and other records obtained at various times during previous years, and
- At the time of compilation of this report, various types of technical investigative work and options analysis was underway and/or being planned. The consultant and SRL have done their utmost to collect relevant information from the studies. Where there may be insufficient information or non-resolution of issues related to design and location of facilities, general advice and guidance have been provided.

Notwithstanding the aforementioned assumptions and limitations, the ESHIA team employed an evidence-based approach and included scientific information relevant to the Project area. Where possible the ESHIA team sought data and information from other sources at a level of detail adequate to conduct the ESHIA study.

Project Description

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The Project also involves the installation of a power transmission line, starting at the SRL power station at Area 1 and terminating at a transformer which will be located on the MLA at Sembehun.

Proposed Road Alignment

A detailed description of the route alignment is provided in section 2.2.2 of the ESHIA, and provides the configuration of both the road and powerline routes, as the powerline will be constructed largely adjacent to the road itself.

The route was selected based on an extensive ground-truthed alternatives analysis undertaken by survey firm Edward Davies and Associates (EDA) and Cemmats. The criteria for the route selection included:

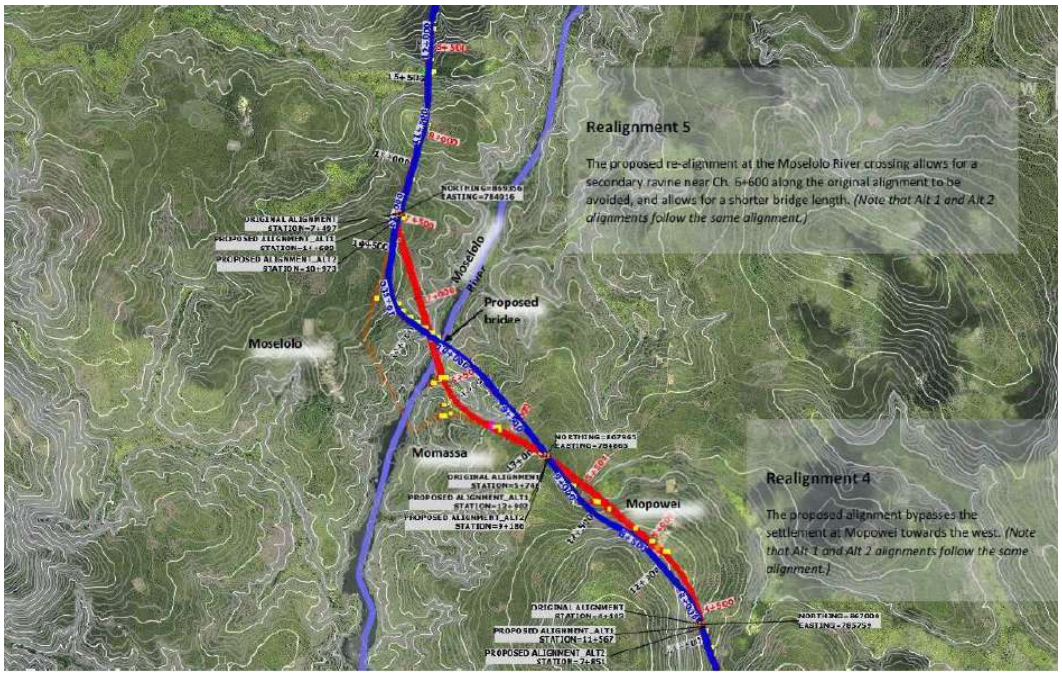
- Determining the most suitable engineering solution, including road safety considerations;
- Avoiding all settlements / villages, to prevent any resettlement of people being required, and
- Identifying areas of environmental sensitivity, and avoiding those areas, or determine the lowest impact option.

The final route selected will be 30 km in length. In summary the preferred alternative alignment will be as follows:

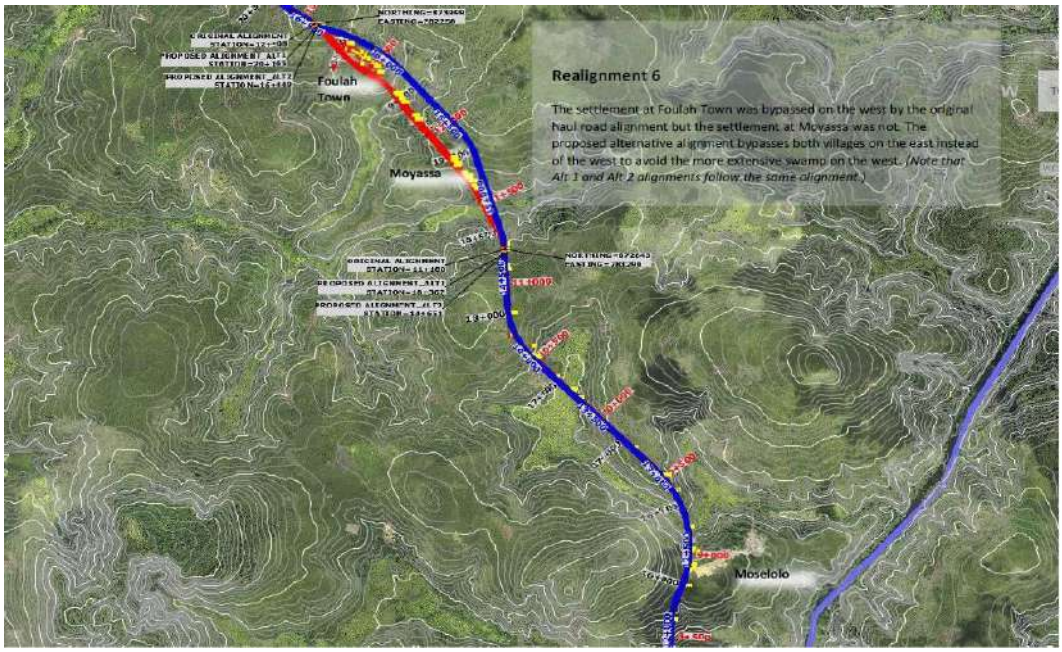
- The preferred road alignment starts at the origin of Alternative 1 (shown in black in the figure below) between Sahun and Largor Junction, which bypasses the Mosenesie 1 and Mogbwemo villages, crossing a small swamp (at its narrowest point where a culvert will be installed) before passing north-east of the existing Gbangbatoke Airfield.

- At 3.7 km from the Area 1 MSP, Alternative 1 (black) coincides with Alternative 2 (blue), resulting in one alignment from this point, until the route joins with the initial alignment proposed (shown in red). The total length of Alternative 1, including where it merges with Alternative 2, until it joins the existing road in Gbangbatoke, is 7 km. Alternatives 1 and 2 follow the existing road corridor from the point of intersection, until the Bengelor area where the existing road passes through the community. Alternatives 1 and 2 still merged, bypass Bengelor using a route west of the settlement.

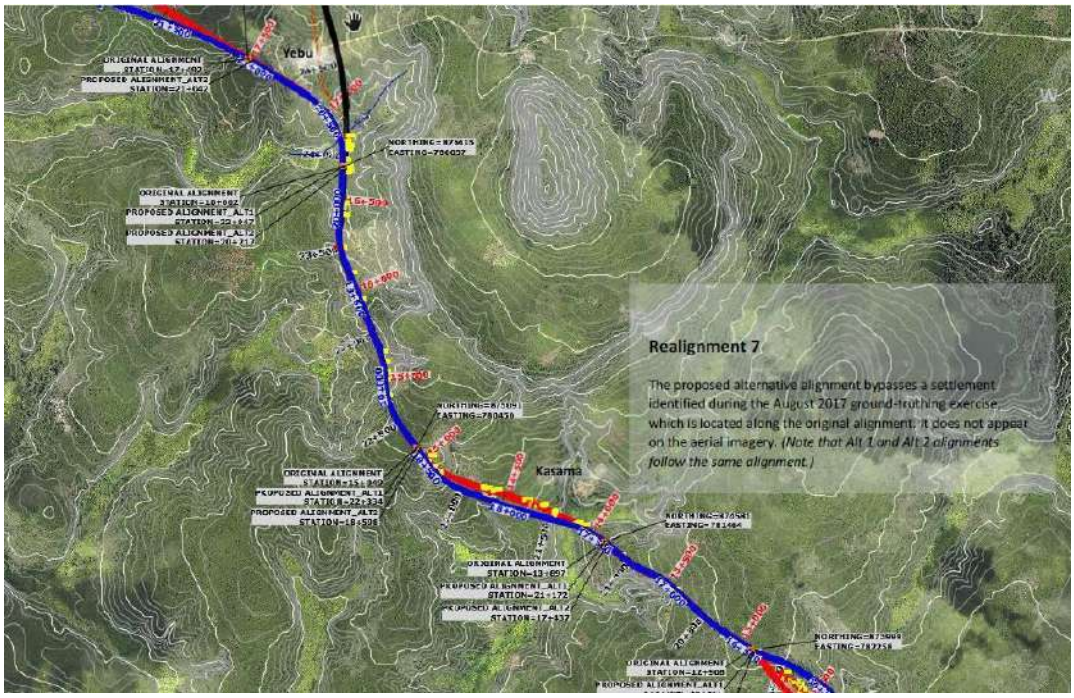
Two more re-alignments occur along the existing road, with Alternatives 1 and 2 still merged, at Morpowoi, bypassing the settlement westward and at the Gbangbaia River where a secondary ravine is avoided, and a narrower crossing point achieved.



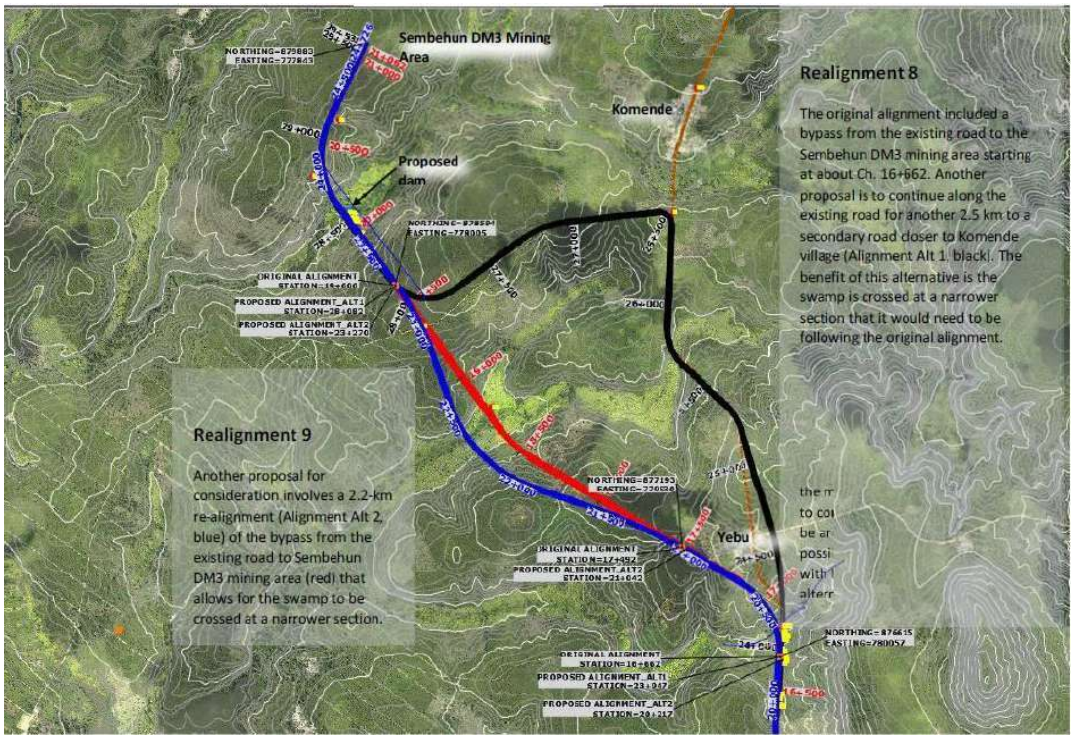
- On the Moselolo side of the Gbangbaia River, Alternatives 1 and 2 follow the existing road until just before Moyasa and Fula Town, where they divert east of both settlements, bypassing a swamp in the process. A small diversion also occurs at Kassama, bypassing the settlement on the west.



- After Kassama, the alternative road alignments and the existing road follow the same route until Ngeiyebu, where all three routes diverge.

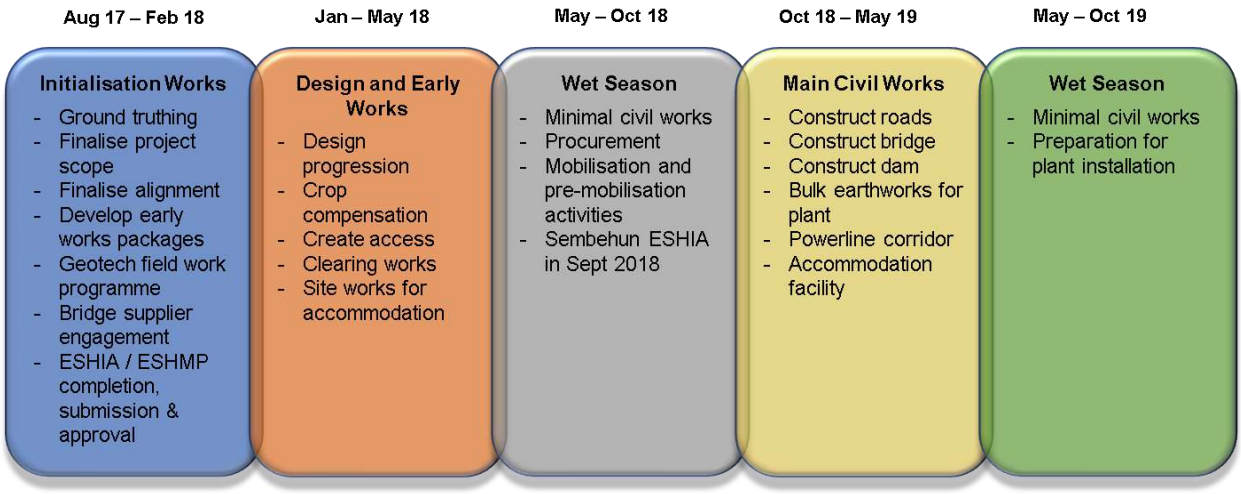


- At this point, the preferred route to be taken is indicated in blue which deviates from the existing road creating a bypass which allows the road to cross a swamp at this location at the narrowest section, before joining the other alignments to end at the Sembehun DM3 site.



Planning and Construction Phase

The project schedule for the road construction and power transmission line works is as follows:



Early Works Phase

This section describes the initialisation works; design and early works; as well as wet season cells in the figure above (from August 2017 – October 2018). This phase will include a number of activities such as finalisation of the road design, completing the feasibility, environmental and social studies (this study), developing tenders for the construction contractors for both the road and power transmission line and awarding the contracts; planning for mobilization; road demarcation; vegetation clearing; transportation of materials to site, etc.

Construction Phase

The construction phase is anticipated to start during the second quarter of 2018 and end in 2019. During this phase, a number of activities will be carried out in relation to the road and bridge construction, as well as the installation of the transmission line and related infrastructure (transformers and switch-room).

The workforce will comprise full-time and part time construction workers, totalling roughly 200 people.

Operations Phase

The road operation is projected to start in mid-2020. The road will be used for trucking HMC from the Sembehun (DM3) mine site to the Area 1 MSP for processing. Trucks will range from 19 m semi-trailers to 27.5 m B-doubles. It will also cater for lighter vehicles – SUVs, cars, motorbikes and some pedestrian traffic.

Analysis and Comparison of Project Alternatives

In accordance with current ESHIA good practice, it is appropriate for the ESHIA to review alternatives considered during planning of the project, and to explain why the proposed project activities have been selected, including any environmental, social and health considerations. The

aim is to establish whether there are reasonable alternatives which could be pursued which meet the project's objectives with less impact on the environment, and if there are, to explain what other factors determined the choice of proposal.

The choice of route alignment, operational options and the no-project option was analysed as is outlined in section 3 of the ESHIA.

The alternatives analysis concluded that many of the adverse environmental and social impacts related to the Project will be short-term and reversible. These adverse impacts can be adequately controlled, provided that the recommended mitigation measures are adopted. Long term positive changes such as the improved infrastructure, will be permanent.

It is concluded that the "No Project" alternative is inappropriate, and that the potential social and socio-economic benefits of project implementation far outweigh the potential adverse impacts on the environment, all of which can be controlled and minimized to an acceptable level.

Policy, Legal, Regulatory and Institutional Context

A detailed review was undertaken of all the Sierra Leonean policy, legal and regulatory requirements to ensure that all such requirements are taken into full consideration throughout the ESHIA / ESHMP. In addition, good international industry practice and the institutional context was considered in this section of the ESHIA (refer to section 4).

The following was assessed:

- Policies and Plans:
    - National Environmental Policy (1994);
    - National Energy Policy (2009);
    - National Land Policy (2015);
    - Road Safety Policy;
    - Forest Policy (2010);
    - National Biodiversity Strategy and Action Plan (2003);
    - Conservation and Wildlife Policy (2010);
    - Disaster Management Preparedness Plan (2006), and Land Tenure and Ownership.
- Legislation
    - *Sierra Leone Environment Protection Agency Act (2008 / 2010);*
    - *Sierra Rutile Agreement (Ratification Act) (2002);*
    - *The Sierra Leone Roads Authority (Amendment) Act (2010);*
    - *The Road Transport Authority Act (1996) (Amended to the Roads Safety Authority Act (2016);*
    - *The Road Maintenance Fund Administration Act (2010);*
    - *Road Traffic Act (2007);*
    - *Sierra Leone Electricity and Water Regulatory Commission Act (2011);*

- *The National Electricity Act (2011);*
- *The National Protected Area Authority and Conservation Trust Fund Act (2012);*
- *The Forestry Act (1988);*
- *Fisheries Act (2007);*
- *Wildlife Conservation Amendment Act (1990), and*
- *Local Government Act (2004).*

- Institutional Context:
  - The Environment Protection Agency Sierra Leone;
  - Ministry of Lands, Country Planning and the Environment;
  - The Ministry of Works, Housing and Infrastructure;
  - Institutional Stakeholders Relevant to the Road Construction and Operation Aspect of the Project:
    - The Ministry of Transport and Aviation;
    - The Sierra Leone Roads Authority;
    - The Road Maintenance Fund Administration;
    - The Sierra Leone Road Safety Authority, and
    - The Sierra Leone Police.
  - Institutional Stakeholders Relevant to the Power Transmission Line Installation aspect of the Project:
    - The Ministry of Energy;
    - Electricity Generation and Transmission Company;
    - Electricity and Water Regulatory Commission, and
    - Electricity Distribution and Supply Authority.
- International Lending Institutions Policies, Standards and Guidelines, including requirements of:
  - World Bank Operational Policies and Bank Procedure;
  - International Finance Corporation (IFC) Performance Standards, and
  - The Equator Principles.

Baseline Survey and Condition

Physical and Biological Environment of the Project Area

Climate

Generally, the climate of the Project area is described as moderately long dry season and a growing period lasting 270 – 300 days (FAO/LRSP TRI 1979).

Rainfall in the area is characterized by a unimodal pattern with the wettest period occurring during the months of July, August and September. The wet season normally last for six months (May – November) but in exceptional years, rains may start as early as April and sometimes run into December. The mean annual rainfall for sixteen years (1980 – 1996) in this area is 2,363 mm. 95%

of this falls between April and November, with July and August being the wettest months, with a monthly mean of 508.3 mm and 579.2 mm respectively.

The annual mean maximum and minimum temperatures are 31.4ºC and 20.3ºC respectively. However, the mean temperature is nearly constant. The average day temperature is approximately 26ºC.

The Harmattan is a dry and dusty north-easterly trade wind that blows from the Sahara Desert over the West African subcontinent into the Gulf of Guinea between the end of November and the middle of March. Typically, this brings cooler temperatures during the dry season and can transport large quantities of dust. Relative humidity readings of 90 per cent are common for extended periods during the rainy season (Area 1 ESIA, 2012).

Dust

Table 5.2-6 presents the average PM_{10} levels measured along the proposed route. Recorded values range from 0.010 mg/m^3 to 0.210 mg/m^3.

Whilst a direct comparison between the measured average values and the World Health Organisation (WHO) maximum 24-hour concentration or annual average concentration guideline levels is not possible, it provides some context to the observed dust levels. Most (91%) of the measurements taken during the current assessment of the Project area are below the WHO air quality standards stipulated maximum threshold of 0.05 mg/m^3 over 24 hours (exceedances are highlighted in red Table 5.2-6). 18% of the average measurements taken in the current assessment were above the WHO air quality standards stipulated annual average concentration of 0.02 mg/m^3 (highlighted in blue Table 5.2-6).

Dry weather at the time of measurement and the fact that the existing road is lateritic with dust easily generated from vehicular traffic, wind and other community activities contributed to seasonally high dust levels. There is also more vehicular traffic on the south side of the route before the bridge than on the North side towards Sembehun as seen from the traffic survey.

Noise

Measured noise levels in the Project area (CEMMATS) ranged from 39 – 77 dBA and are summarised in Table 5.2-8.

As part of the Area 1 ESHIA, existing ambient noise levels were also measured at villages in the 2017 Area 1 survey (SRK). From the Area 1 surveys, it was concluded that ambient noise levels in villages of Area 1 (current operational site) vary around 55 dBA during the day-time and 45 dBA at night-time. IFC guidelines state that noise impacts should not exceed the levels described in Table 5.2-7 or result in a maximum increase in background levels of 3dBA at the nearest receptor; an impact of 3dBA or less is considered insignificant. The Area 1 noise assessment indicated that the haul road noise impacts the first row of houses in the villages by 3 dBA, however the haul roads pass through villages. For the current Project area, the road will bypass all villages which is expected to result in reduced noise impact.

In the current Project area, noise generated in communities is due to normal village activities and occasional vehicular traffic, as no mining activities at Area 5 have begun or haul roads been constructed.

Geology

The project area geology is proximal alluvial placers in origin, with the primary source of mineralisation derived from the quartzo-feldspathic gneisses of the Precambrian (2.1ba) Kasila Group. In the North-eastern part of the Project area is Hypersthene Gneiss-Olivine (Kasila Gneisses-Precambrian 2.1ba), alluvium beach sand lignite, sand clay and lignite are other deposits in the Project area. The heavy mineral suite is hosted within the Bullom Group, which marked the end of a late Tertiary marine regression. Sea levels at this time were approximately 100 metres below its current level, exposing the basement rocks of the Kasila Group to erosion. Mechanical and chemical degradation of the Kasila gneisses lead to the formation of kaolinite and other clay minerals which subsequently liberated the heavy minerals, where they were eroded and deposited into pre-incised channel systems. The quartzofeldspathic gneiss is light-gray, fine- to coarse-grained, foliated, layered muscovitie-bearing quartzofeldspathic gneiss; contains intercalated quartz-muscovite schist. Mineralogy: quartz + plagioclase + microcline + garnet + muscovite + biotite. Deposits in the Project area can be classified into one or more of the six deposits of the Sembehun group namely*: Kibi*, *Dodo*, *Benduma*, *Komende*, *Mokamatipa* and *Matehun*.

Landform

Moyamba District, on the southwest of the Southern Province, is a region where the coastal plain merges into the lowlands. These areas mainly comprise of gently to very gently undulating plains of very low relief (Birchall et al, 1979) and a few high grounds. The highest point is Moyamba Hills forest reserve which is 350 meters above mean sea level (mamsl). Most of the areas in this district lie below 100 mamsl which explains the numerous seasonal floodplains, swamps, streams and tributaries. The low relief across the district may be the reason for the observed low flow rate of water and consequently low sedimentation levels observed along the streams and rivers.

Land Cover and Land Use

Sierra Leone is now principally covered by Secondary Forest and Forest Regrowth. This is as a result of almost all of the original forests having been replaced due to the traditional shifting cultivation with its associated slash and burn method of farming. Forest regrowth accounts for 75 percent of the land cover in the Project area. Mangrove Swamp vegetation is the second most extensive land cover due to the combined effects of the Project area's proximity to the ocean and the Bullum Creek which is heavily characterised by Mangrove Swamp vegetation.

Traffic Management Assessment

The following could be inferred from the detailed surveys (Annexure E):

- There are more activities during the day time than at night along the road alignment;
- Most of the vehicles are of the commercial type, far surpassing the number of private vehicles. There are a higher number of commercial motorbikes as they are considerably cheaper to

purchase and operate, and are more versatile along these poorly maintained gravel routes. Large trucks are mainly SRL vehicles on operational duties;

- There are more activities (vehicular, motor bikes and pedestrian movement) on the Gbangbatoke – Mogbwemo axis (Southern half of route) than on the Gbangbatoke Junction and Moselolo axis. People come from all parts of the country to the Southern end of the route. As the Bonthe District is a particularly good agricultural area; coupled with the large number of residential SRL workers and their families good, regular income; attracts people and goods to the area. Economic activities of the area increase before, on and after the community market (Ndorwei) days on Sundays and Mondays. This is in contrast to the Sembehun end of the road where there are hardly any current activities;
- Cargo from the Project area to Freetown, Bo, Mogbwemo, Moyamba town and other parts of the country includes mostly agricultural products, such as palm oil, cassava, gari, fufu and fish. Most of the vehicles were overloaded;
- Cargo to the Project area includes products such as clothing, construction materials, beverages, provisions, electrical and electronics etc.; Due to the poor road network, shortage of vehicles, widespread poverty and high petroleum prices, a large portion of the population residing in the Project area prefer walking or using motor bikes as a mode of transportation, and
- On the Gbangbatoke – Mogbwemo axis, where the road condition is better, there is regular transportation to and from Freetown, Bo and Moriba Town carrying passengers and basic food stuff. Transportation on either side of the river is more frequent on assigned market days when the community market (Ndorwei) is held on Sundays and Mondays.

Visual and Topographic Assessment

Topographically, Moyamba district can be divided into two topographical zones. The lowest part of the district is located along the south-west and rises gradually to a height of approximately 1,200 mamsl, which is the highest portion of the district.

The landscape of the proposed route is relatively flat and dominated by agricultural land. During the pre-construction stage, land rising, and land development activities will be impacted upon, and bring about changes in landscape and topographic features along the route.

The existing road is lined by vegetation on either side of the fairly narrow alignment. Visual impacts will mostly be permanent and result generally from the following issues:

- Clearing of vegetation within the right of way resulting in the widening of open spaces;
- Construction of the haul road with associated activities;
- Presence of construction machinery and equipment (temporary);
- Dust generation around active construction sites and from vehicular movement on the roads during the mining phase;
- Construction of the bridge across the Moselolo River;

- Construction of transmission line towers, and
- Increased vehicular activity.

Community consultations throughout the project implementation will aid in preparing community members for the changes which will take place at the various stages of the project. Pictoral explanations will further aid this process.

Ecology

The vegetation structure of the Project area is very similar to the general state of the vegetation in Sierra Leone. The landscape is a mosaic of various vegetation cover ranging from gallery forest along the river course, to farmbush (as the dominant land cover at different stages of ecological succession), open land, farm land, small isolated patches of forest and human settlements. The general structure of the landscape is one that is dominated by farmbush and farmlands, as a result of considerable modification due to the widespread practice of the traditional slash-and-burn agriculture. The gallery forest is quite thin, in most cases between 20 and 50 meters from the edge of the river to its outer limits, depending on the location.

A total of 32 species of mammals were recorded, most of which were through secondary information provided by the local hunters (Table 5.2-18). Twelve (12) species of mammals listed in Table 5.2-18 were recorded through direct evidence.

The avifauna diversity indicates that the areas hold a total of 116 bird species belonging to 28 avian families (Annex A of the appendices). Among these, only two species of global conservation concern were recorded: Hooded Vulture *Necrosyrtes monochas* (CR) - two individuals of this species were sighted flying over a community forest (GPS - N: 756737; W: 1227899) near Komende village; and Black-headed Rufous Warbler *Bathmocercus cerviniventris* – one bird heard along a forest stream at Bengeloh (GPS – N: 786849; E: 865722).

A total of 19 species of amphibians belonging to eight families including *Bufonidae; Astylosternidae; Arthroleptidae; Dicroglossidae; Conrauidae; Hyperoliidae; Phrynobatrachidae;* and *Ptychadenidae* were recorded along the proposed haul road (Annex A of the appendices). Among the 19 species recorded include one Vulnerable (VU) species (*Conraua alleni)* and two Near Threatened (NT) species (*Hyperolius zonatus and Phrynobaytachus alleni*).

A total of 14 fish species belonging to 8 families were recorded during this survey (Annex A of the appendices).

Hydrology, Hydrogeology and Water Quality

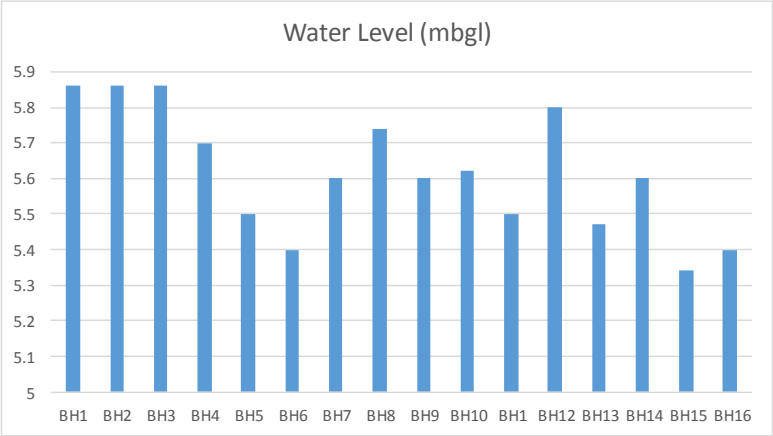
Hydrology:

The hydrology of the Project area is characterized by small, shallow lakes, creeks, rivers and wetlands which are most likely connected to the groundwater system and recharged by the large amount of annual rainfall. Moyamba district consists of two main river basins; these are the Kpangbaa and the Jong (Taia) Rivers. Although these rivers are seasonal, they have deep-sand filled river beds which hold a considerable amount of water, even long after the rainy season. The region is poorly drained and is characterized by several wetland areas.

Historical data (flow rates, seasonal variation, etc.) on hydrology is limited. A detailed hydrological study is currently underway which involves the establishment of a surface water baseline through the collection of flow and water quality data within the Moselolo River and Bagru Creek.

Hydrogeology:

Groundwater quantity and quality are an important environmental component that sustains the availability of surface waters, mainly during the dry seasons and provide water source suitable for commercial and domestic use. The assessment of the effects on groundwater is based on baseline information and hydro census conducted. Table 5.2.21 presents the details of boreholes identified, including location, depth and uses. The following graph highlights borehole water levels recorded in Mogbwemo.



Water Quality:

The primary objective of drinking water quality monitoring is to assess the bacterial purity and chemical composition of the water sources. Results indicate that Water Turbidity and pH did not fluctuate much. TDS values of these water points were within the threshold values recommended by WHO. The concentrations of dissolved Chemicals are also below the threshold values, with the exception of Nitrate which is above the threshold in one area and in some cases minimal and within permissible limits recommended by the World Health Organization.

This survey indicates that some of the water points had levels of bacteriological pollution in excess of the WHO threshold values and it is therefore recommended to administer a complete chlorination process in boreholes as indicated to render it fit for human consumption.

Socio-Economic Baseline Data

Sierra Leone covers a total area of 71,740 km^2 and has a population of 7,075,641 according to the 2015 Housing and Population Census result.

The following table presents information on national social indicators:

Key Social Indicators	Rate	Source
National Population	7,076,641	Statistic Sierra Leone, 2015 Census provisional result

Key Social Indicators	Rate	Source
GDP per capita	$497.89 in 2015	Trading Economics (2017). Sierra Leone GDP per Capita. [online] Available at http://www.tradingeconomics.com/sierra-leone/gdp-per-capita
Economic growth rate	-21.5% in 2015	African Development Bank Group (2017). *Sierra Leone Economic Outlook*. [online] Available at https://www.afdb.org/en/countries/west-africa/sierra-leone/sierra-leone-economic-outlook/
Human Development Index	0.413 in 2014	African Development Bank Group (2017). *Sierra Leone Economic Outlook*. [online] Available at https://www.afdb.org/en/countries/west-africa/sierra-leone/sierra-leone-economic-outlook/
Poverty rate	77.5 (estimated)	UNDP (2016). *About Sierra Leone*. [online] Available at http://www.sl.undp.org/content/sierraleone/en/home/countryinfo.html
Infant mortality rate (IMR)	94/1000 (2010-2015)	United Nations Statistics Division (2017). *Sierra Leone*. [online] Available at http://data.un.org/CountryProfile.aspx?crName=sierra%20leone
Life expectancy at birth	48 years	UNDP (2016) About Sierra Leone. [online] Available at http://www.sl.undp.org/content/sierraleone/en/home/countryinfo.html
Maternal Mortality ratio	1,100/100,000 in 2013	WHO (2014). *Sierra Leone*. [online] Available at http://www.who.int/maternal_child_adolescent/epidemiology/profiles/maternal/sle.pdf
Adult literacy race	41 %	UNDP (2016) About Sierra Leone. [online] Available at http://www.sl.undp.org/content/sierraleone/en/home/countryinfo.html
Primary school gross enrolment (f/m)	129.8/130.1 (2014)	United Nations Statistics Division (2017). *Sierra Leone*. [online] Available at http://data.un.org/CountryProfile.aspx?crName=sierra%20leone
Secondary School gross enrolment rate (f/m)	40/46.9	United Nations Statistics Division (2017). *Sierra Leone*. [online] Available at http://data.un.org/CountryProfile.aspx?crName=sierra%20leone

District Socio Economic Context

Moyamba District

According to the 2015 Housing and Population Census, Moyamba District has an estimated population of 318,588 comprising 153,129 males and 164,889 females. Agriculture remains the largest sector of economy in the Moyamba district, providing livelihoods for over 71% of the population. Livestock remains relatively small and underdeveloped such as household level owning poultry, goats and cattle. In the coastal Chiefdoms, salt production has also traditionally been an important economic activity.

47% of the district population are food insecure (11% severe and 36% moderate).

On an average 62% of household expenditure accounts for food purchases, which leaves the households vulnerable whilst prioritizing other essential family needs. Moyamba and three other

districts (Pujehun, Kailahun and Kenema) exceed the 40% "critical" WHO threshold of chronic malnutrition.

The Moyamba district has two Government and two Mission hospitals. In addition to this, other healthcare support systems include Community Health Centers (CHC), Community Health Posts (CHP), Maternal and Child Health Posts (MCHP) and clinics. On average one health facility covers 2,512 people with 2,350 people per bed.

Bonthe District

According to the 2015 Housing and Population Census, the total population of Bonthe was 200,730; comprising 98,770 males and 101,960 females. Fishing and farming are the two main livelihood activities of the large majority of the district population. Palm oil plantations have been on the rise and more people are engaged in this livelihood in recent years. Bonthe district has one of the world's largest deposits of titanium ore (rutile) in the world which is operated by SRL.

Bonthe district has one of the lowest rates of food insecurity (1% severe and 19% moderate food insecurity) among all districts in the country. 55% of household expenditure is used to buy food for the family, also one of the lowest compared to other districts.

The government general hospital is located in the district capital town. There are 58 other health facilities of the district. According to the Ministry of Health and Sanitation (MoHS) there is one health facility for over an average of 2,800 people and almost 3,000 people per bed.

Socio-Economic Baseline Assessment

Focus Group Discussions

Focus Group Discussion Meetings were held in each of the communities (12 in total) closest to the proposed road alignment. The following table presents a summary of responses from participants during the 12 meetings:

Checklist Issue	Summary of Responses
What is the main livelihood activity?	The main livelihood activity within the Project area is farming, practised in every community. Farming is at subsistence level and rudimentary tools are used such as cutlasses, hoes, axes etc. Crops popularly grown include rice, cassava, potato, beans, corn and maize. Cash crops such as coffee, cocoa, and oil palm are grown by a few farmers within the communities.
What are the secondary livelihood activities?	Participants reported having secondary livelihoods including fishing, hunting and petty trading.
Community awareness of SRL's proposed haul road development project.	All 12 communities confirmed having knowledge of the project. The awareness was reportedly due to the series of community consultative meetings and engagements organised by the Company within the Project area.
Community perceptions regarding the project	11 communities responded positively and welcomed the proposed project. Participants from Komende however stated that they would not allow the road to pass through their community as they had not been paid surface rent for the land occupied by SRL for the past 7 years.
Positive expectations from project	Perceived benefits from the project highlighted by the 12 communities include:

Checklist Issue	Summary of Responses
	• Transportation to Freetown and nearby villages and towns will be easier; • Employment opportunities will become available; • Educational and health facilities will be improved; • Improved social facilities; • Reduction in transport fares; • Reduction in drowning incidents in the Gbangbaia River; • Business activities within the communities will increase, and • Improved access to the communities by NGOs and other developmental organisations.
Perceived negative impacts of project	Potential negative impacts of the project listed by participants include: • Increased crime rates; • Increased accident rates; • Loss of farm land; • Loss of crops; • Increased dust along the road; • Increased noise levels in the affected communities; • Loss of cemeteries, sacred shrines, and other cultural features, and • Influx of people into the communities in search of jobs and business opportunities resulting in encroachment on the limited social facilities and contributing to the incidence of STIs in the affected communities.
Community suggestions for mitigation of perceived negative impacts	Participants proposed the following mitigation measures for the perceived negative impacts: • SRL should collaborate with government and other security agencies to increase security in the affected communities; • Put up road signs indicating speed limits, and erect speed bumps at appropriate places along the road; • SRL should pay adequate compensation for loss of crops and land; • SRL should make adequate compensation for pouring libation ceremony to facilitate the relocation of any sacred sites; • SRL should spray water on the road when necessary to suppress dust along the haulage road; • SRL to help improve the limited social facilities in the affected communities and embark on sensitisation programmes aimed at creating awareness in the communities on protection against incidents of STIs; • SRL should plant trees at edge of the road to suppress dust, and • SRL to provide training facilities to affected community members to make them easily marketable in the area of employment.
Community development needs	Participants were asked what issues within their communities they most required external assistance with. The responses are as follows:

Checklist Issue	Summary of Responses
	• Development of educational and health facilities; • Provision of portable drinking water sources; • Assistance in agricultural activities including provision of improved planting materials, fertilisers and tools; • Provision of a cold storage room for produce; • Provision of storage facilities for produce; • Provision of electricity, and • Construction of community centre.

The following is a summary of the questions which came up during these sessions:

Community Questions	CEMMATS Responses
If crops are destroyed as a result of the project, will SRL pay for them?	Yes. SRL will conduct a crop assessment in the presence of crop owners before project implementation. Payment for the assessed crops will be calculated using rates set by the Ministry of Agriculture, Forestry and Food Security.
If the road passes through sacred shrines, what will SRL do?	SRL will meet the appropriate authorities in the communities and negotiate with them on the cost of the libation ceremony for the relocation of such sacred shrines. Destruction of such shrines will only take place after the necessary ceremonies have been done and the permission to proceed has been given by the authorities concerned.
What will SRL do about our economic trees that are likely to be destroyed during the haulage road construction?	Like all other crops, SRL will make the necessary arrangements for the assessment of such economic trees in the presence of the tree owners for subsequent payment.
Will educational assistance be given to the affected communities?	A CDAP will be prepared by CEMMATS to address the development needs of the affected communities and also to mitigate the negative impacts of the construction project on these communities. Support to education could be one of the projects in the CDAP.
If dwelling houses are affected, how will SRL handle this?	There will be no resettlement of households as a result of the project as the road alignment is designed to avoid all settlements.
What are the chances for employment of youths in the affected communities?	Road construction is a highly technical job that requires highly skilled labour. If there are such skilled personnel in the affected communities, they will be given preference over people that are not indigenes of the affected communities. In the case of non-skilled jobs, indigenes of the affected project communities will also definitely be given preference.
If our clinic or other community facility has to be destroyed as a result of the road construction project, how will SRL handle this?	As stated earlier, there will be no destruction of public or private structures as a result of the project.
Why is the road bypassing towns, shrines and cemeteries?	SRL wishes to reduce as much as possible the negative impacts of the haulage road construction project on the affected communities.
Where will SRL recruit people from for the construction of the road?	SRL will assign the project to a private construction contractor. Opportunities will however be given where possible for employment of local labour.

Community Questions	CEMMATS Responses
What benefits has SRL planned for the project affected communities?	Based on the development needs of the affected communities which have been noted during the ESIA study, a CDAP will be developed that will address some of the needs of the project affected communities.
What will be the route of the haulage road within the affected communities?	The final alignment of the proposed haulage route has not been decided on as it is still being determined.
When will construction start?	The project is scheduled to take off during the first quarter of 2018.

Household Surveys

Questionnaires were administered to 217 participants representing households within the communities surveyed. The following are key statistics obtained, among others, from the survey:

- 70% of questionnaire respondents are male;
- Over half (51.4%) of respondents fell between the age bracket of 30 – 49;
- The majority of respondents (84.8%) are Mendes, followed by Temnes (6.5%);
- The predominant religion (84%) is Islam;
- Over half of respondents (55%) never received any kind of formal education. Less than 3% attained tertiary educational levels;
- Farming was reportedly the main primary livelihood activity of respondents (74%);
- All respondents reportedly owned a portion of land for farming;
- Typical dwelling houses in the Project area are made of mud, plastered with cement and roofed with corrugated iron; this was the type of dwelling inhabited by 60% of respondents;
- Respondents were asked to indicate their primary source of drinking water. The majority drink from surface water sources (stream / river), followed by hand pump well (38.7%), and open well (6.5%);
- Respondents were asked whether they were satisfied with the quality of their drinking water. 96% were not. 56% reported being dissatisfied with the taste; 33% stated the water's colour as a problem;
- Households' sources of health care treatment were investigated, with 94% reportedly relying on their community health centres;
- Awareness of HIV/AIDS was investigated. 82% claimed to have heard about the disease;
- 55.5% reported that they had heard about the disease through the media (radio, TV and/or newspaper, and
- All respondents reported being aware of the proposed project, and when asked how they felt about the proposed project almost all (97%) respondents were optimistic.

Heritage Study

All the communities visited had one or more of the following cultural heritage sites:

- General cemeteries;
- Secret society bushes for men and women, and
- Ceremonial meeting places for ancestral worship and divination (shrines). They were all community shrines and therefore open to all adult members of the community. There were, however, separate meeting places for the men and women.

Most of the sites are generally located very close to the village (often less than a kilometre) and the secret society bushes and ceremonial sites are found within thick forests surrounding the villages. The Poro and Sande ceremonies usually take place during the dry season and often on a yearly basis.

The strong influence of Islam in most settlements has seriously impacted cultural practices like Poro initiation rites.

Details of the cultural heritage sites identified within the Project area are presented in the following table:

Community	Type of Cultural Site	Remarks
Lower Banta Chiefdom		
Largo and Largo Junction	• Poro bush • Sande bush • Cemetery	The Poro and Sande bushes are used for annual initiation ceremonies. Although the bushes may appear sacred, their relocation should not be a problem. This is because any thick forest near the village can serve such purposes. The same applies to the cemetery. There are no special burial grounds whose relocation may be problematic.
Mosenesie 1	• Poro bush • Sande bush • Cemetery	May be easily relocated as described above.
Nyandehun Kugba	• Cemetery	May be easily relocated as described above.
Mokombay	• Poro bush, • Sande bush • Cemetery	May be easily relocated as described above.
Mogbwemo	• Sande bush • Cemetery	May be easily relocated as described above.
Momasa	• Sande bush • Bush for ancestral worship • Cemetery	The ancestral worship ceremony is usually held in January. May be easily relocated as was previously described.
Morporhoi	• Sande bush	The ceremonies are performed usually every three years. There is also a *Kpekei* bush and stone where herbalists and diviners claim to cure certain ailments affecting children, e.g. kwashiorkor.

Community	Type of Cultural Site	Remarks
	• Cemetery • Sacred ancestral worship ground	May be easily relocated previously described.
Bengelor	• Poro bush • Sande bush • Cemetery • Ancestral worship shrine	May be easily relocated previously described.
Bagruwa Chiefdom		
Moselolo	• Sande bush • Cemetery • Ancestral Worship Bush	May be easily relocated as previously described.
Mosenegor	• Sande bush • Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Moyasa	• Poro bush • Sande bush • Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Fula Town	• Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Kpandebu	• Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Kasama	• Sande bush • Cemetery • Ancestral worship ground	May be easily relocated as previously described.
Ngeib	• Ancestral worship shrine (infrequently used)	May be easily relocated as previously described.

Crop Compensation Assessment

A total of 708 acres of land exists within a 50-meter buffer of the proposed road alignment. Out of this total, an estimated 96.5 acres were noted to have various crops. A rapid assessment of these crops was undertaken in the field and four categories of crops were identified along the proposed road alignment as presented in the following table.

Sr. No	Crop	Acre
1	Cassava	10
2	Rice - Upland	1
3	Rice - IVS	0.5
4	Oil Palm	85

It should also be noted that the estimation of costs for vegetables and other tree crops that existed in isolation or in backyard gardens and fallow bush were out of the scope of this assignment mainly due to time and resource constraints. It is strongly recommended that provision be made for such seasonal, annual and permanent crops of this nature.

SRL already has a compensation system with an established team and procedures in place. It is expected that this system will be maintained and utilized for this project. The company will have to liaise with officers from the Ministry of Lands, Country Planning and the Environment (MLPCE), the Ministry of Agriculture, Forestry and Food Security (MAFFS), community Chiefs and land / crop owners to undertake a more detailed crop assessment within the specified right of way. It is also recommended that crop assessment and associated compensation payment are completed before commencement of construction work. Where necessary, a Livelihoods Restoration Plan may be implemented for some of the affected farmers.

Identification of Potential Impacts

An ESHIA study (informed by a combination of desktop studies and on-site observations by the project team) was carried out of the potential environmental and social impacts identified at the time of the study. This was done in order to first, determine the potential for such impacts, and secondly, to identify and propose mitigation measures that would enable avoidance or reduction of severity should the potential impacts occur or to increase the benefit of potential positive impacts.

Environmental and Social Impacts during the Planning and Construction Phase

Impacts at this stage are often temporary. At the planning stage, the main concern will be ensuring that designs for the haul road, bridge and transmission lines are done in such a way as to limit the negative environmental and social impacts that could occur during both the construction and operational phases of the project.

During the construction stage, traffic accidents, occupational safety incidents, as well as environmental impacts are paramount. Risks can be reduced by strict adherence to best construction management practices. The following table presents impacts anticipated during the construction stage which remain of medium and above impact after mitigation. The full table of impacts is presented in Table 7.2.6.

Environmental Aspect	Impact Description	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Post-Mitigation Impact Category
Soil Erosion	Soil erosion is likely to occur as a result of earthworks including the exposure of loose soil as a result of vegetation clearing, creation of embankments, etc. Eroded material can block drains and also end up in watercourses, affecting water quality.	Extreme	- Slope stability measures will be incorporated such as benching and installation of erosion protection features such as silt barriers and sedimentation ponds. - Area to be cleared will be kept to the minimum necessary to prevent disturbance of soils outside the boundary. - Develop Sediment and Erosion Control Management Plan, to minimise risk of soil erosion and ensure dispersion of sediment into aquatic environments are avoided where possible. - Drainage channels to be constructed to divert uncontaminated surface run-off away from construction work areas. - Where possible, drainage outlets will discharge into vegetated areas and not to exposed soil. - Vegetation along drainage lines and gullies will be protected where practicable to provide natural attenuation of flows. - Construction activities and movement of construction vehicles outside designated areas and transport routes will be minimised. - In areas of ground clearance, topsoil will be stripped and salvaged as much as possible	Medium
Water Quality	Pollution of water resources may arise at or close to the base camps and work-sites as a result of inadequate provision of sanitary and waste facilities, and accidental spillage or leakage of polluting materials. Pollution may also occur during construction operations carried out within the Gbangbaia River. Such pollution adversely affects those who depend on local water resources.	Major	- All machinery and equipment are to be maintained in a good condition and serviced according to the OEM specifications. - Refuelling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies, and provided with secondary containment measures. - Adequate controls for the storage, use and handling of hazardous chemical substances must be in place at all times. Safety Data Sheets (SDSs) will be available at the point of use and all hazardous materials will be clearly labelled. Personnel should be trained in the use of such hazardous substances and adequate spill prevention (including the availability of spill kits) and emergency response plans will be adopted. - The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills / leaks, and take necessary measures to prevent materials from falling into the river. - If necessary, alternative water sources will be provided to downstream users of the Gbangbaia River as	Medium

Environmental Aspect	Impact Description	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Post-Mitigation Impact Category

			disturbance of the water during construction cannot be entirely avoided.
			- The Environmental Management Plans including spills and waste management measures will be implemented.
			- Work to be undertaken close to surface water bodies will be limited as far as possible. Where not possible, e.g. at water crossings, additional measures will be taken to ensure that pollution of water resources does not occur, including minimising disturbance of river banks.
			- For construction of the Moselolo bridge:
			  - The duration of construction activities will be as short as practicable, and will be undertaken in the dry season;
			  - The construction of the bridge will take into account the hydraulics of the watercourse in the design to consider stability and flow disruptions, and
			  - The isolation and controlled dewatering of areas where pylons will be installed using a suitable method.
			- Sewage produced at the construction sites will be collected and transported to the Area 1 sewage treatment system for suitable treatment.	

Terrestrial Fauna	Disruption of sensitive faunal communities.	Major	- Where endangered species habitats are identified during the construction phase, a suitably qualified specialist shall be contracted to develop and implement a species-specific relocation management plan.	Medium
Vegetation	Removal of natural riverine vegetation, including potentially sensitive local ecosystems. This will be a very localised impact at the bridge construction site, and at small stream crossings.	Major	- Route selection has taken riverine vegetation locations into consideration, and these areas were avoided where practicable as part of the design process. - Avoid such areas if feasible, clear the minimum footprint required and minimise the disturbance of adjacent habitats limited. - Where practicable, relocate species of importance prior to commencement of construction. - No herbicides are to be used within 100 meters of a riverine environment. - Appropriate culverts will be installed to minimise secondary and/or ongoing impacts. - Construction shall be conducted as far as possible during the dry season.	Medium

<table>
<tr><th>Environmental Aspect</th><th>Impact Description</th><th>Pre-Mitigation Impact Category</th><th>Mitigation / Enhancement Measure</th><th>Post-Mitigation Impact Category</th></tr>
<tr><td></td><td></td><td></td><td>- Once construction has been completed, replant native species.</td><td></td></tr>
<tr><td></td><td>Localised disruption of ecosystem functions, such as ecosystem connectivity and fragmentation.</td><td>Extreme</td><td>- Clear the minimum footprint required.
- Where practicable, enlarged culverts shall be installed to minimise impacts on aquatic environs.</td><td>Medium</td></tr>
<tr><td>Noise and Vibration</td><td>Noise and vibration result from construction activities such as the operation of heavy machinery, concrete mixing plants, blasting in areas of rock excavation, stone crushing, traffic etc.
Noise and vibrations will be a source of disturbance to communities close to the road alignment and if excessive could cause health complaints</td><td>Major</td><td>- Activities producing excessive noise levels (such as crushing and screening at the borrow pits, as well as blasting), will be restricted to the day-time, and equipment normally producing high levels of noise should be suppressed or screened when working within a distance of some 200 m from any sensitive noise receptors.
- Near places of worship, construction producing nuisance level noise be minimised or rescheduled so as not to occur on locally recognised religious day.
- Work areas, will be organised and operated strive to restrict noise levels to not exceed World Bank thresholds at the nearest sensitive receptor during normal activities. If existing noise levels exceed these threshold values, the Project will not cause more than a 3dB increase in measured ambient levels during normal activities.
<table>
<tr><th>Receptor</th><th colspan="2">Noise level
One Hour L_{Aeq} (dBA)</th></tr>
<tr><td>(Type of district)</td><td>Daytime
07:00 – 22:00</td><td>Night-time
22:00 – 07:00</td></tr>
<tr><td>(a) Residential; institutional; educational</td><td>55</td><td>45</td></tr>
<tr><td>(b) Industrial; commercial</td><td>70</td><td>70</td></tr>
</table>
- Advance notice will be given to communities if short-term noisy construction activities are to take place, which could cause these levels to be exceeded. Communities in proximity to blasting activities will be given warning prior to blasting occurring.
- Measures to minimize noise during construction will include:
  - locating and orientating equipment to maximise the distance, and to direct noise emissions away from, sensitive areas;
  - using buildings, earthworks and material stockpiles as noise barriers where possible, and</td><td>Medium</td></tr>
</table>

Environmental Aspect	Impact Description	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Post-Mitigation Impact Category
			- turning off equipment when not in use. - A preventative maintenance program established for equipment and vehicles to not emit excessive noise or vibration due to inadequate maintenance or damage - Personnel will be made aware of the importance of minimising noise and the measures that are required in this regard. - The road will be constructed in such a way as to by-pass all communities thereby reducing noise and vibration impacts from traffic. - Explosives magazines will be constructed and managed in accordance with legal and international best practice standards. The magazines will be located in secured locations. - Blasting will be undertaken in a manner which minimises vibration in as far as practicably possible.	
STDs, HIV/AIDS and Teenage Pregnancy Issues	The risk of the prevalence of STDs, HIV/AIDS and teenage pregnancy in nearby communities is increased with the interaction of construction workers with community youth.	Major	- Sensitization and awareness raising will be provided among workers and communities. - All Project personnel will be provided with appropriate induction training communicating health hazards, including HIV/AIDS, STDs and malaria along with the prevention and mitigation measures required. - Inappropriate behaviour by Project personnel will be carefully managed through relevant human resources processes, to minimise the potential spread of illnesses and infective diseases.	Medium
Community Benefits from Project	Job Opportunities for skilled and unskilled members of the community Business opportunities to provide goods and services to workers (e.g. food and drink)	Minor positive	- Although labour recruitment is a matter for the contractor, who has the right to determine whom to employ, he will be formally encouraged to hire locally wherever possible, in order to maximise the benefit distribution and social acceptability of the project. - An employment plan will be developed to define requirements and procedures to be followed when identifying and developing project employment opportunities. This employment plan and any local employment opportunities will be communicated in a transparent and culturally appropriate manner. - Unskilled labour will be preferentially hired from the local communities. - A vocational training plan will be prepared to provide training to local people to increase their eligibility for employment. In addition, selected community employees will receive skills training to allow them to progress	Extremely positive

Environmental Aspect	Impact Description	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Post-Mitigation Impact Category
			from unskilled to semi-skilled / skilled positions. - Opportunities for sustainable local procurement of goods and services to support road construction will be identified wherever possible and measures will be devised to maximize the potential for these opportunities.	

Environmental and Social Impacts during the Operations Phase

During the operations phase, impacts considered during the planning and development phase would have been be realised. Mitigation measures to minimise these impacts would be implemented and as the project progresses, modifications and inclusions will be made to better address issues based on experience. The following table presents impacts anticipated during this phase which remain of medium and above impact after mitigation. The full table of impacts is presented in Table 7.2.7

Environmental Aspect	Impact Description	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Post-Mitigation Impact Category
Community Benefits from Project	Improved transport availability and reduction in transportation costs for passengers and goods due to reduction in vehicle operating costs as a result of improved road conditions. Construction of a bridge across the Gbangbaia River, linking the Moyamba and Bonthe Districts thereby greatly enhancing access to agricultural products and trade. Improved access to job and business opportunities, medical facilities, schools and other social amenities. This will translate into improved socio- economic conditions within surrounding communities. Better administration and co-ordination of government activities with improved road	Extremely positive	- Ensure that the road and bridge are well maintained to ensure safe use of this infrastructure to the public. - Linking the Moyamba and Bonthe Districts would greatly enhance access to agricultural products and trade. - Improved access to job and business opportunities, medical facilities, schools and other social amenities. This will translate into improved socio-economic conditions within surrounding communities. - Better administration and co-ordination of government activities with improved road network. - Ensure that ongoing and transparent communication is maintained between SRL and the communities.	Extremely positive

Environmental Aspect	Impact Description	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Post-Mitigation Impact Category
	network.			
Influx	Influx of individuals to the project area for business, jobs and other opportunities made available due to the newly constructed bridge and improved road networks. This could put a strain on the local community facilities, e.g. health, education, water and sanitation, etc.	Medium	- It will be difficult to restrict influx into the project area during the operational phase. However, regular communication between SRL and the stakeholders will be implemented to ensure that SRL are aware of challenges faced by the communities.	Medium
Increase in Crime	With increase in movement to and within the project area, and development of new businesses, etc. there is a potential for crime to increase.	Medium	- Management of crime will remain the responsibility of the Sierra Leone Police Service. - Where crime is directly related to SRL's activities, contractors and/or employees, relevant disciplinary processes will be followed.	Medium

Environmental Social and Health Management Plans

The Environmental, Social and Health Management Plan (ESHMP) for the Project identifies the principles, approach, procedures and methods that will be used to control and minimize the environmental, social, health and safety impacts of all construction and operational activities associated with Project development.

Waste Management Plan

The Waste Management Plan (WMP) describes the procedures, systems, equipment, and structures specific to waste management and disposal. Waste generation should be limited at all levels of the operation in order to decrease the volume of waste generated and make waste disposal more manageable. The WMP also defines who is responsible for developing and implementing the plan, and what records and reporting will be required.

Road Safety Management Plan

The Road Safety Management Plan (RSMP) outlines road safety precautions which must be implemented to prevent drivers on the road from causing unnecessary accidents and at the same time helping pedestrians and cyclists understand the rules governing their safety on a major road. The RSMP details the road safety and traffic management principles, strategies and measures that will be applied, road user requirements including: provision of a safe environment for the travelling public, and minimising impacts on the road network. The RSMP further highlights the social and economic implications of road traffic accidents, in order to appreciate and drastically reduce such accidents and help raise awareness for road safety improvement.

Emergency Response Plan

The Emergency Response Plan (ERP) provides employees and managers with specific instructions that will allow them to respond quickly and efficiently to any foreseeable emergencies likely to occur during the Project. It is developed using recognized and accepted methods and practices, and includes specific responses, protocols, and management contacts. The ERP essentially has the goal of protecting people, the environment, property and the operations. This document deals with typical emergency types that characterize the operation which include:

- Fire or explosion;
- Pollution or chemical spills;
- Road traffic accidents;
- Flooding, rain storm (natural disaster);
- Medical health cases, and
- Civil unrest & disturbances.

Community Development Action Plan

The Community Development Action Plan (CDAP) outlines the recommended development and social assistance programmes, which are aimed at improving the living conditions of the local communities in a sustainable manner.

Public Consultation and Disclosure Plan

The Public Consultation and Disclosure Plan (PCDP) is intended to define objectives and establish the framework necessary to provide understandable information to all parties involved. This plan will be implemented to ensure timely and effective communication between the project's management (SRL) and the affected stakeholders. The main objective of the PCDP is to establish a program for multi-directional communication between the management and stakeholders.

Conceptual Closure Plan

The conceptual Closure Plan (CP) documents plans to be put in place when the haul road will no longer be required by the company e.g. at end of mine life.

Once the Project has reached its economic life span and renders no further beneficial post-operational use for the Company, the road will be handed to the management of GoSL. In the event that GoSL does not accept responsibility for the upkeep of the road, or does not foresee a further beneficial use thereof, the Mines and Minerals Operational Regulations, 2013 stipulates: "Where roads are no longer necessary, the site must be restored as follows:

- At road surfaces; shoulders; escarpments; steep slopes; regular and irregular benches must be rehabilitated to prevent erosion, and
- Road surfaces and shoulders must be scarified, blended into natural contours and re-vegetated."

The closure plan describes the closure and post-closure activities considered for the project. It incorporates both the physical rehabilitation and socio-economic considerations as part of the Project life cycle (IFC EHS Guidelines – Mining, 2007).

Environmental Monitoring Plan

The Environmental Monitoring Plan (EMP) outlines a comprehensive monitoring plan.

Summary and Conclusion

Summary

Components of the ESHIA

The principal objective of the ESHIA is to satisfy the requirements of the local environmental regulatory body, EPA-SL for the issuance of the EIA license for the project to commence.

The study involved predicting the social and environmental impacts of the project as described, and suggesting mitigation measures where impacts are adverse and enhancement measures where impacts are positive.

This report comprises the result of an ESHIA study based on primary and secondary information obtained through field and desktop studies.

The investigations of impacts on the social environment were a crucial part of the study, since the operation will affect the livelihoods of the communities that reside closest to the proposed haul road alignment. The investigation of social impacts has involved the following:

- A baseline socio-economic study of communities surrounding in and around the Project area involving desktop studies and household surveys, and
- Undertaking stakeholders' focus group discussions to sensitise stakeholders and the potentially affected communities regarding the Project.

Discussions and meetings with stakeholders during the public consultation and disclosure process indicated general acceptability for the project with demonstrated enthusiasm at the local level. Local authorities within the Project area expressed their opinions, concerns and general willingness for full co-operation and support during the survey and these were evident during the field investigations.

Key Assessment Findings

Physical Environment:

There are potential impacts relating primarily to air quality, hydrology and water quality, biodiversity and soil erosion. Mitigation measures to limit the extent of all impacts have been highlighted and will be implemented.

Biological Environment:

There will be some displacement and/or loss of flora and fauna species during land clearing and preparation, however it is not expected that any species will be permanently eliminated from the region as a result. Mitigation measures have been presented to ensure that minimal clearing is carried out to limit the extent of biodiversity loss.

Socio-Economic Environment:

Perhaps the most critical aspect of the project is the potential loss of crops or reduction of farm lands, potential conflict from issues related to labour, unrealistic expectations held by the communities with regard to benefits created by the project, as well as vehicular traffic and safety risks. The selection of the road alignment was done primarily to avoid the need for community relocation. As such resettlement is not going to be an issue.

The project is likely to have positive impacts in the area of job creation, improving the quality of life of some of the locals and, on the regional scale, provide improved access for job, business and socio-economic facilities.

Conclusions and Recommendation

The nature of the haul road and transmission line project is such that many of the adverse impacts which are associated with road projects are not expected to occur in connection with the road project. This is because, apart from a few by-passes, it is an existing road requiring upgrading primarily within the existing centre-line, thus avoiding or reducing many of the adverse effects which are normally associated with new road construction. The transmission line also follows the road alignment, thus having largely the same environmental and social impacts. No adverse direct or indirect impacts are anticipated in respect of environmentally sensitive areas like National Parks, Wildlife Reserves, National Forest Priority Areas, land prone to erosion, wetlands of national or international importance or archaeological or heritage sites.

During the operational phase, traffic levels will be much higher, especially with haul trucks plying the route and with more public forms of transportation making use of the route, given the enhanced access created. This will give rise to complications of noise, air pollution, cross-road access for pedestrians and safety. Electrical safety will also be of particular concern for workers involved in the transmission line installation. Measures have however been outlined in the mitigation and management measures to address these.

However, the construction and operation of the road and transmission line will lead to a variety of changes in the local and wider environment. Many of the effects will be beneficial, particularly the impact at a regional level of increasing the reliability of road transport and the potential to develop the local economy through improved infrastructure and employment opportunities. The potential beneficial impacts associated with project implementation are also expected to lead to improved quality of life, particularly for those communities who live in proximity to the road.

The new upgraded road will provide good opportunity for goods and services to move along the route. In addition, the increased flow of traffic and goods will ignite economic opportunities for the benefit of the people along the road. The study has also shown that road communities are poor, but blessed with rich potential, which if properly nurtured, can lift the communities up to higher incomes.

The construction of the bridge across the Gbangbaia River means essentially linking two distinct parts of the country, thereby providing a shorter link between the Moyamba and Bonthe Districts. This, apart from easing human access will greatly enhance access to agricultural products.

There will nevertheless be adverse effects, which result from increasing the carriage width and at some locations, due to alignment improvement. Many of these effects will be short-term and reversible in nature and stem from ground disturbance, operation of equipment and housing of the labour force, but very few that will lead to permanent change. There will also be a need to pay compensation for crops destroyed as a result of the road construction.

These adverse impacts are capable of being controlled within acceptable limits, provided that the recommended mitigation measures are adopted. Therefore, if the mitigation and benefit

enhancement measures recommended in this ESHIA report are implemented properly, there are no environmental and/or social grounds for not proceeding with implementation of the project in the form in which it is presently envisaged, since the long-term benefits of project implementation outweigh the largely short-term adverse impacts associated with road and transmission line construction, all of which can be mitigated satisfactorily.

1 INTRODUCTION

1.1 Background

Sierra Rutile Limited (SRL) is one of the world's largest rutile producing companies, generating high quality rutile, ilmenite and zircon rich concentrate. SRL's Mine Lease Areas (MLAs) are located approximately 135 kilometres (km) southeast of the Sierra Leone capital city, Freetown, and approximately 30 km east of the Atlantic Ocean.

In December 2016, SRL was acquired by and became a wholly owned subsidiary of Iluka Resources Limited (Iluka / the Company). Iluka, which has its headquarters in Australia, is the world's largest producer of zircon and a major producer of the high-grade titanium dioxide products, rutile and synthetic rutile. Iluka has significant industry technical expertise including mining; metallurgical; and processing capabilities. The Company explores internationally for mineral sand deposits and is currently conducting exploration activities in Australia; Sri Lanka; Kazakhstan; South America; Canada and in Africa.

SRL's MLAs span the Moyamba and Bonthe districts, which are further sub-divided into Chiefdoms. The Southern half of the MLA is known as Area 1; consists of discrete deposits; and has been extensively mined since its inception and for over 50 years. The majority of Area 1 has been mined by bucket line dredging accompanied by a wet gravity separation plant, which carries out pre-concentration functionality. Smaller deposits have been mined more recently by dry mining and associated pre-concentration plants. The resultant product, known as Heavy Mineral Concentrate (HMC), is trucked to the Area 1 Mineral Separation Plant (MSP) for further separation into individual product streams through incorporation of gravity; electrostatic; and magnetic separation methods.

With the deposits in Area 1 becoming exhausted, SRL plans to start mining the Sembehun deposits in the Northern half of its MLA (Area 5), which is located in the Bagruwa Chiefdom, some 30 km north of the Area 1. Mining will still proceed in tandem in some parts of Area 1 through dry mining, and potentially limited dredge mining (options analysis is currently underway). The inception of mining in the Sembehun deposits will require extensive preparation of the Sembehun area, as well as providing road haulage and power linkages with Area 1. Once the Sembehun mine is operational, HMC will be hauled from Sembehun to the Area 1 MSP, and power will be sourced from the existing 25 MW power station at the Area 1 MSP.

This project requires an ESHIA for the haul road and transmission line linking Area 1 to Area 5 in order to obtain an Environmental Impact Assessment (EIA) Licence in line with requirements of the Environment Protection Agency of Sierra Leone (EPA-SL). ESHIA studies are concurrently being conducted for both the current operational site (Area 1) and the new Sembehun mine site (Area 5). SRL contracted the execution of the ESHIA studies on the Haul Road Construction and Transmission Line Installation to CEMMATS Group Ltd. (CEMMATS).

A Scoping Study was conducted in September 2017 culminating in the production of a Scoping Report which outlines the initial findings of the CEMMATS team and makes necessary suggestions for further work to be carried out during the main ESHIA investigations. This report, including a Terms of Reference (ToR) for the study, was submitted to the EPA-SL and subsequently approved.

The main ESHIA investigations have since been carried out by a team of environmentalists and socio-economists during October and November 2017. This report presents the results and outcomes of data and information collected and consultations carried out during the study.

1.2 National Perspective

1.2.1 Transport (Road) Sector

Road transport is the most dominant mode of transport and represents about 85% of the entire transport system in Sierra Leone. The country has a public road network of approximately 11,700 km, of which 8,700 km are functionally classified in the National Road System (Logistics Capacity Assessment, 2016).

The Sierra Leone Roads Authority (SLRA) oversees the management of the national roads, while the Ministry of Transport and Aviation (MoTA) provides the policy and regulatory framework for transport management in Sierra Leone. The Ministry has the mandate to draft and table amendments of traffic regulations to Parliament.

The Ministry of Works, Housing and Infrastructure (MOWHI) oversees the policy guidance and execution of the road, housing and infrastructure sectors in the country. The MOWHI is responsible for the management of the construction, reconstruction, rehabilitation and overall maintenance of the road sector infrastructure (Logistics Capacity Assessment, 2016).

Road transport is almost entirely operated by small private operators. There is free market entry for operators of trucks or passenger vehicles, subject to tariffs in the private sector, which are not regulated in practice, although the tariffs charged by the Sierra Leone Road Transport Corporation (SLRTC) are subject to government control.

1.2.2 Energy Sector

The electricity sector in Sierra Leone is severely challenged across generation, transmission and distribution, with less than 10% of the population having access to electricity (United Nations Development Programme, 2012). Generation capacity is insufficient, and transmission and distribution networks are largely inadequate and aging. A large part of the electricity network suffered damage during the war. Activities in recent years have concentrated on bringing the existing network back to operation. The current electricity system covers mainly the western region of the country. The bulk of electricity consumption takes place in Freetown, the capital city of Sierra Leone.

Energy consumption in Sierra Leone is dominated by biomass, which accounts for over 80% of energy used. The largest source of biomass energy is wood fuel followed by charcoal. Imported petroleum products are the next largest source of power at approximately 13%.

The Ministry of Energy (MoE) has the primary responsibility concerning energy access programs. Based on the National Energy Policy, a National Electrification Scheme is to be set up by the Ministry to provide 100% access to electricity by 2030.

1.3 Project Area

The Project area falls within the Bagruwa and Lower Banta Chiefdoms of Moyamba District, with a small footprint in the Bonthe District where the transmission line connects to the transformer in Area 1.

Moyamba District is the largest district in the Southern Province of Sierra Leone covering an area of 6,902 km^2, approximately 115 km by road from Freetown. The district is bordered by the Atlantic Ocean on the west; Port Loko and Tonkolili Districts to the North; and Bo and Bonthe Districts in the east and south respectively.

The Bonthe District comprises of several islands and an area of mainland next to the Atlantic Ocean. The capital is Mattru Jong which is approximately 215 km by road from Freetown.

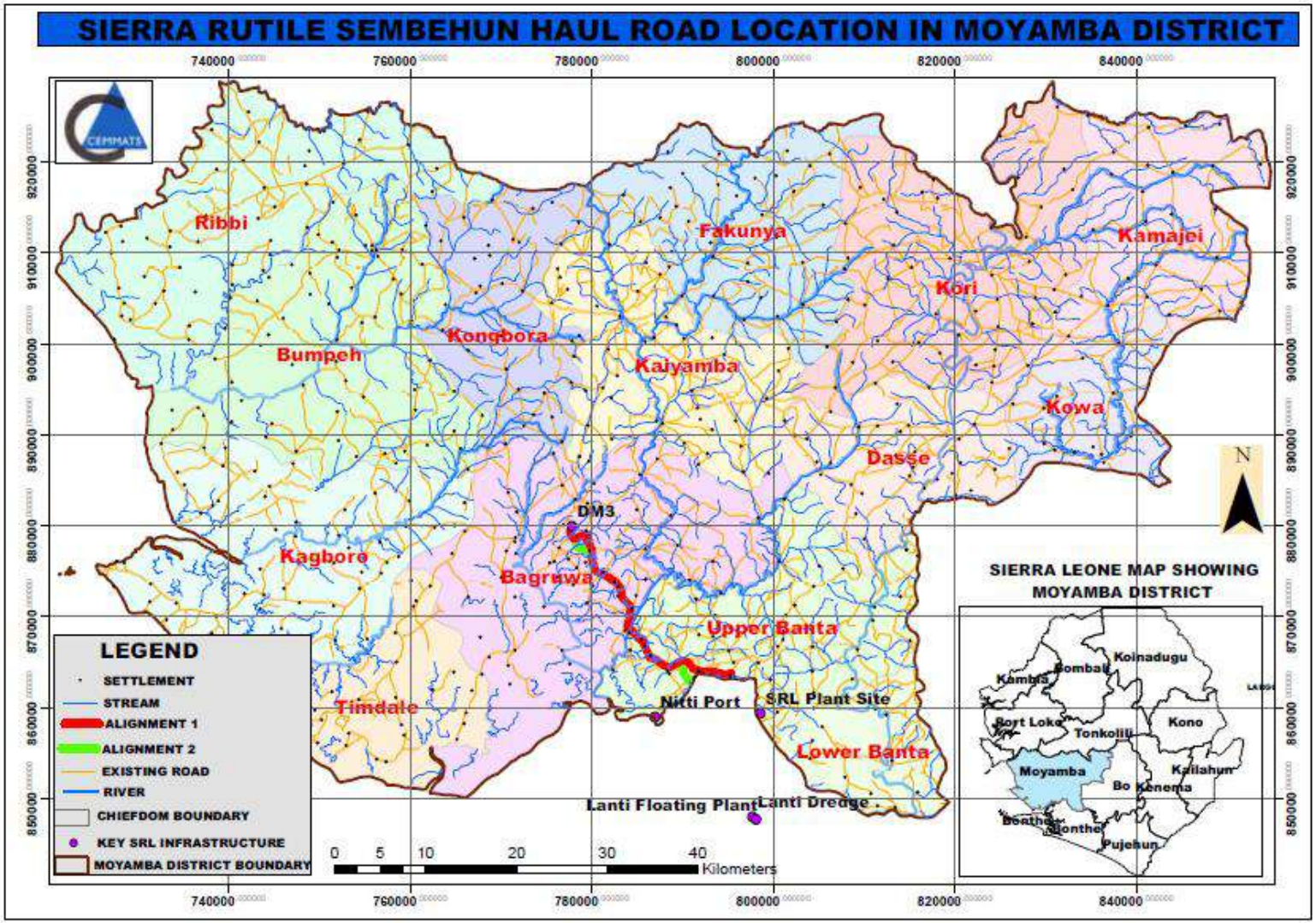


Figure 1.3-1: Map of Moyamba District

1.4 Environmental and Social Impact Assessment Process

1.4.1 Stages of the ESIA Process

Prior to commencement of any project that may affect the environment and communities, it is mandated by legislation that an ESIA (or ESHIA) study be completed, and, upon approval by EPA-SL, a licence is secured.

The *Sierra Leone Environment Protection Agency Act (2008)* (SLEPAA, 2008) and the EIA Supplementary Acts (2010), describe the requirements and process for securing an EIA licence, which is laid out in a "checklist" prepared by EPA-SL. In short, the client first applies to the local regulatory body, the EPA-SL for an EIA Licence. EPA-SL requires that a screening form be completed and submitted with the application letter, after which they decide on the category of the project. This is followed by a scoping investigation and report. EPA-SL will then decide on the Terms of Reference (TOR) to be drafted by the project proponent or an independent consultant carrying out the ESHIA study on behalf of the project proponent.

Upon the approval of the Agency, the consultant carries out an assessment of the environmental, social and health impacts of the planned operations on ecosystems, the physical environment and communities within the Project area. A report is prepared at the end of the study and submitted to EPA-SL for review (this report). If approved, the proponent will then be requested to conduct public disclosure meetings with relevant stakeholders on the findings and recommendations of the study, and incorporate comments, suggestions and requests made during those meetings into a public consultation and disclosure report. Finally, all reports pertaining to the ESIA study are then forwarded to the Board of EPA-SL for a decision to be made on the issuing of the licence.

1.4.2 Purpose of the ESIA Study

The purpose of the ESHIA is to identify environmental, social and health impacts, and present plans for the mitigation of potential negative impacts, as well as to enhance positive impacts. This is done through the conduct of desktop and field studies to:

- Obtain primary and secondary biophysical and socio-economic data;
- Evaluate the potential impact of the proposed project on the environment and communities, and
- Propose an environmental, social and health management plan (ESHMP) that mitigates adverse impacts whilst enhancing positive ones.

These were achieved by employing a methodology that consists of a literature review, field investigations, focus group discussions and stakeholder consultation.

The purpose and findings of the study will be disclosed to project interested and affected persons in a series of stakeholder consultation and disclosure meetings to elicit community acceptance, participation and on-going stewardship that are imperative for the construction and operation of the extension project.

1.4.3 Objectives of the ESHIA Study

The objectives of the study are as follows:

- To assess the potential positive and negative impacts of the Project on society and the environment;
- To recommend mitigation measures to avoid or reduce negative impacts and enhance benefits;
- To recommend an ESHMP that integrates mitigation measures into project management;
- To recommend an Environmental Monitoring Plan (EMP) and a Community Development Action Plan (CDAP) as part of the ESHMP;
- To develop relevant environmental and social management plans for the successful implementation of the Project as follows:
  - Waste Management Plan (WMP);
  - CDAP, and
  - Emergency Response Plan (ERP).
- To develop a Conceptual Closure Plan;
- To develop a Public Consultation and Disclosure Plan (PCDP), and
- To conduct public disclosure and consultation meetings on the findings and recommendations of the ESHIA study.

1.4.4 ESHIA Consultants and Teams

A number of specialists were identified to undertake the investigations and address these issues during the ESHIA phase. The studies anticipated were divided into 3 main categories, namely physical, ecological and socio-economic. A team was formed of the respective ESHIA consultants and sub-teams (Table 1.4-1: ESHIA Team).

The terms of reference for each of these studies are outlined in Section 1.5. The specialist studies were undertaken during the ESHIA phase. An ESHIA report (this report) summarizing all their findings has been compiled using the information gathered during these studies. The recommendations and mitigation measures developed from these studies have also been integrated to generate an ESHMP, which will be adhered to during the various stages of each project component. The ESHMP is featured as Volume 2 of this report.

Table 1.4-1: ESHIA Team

Specialist	Specialist investigation
Andrew Keili	Project Director
Vanessa James	Project Manager
Arthur Chinsman-Williams	Hydrologist / Water Quality Specialist
Hawanatu Dumbuya	Mining Engineer
Leonard Buckle	Environmental Specialist / GIS
Arnold Okoni Williams	Ecologist – Avifauna

Specialist	Specialist investigation
Edward Aruna	Ecologist – Terrestrial Ecology
Komba Konoyima	Ecologist – Aquatic Ecology
Sylthea Redwood-Sawyerr	Electrical Engineer
Emeric Johnson	Electrical Engineer
Henry Maada Kangbai	Socio-Economist
Rashidu Sinnah	Socio-Economist
Bartholomew Bockarie	Land Use and Crop Compensation Specialist
Joseph Gbassa	GIS Specialist

1.5 Description of the Terms and References (TOR)

The current ESHIA study conducted by CEMMATS, on behalf of SRL was undertaken to meet the local requirements for securing the EIA Licence from EPA-SL.

This study is an ESHIA study, as required by EPA-SL, which consists of biophysical and socio-economic baseline data collection and impact assessments, conducted in the Project area by an inter- and multi-disciplinary team of professionals during October and November 2017.

Table 1.5-1 Terms of Reference for ESHIA

Activity	ESHIA for Road Construction	ESIA for Power Transmission Line
Technical Assessment and Reporting: EPA-SL EIA Licensing Stages 1 to 4		
Hydrogeology and surface water	Objectives: The main objectives of this assessment include establishing the baseline qualitative and quantitative conditions of the Project area and determining the direct physical impacts of the project on the surface and groundwater. Desktop study: A review of existing data on this area will be undertaken together with additional information which may include: • A description of site in terms of sensitive characteristics; • A review of land (water) uses and predicting the potential impacts that could arise from the proposed project; • Review of existing baseline water quality data (local/regional) and the national water quality targets applicable to the project, and • Hydrological information and water management: Information on rainfall in the localities, evapo-transpiration, water management, run-off, hydrology, sediment control etc. Field surveys: • A hydrocensus of the study areas will be undertaken. During the hydrocensus, important data pertaining to the current groundwater conditions and uses in communities along the alignment areas, will be collected. This will include localities of current groundwater abstraction points, ownership, current usage volumes and types, equipment and groundwater levels. The number of samples to be taken depends on the number of villages along the route and their proximity to the road alignment. However, at least 5 samples will be taken at appropriate distances along the route. The data collected will serve as a reference point against historical and future groundwater conditions in the area; • Sampling for laboratory analysis of hydrochemical (anions and cations) and microbiological (faecal and total coliforms) characteristics in surface and groundwater samples; • Identify potential sources of pollution; • Identify potential impacts that could result from the proposed project on the surface and groundwater resources, and • River flow characteristics will be determined and swamps / wetlands, surface water / riparian areas and springs / wells identified and inspected.	
Air quality	Objectives: The main objective for conducting a dust assessment is to collect baseline data and predict the potential impact(s). A qualitative assessment will be undertaken which will evaluate the possible impacts of other polluting sources within the area. Desktop study: • Review of construction and installation processes to identify key aspects that might have significant air quality impacts during the construction and operational phases, and	

Activity	ESHIA for Road Construction	ESIA for Power Transmission Line
	• Development of mitigation measures to minimise impacts. Field surveys: • Identification of potential point and non-point sources of pollution; • Establishment of baseline conditions through in situ dust level measurements; • A qualitative assessment will be undertaken which will evaluate the possible direct and indirect impacts of the road, and • Potential sources of pollution within the Project area, outside of the road construction activities will be identified such as oil palm processing, burning of bush farms, etc.	
Noise / Vibration	Objectives: To assess the ambient noise levels in the proposed Project area in accordance with appropriate international standards and guidelines. Desktop study: • Review of construction and installation processes to identify key aspects that might generate significant noise impacts during the construction and operational phases, including night time work and limited blasting at the borrow pit sites, and • Development of mitigation measures to minimise impacts. Field survey: • Sound pressure readings will be done at the closest residential area. Readings will be taken in at least 5 residential areas at reasonably spaced distances along the route as identified in the preliminary survey, and • Ambient noise levels will be measured at various times of the day and night.	
Soils, land use, and geology	Objectives: The soil study will aim to characterize the soils in the study area that are to be affected by the proposed project. It will provide an indication of the existing soil and land capabilities for the survey area and give a characterization of the land capability within the Project area. Desktop study: • Literature reviews will be done on the soils and geology of the Project area based on available literature. A description of this in relation to the proposed activities will be presented in the ESHIA report; • Soil suitability for land use and susceptibility to erosion, landslide etc., will be ascertained, and • Information on land use patterns, subsistence agriculture, mapping existing land use categories aligned with a vegetation map. Field survey: • Determination of land use patterns through community consultations using household questionnaires and focus group meetings.	
Land and Aquatic Ecology	Objectives: Determination and description of the different types of flora and fauna along the road and power line alignment, the impact of the road construction and operational activities, and transmission line installation, and the mitigation / monitoring measures to be put in place.	

Activity	ESHIA for Road Construction	ESIA for Power Transmission Line
	Desktop studies: • Land and aquatic ecology (flora and fauna) assessments will be conducted based on literature reviews on previous studies carried out within the Project area; • Ways in which aquatic habitat may be altered / affected will be investigated; • Fauna and flora lists will be generated and the relationship between fauna species and their habitat discussed, and • Mitigation measures and monitoring requirements to limit ecological impacts will be outlined. Field studies: • Field assessment will be conducted to obtain an understanding of the current ecological conditions (land and aquatic) along the route, and to corroborate or update information obtained during literature reviews; • Wildlife habitats, rare, threatened, or endangered species and / or high biodiversity / sensitive habitat, and watercourses will be identified, with a view to determine the impacts of the road project on them. This will also extend to critical terrestrial and aquatic habitats (e.g. estuaries, old-growth forests, wetlands, and fish spawning habitats); • Flora and fauna surveys will be conducted; • Mammal species around the project area will be noted through ecological indicators, such as calls, tracks and dung, and • The presence of avifauna will be recorded by means of sightings, calls, droppings and the presence of nesting sites.	
Waste Management	Objectives: The study aims to ensure that waste streams generated by the project are adequately managed in order to prevent environmental and community health and safety risks. Management of waste from activities in all phases of the project will be assessed. Desktop studies: • Literature review of documents provided by SRL and other relevant sources; • Review of potentially hazardous materials to be used in the power line installation to which communities will be exposed; • Analyses of current waste management methods of areas currently managed by SRL, and • Provision of guidelines for the management of waste streams likely to be generated by the project. Field studies: • Observational assessment of SRL's current waste management practices.	
Technical Works / Implementation Plan / Risk Assessment	Objectives: Provide a description of relevant features of the project, such as location, scale, capacity, equipment, installations, staff and support, early works activities, construction activities, schedule, risks, operations, facilities etc. Desktop study: • A review will be done on the construction and operational aspects of the project and the main health and safety hazards summarized;	

Activity	ESHIA for Road Construction	ESIA for Power Transmission Line
	• Review of road and transmission line plans and design; • Review of SRL's Occupational Health and Safety (OHS) Policy; • Review of SRL's Environmental Health and Safety Policy; • Review of SRL's Sustainability Policy (2015) – commits the company to implement management systems that make health, safety, environment and community responsibilities an integral part of business decisions and activities; • Review of SRL's Environmental Policy (2015) – commits the company to environmental excellence based on the promotion of open and honest communication on environmental and community issues, protection of the environment, promotion of sound and responsible practices and fostering of continual improvement; • Review of SRL Occupational Health and Safety Policy (2015) – commits the company to "zero harm" to people and achievement of highest standards across the operations. This includes the compliance to Sierra Leonean law and alignment to the OSHAS 18001 system; • Review of Iluka Health, Safety, Environment and Community Policy (2017) – commits the company to operate in a sustainable manner by targeting high levels of performance and pursuing leading practice in the areas of health, safety, environment and community reflecting the company's values of Commitment, Integrity and Responsibility. • Review of SRL's equipment maintenance schedule and record keeping on site, and • Investigation of the handling and storage procedures of pesticides and other hazardous materials <u>Field studies:</u> Field studies will not be required as there is currently no operational activity to be observed on site.	
Visual and Topographic Assessment	<u>Objectives:</u> The objective of this study is to present a description of the project features and the ways in which they may impact visually on community members. <u>Desktop studies:</u> • The assessment will include landscape characterization and evaluation; description of local topography; • Review of maps, project plans, etc., and • Provide a description on the effect of project features on communities. <u>Field studies:</u> • To inspect the Project area and include a photographic survey with a focus on the project site.	
Traffic Management	<u>Objective:</u> This will be carried out to assess the impact of the project, during construction and operation within the Project area and recommend ways in which to minimise negative impacts and maximise positive ones. <u>Desktop studies:</u> • Description of the baseline traffic condition within the proposed route; • Determine the typical impacts likely to occur during road construction and operation and transmission line installation, and	

Activity	ESHIA for Road Construction	ESIA for Power Transmission Line
	• Outline traffic management measures to ameliorate the impacts of proposed works and assessment of public transport services affected. Field studies: • Conduct a traffic count and survey along the proposed route, and • Additional traffic considerations related to transmission line along road will be given.	
Socio Economic and Social Impact Assessment	Objectives: This assessment aims to determine the number of households (and people) that will be affected by the project and determine the possible impacts (positive and negative) of the project on health, livelihoods, income levels, education levels, food security and other factors relevant to the affected communities. The particular tools or techniques selected will be context specific and will include focus group sessions and interviews (open-ended and semi-structured), as well as a socio-economic household survey. Desktop studies: • A description of the national and local socio-economic status will be provided, as well stakeholders' perceptions on and expectations from the proposed project; • Identification of potential impacts of the project on communities and recommendation of mitigation measures; • Development of management plans including a Community Development Action plan (CDAP) and a Public Consultation and Disclosure Plan (PCDP), and • Develop a framework for crop compensation. Field studies: An action-research approach will be adopted using participatory techniques aimed at assessing the understanding and perception of people within the Project area, facilitating and enhancing awareness, mutual understanding, trust and capacity building. Specific activities will include: • Conducting household surveys on selected households in neighbouring communities; • Holding focus group discussion meetings, and • Conducting a crop survey through community consultations and measurements.	
Heritage Studies	Objective: The study will help determine the sacred or culturally important elements or activities within the Project area which might be affected by the project. Desktop studies: • Conduct a review of the cultural heritage history of the Project area; • Describe the heritage of the Project area, and • Recommend mitigation measures for proposed project related impacts. Field studies: • Community consultations and observational assessments.	

Activity	ESHIA for Road Construction	ESIA for Power Transmission Line
Community Health and Safety	Objectives: To determine the potential health and safety impacts of the project on communities and ensure that measures are put in place to protect their health and safety. Desktop studies: • Review of project aspects which could put community's health or safety at risk, and • Ensure regular communication with communities and provide community assistance to mitigate identified community health and safety impacts. Field studies: • Information required for this assessment will be obtained through the participation techniques described under the socio-economic and social impact assessment study.	
Occupational Health and Safety (OHS)	Objectives: Aims to assess the safety of the workers involved in construction and installation processes and identify the OHS hazards specific to the project. Desktop studies: • Review of SRL OHS Policy. • Review of Iluka's HSEC Policy. Field studies: Field studies will not be required as there is currently no operational activity to be observed on site.	

1.6 Summary of Scope of Work

In summary, the scope of work is as follows:

- Collection of primary and secondary environmental, social and cultural data from relevant literature on the project region;
- Organization of field visits to obtain baseline data of prevailing environmental and social conditions, and
- Preparation of an ESHIA report that includes environmental and social management plans.

1.7 Assumptions and Limitations

- The ESHIA study has been undertaken to meet the national requirements for securing the EIA Licence. Relevant international guidelines, consistent with Iluka's Corporate Policies have also been incorporated into the ESHIA;
- The timeframe within which the study was undertaken did not allow for seasonal variations to be taken into consideration. However, desktop studies were undertaken to obtain historical climatic data and other records obtained at various times during previous years, and
- At the time of compilation of this report, various types of technical investigative work and options analysis was underway and/or being planned. The consultant and SRL have done their utmost to collect relevant information from the studies. Where there may be insufficient information or non-resolution of issues related to design and location of facilities, general advice and guidance including ESHMP have been provided.

Notwithstanding the aforementioned assumptions and limitations, the ESHIA team employed an evidence-based approach and included scientific information relevant to the Project area within the stated limited options. Where possible the ESHIA team sought data and information from other sources at a level of detail adequate to conduct the ESHIA study.

1.8 Organisation of the ESHIA Report(s)

This final report consists of two (2) volumes of documents. Below are brief comments on the contents.

1.8.1 The ESHIA Report

Volume 1 – The Executive Summary and Environmental, Social and Health Impact Assessment (ESHIA) contains the policy, legal and administrative framework under which the ESHIA was carried out. There is an analysis of the feasible alternatives, including the "no project" alternative, and a description of the project in its geographic, ecological, social and temporal context. It includes baseline data describing the relevant physical, biological and historical conditions, as well as the potential environmental, social and health effects associated with project implementation. Mitigation measures needed to control those effects to acceptable levels are presented, as well as an analysis of the cumulative impacts.

Volume 2 – Environmental, Social and Health Management Plan (ESHMP) presents the environmental, social and health management, mitigation, monitoring and institutional measures to be taken during project implementation and operation, to reduce adverse environmental, social and health effects to acceptable levels. It specifically defines what actions must be taken and who is responsible to reduce project impacts. The ESHMP also includes several component-plans defining specific action programs for waste management; emergency response; closure and reclamation; community development; public consultation and disclosure. The ESHMP highlights the issues and concerns that are presented in the ESHIA and identifies reasonable and practical responses to address and mitigate potentially adverse effects. It describes the specific actions that will be required to effectively implement those responses in a timely manner and describes the methods by which management will demonstrate that those requirements have been met. It also establishes the course that will follow in complying with GoSL's environmental laws and regulations as well as international policies and guidelines.

1.8.2 Management Plans featured in the ESHMP

1.8.2.1 Waste Management Plan

The WMP describes the procedures, systems, equipment, and structures specific to waste management and disposal. Waste generation should be limited at all levels of the operation in order to decrease the volume of waste generated and make waste disposal more manageable. The WMP also defines who is responsible for developing and implementing the plan, and what records and reporting will be required.

1.8.2.2 Emergency Response Plan

The ERP provides employees and managers with specific instructions that will allow them to respond quickly and efficiently to any foreseeable emergencies likely to occur during the project. It is developed using recognized and accepted methods and practices and includes specific responses, protocols, and management contacts. The ERP essentially has the goal of protecting people, the environment, property and the operations. This document deals with typical emergency types that characterize the operation which include:

- Fire or explosion;
- Pollution or chemical spills;
- Road traffic accidents;
- Flooding, rain storm (natural disaster);
- Medical health cases, and
- Civil unrest & disturbances.

1.8.2.3 Road Safety Management Plan

Road safety precautions must be put in place to prevent drivers on the road from causing unnecessary accidents and at the same time, helping pedestrians and cyclists understand the

rules governing their safety on a main road. The plan highlights the social and economic implications of road traffic accidents, in order to appreciate and drastically reduce such accidents and help raise awareness for road safety improvement.

1.8.2.4 Community Development Action Plan

The community development and social assistance programmes aimed at improving the living conditions of the local communities in a sustainable way are captured under the CDAP. The CDAP will be executed by the already established SRL Community Development Committee (CDC).

1.8.2.5 Public Consultation and Disclosure Plan

The PCDP is intended to define objectives and establish the framework necessary to provide understandable information to all parties involved. This plan will be implemented to ensure timely and effective communications between the project's management and the affected stakeholders. The main objective of the PCDP is to establish a program for multi-directional communication between the management and stakeholders.

1.8.2.6 Conceptual Closure Plan

Once the project has reached its economic life span and renders no further beneficial post-operational use for the Company, the road will be handed to the management of GoSL. In the event that GoSL does not accept responsibility for the upkeep of the road, or does not foresee a further beneficial use thereof, the Mines and Minerals Operational Regulations, 2013 stipulates: "Where roads are no longer necessary, the site must be restored as follows:

- At road surfaces; shoulders; escarpments; steep slopes; regular and irregular benches must be rehabilitated to prevent erosion, and
- Road surfaces and shoulders must be scarified, blended into natural contours and re-vegetated."

The closure plan describes the closure and post-closure activities considered for the project. It incorporates both the physical rehabilitation and socio-economic considerations as part of the project life cycle (IFC EHS Guidelines – Mining, 2007).

2 PROJECT DESCRIPTION

2.1 Introduction

The project involves the development of a haul road to transport Heavy Minerals Concentrate (HMC) from SRL's Sembehun Dry Mine (DM3) site to the MSP in Area 1 at Mogbwemo, which is located approximately 30 km southeast, for further processing.

The road design is proposed to be a class 4B road which can be described as an all-weather, two-lane road, formed and gravelled.

A bridge of approximately 150 m in span will be constructed over the Gbangbaia River near the town of Moselolo. The width of the bridge (i.e. single or double lane) was still under investigation at the time of completion of this report.

The project also involves the installation of a power transmission line, starting at the SRL power station at Area 1, Mogbwemo (Bonthe District). The power transmission line will follow the new and existing haul road alignment, and terminate at a transformer located on the MLA at Sembehun. At this location, the voltage will be stepped down from 46 kV to 13.8 kV for distribution within the MLA (Area 5). Proximate to the Area 1 power station, the power transmission line will deviate from the existing haul road alignment for approximately 2 km where additional vegetation clearance will be required.

2.2 Proposed Road Alignment

2.2.1 General Description of Proposed Route

An initial alignment, largely following the existing road's alignment, was originally proposed. This initial alignment was to start in Gbangbatoke town (863769N, 788532E), approximately 150 m south of the Benji Bridge, and approximately 3 km from the Mogbwemo village intersection on the Nitti Port haul road, and would have been a total length of approximately 21 km, terminating at the DM3 mine site (879883N, 777843E) (Figure 2.2-1).

Several settlements like Gbangbatoke, Bengelo, Baoma, Morphohoi, Moselengor, etc., fell within or close to this proposed road corridor. SRL made a decision to by-pass all settlements in order to avoid the need for the resettlement of communities and/or households.

In order to determine the best possible options for the road corridor which would avoid all communities, a ground-truthing exercise was undertaken by the consultancy firm Edward Davies and Associates (EDA), in which two alternative alignments were proposed. The alternative routes generally follow the alignment initially proposed by SRL (Figure 2.2-1), but create by-pass alignments around the settlements within or close to the road corridor. The alignment options proposed, intercept the Nitti Port haul road at different points from what was initially proposed with two alternative road lengths of 29.5 km (Alternative 1 shown in black) and 24.7 km (Alternative 2 shown in blue) (Figure 2.2-2 to 2.2-8).

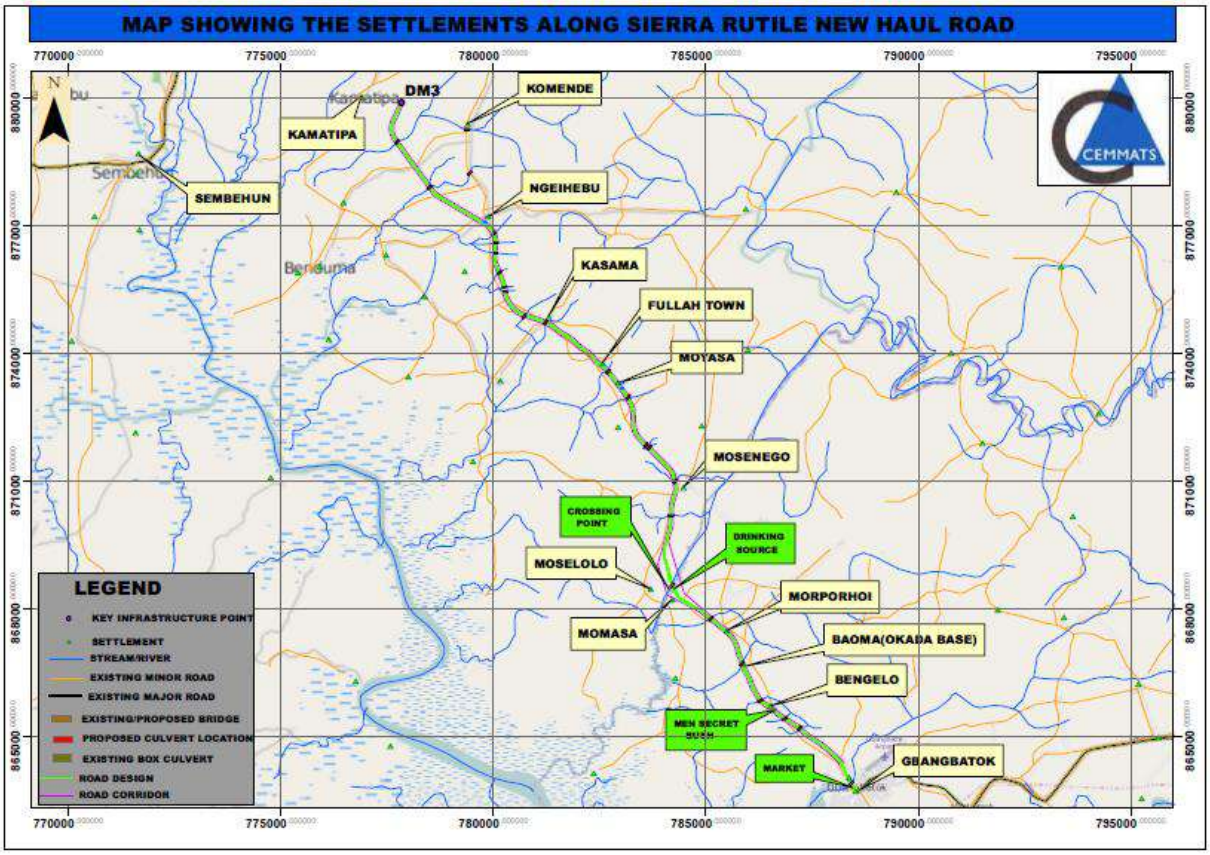


Figure 2.2-1: Initial Proposed Route

During CEMMATS' main ESHIA field visit, a decision was made on which of the two proposed alignments generated the least environmental and social issues, taking into consideration the location of communities, topography and drainage of the area, and narrowest crossing points across streams and swamps (EDA, 2017).

2.2.2 Description of Final Alignment

The descriptions in this section are based on information provided by the EDA Road Alignment Options Report (September 2017).

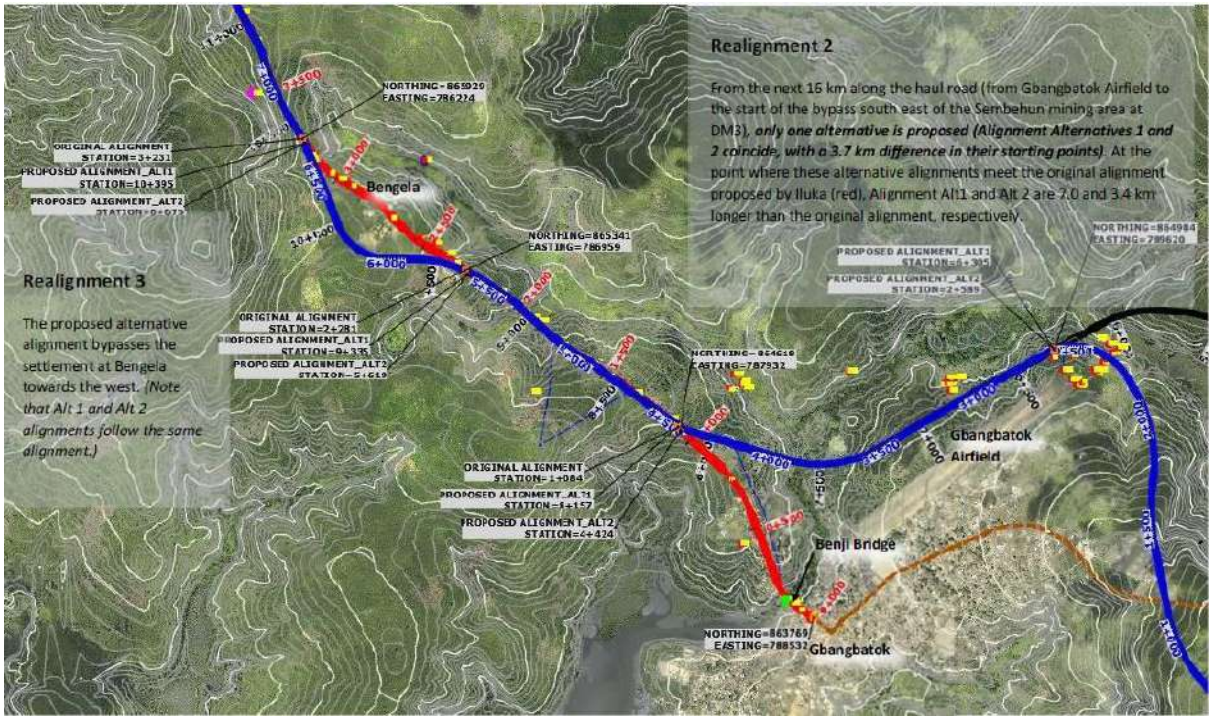
It should be noted that this description of the alignment, provides the configuration of both the road and powerline routes, as the powerline will be constructed adjacent to the road itself.

The preferred road alignment starts at the origin of Alternative 1 between Sahun and Largor Junction, which bypasses the Mosenesie 1 and Mogbwemo villages, crossing a small swamp (at its narrowest point where a culvert will be installed) before passing north-east of the existing Gbangbatoke Airfield (Figure 2.2-2).

Source: EDA, 2017

Figure 2.2-2: Map showing starting point of Alternative 1 (in black) and Alternative 2 (in blue)

At 3.7 km from the Area 1 MSP, Alternative 1 (black) coincides with Alternative 2 (blue) (Figure 2.2-2), resulting in one alignment from this point, until the route joins with the initial alignment proposed (shown in red in Figure 2.2-3). The total length of Alternative 1, including where it merges with Alternative 2, until it joins the existing road in Gbangbatoke, is 7 km.

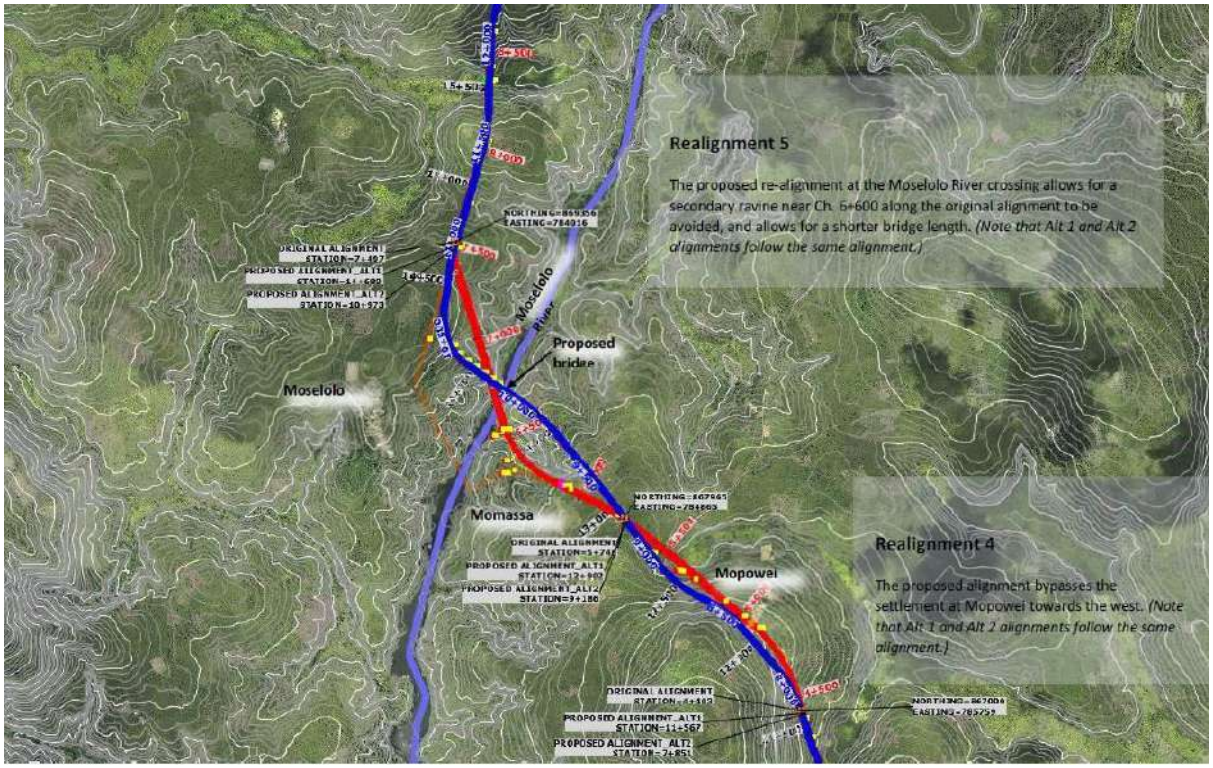


Source: EDA, 2017

Figure 2.2-3: Map showing where Alternatives 1 (in black) & 2 (in blue) merge before joining the original alignment (in red)

Alternatives 1 and 2 follow the existing road corridor from the point of intersection, until the Bengelor area where the existing road passes through the community. Alternatives 1 and 2 still merged, bypass Bengelor using a route west of the settlement (Figure 2.2-3).

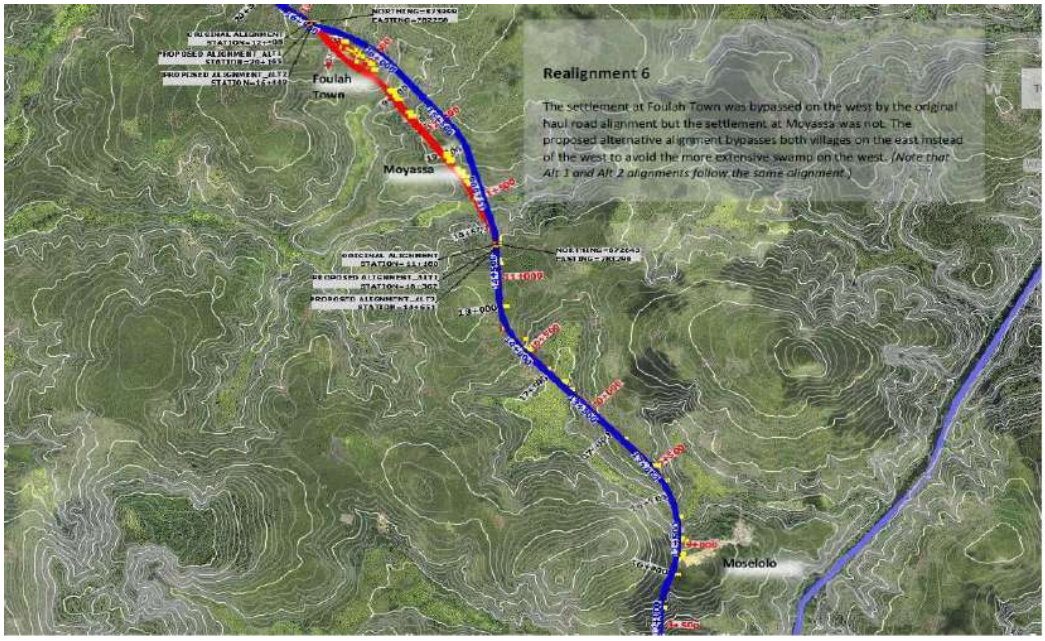
Two more re-alignments occur along the existing road, with Alternatives 1 and 2 still merged, at Morpowoi, bypassing the settlement westward and at the Gbangbaia River where a secondary ravine is avoided, and a narrower crossing point achieved (Figure 2.2-4).



Source: EDA, 2017

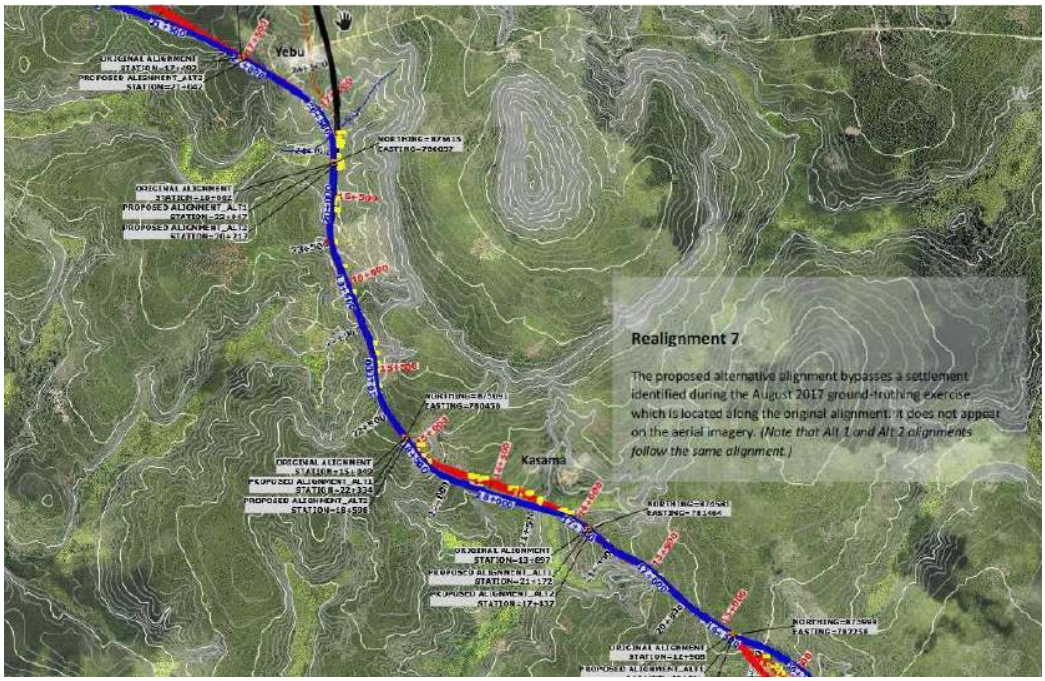
Figure 2.2-4: Map showing two more diversions and proposed crossing point at Gbangbaia River

On the Moselolo side of the Gbangbaia River, Alternatives 1 and 2 follow the existing road until just before Moyasa and Fula Town, where they divert east of both settlements, bypassing a swamp in the process (Figure 2.2-5). A small diversion also occurs at Kassama, bypassing the settlement on the west (Figure 2.2-6).



Source: EDA, 2017

Figure 2.2-5: Map showing diversion at Moyassa and Fula Town



Source: EDA, 2017

Figure 2.2-6: Map Showing Diversion at Kassama

After Kassama, the alternative road alignments and the existing road follow the same route until Ngeiyebu, where all three routes diverge.

At this point, the preferred route to be taken is indicated in blue which deviates from the existing road creating a bypass which allows the road to cross a swamp at this location at the narrowest section, before joining the other alignments to end at the Sembehun DM3 site.

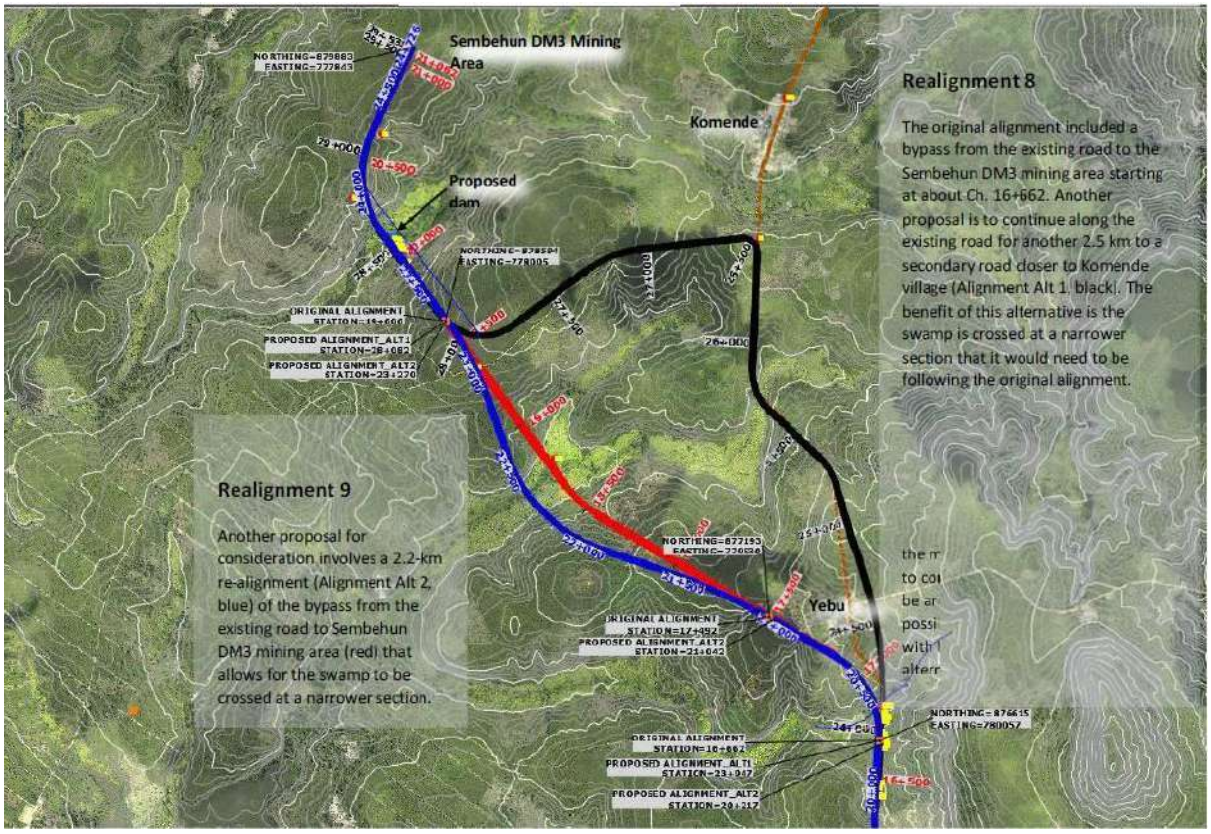
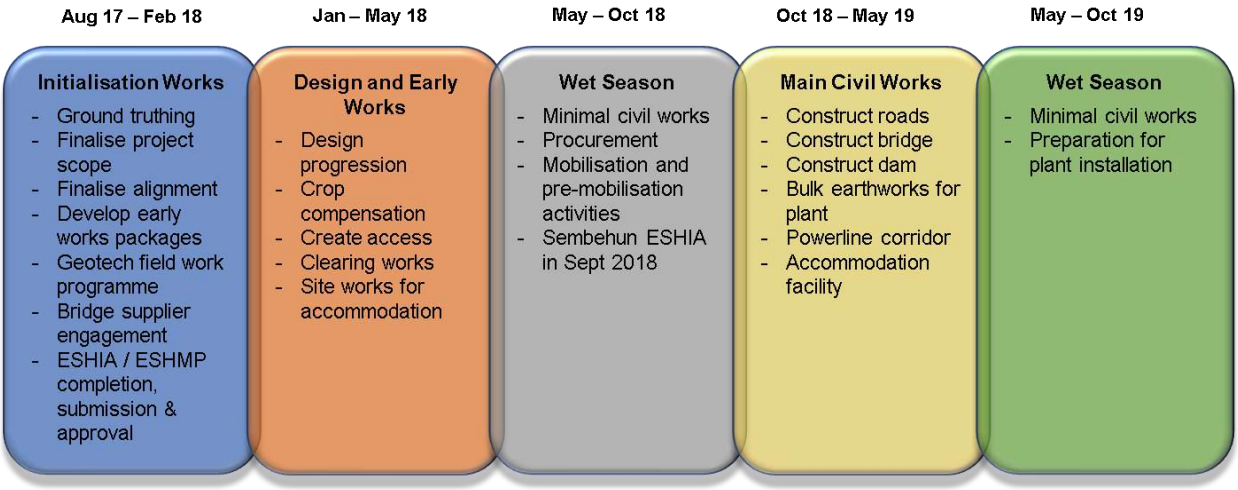


Figure 2.2-7: Map showing the three alternatives for the diversion from the existing road to the Sembehun DM3 site (Alternative 2 in blue is preferred)

2.3 Planning and Construction Phase

The project schedule for the road construction and power transmission line works is as follows:



The stages outlined in the schedule can be broadly divided into early works (pre-construction) and construction phases.

2.3.1 Early Works Phase

This section describes the initialisation works; design and early works; as well as wet season cells in the figure above (from August 2017 – October 2018). This phase will include a number of activities such as finalisation of the road design, completing the feasibility, environmental and social studies (this study), developing tenders for the construction contractors for both the road and power transmission line and awarding the contracts; planning for mobilization; road demarcation; vegetation clearing; transportation of materials to site, etc.

Currently the necessary hydrology and geotechnical studies are being conducted, as well as the ongoing ESHIA study.

Once these work streams have all been completed; the necessary licences acquired; and the construction contractor assigned; the site preparatory activities will commence and be inclusive of vegetation clearance and the stripping of topsoil in preparation for stable foundations. It is planned for this early work to commence in the first quarter of 2018.

The locations for work camps, equipment maintenance and storage sites, borrow and spoils sites will be determined during the first quarter of 2018. Temporary facilities including sanitary facilities for workers, work yards, etc. will be set up and construction materials and equipment transported to site.

2.3.2 Construction Phase

The construction phase is anticipated to start during the second quarter of 2018 and end in 2019. During this phase, a number of activities will be carried out in relation to the road and bridge construction, as well as the installation of the transmission line and related infrastructure (transformers and switch-room).

The workforce will comprise full-time and part time construction workers, totalling roughly 200 people. Some of the main activities to be carried out during this period include the following:

2.3.2.1 Base Camps and Other Worksite Areas

The contractor will establish a main construction base camp and may also establish smaller advance camps at other strategic locations. The contractor will make arrangements to use land, probably through the local authorities and Chiefs. When the construction works have been completed, base camps and other areas used temporarily by the contractor, will be decommissioned, involving the removal of all structures, equipment and machinery.

2.3.2.2 Creation of Right of Way

Trees and vegetation will be cleared within the right of way for the road construction and transmission line, in addition to new clearing particularly so in areas which fall outside the existing route. Vegetation clearance will also be undertaken along the length of the existing road in order to widen the right of way. This will make room for the movement and operation of equipment and machinery. In relation to the transmission line segment of the right of way, trees and vegetation must be permanently removed, from the roots, to prevent trees re-growing and reaching a height that could grow into the transmission lines.

2.3.2.3 Earthworks

This includes excavation or cutting, using earth moving equipment (bulldozers, excavators, etc.). Where rocks or boulders that cannot be ripped are encountered, drilling or some controlled blasting may be required.

2.3.2.4 Establishment of Borrow Pits

Borrow pits will be opened adjacent to the road, along the length of the route in order to supply suitable base material for the road. Materials available from within the road reserve may be approved for utilization as borrow material for fill, subject to it meeting the required specification.

The exact locations and number of borrow pits required, will be determined after a detailed geotechnical study has been completed in the first quarter of 2018.

Limited drilling and blasting may be required in certain locations depending on the rock encountered. Explosives storage magazines will be established in secured locations and will

comply with legal and international best practice standards. Blasting will be designed in a manner to mitigate vibration.

2.3.2.5 Establishment of Spoils Sites

Spoils sites for the disposal of unwanted road materials will be identified and maintained. Material which can be re-used on-site, but which cannot be directly re-placed will be stored in designated stockpile areas on-site.

The construction contractor will identify storage areas prior to commencement of construction in each area primarily to ensure that disturbance to local residents is minimised, local amenity is maintained, and to protect receiving waters from potential runoff. These will be determined during the early works phase.

2.3.2.6 Road Construction

Following the stripping of topsoil and unusable materials, haul road construction involves the creation of several layers which have specific functions in the road design:

2.3.2.6.1 Sub-Grade Layer

This is the naturally occurring in-situ material which remains after unsuitable material has been stripped away, on which the road is built. Soft in-situ material must be protected with thicker subsequent layers to prevent deformation and displacement during road use, which inevitably leads to the creation of potholes and ruts. Calculations during the structural design phase will inform on the required protection for this layer to prevent premature failure.

2.3.2.6.2 Fill

Sometimes also referred to as sub-grade, fill is often used if the in-situ material is not level, in order to create a level construction surface before road-building starts. Once the in-situ or fill is level (or 'on-grade') and the cross-sectional shape or 'road-prism' is established, the road building can commence.

2.3.2.6.3 Sub-Base

This is the layer above the sub-grade or fill layer. The sub-base provides a working platform upon which overlying layer works can be compacted. The material used to create this layer is generally harder than the sub-grade / fill material but softer than the subsequent base layer. In some design methods, the sub-base and base layers are combined.

2.3.2.6.4 Base

This is the layer immediately below the wearing course. It is important because it 'protects' the softer material below (in much the same way as the sub-base) from the loads imposed by the vehicles and trucks running on the wearing course.

2.3.2.6.5 Wearing Course / Sheeting

This is the layer of material on the top of the road - also called surfacing or sheeting. For mine roads it is often an (unbound) gravel mixture. The safety and efficiency of the road can be affected by the choice of sheeting material which can result in issues such as becoming slippery when wet and high dust levels when dry.

2.3.2.7 Road Construction Equipment

Various types of machinery and equipment are used in road construction. Some major types of equipment include:

2.3.2.7.1 Dozers

Used primarily for ripping and shaping sub-grade / in-situ layer. It is also used to shape the material on which the road is built through removal of oversized rocks, ripping the material loose if required and grading.

2.3.2.7.2 Compaction Equipment

Compaction involves a large steel drum vibrating roller, impact (or grid roller), needed to shake the layers down, interlock the material, increase their density and ultimate strength. A large vibratory roller (230kN vibratory force) can assist in layer compaction - especially gravelly material, fill, sub-base, base and wearing course.

2.3.2.7.3 Grader

A grader is used during construction to open and spread layer works material prior to compaction and re-shape layer works following compaction.

2.3.2.7.4 Water Truck

The water truck is very important, especially during compaction of the (non-rocky) layer works. It is used to apply water to the loose material being compacted and also maintain dust levels within the operating areas.

2.3.2.8 Bridge Construction

A bridge will be constructed across the Gbangbaia River crossing between Moselolo and Mosama. Accumulated sediments and clay layers may be removed before foundations are installed to ensure the long-term stability of the structure.

Other activities related to the bridge construction may include but will not be limited to:

- Piling (driving of piles to into the river bed to support the bridge. Piles will be made of steel or concrete);
- Construction of pile caps;
- Construction of piers;
- Construction of abutments, and

- Construction of superstructures including parapets, bridge bearings, expansion joints, etc.

Pending finalised designs, a second smaller bridge may be required north-east of Gbangbatok along the new bypass road of Gbangbatok. Similar activities as described above will be undertaken, albeit at a smaller scale. The coordinates of this potential smaller bridge is Latitude 7.807811177 degrees and Longitude -12.381709622.

2.3.2.9 Power Transmission Line Installation

Following the decision on the characteristics and design of the transmission line to be used, construction will follow the following broad phases:

2.3.2.9.1 Clearing of Transmission Line Corridor

This involves clearing or trimming of trees and vegetation along the transmission line corridor where necessary to allow equipment access to the work site and enough clearance for the reliable operation of the line. The transmission line route will mostly follow the existing and new haul road alignment, except near the Area 1 power station, where the power transmission line will deviate from the existing haul road for approximately 2 km, where additional vegetation (~ 20 meters wide) will be required.

When construction is complete, disturbed areas will be restored and native shrubs and ground cover allowed to re-grow. However, species of trees that may affect the transmission line operations must be permanently removed. These include trees likely to grow into or rest on the transmission lines.

2.3.2.9.2 Preparation of Work Area

Construction vehicles and other large equipment must be able to access the location of each structure that will support the transmission lines. Short access roads or paths to areas which fall outside the haul road right of way will be created. Large level work areas (approximately 40 meters by 30 meters), called crane pads, will be created to stabilize equipment, such as drill rigs and cranes.

2.3.2.9.3 Foundation Installation

Foundations will be drilled for the new powerline poles. The design of the foundations was under investigation at the time of compilation of this report, but would be informed by the relevant international standards, as well as incorporate information obtained from the geotechnical investigation. Generally, the construction of foundations involves drilling holes, which are then typically filled with concrete for structure foundations. Drilling operations occur for a few days at each new structure location. Once drilling is complete, a steel rebar cage is placed in each hole and concrete is poured to create a secure foundation for the new steel or lattice structure. Concrete trucks are used to deliver the concrete mix for the foundations.

2.3.2.9.4 New Structure Installation

Once the foundation is cured, transmission structure installation can begin. Steel poles often come in sections that are assembled on or near the foundation. Cranes and/or bucket trucks are used to lift the poles and set them into position on the foundations. The power line will consist primarily of poles of a suitable height and material to support the required conductors and achieve the minimum ground clearances.

The structure components are delivered to the transmission corridor well in advance of this installation process. Generally, it takes one to three days to assemble and erect each new structure. After installation, the structure is grounded for safety purposes.

With the new structures in place, the next step is to install the wire (conductor) and fibre for internet connectivity. The wire-stringing operation requires equipment at each end of the section that is being strung. Wire is pulled between these "pulling sites" through stringing blocks (pulleys) at each structure. These pulling sites are set up at various intervals along the transmission corridor, typically one to three miles apart. Specific pulling sites are determined close to the time the stringing activity takes place. Once the wire is strung, the stringing blocks are removed, and the wire clipped into its final hardware attachment.

2.3.3 Waste Management

Waste generated during this phase will typically consist of domestic (including waste water / sewage) and construction type wastes.

2.3.3.1 Construction Wastes

Construction wastes will include waste materials from the road construction and the transmission line installation. These may consist of unusable / excess soils, scrap materials (wood, metal, etc), packaging (cement bags, cardboard, plastics, etc), and excess materials (e.g. concrete). The following principles will be applied in the management of construction wastes:

- Waste avoidance: Minimising the amount of material that needs to be generated and managed from the road design stage. For example, adjusting the road alignment to avoid cut areas that require extensive excavation. It could also be through careful calculation of materials needed to prevent unusable leftovers;
- Resource recovery: Where excess excavated material is generated, re-using the material onsite first before considering beneficial re-use locations outside of the Project area. This reduces the need to import materials onto the site, reduces the need to find off site re-use or disposal locations and the associated materials handling and transport issues, reduces fuel use and minimises the project footprint, and
- Disposal: Disposal is the last and least preferable management option to be considered. Excess excavated material will be backfilled into the borrow pits. Other construction wastes not suitable for final disposal / backfilling into the borrow pits, will be disposed to the SRL Area 1 landfill.

2.3.3.2 Domestic Wastes

Domestic waste will be managed through the provision of suitable waste bins at the construction camps and all waste will be transported to the SRL Area 1 landfill for disposal.

Wastewater will be generated, including sanitary wastewater, equipment wash water and storm-water runoff. Sanitation facilities will be set up for workers and will cater for sewage management.

Equipment wash water will be directed into soak-away pits.

2.3.4 Utility Requirements

2.3.4.1 Water

The contractors will require substantial volumes of water for various construction purposes such as adjustment of moisture content of fill, road sub-base and base courses, and watering of haul routes to suppress dust.

Water for potable and sanitation purposes will be sourced from SRL's water reservoir / water treatment plant at Area 1. It is probable that some of the contractor's water requirements for construction purposes will need to be met by abstraction from watercourses.

2.3.4.2 Electricity

Diesel generators (50 KVA) will be used during the construction phase to provide lighting at the construction camps, work sites, storage areas, etc.

2.3.4.3 Fuel

Fuel storage sites will be set up at specific locations along the route for re-fuelling of vehicles and machinery.

2.3.5 Employment, Labour and Working Conditions

SRL has a high standard of commitment to its human resources and therefore observes all the national labour laws of Sierra Leone, as well as applicable international policies. It has a Human Resources Department that is responsible for the acquisition, maintenance and development of a large multinational workforce. The current workforce strength is approximately 1,800.

SRL is a member of the Mining Trade Group Negotiating Council which comprises representatives of all the mining companies in Sierra Leone. At three-yearly intervals, the Mining Trade Group Negotiating Council negotiates with the United Mine Workers Union (UMU) for working hours, salaries and leave entitlements for employees below supervisory level (plant staff) in all member companies of the Mining Trade Group Negotiating Council in the country. Also at three-yearly intervals SRL makes a Side Agreement with the Branch Executive of UMU for sundry allowances and overtime for employees below supervisory

level. The current Collective Bargaining Agreement between the Mining Trade Group Negotiating Council and the UMU became effective in 2016 and will expire in 2019.

SRL has a well-developed OHS management system in place which conforms to Sierra Leone's legislative requirements, as well as to various international standards. The contractor will be required to conform to these standards at all times.

2.3.5.1 Training and Supervision

The contractor shall ensure that no person is employed on any operation unless:

- The person has sufficient knowledge of and experience in the type of operation being conducted; or
- The person is being adequately supervised and trained by a person with sufficient knowledge of and experience in the type of operation being carried out and the person has been adequately instructed as to the dangers likely to arise in connection with that particular quarrying operation and the precautions to be taken against those dangers.

2.3.5.2 Lights and Lighting

Approved lighting shall be provided in all inside working places where natural lighting is inadequate to provide safe working conditions and in all places in the surface workings where work is carried out during the hours of darkness.

2.3.5.3 Personal Protective Equipment

The contractor shall supply to each construction worker Personal Protective Equipment (PPE) including hard hats; safety boots; high visibility long sleeve shirts or high visibility vests to be worn over long sleeve shirts; long pants / overalls; and safety goggles. Where required for specific jobs, safety gloves, dust masks and hearing protection will be provided.

When working in streams and rivers, workers shall be supplied with life jackets and be secured to the bank by safety harnesses.

2.3.5.4 Machinery and Equipment

All equipment, machinery and tools used in the construction activities shall be maintained to be in a safe condition.

All elevated platforms, walkways, and ladder ways shall be provided with adequate handrails and kickboards, unless otherwise proved.

Machinery shall not be cleaned or oiled manually while it is in motion, unless the oiling points are completely guarded from all moving parts.

2.3.5.4.1 Operation of Machinery and Equipment

No worker shall drive or operate any vehicle or machinery unless:

- He / she is the holder of a current appropriate motor driver's license, and

- He / she has demonstrated to the manager or to some competent person appointed in writing by the manager, by a thorough practical test, their ability to drive / operate vehicles / machinery and that they have the manager's written authority to do so.

At the commencement of each shift, the controls and safety attachments of vehicles / machinery shall be examined by the operator, who shall immediately report any defect to the project manager.

2.3.5.5 OHS Issues Specific to Transmission Lines Construction and Installation

In addition to the general OHS measures to be implemented, the following measures will be taken in respect of the construction and installation of the power transmission infrastructure:

2.3.5.5.1 Working at Heights

Every employee working at a height greater than two metres above the ground surface, shall be attached at all times to a properly secured stationary object by means of a safety belt or other approved appliance. The provisions of the SRL working at heights management system shall be followed at all times.

2.3.5.5.2 Confined Space Entry

Every employee who descends into any bin, hopper, or stockpile cavity shall be attached at all times to a properly secured safety rope by means of a safety belt; harness or other approved appliance, and shall at all times be attended by a second person in a safe place who shall ensure that the safety rope is properly secured and that there is no unnecessary slack rope. The provisions of the SRL confined space management system shall be followed at all times.

2.3.5.6 Exposure to Chemicals

Chemicals and hazardous substances utilised during the construction phase will be subject to precautions of use and protection as specified by the relevant Safety Data Sheets (SDS's) and shall be stored and disposed of in a manner consistent with SL regulations. If no approved disposal facility is available, such chemicals and hazardous substances will be appropriately stored (adequate bunding; security; prevention of rainwater ingress etc.) until such a time when suitable disposal methods become available.

2.3.5.7 Suppression of Dust

The Contractor shall make provision for preventing or minimising dust and its related health and safety impacts.

The provisions shall be such as to supress the dust by the use of water delivered from sprays or jets or other effective methods.

2.3.6 Community Health and Safety

The construction and operation of the haul road and transmission line may result in several community health and safety issues including:

- Increased traffic in the affected communities which will increase the probability of road traffic accidents;
- Dust generation from increased vehicular traffic which will pose a threat to the health of the community members;
- Influx of employees, job seekers, and other new residents could result in the spread of diseases, including Sexually Transmitted Diseases (STDs) and HIV/AIDS;
- Influx of the people into the affected communities may encroach on the limited socio-economic facilities in the affected communities, thus placing additional strain on socio economic infrastructure and services, and
- Increased noise levels due to the increased movement of construction trucks, machinery and equipment in communities.

The ESHMP outlines mitigation measures in to be implemented in respect of community health and safety, livelihoods restoration, and community awareness and education programmes. The management of these elements of the project will remain the responsibility of SRL and will be funded through operational capital.

The CDAP includes a programme and budget to support community initiatives such as education support, which will be identified by the SRL Community Development Committee (CDC).

The PCDP requires regular meetings with and awareness / sensitization programmes for communities on issues pertaining to their health and safety including road safety; STDs; HIV/AIDS; teenage pregnancy; and other relevant issues. This will be managed as part of the EHSMP.

2.4 Operations Phase

2.4.1 Haul Road Operations

The road operation is projected to start in mid-2020. The road will be used for trucking HMC from the Sembehun (DM3) mine site to the Area 1 MSP for processing. Trucks will range from 19 m semi-trailers to 27.5 m B-doubles. It will also cater for lighter vehicles – SUVs, cars, motorbikes and some pedestrian traffic.

During the operational life of the haul road, it will be subject to constant wear and tear from the movement of vehicles and machinery and environmental conditions. This may result in surface deterioration, excessive dust generation and road safety concerns such as reduced tyre traction when wet, as well as accelerated tyre wear. To prevent these and other potential problems which may occur during day to day utilisation of the road, the following measures will be put in place:

- Dust suppression;

- Clearing of culverts and trenches of rubbish and silt;
- Regular inspections of the road surface condition, and undertaking repairs where necessary;
- Regular inspections of the wearing course, and
- Routine maintenance condition surveys.

2.4.2 Transmission Line Operations

Periodic inspections and required maintenance will be conducted throughout operations on the following:

- Conductor condition;
- Conductor sag and clearance to ground, trees, and structures;
- Insulator conditions;
- Line hardware for roughness and tightness. Excess inhibitor found should be removed from conductors to prevent corona discharges;
- Structure vibration and alignment;
- Guys for anchors that are pulling out, guy wire conditions, and missing guy guards;
- Ground-wire connections and conditions;
- Ground resistance;
- Structure footings for washouts or damage, and
- Obstruction light operations for aircraft warning.

2.4.2.1 Exposure to Live Power Lines

All work on live power lines shall be subject to SRL's isolation procedures.

Prevention and control measures associated with power lines include:

- Only trained and qualified technicians will be allowed to work on the construction and installation of the power lines. Such qualified technicians will be able to:
  - Distinguish live parts from other parts of the electrical system;
  - Determine the voltage of live parts;
  - Understand the minimum approach distances outlined for specific live line voltages, and
  - Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system.
- Workers not directly associated with power transmission and distribution activities who are operating in the vicinity of the power lines, will be made aware of and be required to adhere to local legislation, standards, and guidelines relating to minimum approach distances for active transmission line work areas.

2.4.2.2 Exposure to Electric and Magnetic Fields

Electric utility workers typically have a higher exposure to Electric and Magnetic Fields (EMF) than the general public due to working in proximity to electric power lines. Occupational EMF exposure will be prevented or minimized through the preparation and implementation of an EMF safety program to be prepared by the construction contractor including the following components:

- Identification of potential exposure levels;
- Training of workers in the identification of occupational EMF levels and hazards, and
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers.

3 ANALYSIS AND COMPARISON OF PROJECT ALTERNATIVES

3.1 Introduction

In accordance with current ESHIA good practice, it is appropriate for the ESHIA to review alternatives considered during planning of the project, and to explain why the proposed project activities have been selected, including any environmental, social and health considerations. The aim is to establish whether there are reasonable alternatives which could be pursued which meet the project's objectives with less impact on the environment, and if there are, to explain what other factors determined the choice of proposal.

Analysing the project alternatives / options helps in assessing those key elements that would give the best environmentally, socio-economically and technologically feasible options for the project, within the context of an ESHIA and in terms of various advantages of the alternatives compared to each other.

The alternatives for this project are multifaceted. They relate to SRL's mining operation in its entirety while the haul road and the transmission line projects are separate entities.

If mining at Sembehun were not to proceed, the positive effects of SRL's mining operation on the local and national socio-economic situation would be discontinued. If mining of the Sembehun deposits were to proceed, road access to the current operations in the Southern part of its MLA (Area 5), becomes mandatory. Access to power from its 25MW power station at the Area 1 plant site for the Sembehun operation also becomes mandatory. This analysis will therefore dwell on the alternatives for providing road access and access to power as well as the "No Project" alternative.

3.2 The "No Project Option"

This option for the road will mean that the access from the Area 1 plant site to Sembehun will be by one of two alternatives:

- Option 1: this would involve using the existing road to Sembehun through Gbangbatoke and essentially stopping at the Gbangbaia River. Personnel will only be able to cross to the Sembehun side of the Gbangbaia River by boat, where separate transportation would need to be provided from Moselolo to the Sembehun mine site. Compounding to the difficulty of this option, the roads on either side of the river are in a poor state. This option would make it near impossible for the Sembehun mine to operate efficiently and be serviced from the Area 1 plant site.
- Option 2: this requires using a long route through Mokanji to Sembehun. This distance is approximately twice as long as the route through Gbangbatoke and across the Gbangbaia River. Apart from the length of this route, the road is also in a very poor state and passes through several settlements, posing road safety danger from haulage trucks to those communities.

In relation to the transmission line, the no project option would mean constructing a new power station at Sembehun. The costs, environmental and social effects, as well as the non-utilisation of the existing power house at the Area 1 plant site, will result in significant costs for SRL. An alternative route for the transmission line as different from the haul road alignment cannot be environmentally or economically justified as it will mean double or more environmental and budgetary impacts.

3.3 Choice of Road Alignment

Three road alignment options were considered as described in section 2.2 Proposed Road Alignment:

- Initial Proposed Route: involved largely following the existing road between Gbangbatoke and Sembehun. This presented issues with the haul road running through several communities and crossing numerous rivers and swamps;
- Alternative 1: This option bypasses all communities preventing the need for the physical displacement of communities and/or households. It also takes advantage of the shortest distances across watercourses for the installation of culverts and a bridge, and
- Alternative 2: This option involves bypassing most of the communities between Gbangbatoke and Sembehun, but still passes through a few. The shortest distances across watercourses are also considered in this option.

The ESHIA concluded that the preferred alternative would be Alternative 1, although longer (at 29.5 km) than the two alternatives, presents less environmental and social impacts, and by extension, cost implications, than the other two options.

3.4 Operational Options

Other options considered to optimise mining operations in lieu of constructing the haul road using the Gbangbatoke route and constructing a bridge are as follows:

- Alternative 1: Utilising pumping or conveying to transport HMC from Sembehun to the Area 1 MSP, and
- Alternative 2: Expanding and refurbishing the existing road through Mokanji to Sembehun.

Alternative 1 can be discounted as pumping and conveying will also present environmental and safety challenges. Furthermore, the project is still required to address the difficulty of access to Sembehun by personnel and machinery, as well as power line requirements. Alternative 2 can be discounted on the basis of costs and environmental and social impacts.

The power line alternatives would logically mirror those for the road on the basis of constructing the line and servicing it. Overhead lines are also the preferred option above the use of underground lines in terms of construction and maintenance requirements as well as savings in energy losses.

3.5 Conclusion

Many of the adverse environmental and social impacts related to the project will be short-term and reversible. These adverse impacts can be adequately controlled, provided that the recommended mitigation measures are adopted. Long term positive changes such as the improved infrastructure, will be permanent.

It is concluded that the "No Project" alternative is inappropriate, and that the potential social and socio-economic benefits of project implementation far outweigh the potential adverse impacts on the environment, all of which can be controlled and minimized to an acceptable level.

4 POLICY, LEGAL, REGULATORY AND INSTITUTONAL CONTEXT

4.1 Policies and Plans

4.1.1 National Environmental Policy (1994)

The National Environmental Policy seeks to achieve sustainable development in Sierra Leone through the implementation of sound environmental management systems which will encourage productivity and harmony between humans and the environment. It also promotes efforts which will prevent or eliminate damage to the environment and biosphere; stimulate the health and welfare of nationals; and serves to enrich the understanding of ecological systems and natural resources important to the Nation. Thus, the key objective of the Policy is to secure for all Sierra Leoneans a quality environment that can adequately provide for their health and well-being.

The Policy takes into consideration major sector goals and policies for enhancing sustainability in environmental management systems. The following sectoral policies are highlighted within the National Environmental Policy:

- Land Tenure, Land Use and Soil Conservation;
- Water Resources Management;
- Forestry and Wildlife;
- Biodiversity and Cultural Heritage;
- Air Quality and Noise;
- Sanitation and Waste Management;
- Toxic and Hazardous Substances;
- Coastal and Marine Resources;
- Working Environment (OHS);
- Energy Production and Use;
- Settlements, Recreational Space and Greenbelts;
- Public Participation;
- Quality of Life;
- Gender Issues and the Environment;
- Institutional and Government Arrangements, and
- Legal Arrangement.

Subsequent to this Policy, the SLEPAA (2008) was promulgated. (Refer to Section 4.2.1.)

4.1.2 National Energy Policy (2009)

The National Energy Policy serves as a Policy instrument for the development and more efficient management of the country's energy sector. The main goals of the Policy are as follow:

- To produce on a sustainable basis, adequate modern energy supply to meet the development aspirations of the country;
- To provide electricity at affordable prices everywhere in the country;
- To ensure uninterrupted supply of petroleum products throughout the country at affordable prices;
- To provide environmentally friendly, affordable household energy on a sustained basis, and
- To develop indigenous fossil and renewable energy sources for the country.

4.1.3 SL Energy Sector Roadmap

The Sierra Leone Energy Policy statement related to the project is as follows:

- The GoSL will explore all avenues to ensure reliable power supplies to all energy demand sub-sectors;
- GoSL will establish an adequate and transparent, legal and regulatory framework in a Reformed Power Sector structure that is conducive to private sector participation in the development of the energy sector;
- GoSL will encourage the entry of multiple players into the generation and distribution market. Generation and Distribution of electric power shall be fully open to private and public investors as Independent Power Producers;
- GoSL will develop a national grid that will extend the transmission line throughout the country, and to the sub-region;
- GoSL will undertake the development of mini/micro hydro sites and other renewable energy technologies, through public/private partnership arrangements, and
- GoSL will encourage and consider proposals by local authorities to provide and distribute power and will propose parameters for local governments.

4.1.4 National Lands Policy (2015)

The Land Policy of Sierra Leone aims at the judicious use of the nation's land and all its natural resources by all sections of the Sierra Leone society in support of various socio-economic activities undertaken in accordance with sustainable resource management principles and in maintaining viable ecosystems.

In specific terms, the objectives of this Policy are to:

- Ensure that every socio-economic activity is consistent with sound land use practices through sustainable land use planning in the long-term national interest;
- Ensure the payment, within reasonable time of fair and adequate compensation for land acquired by government;
- Provide laws that will protect citizen's right to land against Government, and
- Instil order and discipline into the land market to curb the incidence of land encroachment, unauthorized development schemes, multiple or illegal land sales, falsification and multiple registration of land documents, land speculation and other forms of land racketeering.

For the purpose of sustainability of land use, it is stipulated in section 4.4 of the Policy, that:

- Inland and coastal wetlands are environmental conservation areas and activities considered incompatible with their ecosystem maintenance and natural productivity are strictly prohibited, and
- All land and water resources development activities must conform to the environmental laws in the country and where Environmental Impact Assessment report is required this must be provided. Environmental protection within the 'polluter pays' principle will be enforced.

4.1.5 Road Safety Policy

The overall road safety goals of the Road Safety Policy are:

- To reduce the number of accidents, fatalities and injuries in road traffic;
- To put in place effective road safety management and coordination functions;
- To bring in place the necessary legal, policy, administrative and financial foundation for road safety interventions;
- To establish systems and analysis tools providing reliable and timely statistical information about road traffic accidents, which can form the basis for qualified decisions on road safety interventions;
- To bring into place cost effective road design and maintenance procedures that consider all road users, minimise road user error (self-explanatory roads) and produce a more forgiving roadside;
- To improve safe road user behaviour through increased awareness of traffic regulations and accident risks, and
- To improve the competence of drivers and in particular to produce safety conscious drivers through training and testing standards.

4.1.6 Forestry Policy (2010)

The Forestry Policy support relevant provisions of the Constitution which permits restrictions on activities within forests which are reasonably required in the interests of conservation of the natural resources, the respect for international law and treaty, obligations, as well as the seeking of settlement of international disputes by negotiation, conciliation, arbitration or adjudication.

This Forestry Policy also supports strategies outlined in the Framework for Effective Management of Natural Resources.

4.1.7 National Biodiversity Strategy and Action Plan (2003)

The action plan proposed in the Sierra Leone Biodiversity Strategy and Action Plan comprises a series of measures and mechanisms intended to conserve and promote the sustainable use of the different components of the country's biodiversity. The action proposed covers several key thematic areas under: terrestrial biodiversity, inland water ecosystems, forest biodiversity, marine and coastal biodiversity and agricultural biodiversity.

This Action Plan is intended to:

- Provide a framework for setting priority policies and actions for the conservation and sustainable use of biological diversity in Sierra Leone;
- Catalyse and provide guidance for legal policy and institutional reforms necessary to achieve effective conservation and sustainable use of biological diversity;
- Enhance the planning and co-ordination of national efforts aimed at the conservation and sustainable use of biological diversity;
- Guide the investment and capacity building programmes for the conservation and sustainable use of bio-diversity, and
- Facilitate information sharing and coordinated action among the various stakeholders at the national level and foster scientific and technical cooperation with other countries and international organisations.

4.1.8 Conservation and Wildlife Policy (2010)

The Conservation and Wildlife Policy was developed in recognition that the previous Wildlife Conservation Policy was in need of modernisation. Current legislation based on the *Wildlife Conservation Act (1972)* (as was the case of the previous Wildlife Conservation Policy) does not reflect the advances made in biodiversity conservation in the past four decades; it also does not take into account international obligations that arose after its entry into force, such as the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species (CITES) and the United Nations Framework Convention on Climate Change (UNFCCC). The Conservation and Wildlife Policy identifies that challenges to biodiversity conservation in Sierra Leone result from a lack of knowledge due to “recent conflict, land use change, uncontrolled exploitation of natural resources, and a lack of recent comprehensive inventory". The vision of the Policy document is to establish “an integrated wildlife sector that achieves sustainable, rights-based management of wildlife resources for biodiversity conservation inside and outside wildlife conservation areas which benefits present and future generations of Sierra Leone and humankind in general.” The Policy presents a plan for biodiversity conservation based on a set of “Policy Statements” outlining concrete Policy goals and develops the necessary institutional arrangements for Policy implementation.

4.1.9 Disaster Management Preparedness Plan (2006)

As part of its post-war recovery effort, the GoSL reviewed its National Security Structure to meet the demands of the 21st century. This led the Government to enact the *National Security and Central Intelligence Act* in 2002 thereby mandating The Office of National Security to be ‘the Government of Sierra Leone’s primary Co-ordinator for the management of national emergencies such as disasters both natural and man-made’.

The disaster Management Plan, 2006 is a comprehensive approach that enhances increased political commitment to disaster risk management, thereby encouraging government agencies to take the lead and supported by non-governmental organisations. It also promotes public awareness and the incorporation of disaster risk management into development planning. The

Policy highlights the sources of funding and the reduction of bureaucracies in accessing such funds for effective disaster co-ordination.

The Policy document emphasizes the following:

- Ensure the integration of disaster risk management into sustainable development programmes and policies to ensure a holistic approach to disaster management;
- Ensure priority and requisite institutional capacities for disaster risk reduction at all levels;
- Enhance the use of knowledge, education, training, innovation and information sharing to build safe and resilient societies;
- Improve the identification, assessment, monitoring and early warning of risks, and
- Improve effectiveness of response through stronger disaster preparedness.

4.1.10 Land Tenure and Ownership

Land administration in Sierra Leone is governed by a dual system of law, dispersed in about twenty statutes and regulations, including:

- In the Western Area of Sierra Leone, land tenure is governed by Property Statutes. Land is either State (publicly) owned or privately owned. The right of the state to public land is inalienable and indefeasible. Rights of occupation over public land may be granted under warrant. The state has the power, conferred by the *Unoccupied Lands Act (Cap 117),* to take possession of unoccupied land, and
- In the provinces, customary law co-exists with statutes. The recognition of the force of customary law in the provinces is established by section 76 (1) of the *Courts Act (1965).*

Through customary law, ownership of land is vested in the Chiefdoms and communities; and can never be owned freehold. Land always belongs to the communities under the different forms of tenure under customary law. This principle is established by the *Chiefdom Councils Act* as well as by Section 28 (d) of the *Local Government Act (1994).*

4.2 Legislation

Legislation governing environment issues are found as Acts enacted in Parliament. The legislation of the various government line Ministries or institutions include the following.

4.2.1 Sierra Leone Environment Protection Agency Act (2008 / 2010)

The SLEPAA (2008) is the GoSL's overarching legislation that deals with the protection of the environment. The EPA was established with a Board of Directors set up as its governing body. The control and supervision of the Agency is the responsibility of the Board, which acts in liaison and co-operation with other government agencies.

The general administrative functions of the Board as stipulated by the *SLEPAA (2008)* include the following:

- Promoting effective planning and the management of the environment;

- Coordinating and monitoring the implementation of national environmental Policies relating to Sierra Leone;
- Providing Policy guidance and advice to ensure the efficient implementation of the functions of the Agency so as to enhance its overall performance;
- Facilitating cooperation and collaboration among Government Ministries, local authorities and other governmental agencies, in all areas relating to environmental protection, and
- Coordinating environmentally related activities as well as serving as the focal point of national and international environmental matters, relating to Sierra Leone.

Part IV of the *SLEPAA (2008)* exclusively deals with the activities and requirements of an EIA. This part of the Act emphasizes the processes and procedures leading to the acquisition of an environmental licence with respect to the conduct of fully acceptable EIA studies. It further stipulates the duties and obligations of both the environmental licenses' holder and the Board of Directors in the event that an environmental license is granted.

The 2010 amendment focused on the duties and responsibilities of the EPA.

4.2.2 Sierra Rutile Agreement (Ratification Act) (2002)

The Act was passed to ratify the agreement between the GoSL and Sierra Rutile. The Act outlines the terms and conditions of the company's mining lease, prospecting licence and other related issues. It also highlights their rights and obligations as a mining company. This includes the right to carry out accessory works and installations:

"Subject to the provisions of sections 40 and 61 of the Minerals Act, the Company shall have the right to construct and operate within the Prospecting Area or Mining Lease Area, roads, buildings, plants, structures, living quarters, water supply systems, pipelines, communications systems, electric power systems, ship loading stations, airstrips, barge channels, storage facilities and other similar accessory works and installation which are necessary or useful in carrying out its operations under this Agreement".

4.2.3 The Sierra Leone Roads Authority (Amendment) Act (2010)

This Act amends the *Sierra Leone Roads Authority Act (1992)* and governs the development, maintenance, efficient planning and reliable management of the national road network to provide the entire country with a safe, reliable and sustainable means of transport. In order to attain set objectives, the Authority will:

- Develop a national Policy on the management of the national road network;
- Specify the national road network and sets the width of the right-of-way for roads which form part of the national road network;
- Develop strategies, technical instructions and standards, programmes for roads;
- Commission location and design studies and preparation of construction plans and also erect and maintain traffic signs on roads;
- Provide technical guidance and support to local councils in roads maintenance, and
- Carry out any other such activities as may be required under this Act.

4.2.4 The Road Transport Authority Act (1996) (Amended to the Roads Safety Authority Act (2016)

This Act establishes the Road Transport Authority (now the Sierra Leone Roads Safety Authority (SLRSA)) for the regulation and development of the road transport industry including the registration and licensing of vehicles, licensing of drivers, prescription of routes for passenger and goods transportation, and other related matters.

The objectives of the Authority include regulating, coordinating and promoting efficiency in all activities within the road transport sector with a view to enhancing or improving the contribution of the sector to the economic development of Sierra Leone.

The Authority shall design, develop and administer rules and regulations regarding:

- The registration and licensing of private and commercial vehicles;
- The testing of vehicle fitness for their intended use and fitness of persons to be drivers of vehicles;
- Licensing of drivers, and
- Inspection and supervision of vehicle repair and maintenance services.

4.2.5 The Road Maintenance Fund Administration Act (2010)

This Act was set up to establish a fund to be known as the Road Maintenance Fund and an administration to finance the maintenance of the core road network in Sierra Leone, as well as provide for other related matters. The general functions of the administration are to:

- Manage and administer the fund;
- Approve the amount of funding to be made available to the Administration from the fund for the performance of the Administration's functions;
- Effectively monitor the use of monies allocated from the fund;
- Approve any application from any local council or body for funding from the fund, of any road-related activity, and
- Do all other things as will contribute to the attainment of the stated objectives.

The monies for the Fund shall be derived from road user charges levied on fuel; vehicle license and registration fees; road donations or grants; profits made from investments plus any other road user charges. Funds generated shall be used for road maintenance activities and any other expenditure relating to the achievement of the Authority's objectives.

4.2.6 Road Traffic Act (2007)

Sierra Leone enacted a new *Road Traffic Act* in 2007 as a way to effect a favourable road safety environment. The Act consolidates, with amendments the law relating to road traffic and deals with issues such as registration of vehicles, licencing, use of vehicles, driving test, vehicle examination and other related issues.

It outlines punishable offences by drivers and the punitive actions to be taken against defaulters.

4.2.7 Sierra Leone Electricity and Water Regulatory Commission Act (2011)

This Act serves to regulate the provision of electricity and water services and to provide for other related matters. The Commission is established is to regulate the provision of the highest quality of electricity and water services to consumers.

Functions of the commission include among other things:

- Provide guidelines on rates chargeable for provision of electricity and water services;
- Protect the interest of consumers and providers of electricity and water services;
- Monitor standards of performance for provision of electricity and water services;
- Initiate and conduct investigations into the quality of services given to consumers, and
- Maintain a register of public utilities.

4.2.8 The National Electricity Act (2011)

This Act was enacted in 2011 by Parliament to divide National Power Authority (NPA) into two entities. That is, the Electricity Generation and Transmission Company (EGTC) and the Electricity Distribution and Supply Authority (EDSA).

Main functions of management of the EDSA include the following:

- Be responsible for the supply, distribution and retail sale of electricity for the entire country except in areas which the Commission has issued a distribution licence to another appropriately qualified entity;
- Be responsible for dispatch and system control of electricity within its territory;
- Establish as far as is practicable uniform standard voltages throughout its area of supply;
- Secure the supply of electricity at reasonable prices;
- Carry on any business usually associated with electricity distribution and supply;
- Promote and encourage the economic and efficient use of electricity, especially for domestic, commercial, agricultural, industrial and manufacturing purposes, and
- Perform any other functions incidental or consequential to its functions under the 2011 Act.

4.2.9 The National Protected Area Authority and Conservation Trust Fund Act (2012)

The Act provides for the establishment of the National Protected Area Authority and Conservation Trust Fund, to promote biodiversity conservation, wildlife management and research, as well as to provide for the sale of ecosystems services in the National Protected Areas and to provide for other related matters.

The Authority is established exercises oversight authority over National Parks and Protected Areas designated for conservation purposes so as to protect the fauna and flora in its natural state, promote sustainable land use practices and environmental management.

4.2.10 The Forestry Act (1988)

The *Forestry Act*, which first came into effect on 1st July 1988, mandates the Forestry Department to take steps to ensure compliance with the provisions of the Act. It mandates the Director of Forestry or his representatives to enforce the legislation.

The following activities in a forest reserve are considered offences under Sierra Leone forest laws:

- Establishing or carrying on a forest industry in or with resources of the core forest: charcoal burning, wood cutting, hunting, stone or soil deportation;
- Clearing, cultivating or breaking up land for any reason;
- Removing soil, sand or gravel;
- Erecting a building or shelter in the core forest or its buffer zone;
- Lighting, keeping or carrying fire;
- Carrying a firearm, pasturing cattle or permitting them to trespass;
- Damaging, altering or removing any notice board, land-mark or fence;
- Assaulting or obstructing any person carrying out his/her duty under the *Forestry Act* e.g. Forest Guards, and
- Altering, defacing or obliterating any mark placed on timber by a forest officer.

The maximum penalty under the Forestry regulations is Le 5,000,000 or one-year imprisonment. Once convicted, an offender can also lose the equipment that was used to carry out the offence, as the court may order that it be forfeited to the state in addition to the imposition of a fine or term of imprisonment.

4.2.11 Fisheries Act (2007)

The *Fisheries Act* provides protection for both fresh and marine water species as classified by IUCN with the Sierra Leone water. It defines clearly where commercial vessels could harvest-Exclusive Economic Zone (EEZ) and where artisanal fisheries operations could exploit – Inshore Exclusive Zone (IEZ).

4.2.12 Wildlife Conservation Amendment Act (1990)

The *Wildlife Conservation Act, 1972* and the *Forestry Act, 1988* are the main legislation that deal with issues of biodiversity conservation in Sierra Leone. It provides for the establishment, conservation and management of National Parks, Game Reserves and other forms of Natural Reserves.

Specific provisions dealing with the protection, management and conservation of these areas and the limitations therein are highlighted in Part II of the Act and include the following:

- Prohibition of all forms of hunting, capture and other activities leading to the injury of wild animals;
- Destruction of any plant form by any means including fire;
- Fishing within these protected areas;

- Erection of structures, construction of dams, forestry, agriculture, mining or prospecting activities, and
- Introduction of species from outside of the boundaries of the reserve.

The *Wildlife Conservation Act (1972)* saw minor amendment in 1990 (known as the *Wildlife Conservation Amendment Act*), which included redefinition of terms, and other modifications and qualifications. For example, the prohibition of hunting of elephants which was limited to protected areas in the 1972 Act was extended to include all forests. The 1990 *Amendment Act* provided for change of name from Forestry Department to Forestry Division.

The Wildlife Regulations of 1997 however makes provision for the acquisition of licences or permits for hunting in such designated areas and for other purpose as may be prescribed.

4.2.13 Local Government Act (2004)

This Act deals with the establishment and operation of local councils around the country to enable meaningful decentralization and devolution of Government functions. It stipulates that a local council shall be the highest political authority in the locality and shall have legislative and executive powers to be exercised in accordance with this Act or any other enactment. It shall be responsible, generally for promoting the development of the locality and the welfare of the people in the locality with the resources at its disposal and with such resources and capacity as it can mobilize from the central government and its agencies, national and international organisations, and the private sector. The local council should initiate and maintain programmes for the development of basic infrastructure and provide works and services in the locality. A local council shall cause to be prepared a development plan which shall guide the development of the locality.

Many companies are bound to operate within areas controlled by one local council or another. There is also a relationship between the local council and the Chiefdom within which a company operates. It is advisable for companies to involve local councils in their development work. The schedules to the *Local Government Act* outline the activities of various MDAs that have been devolved to local councils.

4.3 Regulations

4.3.1 The Road Traffic Regulations (2011)

The regulations consist of the following sections:

- PART II – Registration of motor vehicles;
- PART III – Licences for motor vehicles;
- PART IV – Special trade licences;
- PART V – Driving school licence;
- PART VI – Identification number plates;
- PART VII – Motor driver’s licence;
- PART VIII – Public service vehicles;

- PART IX – Use and construction of motor vehicles;
- PART X – Driving speed limits, etc.;
- PART XI – Removal of motor vehicles;
- PART XII – Special regulations relating to driving of motor vehicles;
- PART XIII – Special provisions relating to roads, and
- PART XIV – Miscellaneous.

4.3.2 Forestry Regulations (1990)

These Regulations are deemed to have come into force on the 1st July 1990. The Chief Conservator holds the same responsibilities as he does for the Act of 1988.

Generally, community forests are managed by the Forestry Division or by agreement with the Division; it could be managed by the local government; or Community Forest Association. Based on this responsibility of the Division, no protected forest shall be tampered with in any way as is stated in section 21, subsection (2) of the *Forestry Act (1988)*, without written permission from the Chief Conservator of the forest.

As a method of environmental protection, it is stated in section 38 of part XI that no land between the high and low water marks, nor those above the high-water mark on both sides of the bank of any waterway, covering a distance of one hundred feet (approx. 33m), shall be cleared of any vegetation except permitted by a clearance licence.

Sacred bushes are protected by the stipulated regulations of section 40, whereby clearance of vegetation from land designated as sacred bush, is prohibited except by clearance authority from the Chief Conservator.

4.3.3 Fisheries Regulations

National Fisheries Regulations such as the *Fisheries Act (1988)* and *Fisheries Amendment Act (1990)* respectively, have evolved over time in order to address specific matters relating to the conservation and management of natural resources within the marine environment.

The 1994 Decree further established sufficient provisions for the conservation of marine resources. These range from monitoring, control and surveillance provisions, as well as those relating to enforcement.

The Maritime Zone (Establishment) Decree of 1996 sets the limits of the sovereignty of Sierra Leone's maritime for which the government has absolute jurisdiction, in conformity with the United Nations Convention on the Law of the Sea. Such jurisdictions may be extended over the establishment and use of installations and other structures.

Section 9 (1 &2) of the Decree, gives the government sovereign right over the Economic Exclusion Zone. They include rights for the exploitation, exploration, conservation and management of its natural resources. It further stresses the requirement for a written consent to be provided by government for any form of activities to be undertaken within this zone by states, international organizations or persons.

Other forms of empowerment as provided by the decree include controls necessary to prevent infringement as well as maintaining sanitary and environmental regulations.

The Decree also provides for specific punishments to be meted out for any breach of the regulations.

The *Fisheries Act (2007)* provides protection for both freshwater and marine species as classified by the International Union for Conservation of Nature (IUCN), within Sierra Leonean waters. It clearly defines where commercial vessels are to harvest, that is the EEZ and where artisanal fishing is to harvest that is the IEZ. It also stipulates the fishing equipment tolerable in Sierra Leone, and it also stipulates the quality and quantity of fish to be harvested.

4.3.4 Draft Wildlife Regulations (1997)

The Wildlife Regulations came in to force in 1997. It describes Wildlife Conservation Estate as areas described under the *Wildlife Conservation Act (1972)* as a National Park, Game Reserve, Strict Natural Reserve, Game Sanctuary or Non-hunting Forest Reserve. The regulation prohibits all unlicensed hunting with a Wildlife Conservation Estate, which includes the removal of honey. It prohibits the hunting of young and immature wild animals or birds; female wild animal accompanied by its young; and birds which are apparently breeding. It also prohibits hunting at night with lights to dazzle birds and animals.

The regulations stipulate that a license or permit should be sought before any form of hunting of game and bird can be done as required by Section 33 and 34 of the Act. The regulation also states that such licenses and permits can be revoked by the Chief Conservator of Forest if the holder fails to comply with the provisions of the regulations.

4.4 Institutional Context

4.4.1 The Environment Protection Agency Sierra Leone

The EPA-SL was established through the *SLEPAA (2008)* and became operational in 2009. It is the main government agency in charge of all issues concerning the environment and climate change. The EPA was established with the goal of creating and enforcing a strict regulatory framework for environmental regulation in Sierra Leone. It has the mandate to coordinate, monitor and evaluate the implementation of national environmental policies, programmes and projects, including issuing EIA licences.

4.4.2 Ministry of Lands, Country Planning and the Environment

This Ministry develops appropriate policies and programmes for lands country planning and the environment (role now limited with the formation of the EPA-SL) and carry out activities under the following major headings:

- Land and Land Tenure;
- State Lands;

- Surveys, Mapping and Triangulations;
- Relations with the Directorates outside Sierra Leone;
- Geodetic and Topographical Surveys;
- Enforcement of planning and building control;
- Demolition of unauthorized structures, and
- Collaboration with relevant Government Ministries and with national and international organisations and Institutions.

4.4.3 The Ministry of Works, Housing and Infrastructure

This Ministry is responsible for the development of appropriate policies and programmes for the improvement of public infrastructure including housing, by carrying out activities under the following major headings:

4.4.3.1 Public Works Division

This division is responsible for:

- The SLRA;
- Regulation of Civil Building and Civil Engineering Standards;
- Registration of Civil Work Contractors, and
- Sea Face Protection.

4.4.3.2 Housing Division

This division is responsible for:

- Approval of building plans and issuance of building permits, and
- Enforcement of development control of building regulations.

4.4.3.3 Infrastructure Division

This division is responsible for:

- The development of a National Infrastructure Policy in collaboration with line ministries, and
- To offer professional service advice to all ministries, departments, agencies, and private sector entities that are involved in infrastructure development, including electricity supply, water supply sewage system sanitation.

4.4.4 Institutional Stakeholders Relevant to the Road Construction and Operation Aspect of the Project

4.4.4.1 The Ministry of Transport and Aviation

The MoTA is responsible for developing policies and providing policy guidelines for delivery of safe, reliable, affordable and sustainable maritime, land transportation and aviation systems throughout Sierra Leone.

The overall goal of the Ministry is to increase access through the provision of transport services and connecting rural farming population and urban poor to market centres. The Ministry also aims to provide social and economic services through, efficient, affordable and sustainable transport systems through policy directives and effective monitoring of the activities of parastatals and departments supervised by the Ministry.

4.4.4.2 The Sierra Leone Roads Authority

The SLRA has the responsibility for road building and upgrading. It is semi-autonomously responsible for the administrative control, planning, development and maintenance of all roads in the country. It receives most of its funds for road maintenance from the Road Fund.

It reports administratively to the Ministry of Works, which is responsible for submitting the Authority annual budget for Parliamentary approval. SLRA contracts some 70% of all maintenance works to the private sector.

4.4.4.3 The Road Maintenance Fund Administration

The Sierra Leone Road Maintenance Fund Administration (RMFA) was established by an Act of Parliament and signed into law by His Excellency the President Dr. Ernest Bai Koroma, on the 9th April 2010.

The Administration aims to secure and manage funds in a cost-effective manner so as to ensure timely routine and periodic maintenance of the core road network. Implementing partners include the SLRA responsible for the timely routing and periodic maintenance of all primary and secondary roads; and the Local Councils responsible for the maintenance of feeder (Class F) roads.

4.4.4.4 The Sierra Leone Roads Safety Authority

The SLRSA was set up through an Act of Parliament (see section 4.2.4: *The Road Transport Authority Act (1996) (Amended to the Roads Safety Authority Act (2016)*).

The core functions of the SLRSA includes providing guidance on road safety and transportation, develop the human resources needed to service the transport industry and establish a database of information on the transport industry as a whole.

4.4.4.5 The Sierra Leone Police

The Sierra Leone Police (SLP) is the national police force primarily responsible for maintaining law and order.

Traffic Police Unit is primarily responsible for enforcing traffic safety and controlling the movement of traffic in all highways and major traffic crossings across Sierra Leone.

Other stakeholders within this sector include:

- The Ministry of Health and Sanitation (treatment of accident victims);

- Private sector institutions – Indigenous Transport Owners Association (IOTA), Drivers Union and Transport Workers Union, and
- International Partners – European Union (EU), World Bank, African Development Bank (AfDB), etc.

4.4.5 Institutional Stakeholders Relevant to the Power Transmission Line Installation aspect of the Project

4.4.5.1 The Ministry of Energy

The MoE has the mandate for the development of policies and programmes for the provision of energy (electrical or otherwise) on a constant and sustainable basis, to the entire population of Sierra Leone, by carrying out activities under the following major headings:

- Electrical generation and distribution;
- Development of Hydroelectric projects;
- Alternative energy sources;
- Rural Electrification;
- Radiation Protection, and
- Storage of petroleum products.

In collaboration with:

- Relevant Government Ministries and national and international organizations / institutions, and
- International Atomic Energy Agency.

4.4.5.2 Electricity Generation and Transmission Company

The *National Electricity Act (2011)* incorporates the EGTC which is responsible for generating and transforming electricity in Sierra Leone. The EDSA purchases electricity from the EGTC for distribution subject to a power purchase agreement approved by the Electricity and Water Regulatory Commission (EWRC).

4.4.5.3 Electricity and Water Regulatory Commission

To aid the Ministry in its tasks of ensuring reliable, efficient, effective, and affordable power generation and distribution, the government established the regulatory Commission known as the Sierra Leone EWRC in 2011.

The Commission is in place to regulate the provision of electricity and water services and to provide for other related matters.

Section 2 (1) of the Sierra Leone *Electricity and Water Regulatory Commission Act* provides that "Subject to this Act, the Commission shall have power to- (a) set or otherwise determine rates for electricity and water services; and (b) carry out regular reviews of rates and charges for regulated and unregulated services.

4.4.5.4 Electricity Distribution and Supply Authority

The EDSA came about as a result of challenges faced by the former NPA in providing electricity services. A *National Electricity Act* promulgated in 2011 by Parliament, saw the unbundling of the vertically integrated NPA into two entities - the EDSA and the EGTC.

The EDSA is responsible for the supply, distribution, and retail sale of electricity in Sierra Leone. It is responsible for dispatching system control of electricity and to ensure uniform standard voltages throughout its area of supply at reasonable prices.

EDSA handles all issues associated with electricity distribution and supply, and promotes and encourages the economic and efficient use of electricity; especially for domestic, commercial, agricultural, industrial and manufacturing purposes.

4.5 International Conventions Policies, Protocols and Guidelines

4.5.1 International Conventions

Sierra Leone is a party to many international agreements, conventions, and protocols that seek to protect the environment and ensure sustainable development. Below is a summary of these international commitments and agreements:

Table 4.5-1 : List of International Conventions and Agreements to which Sierra Leone is Party

International Commitments and/Agreements	Republic of Sierra Leone
The UN Framework Convention on Climate Change (New York, 1992)	Yes +
The Kyoto Protocol is a protocol aimed at fighting global warming. The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005.	Yes +
Ramsar Convention for the Internationally Important Wetlands Especially as Waterfowl Habitats (1971)	Yes+
The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal (Basel, 22 March 1989)	Yes+
Convention on the Environmental Impact Assessment in a Transboundary Context (EPS, Finland, 1991)	Yes+
Stockholm Convention on Persistent Organic Pollutants (22 May 2001; has not come into force yet)	Yes+
Convention on Biological Diversity (Rio de Janeiro, 1992)	Yes+
Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992)	Yes+
Convention on International Trade in Endangered Species of Wild Flora and Fauna (Washington, 1973)	Yes+

International Commitments and/Agreements	Republic of Sierra Leone
Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (1998)	Yes+
Rio Declaration on Environment and Development (UN Conference, 1992)	Yes+

4.5.1.1 United Nations Framework Convention on Climate Change

Sierra Leone ratified this convention on 22 June 1995. The objective of this convention is to regulate levels of greenhouse gas concentration in the atmosphere, so as to avoid the occurrence of climate change on a level that would impede sustainable economic development, or compromise initiatives in food production. The Parties are required to protect the climate system for present and future generations. Developing countries should be accorded appropriate assistance to enable them to fulfil the terms of the Convention. The Parties should work in cooperation, so as to obtain maximum benefit from initiatives in the control of the climate systems; The Parties are to prepare national inventories on greenhouse gas emissions, and on actions taken to remove them; formulate and implement programmes for the control of climate change; undertake cooperation in technology for the control of change in the climate system; incorporate suitable policies for the control of climate change in national plans; undertake education and training policies that will enhance public awareness in relation to climate change. The developed country Parties (and other Parties listed commit themselves to take special measures to limit their anthropogenic emissions of greenhouse gases, and to enhance the capacity of their sinks and reservoirs for the stabilization of such gases.

4.5.1.2 United Nations Convention on Biological Diversity

This convention, the main objectives of which is to preserve biological diversity and rehabilitate all degraded areas, was ratified by Sierra Leone on 12 December 1994. All signatory States are obliged to affect the prescribed undertakings which include:

- Development of national biological diversity strategy plan;
- Establishment of protected areas;
- Prevention, control and eradication of invasive and alien species, and
- Provision of educational facilities.

4.5.1.3 Vienna Convention for the Protection of the Ozone Layer

The Vienna Convention, concluded in 1985, is a framework agreement in which States agree to cooperate in relevant research and scientific assessments of the ozone problem, to exchange information, and to adopt “appropriate measures” to prevent activities that harm the ozone layer. The obligations are general and contain no specific limits on chemicals that deplete the ozone layer. The ozone layer protects the earth against excessive ultraviolet radiation, which could cause damage and mutations in human, plant, and animal cells.

4.5.1.4 Montreal Protocol

The Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. The Treaty was opened for signature on 16 September 1987, and entered into force on 1 January 1989, followed by the first meeting in Helsinki in May 1989. Since then, it has been revised seven times, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), and 1999 (Beijing). It is believed that adherence to the international agreement will lead to the recovery of the ozone layer by 2050.

4.5.1.5 Rotterdam Convention

The Rotterdam Convention is a multilateral treaty to promote shared responsibilities in relation to the importation of hazardous chemicals. The Convention promotes the sharing of information and calls on exporters of hazardous chemicals to use proper labelling, include directions on safe handling, and inform purchasers of any known restrictions or bans. Parties can decide whether to allow or ban the importation of chemicals listed in the Convention, and exporting countries are obliged to ensure compliance by producers within their jurisdiction.

4.5.1.6 Convention on Wetlands of International Importance (RAMSAR)

The Ramsar Convention on Wetlands (Ramsar) was signed by Sierra Leone on December 13, 1999, and went into effect on April 13, 2000. Signatory countries to the Ramsar convention agree to:

- Include conservation of wetlands in land use planning throughout the country, including the promotion of “wise use” of wetlands;
- Establish nature reserves within wetland areas;
- Promote training in the fields of research, management, and gardening, and
- Consult with other signatory countries about implementation of the convention especially in areas of shared wetlands, shared water systems, and shared species.

As required by Ramsar, Sierra Leone identified and listed one wetland site for inclusion on the Ramsar wetland list. This non-contiguous wetland is located along the Sierra Leone River Estuary near Freetown. The three areas making up the wetland have a combined area of approximately 295,000 hectares (ha) and include mangrove swamps and upland coastal plains. The mangrove swamp included in this wetland makes up approximately 19% of all the mangrove swamp in Sierra Leone.

4.5.1.7 The Stockholm Convention on Persistent Organic Pollutants

The Stockholm Convention on Persistent Organic Pollutants (POPs) is an international environmental treaty that aims to eliminate or restrict the production and use of POPs - chemicals that are persistent bio-accumulates found in fatty tissues and are bio- magnified

through the food chain, and adversely affect health and the environment. This Convention was adopted on the 22 May 2001 in Stockholm and Sierra Leone became a signatory on the 27th August 2001. The convention came into force on 17 May 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agree to outlaw nine of the dozen dirty chemicals, and curtail inadvertent production of dioxins and furans.

This Convention recommends the elimination or restriction of production and use of all internationally produced POPs (i.e. Industrial chemicals and pesticides), particularly, Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Hexa-chlorobenzene (HCB), Mirixtexaphene, Polychlorinated Biphensylsis (PCBs). The convention also seeks continuing minimization and, where feasible, ultimate elimination of the releases of POPs, such as Dioxins and Furans. Wastes containing POPs, must be managed and disposed of in a safe, efficient and environmentally friendly manner, with regards for international rules, standards and guidelines.

4.5.1.8 Convention on the International Trade of Endangered Species

The requirements of the Convention on the International Trade of Endangered Species (CITES) became effective in Sierra Leone on the 16th January 1995. The convention seeks to eliminate and/or reduce trade in certain species inclusive of those that are considered endangered. By this convention, a list has been produced comprising of species that require protection against trade. The majority of the species listed in CITES are those also considered by the IUCN, as endangered and threatened. CITES also takes cognizance of species not necessarily threatened, but which require trade control to protect them from being threatened or endangered.

4.5.1.9 The UNESCO Convention for the Protection of the World Cultural and Natural Heritage (the World Heritage Convention), 1972

This convention is the foremost example of an international treaty developed to protect outstanding natural areas and resources. These sites, usually nominated for preservation by the state, are listed as part of "the world heritage". A 21-State elected committee of the treaty parties (the World Heritage Committee) decides which to list, and then States are obligated to protect their sites in perpetuity. Over 100 States are parties to the treaty, and 119 "natural" and "mixed" natural-cultural sites have been established as of 1996. Sierra Leone ratified this convention in 2005; however, there are no sites currently listed in Sierra Leone.

4.5.2 International Lending Institutions Policies, Standards and Guidelines

Recognizing the political and resource differences among nations in their ability to set and implement environmental and social safeguards, the International Lending Institutions (ILI), development banks and private financial institutions, developed environmental and social safeguard policies and procedures. The purpose of these safeguards was to foster adoption and enforcement of the environmental and social assessment and protective measures required to implement the provisions of international agreements; to reinforce the intent of national legislation, and to foster sustainable development. Examples of these safeguards can be found in the following:

- World Bank Operational Policies and Bank Procedure;
- International Finance Corporation (IFC) Performance Standards, and
- The Equator Principles.

5 BASELINE SURVEY AND CONDITION

5.1 Introduction - Environmental Context of the Project Area

The description of the existing environment includes primary and secondary data and information from all relevant and available sources, and the text is illustrated with summary tables of data, maps, graphs, photographs and detailed written descriptions.

5.2 Physical and Biological Environment of the Project Area

5.2.1 Climate

5.2.1.1 Methodology

The data presented in this section were those reviewed from previous studies in the Project area and in Area 1, along with actual field measurements, observations and assessments.

5.2.1.2 Results

Generally, the climate of the Project area is described as moderately long dry season and a growing period lasting 270 – 300 days (FAO/LRSP TRI 1979).

Rainfall in the area is characterized by a unimodal pattern with a wettest period occurring during the months of July, August and September. The wet season normally last for six months (May – November) but in exceptional years, rains may start as early as April and sometimes run into December. The mean annual rainfall for sixteen years (1980 – 1996) in this area is 2,363 mm. 95% of this falls between April and November, with July and August being the wettest months, with a monthly mean of 508.3 mm and 579.2 mm respectively.

The annual mean maximum and minimum temperatures are 31.4^{o}C and 20.3^{o}C respectively. However, the mean temperature is nearly constant. The average day temperature is approximately 26°C.

The Harmattan is a dry and dusty north-easterly trade wind that blows from the Sahara Desert over the West African subcontinent into the Gulf of Guinea between the end of November and the middle of March. Typically, this brings cooler temperatures during the dry season and can transport large quantities of dust. Relative humidity readings of 90 per cent are common for extended periods during the rainy season (Area 1 ESIA, 2012).

5.2.1.2.1 Rainfall

Over the Gbangbaia River Basin, rainfall varies between 2,500 mm and 3,000 mm. High intensity rainstorms take place in the early and late wet season. The wet season begins in May and ends in November, and is characterised by heavy rain. A summary of the climatic data is given in Table 5.2-2.

The monthly mean rainfall ranges from 1.4 mm in January to 146 mm in September. The highest rainfall period is between June and October with lowest between December and February. The Project area is classified as being in the transitional rainforest savannah.

In terms of water regime, the characteristics of the region are shown in the annual water budget for the Moyamba as shown in Table 5.2-1:

Table 5.2-1:Annual Water Budgets for Moyamba

Budget Component	Value (mm)
Precipitation	2,451
Evapotranspiration	1,440
Water Surplus	1,451
Water Deficit	441
Rain surplus	1,351
Effective Precipitation	1,100
Growing Period Duration (days)	275

Source: (UNDP/FAO- TR5, 1980)

Table 5.2-2: Summary of Some Climatic Data for Moyamba Area in 1980

Climatic Variable		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Mean Temperature (°C)	Max	32.9	33.8	33.8	33.0	33.0	31.0	30.3	28.5	30.0	31.5	31.4	32.4
	Min	20.4	21.6	21.6	21.0	20.5	20.0	21.3	21.0	20.0	20.9	21.4	19.6
Average Relative Humidity (%)	9 a.m.	79.1	91.8	80.4	82.0	85.5	88.0	90.4	91.8	90.0	88.0	87.8	78.9
	3 p.m.	43.6	43.7	44.8	48.0	59.1	66.0	72.3	75.2	70.0	66.8	61.9	49.5
Monthly Mean Rainfall (mm)		1.4	4.3	12.3	34.0	75.4	118.0	136.	120.	146.0	102.0	56.6	21.0
Monthly Mean Evapotranspiration		41	39.3	43.3	44.0	43.6	40.0	37.5	37	36.0	38.3	38.3	40.7

Source: (UNDP/FAO-TR5, 1980)

Monthly rainfall records for the Area 1 plant site (for the period 2001 to 2017) and Lanti mining site (for the period 2001 to 2007) were made available by SRL. These are presented in the following table and charts:

Table 5.2-3: Average Monthly Rainfall at Area 1 Plant Sites for period 2001 - August 2017

Month	Average (mm)	Standard Deviation (mm)	Maximum (mm)	Minimum (mm)
Jan	6	17	55	0
Feb	11	15	50	0
Mar	50	38	124	1
Apr	93	48	204	23
May	240	108	456	80
Jun	376	100	590	229
Jul	515	184	887	255
Aug	637	159	952	291
Sep	450	131	711	202
Oct	278	66	415	151
Nov	147	66	242	18
Dec	24	44	174	0
Annual	2827	342	3526	2353

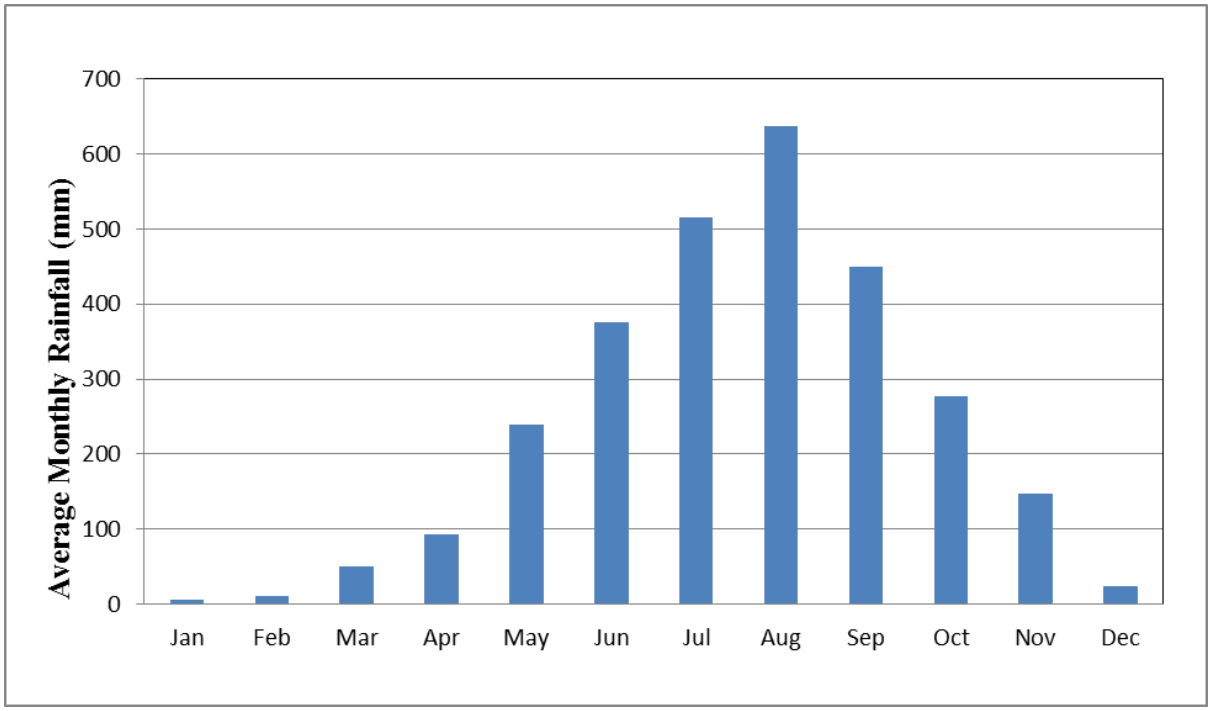


Figure 5.2-1: Average monthly rainfall for Area 1 plant site

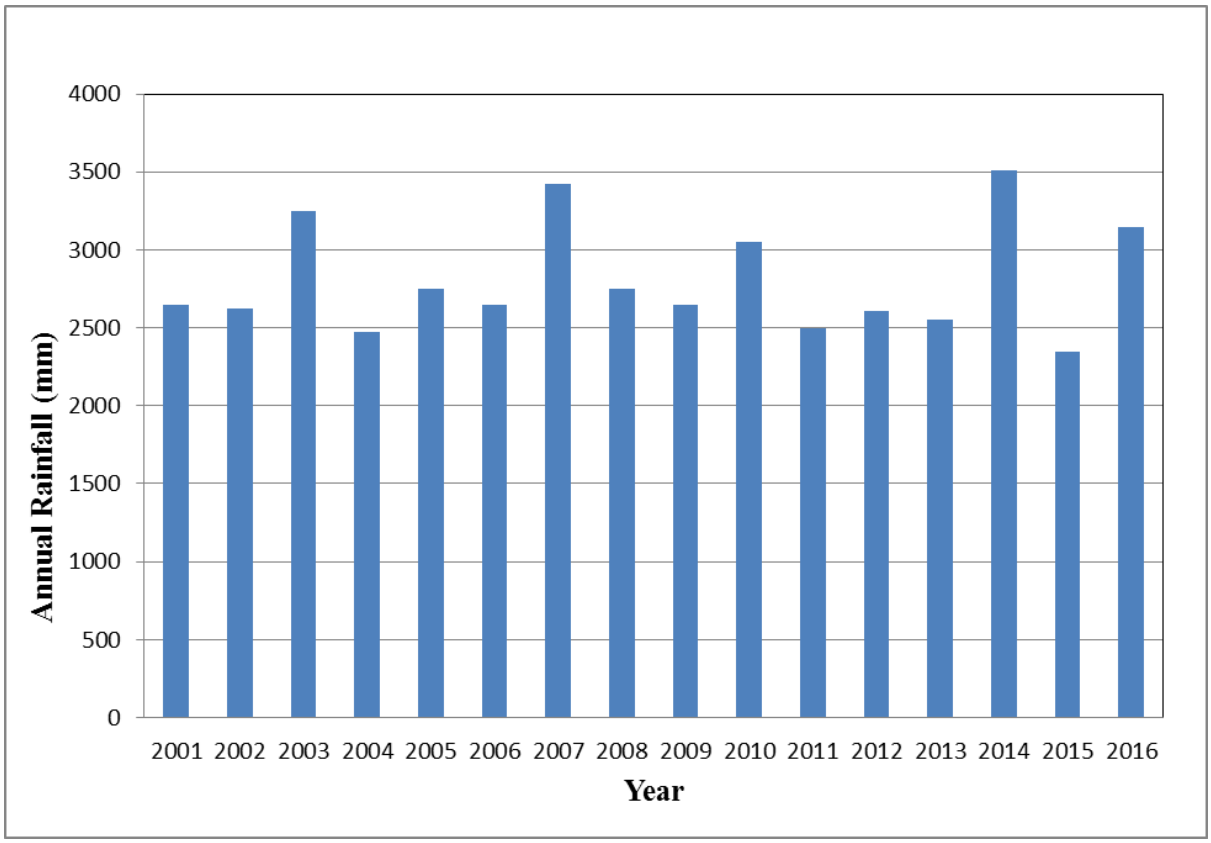


Figure 5.2-2: Annual Rainfall Figures for Area 1 from 2001 – 2016

5.2.1.2.2 Relative Humidity

Relative humidity ranges between 43.6 and 91.8%. Since the wet season begins in April and ends in November, and is characterised by heavy rain (maximum of around 146.0 mm in September), there is high humidity (90.1-91.8%), during which the air temperatures are generally below the annual average of 22°C. Rainfall decreases as the dry season progresses, until December when there is very little or no rain at all. Humidity is lower, and temperatures are a little above average, at generally around 33.8°C in the day and 19.6°C at night.

5.2.1.2.3 Temperature

Temperature is generally around 28.5 - 33.8ºC in the day and 19.6 - 21.6ºC at night. February and March are the hottest months when temperatures reach the annual maximum of 33.8ºC. Conditions are modified by the Harmattan, which is a dry, dust-laden wind, blowing south-west from the Sahara intermittently between December and March, for periods of up to a few days. At such times the sun can be obscured by airborne dust and temperatures can fall to 10ºC.

5.2.1.2.4 Wind Speed

Wind speed measurements were recorded at 22 selected locations within settlements close to the haul road and along the road corridor in October 2017; at different times of the day; and by using the Vane Probe Portable Anemometer.

From this analysis, it was determined that the wind speed along the Project area is generally low during the first part of October. The maximum wind speed was recorded at Ngeiyebu which has a relatively open space that accommodates wind movement. Reduced wind speeds within settlements are due to the closeness of housing structures, and the presence of nearby vegetation.

The wind directions and speed normally vary with time and elevation from one location to another.

Table 5.2-4: Wind speed measurements

Location	GPS coordinates	Date	Time	Average Wind speed m/s
Start of road alignment near Mogbwemo	0795374 0863860	4/10/17	11:10	0.2
Along road alignment	0793479 0864039	4/10/17	11:50	0.2
Small Mosenesie	0792232 0863920	5/10/17	10:20	0.4
Start of Alternative 2 haul road alignment	0790804 0862918	5/10/17	10:50	0.0
Mogbwemo	0791189 0863259	5/10/17	11:15	0.3
Along Alternative 2 road alignment	0790171 0863841	5/10/17	11:50	0.3
Along Alternative 2 road alignment	0789987 0864812	5/10/17	12:35	0.0
Close to old Gbangbatoke airfield	0789004 0864277	5/10/17	13:10	0.6
Edge of Gbangbatoke settlement	0788254 0864235	5/10/17	14.10	0.6
Bengelo	0786582 0865541	6/10/17	10:50	0.6
Baoma	0785866 0866710	6/10/17	11:35	0.4
Morporhoi	0785493 0867434	6/10/17	12:05	0.1
Momasa	0784227 0868186	6/10/17	13:00	1.0
Moselolo	0783627 0868446	9/10/17	09:45	0.1
Mosenegor	0784424 0870748	9/10/17	12:05	0.2
Moyasa	0782911 0873295	9/10/17	12:40	0.6
Fula Town	0782537 0873794	9/10/17	13:15	0.8
Kasama	0781302 0874864	9/10/17	13:45	0.4
Ngeihebu	0779911 0877239	9/10/17	14:25	1.1
Komende	0779490 0879320	10/10/17	11:40	0.4
Kamatipa	0776895 0879906	10/10/17	15:55	0.1
Sembehun (DM 3) site	0777802 0879954	10/10/17	17.00	0.1

Source: CEMMATS field measurements, Oct 2017

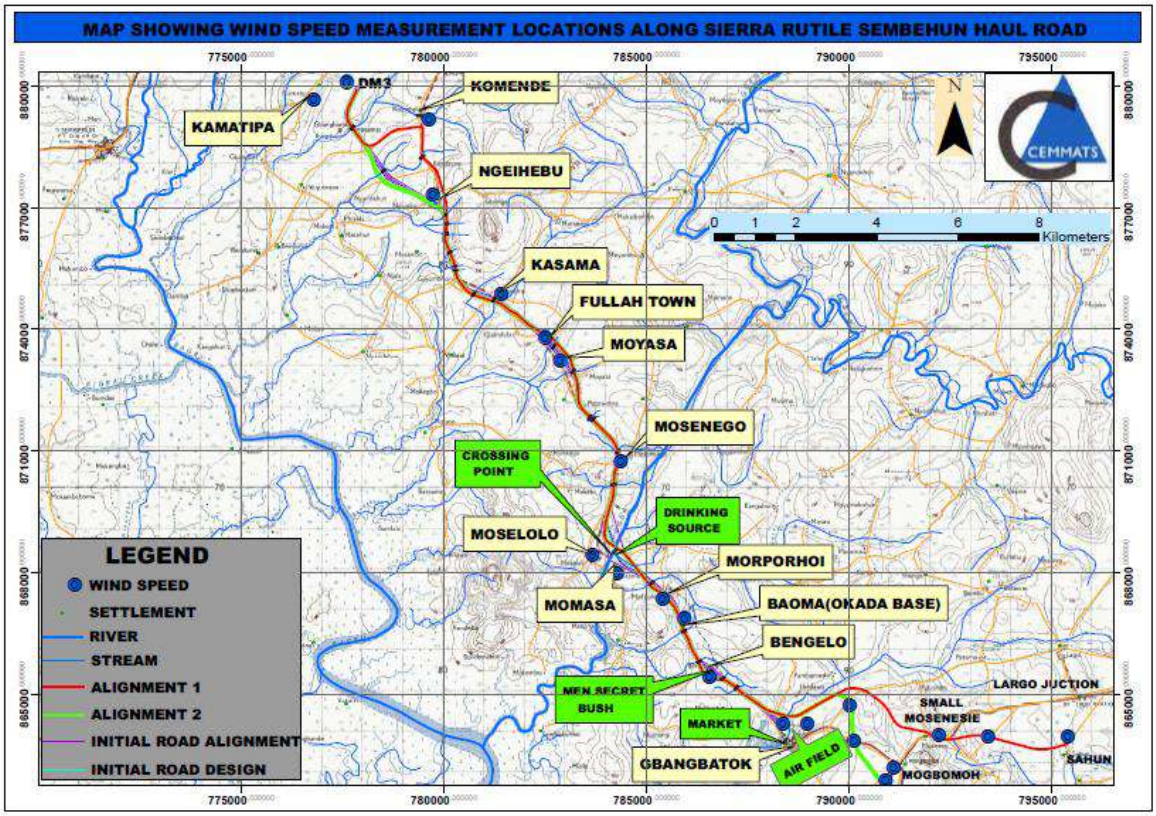


Figure 5.2-3: Wind Speed Measurement Points

5.2.2 Dust

5.2.2.1 Methodology

Ambient air quality guidelines and standards for inhalable particles or PM_{10} (i.e. particulates with an aerodynamic diameter of 10 µm or less) are presented in Table 5.2-5. PM_{10} provides a measure of respirable dust, which has the potential to affect human health when inhaled.

The baseline dust levels / Particulate Matter (PM_{10}) in the air was recorded within and around twenty-two (22) locations in the settlements closest to the road corridor in October 2017. The measurements were recorded at different times of the day using a portable micro-dust pro aerosol monitoring system.

Table 5.2-5: WHO Guidelines on Dust Levels in air

WB / IFC Guidelines[1]	Maximum 24-hour Concentration	Annual Average Concentration
Units	µg/m^3	µg/m^3
Interim Target 1[2]	150	70
Interim Target 2[3]	100	50
Interim Target 3[4]	75	30
Guideline[5]	50	20
1) WB / IFC, 2007. General EHS guidelines: Environmental. Air emissions and ambient air quality. 2) Interim target-1 (IT-1) – These levels are associated with about a 15 % higher long-term mortality risk relative to the AQG (WHO Air Quality Guideline) level.		

3) Interim target-2 (IT-2) – In addition to the other health benefits, these levels lower the risk of premature mortality by approximately 6% [2-11%] relative to the IT-2 level.
4) Interim target-3 (IT-3) – In addition to the other health benefits, these levels reduce the mortality risk by approximately 6% [2-11 %] relative to the IT-2 level.
5) Guideline (AQG) – In addition to the lowest levels at which total cardiopulmonary and lung cancer mortality have been shown to increase with more than 95 %confidence in response to long term exposure to $PM_{2.5}$
Interim targets are provided by WB / IFC in recognition of the need for a staged approach to achieving the recommended guidelines.

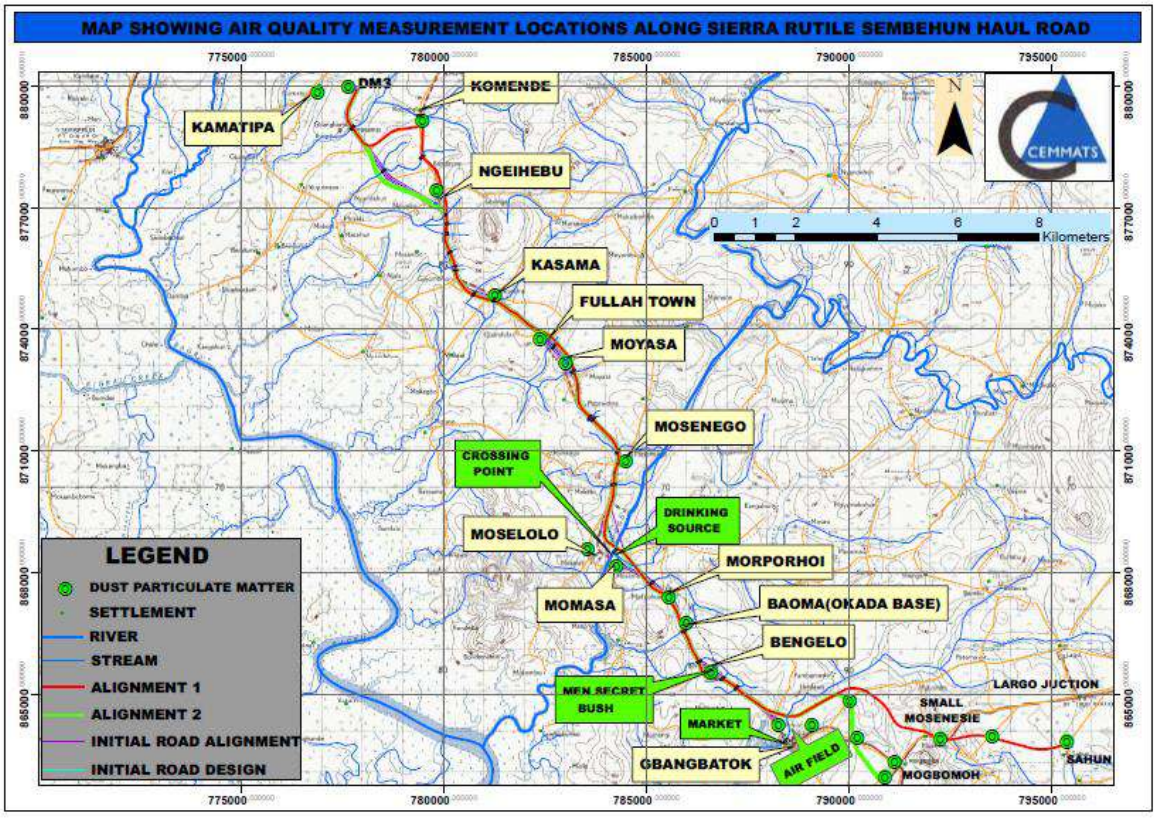


Figure 5.2-4: Dust Particulate Measurement Points

5.2.2.2 Results

Table 5.2-6 presents the average PM_{10} levels measured along the proposed route. Recorded values range from 0.010 mg/m^3 to 0.210 mg/m^3.

Whilst a direct comparison between the measured average values and the World Health Organisation (WHO) maximum 24-hour concentration or annual average concentration guideline levels is not possible, it provides some context to the observed dust levels. Most (91%) of the measurements taken during the current assessment of the Project area are below the World Health Organisation (WHO) air quality standards stipulated maximum threshold of 0.05 mg/m^3 over 24 hours (exceedances are highlighted in red Table 5.2-6). 18% of the average measurements taken in the current assessment were above the WHO air quality standards stipulated annual average concentration of 0.02 mg/m^3 (highlighted in blue Table 5.2-6).

Dry weather at the time of measurement and the fact that the existing road is lateritic with dust easily generated from vehicular traffic, wind and other community activities contributed to seasonally high dust levels. There is also more vehicular traffic on the south side of the

route before the bridge than on the North side towards Sembehun as seen from the traffic survey.

Table 5.2-6: Dust levels Recorded along Road Corridor

Location	GPS coordinates	Date	Time	Measured Values (mg/m^3)
Start of road alignment near Mogbwemo	0795374 0863860	4/10/17	11:40	0.012
Along road alignment	0793479 0864039	4/10/17	12:17	0.014
Small Mosenesie	0792232 0863920	5/10/17	10:48	0.014
Start of Alternative 2 haul road alignment	0790804 0862918	5/10/17	11:18	0.022
Mogbwemo	0791189 0863259	5/10/17	11:45	0.026
Along Alternative 2 road alignment	0790171 0863841	5/10/17	12:19	0.020
Along Alternative 2 road alignment	0789987 0864812	5/10/17	13:05	0.210
Close to old Gbangbatoke airfield	0789004 0864277	5/10/17	13:39	0.019
Edge of Gbangbatoke settlement	0788254 0864235	5/10/17	14.35	0.020
Bengelo	0786582 0865541	6/10/17	11:31	0.015
Baoma	0785866 0866710	6/10/17	12:01	0.017
Morporhoi	0785493 0867434	6/10/17	12:32	0.017
Momasa	0784227 0868186	6/10/17	13:23	0.017
Moselolo	0783627 0868446	9/10/17	10:11	0.014
Mosenegor	0784424 0870748	9/10/17	12:32	0.018
Moyasa	0782911 0873295	9/10/17	13:08	0.019
Fula Town	0782537 0873794	9/10/17	13:42	0.017
Kasama	0781302 0874864	9/10/17	14:13	0.017
Ngeihebu	0779911 0877239	9/10/17	14:55	0.020
Komende	0779490 0879320	10/10/17	12:09	0.010
Kamatipa	0776895 0879906	10/10/17	16:24	0.016
Sembehun (DM 3) site	0777802 0879954	10/10/17	17.18	0.070

5.2.3 Noise

5.2.3.1 Methodology

Noise levels (dBA) were measured and the range of levels recorded within and around twenty-two (22) locations in the settlements closest to the road corridor in October 2017. The measurements were recorded at different times of the day using a hand-held Lutron sound level meter.

Noise levels were measured and recorded within and around twenty-two (22) locations in the settlements closest to the road corridor in October 2017. The measurements were recorded at different times of the day using a hand-held Lutron sound meter.

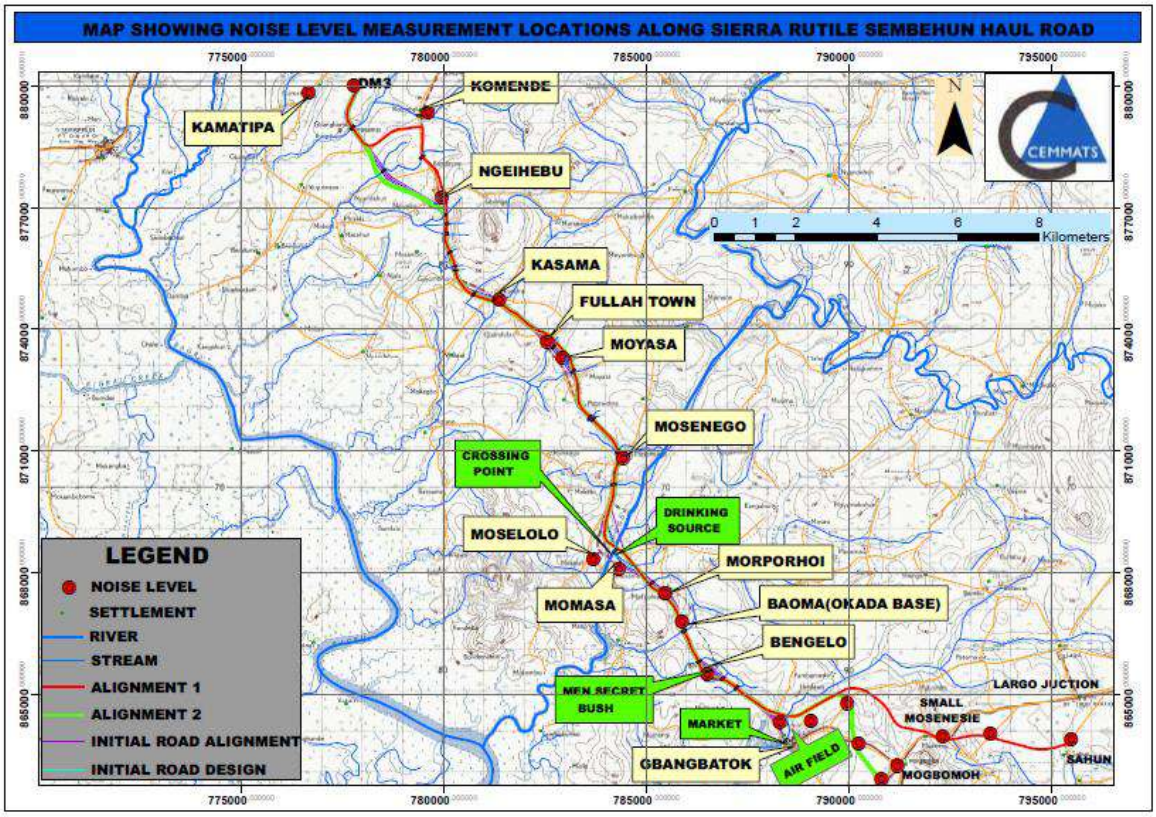


Figure 5.2-5: Noise Level Measurement Points

5.2.3.2 Results

Whilst direct comparison between instantaneous measured noise values (dBA) and the World Bank 'One Hour LAeq' limits (as per Table 5.2-7) is not possible, it provides some context to observed noise levels and potential impacts.

Table 5.2-7: World Bank limits noise level guidelines for maximum outdoor noise level dBA

Receptor	Noise level One Hour L_{Aeq} (dBA)	
(Type of district)	**Daytime** 07:00 – 22:00	**Night-time** 22:00 – 07:00
(a) Residential; institutional; educational	55	45
(b) Industrial; commercial	70	70

Measured noise levels in the Project area (CEMMATS) ranged from 39 – 77 dBA and are summarised in Table 5.2-8.

As part of the Area 1 ESHIA, existing ambient noise levels were also measured at villages in the 2017 Area 1 survey (SRK). From the Area 1 surveys, it was concluded that ambient noise levels in villages of Area 1 (current operational site) vary around 55 dBA during the day-time and 45 dBA at night-time. IFC guidelines state that noise impacts should not exceed the levels described in Table 5.2-7 or result in a maximum increase in background levels of 3dBA at the nearest receptor; an impact of 3dBA or less is considered insignificant. The Area 1 noise assessment indicated that the haul road noise impacts the first row of houses in the villages by 3 dBA, however the haul roads pass through villages. For the current Project area, the road will bypass all villages which is expected to result in reduced noise impact.

In the current Project area, noise generated in communities is due to normal village activities and occasional vehicular traffic, as no mining activities at Area 5 have begun or haul roads been constructed.

Table 5.2-8: Noise levels recorded along the Road Corridor

Location	GPS coordinates	Date	Time	Noise Level Range (dBA)
Start of road alignment near Mogbwemo	0795374 0863860	4/10/17	11:40	47 - 69
Along road alignment	0793479 0864039	4/10/17	12:17	41 - 69
Small Mosenesie	0792232 0863920	5/10/17	10:48	44 - 69
Start of Alternative 2 haul road alignment	0790804 0862918	5/10/17	11:18	46 - 61
Mogbwemo (Area 1 SRK LDay / LNight: 47/42 dBA)	0791189 0863259	5/10/17	11:45	58 - 77
Along Alternative 2 road alignment	0790171 0863841	5/10/17	12:19	51 - 67
Along Alternative 2 road alignment	0789987 0864812	5/10/17	13:05	39 - 48
Close to old Gbangbatoke airfield	0789004 0864277	5/10/17	13:39	45 - 64
Edge of Gbangbatoke settlement	0788254 0864235	5/10/17	14.35	44 - 64

Location	GPS coordinates	Date	Time	Noise Level Range (dBA)
Bengelo	0786582 0865541	6/10/17	11:31	40 - 56
Baoma	0785866 0866710	6/10/17	12:01	44 - 61
Morporhoi	0785493 0867434	6/10/17	12:32	43 - 53
Momasa	0784227 0868186	6/10/17	13:23	42 - 63
Moselolo	0783627 0868446	9/10/17	10:11	42 - 62
Mosenegor	0784424 0870748	9/10/17	12:32	39 - 56
Moyasa	0782911 0873295	9/10/17	13:08	41 - 63
Fula Town	0782537 0873794	9/10/17	13:42	44 - 57
Kasama	0781302 0874864	9/10/17	14:13	43 - 61
Ngeihebu	0779911 0877239	9/10/17	14:55	44 - 66
Komende	0779490 0879320	10/10/17	12:09	44 - 55
Kamatipa	0776895 0879906	10/10/17	16:24	43 - 60
Sembehun (DM 3) site	0777802 0879954	10/10/17	17.18	39 - 46

5.2.4 Geology

5.2.4.1 Methodology

The geology assessment was done through literature review and desk studies on reports and data on Sierra Leone and the Project area.

5.2.4.2 Results

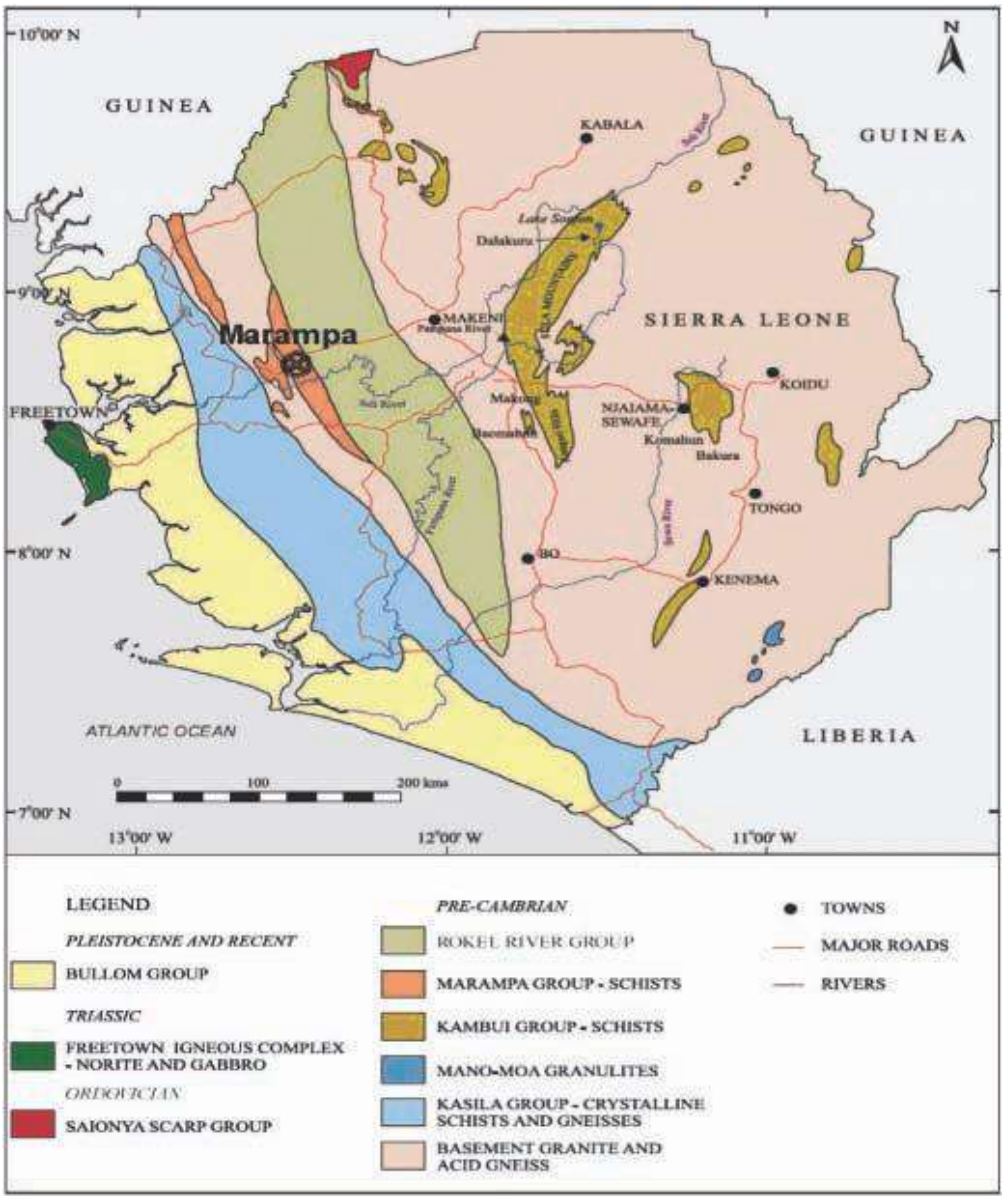
5.2.4.2.1 General Geology of Sierra Leone

Sierra Leone is split between two tectono- stratigraphic units; the majority of which covers the eastern side of the country and forms part of the stable Precambrian West African Craton. The western unit contains elements of an orogenic belt that was deformed during the Pan-African tectono- thermal event about 550 Ma ago. A 20 to 40 km wide coastal strip to the west comprises of Pleistocene to Recent sediments.

The Precambrian units in the east can be subdivided into infracrustal rocks (gneisses and granitoids); supracrustal rocks (forming synclinal greenstone belts); and basic / ultrabasic igneous intrusions3. The infracrustal rocks were formed and reworked during two major orogenic cycles, an older Leonean episode (~2,960 Ma) and a younger Liberian episode (~2750 Ma). Deformation during the Leonean event was E-W and N-S during the Liberian event. Most prominent is the (Archaean age) Kasila Group, which is a linearly extensive belt of supracrustal rocks approximately 30 km wide and reworked during the Pan-African Orogeny. It consists of mostly of quartzo-feldspathic garnet gneisses and charnockites. The

(late Proterozoic age) Rokel River Group to the east of the Kasila Group forms the eastern-most boundary of the orogenic belt and is comprised of marls, quartzites, sandstones and various volcanic rocks.

The coastal Bullom Group comprising of alluvial, marine and estuarine sediments of Tertiary to Recent age lies unconformably on the basement rocks. The deposition of the Bullom Group followed a late Tertiary-age marine regression, which exposed the basement to differential erosion and deposition of the alluvium, sands, clays, silts and lignites that typify this Group.



Source: Introduction to Geology and Minerals (Mason, 2016)

Figure 5.2-6: Geology Map of Sierra Leone

5.2.4.2.2 Project Area Geology

The area geology is proximal alluvial placers in origin, with the primary source of mineralisation derived from the quartzo-feldspathic gneisses of the Precambrian (2.1ba)

Kasila Group. In the North-eastern part of the Project area is Hypersthene Gneiss-Olivine (Kasila Gneisses-Precambrian 2.1ba), alluvium beach sand lignite, sand clay and lignite are other deposits in the Project area. The heavy mineral suite is hosted within the Bullom Group, which marked the end of a late Tertiary marine regression. Sea levels at this time were approximately 100 metres below its current level, exposing the basement rocks of the Kasila Group to erosion. Mechanical and chemical degradation of the Kasila gneisses lead to the formation of kaolinite and other clay minerals which subsequently liberated the heavy minerals, where they were eroded and deposited into pre-incised channel systems. The quartzofeldspathic gneiss is light-gray, fine- to coarse-grained, foliated, layered muscovitie-bearing quartzofeldspathic gneiss; contains intercalated quartz-muscovite schist. Mineralogy: quartz + plagioclase + microcline + garnet + muscovite + biotite. Deposits in the Project area can be classified into one or more of the six deposits of the Sembehun group namely*: Kibi*, *Dodo*, *Benduma*, *Komende*, *Mokamatipa* and *Matehun*.

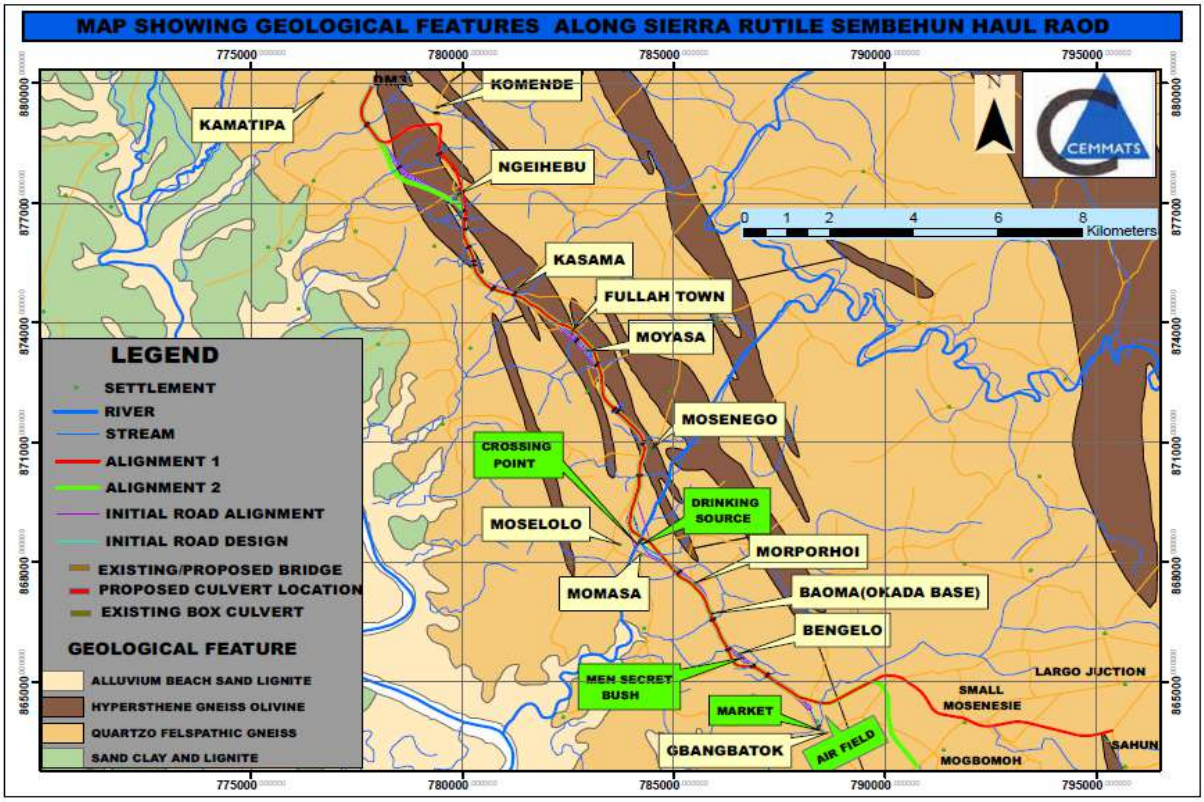


Figure 5.2-7: Geology of Project Area Map

5.2.5 Landform

5.2.5.1 Methodology

The landform assessment study was done mainly through desktop review of secondary data and field observations.

5.2.5.2 Results

Moyamba District, on the southwest of the Southern Province, is a region where the coastal plain merges into the lowlands. These areas mainly comprise of gently to very gently undulating plains of very low relief (Birchall et al, 1979) and a few high grounds. The highest point is Moyamba Hills forest reserve which is 350 meters above mean sea level (mamsl). Most of the areas in this district lie below 100 mamsl which explains the numerous seasonal floodplains, swamps, streams and tributaries. The low relief across the district may be the reason for the observed low flow rate of water and consequently low sedimentation levels observed along the streams and rivers.

5.2.6 Land Cover and Land Use

5.2.6.1 Methodology

5.2.6.1.1 Desktop Review

A thorough literature search was conducted to obtain an adequate understanding of the various types of land cover and land uses in the Project area. Available literature on land use for Sierra Leone were reviewed which provided adequate descriptions and analysis of land use and land cover relative to the Project area. Google Earth Image Landsat (United States of America Department of State Geographers, 2016/17), ESRI's ArcMap version 10.4.1 background image and Sierra Leone's 50K Topography map served as other major sources of secondary information in the absence of available satellite imagery of the Project area. The use of Google Earth, ESRI's ArcMap image in combination with Quantum GIS version 2.0, ArcGIS version 10.4.1 with all related technologies were also helpful in providing accurate locational estimates. These data sources offered the consultant most needed data required for land use and land cover assessment of the Project area.

5.2.6.1.2 Primary Data Collection

Primary research served as the main trust of information for land use and land cover analysis. The land use and land cover data collection forms were designed using Kobo Toolbox and associated Kobo Collect mobile data collection application. The forms were used to collect information on land use and land cover at the individual household and community levels. The responses captured were downloaded from Kobo Toolbox in Microsoft file format, cleaned and exported into the Statistical Package for Social Scientist (SPSS) software and analysed. These individual and community responses were complimented by 4 focus group

discussions and three key informant interviews (1 in Lower Banta and 2 in Bagruwa) on land cover and land use issues. In each of the focus group discussions, there were either 6 or 8 persons involved with a grand total of 28 persons selected from four categories of individuals.

Table 5.2-9: Focus Group Discussion Matrix

Chiefdom	Category	No of discussion	Location	Number of persons
Bagruwa	Youth (young men and women)	1	Ngiebu	6
	Women	1	Moselolo	8
Lower Banta	Men	1	Bengellor	6
	Plantation Owners	1	Morpormoi	8
	Total	**4**	**4**	**28**

The focus group discussions and the two key informant interviews were geared towards the provision of first-hand information on land cover and land use topics investigated. These included settlement expansion possibilities, type, method and extent of farming and mining activities, the location of sacred and cultural sites among others.

A transect walk along the proposed road with visits to all communities within 2 km buffer of the road made it possible to conduct a first-hand assessment of land cover types and various land uses in the area.

5.2.6.2 Results

5.2.6.2.1 Land Cover

Sierra Leone is now principally covered by Secondary Forest and Forest Regrowth. This is as a result of almost all of the original forests having been replaced due to the traditional shifting cultivation with its associated slash and burn method of farming. As shown in Figure 5.2-8, Forest regrowth accounts for 75 percent of the land cover in the Project area. Mangrove Swamp vegetation is the second most extensive land cover due to the combined effects of the Project area's proximity to the ocean and the Bullum Creek which is heavily characterised by Mangrove Swamp vegetation.

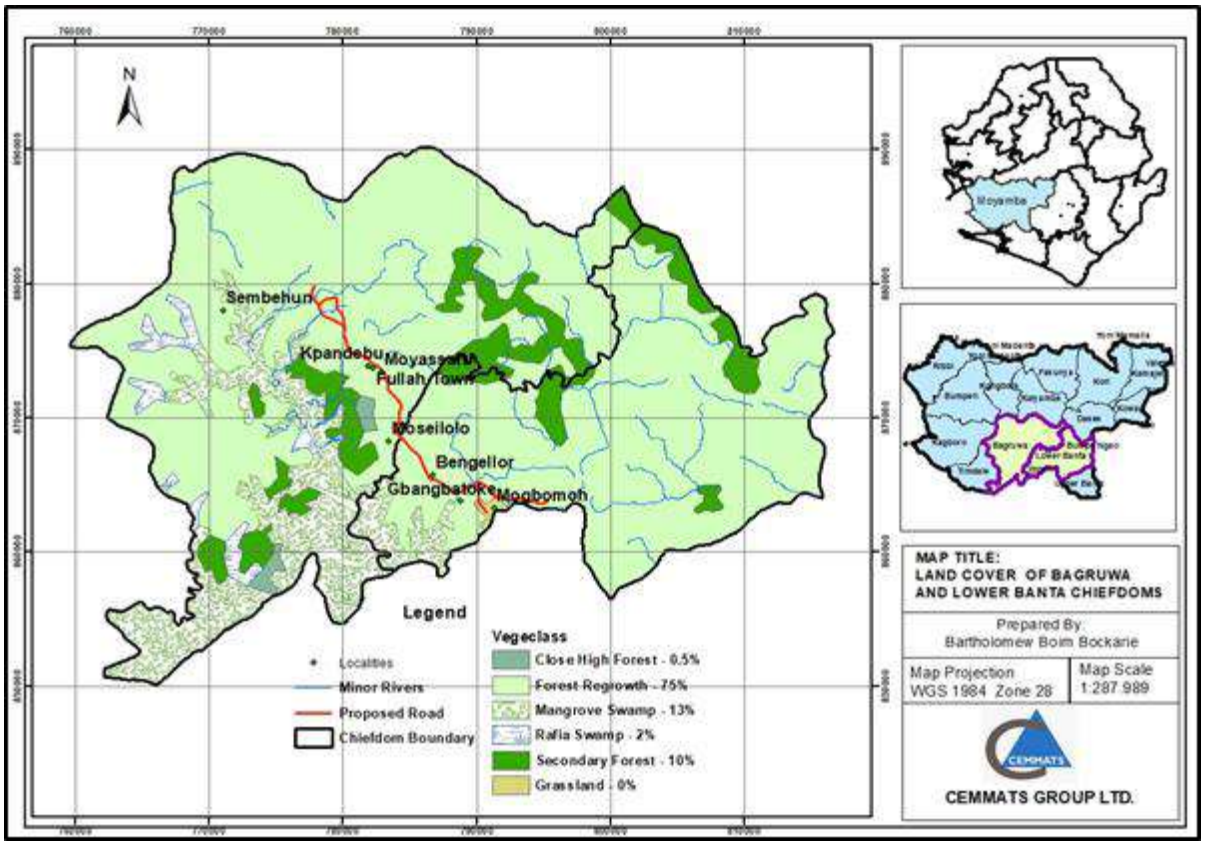


Figure 5.2-8: Land cover Map

According to the Moyamba District Council (2013), the Secondary Farm Bush, Grassland, Mangrove and Inland Valley Swamps (IVSs) are the main vegetation of Moyamba district.

5.2.6.2.2 Forest and Secondary Forest

A triangulation of results from visual observations and desktop studies has established the existence of isolated or patches of evergreen forests at certain locations along the proposed road and its immediate surroundings. Similarly, secondary forests were observed to be more extensive than the evergreen forest and were mostly found at the fringes of the evergreen forests. Evergreen forests were seen around settlements and riverbanks within the Project area. In some instances, the proposed road cuts through such forests as was the case around Mosenesi One (1), and Bengelor. Along the banks of the Gbangba, Kpakui and Jong rivers, strips of forests approximately 0.2 km to 0.5 km width were observed. Similarly, forests around settlements visited, including Moselolo, Mosenegor, Kpandebu, Mormorpoi, etc., were mostly much wider and mostly existed for the purposes of traditional or societal practices. Typical of forests around settlements, is the existence of a mixture of economic trees.

Generally, secondary forest as well as forest regrowth or farm bush, are derived from shifting cultivation and related bush fallow practices. Also known as Gallery Forest, it is mostly characterised by tall trees about 20 to 30 m high. Associated with this type of land cover are Musanga Cecropioides or Umbrella tree, Terminalia Ivorensis and Ceiba Pentandra mostly

with buttress roots that are moisture accommodating. Sometimes, these exist together with tall and large oil palm (*Elaeis guineensis*) plantations (aged 5 – 15 years) along the proposed road. It represents a kind of evergreen vegetation that maintains the soil stability hence controls degradation through soil erosion.

5.2.6.2.3 Forest Regrowth or Young Farm Bush

Forest regrowth, also known as farm bush, remains the most extensive land cover in the Project area. It is a replacement of secondary forest resulting from limited fallow period. It is usually either under crop cultivation, in this case rice and cassava crops or undergoing various stages of bush fallow. Forest regrowth is different from secondary forest by its characteristic nature of deciduous plants and trees, a blend of low shrubs, grasses in certain places, herbs and crop remnants to about six years of dense thicket regrowth vegetation. The tree species associated with this land cover are about 5 to 10 m high and specific species include *Morinda geminata* (brimstone), *Elaeis guineensis* (oil palm tree) amongst others. The shrubs characterising this vegetation generally makes it difficult to walkthrough. The nature of this land cover suggests that it is an outcome of extreme shortening of the fallow period, soil degradation and decreased loss in soil productivity.

5.2.6.2.4 Hydromorphic Vegetation

The most dominant type of hydromorphic vegetation in the study are is the IVS which is drained by seasonal and sluggishly flowing streams that are susceptible to months of flooding in the raining season. Typical of the IVS vegetation is low dense grass and herbaceous plants combined with scattered tree species that thrive under hydromorphic conditions. Linked with this land cover are plant species that include *Coix lachryma jobi* (sword grass), *Cappertonia Ficifolia* (herbaceous plants), *Mitragyna stipulosa* (agidi leaf tree) and occurrences of *Raphia vinifera* (Raphia palm) etc.

IVSs are very fertile and ideal for intensive rice cultivation in the wet season and vegetable gardening in the dry season.

5.2.6.2.5 Land Use Types

a) Settlements

A total of 352 localities (222 in Bagruwa and 129 in Lower Banta) were confirmed, from the analysis of Statistics Sierra Leone's 2015 Population and Housing Census Cartographic mapping data, to be the number of localities in the two Chiefdoms. However, some of these were identified during the field work as desolate localities. An estimated 34 of these localities are found within the 2 km of the proposed road alignment, and the livelihood of some of these communities will likely be affected. The average size of the localities visited and mapped was 0.084 km^2. Gbangbatoke is the largest with 1.975 km^2 compared with the smallest communities that included Modimidoh, Mano Kpaku and Nyandehun.

Table 5.2-10: Communities with 2 km of Proposed Route

	Name	Area (km^2)	Eastings	Northings
1	Mogbwemo	0.155	791315	863393
2	Gbangbatoke	1.975	788834	863819
3	Bengellor	0.046	786601	865586
4	Morpormoi	0.019	785559	867529
5	Momassah	0.010	784233	868152
6	Moselolo	0.065	783585	868526
7	Mokebbie	0.018	783136	869927
8	Mosenegor	0.047	784530	870800
9	Moyassah	0.025	782918	873308
10	Fula Town	0.017	782510	873814
11	Kpandebu	0.009	781829	873862
12	Kassama	0.020	781383	874904
13	Ngeibu	0.022	779901	877233
14	Komende	0.061	779550	879494
15	Gbonge	0.016	781063	877245
16	Niombohun	0.010	781063	879692
17	Nyandehun	0.005	777699	877352
18	Mosegie	0.008	777541	876583
19	Matehun	0.011	777500	876268
20	Njala	0.015	778519	875287
21	Fungihun	0.008	787027	868414
22	Mokango	0.011	782663	870939
23	Modimidoh	0.003	785509	868536
24	Modimidoh	0.002	785585	868404
25	Congowo	0.023	796221	865011
26	Largo Junction	0.112	795527	864978
27	Petema 1	0.021	793308	865804
28	Largo Old Town	0.086	795249	865871
29	Mokonbay	0.003	791730	865292
30	Mosenesi 1	0.026	791757	863901
31	Moyanga	0.025	790902	863446
32	Bassai	0.046	780173	873314
33	Mossepeh	0.006	784346	866322
34	Mano-Kpaku	0.003	783631	866673

Source: GIS Analysis using ArcMap Version 10.5 background Image

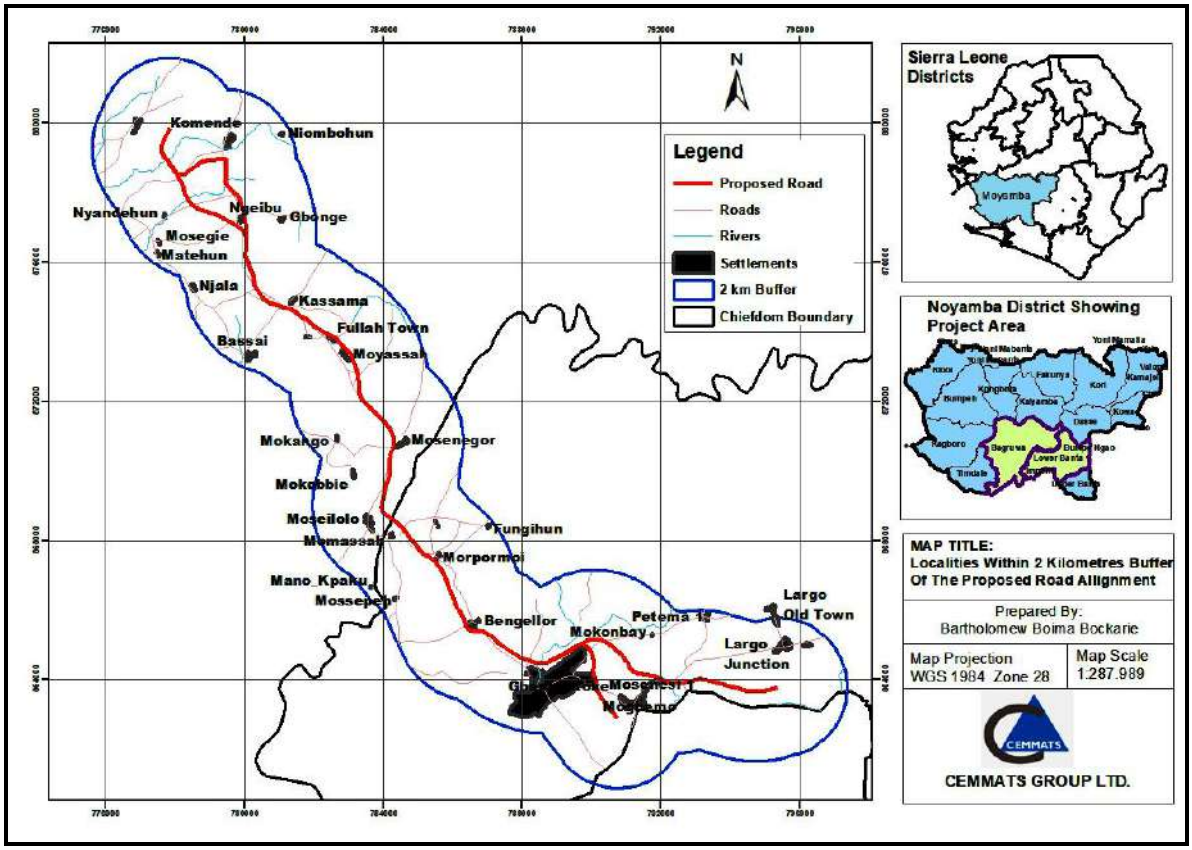


Figure 5.2-9: Map of Communities within 2km of proposed Route

These communities, as is typical of most rural settlements in Sierra Leone, were surrounded by a mixture of various land use types ranging from backyard gardening to tree crops including oil palm plantations.

b) Agriculture

Generally, the agricultural sector in Sierra Leone comprises food and tree crops, livestock, forestry and fisheries. Nevertheless, the food crop component of the sector is the most extensive in the country (Statistics Sierra Leone, 2010). Statistics Sierra Leone (SSL) (2016), have estimated that agriculture employs 59.2% of the employed population in the country. In the rural areas, 86.1% are agricultural households with the Southern Region dropping below this national average with 73.4% of all households being agricultural households (Ibid, 2016).

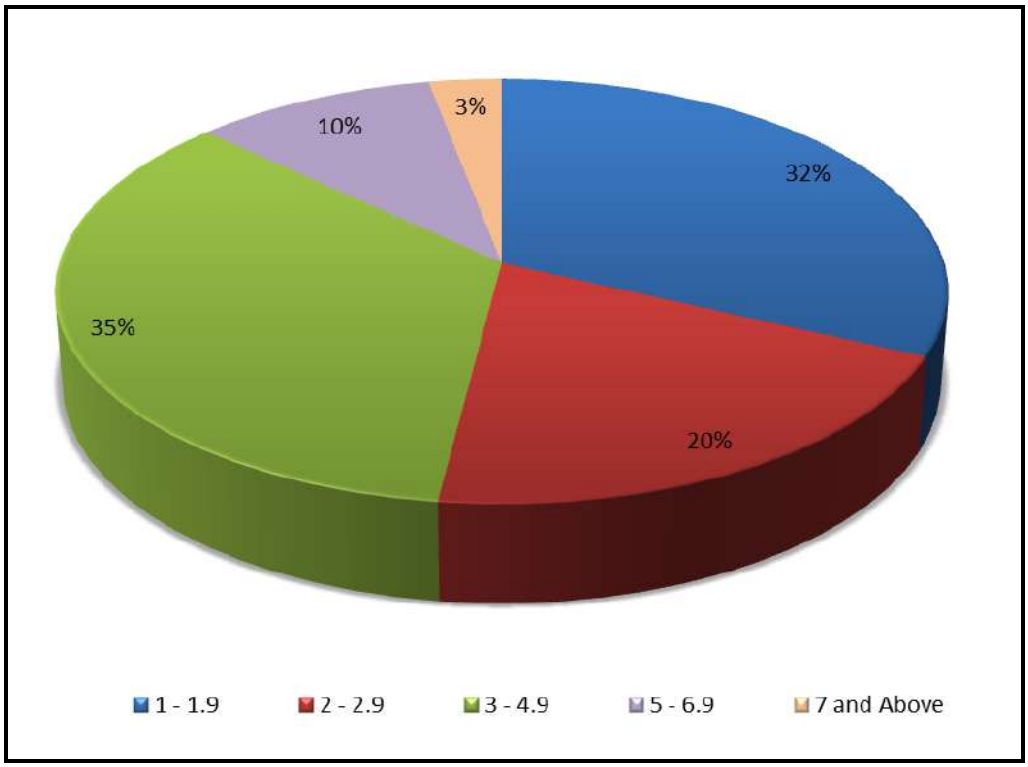
b-i) Farming

Crop farming, especially rice and cassava, is the most popular and extensive agricultural land use in the two Chiefdoms in the Project area. However, it was unclear which of the two crops is most extensively cultivated in the area. One thing that was made clear is that both crops are cultivated simultaneously. That is, when the bush is cleared, cassava is initially planted before the field is ploughed for rice. At this stage, there is enough space between the cassava heaps stems to allow the rice enough space to grow. Once the rice is harvested, the entire field is converted to cassava farm. Rice is cultivated both on IVSs and upland ecologies. It was noted

that IVS is not very popular, which, according to the farmers, is as a result of the associated upland ecology with respect to mix cropping (in this case, rice and cassava) and crop rotation.

The observed farming methods in the Project area comprised a combination of mix farming, mix-cropping and crop rotation which are tied to the shifting cultivation related bush fallow. In the Chiefdoms in the Project area, shifting cultivation requires the land to be cleared for rice and cassava cultivation but other crops such as corn, guinea corn, bennie, beans, and okra etc. are simultaneously cultivated.

Traditionally, land was left to fallow for some 10 to 15 years but this is no longer the case; due to population pressure the heavy cultivation of cassava which may be continuously cultivated on a piece of land for up to five years. Consequently, the land is hardly left to fallow for more than five years hence very young farm bushes are constantly cleared for new farm lands.



Source CEMMATS survey October, 2017

Figure 5.2-10: Average Farm Size (Acres) in the Project Area

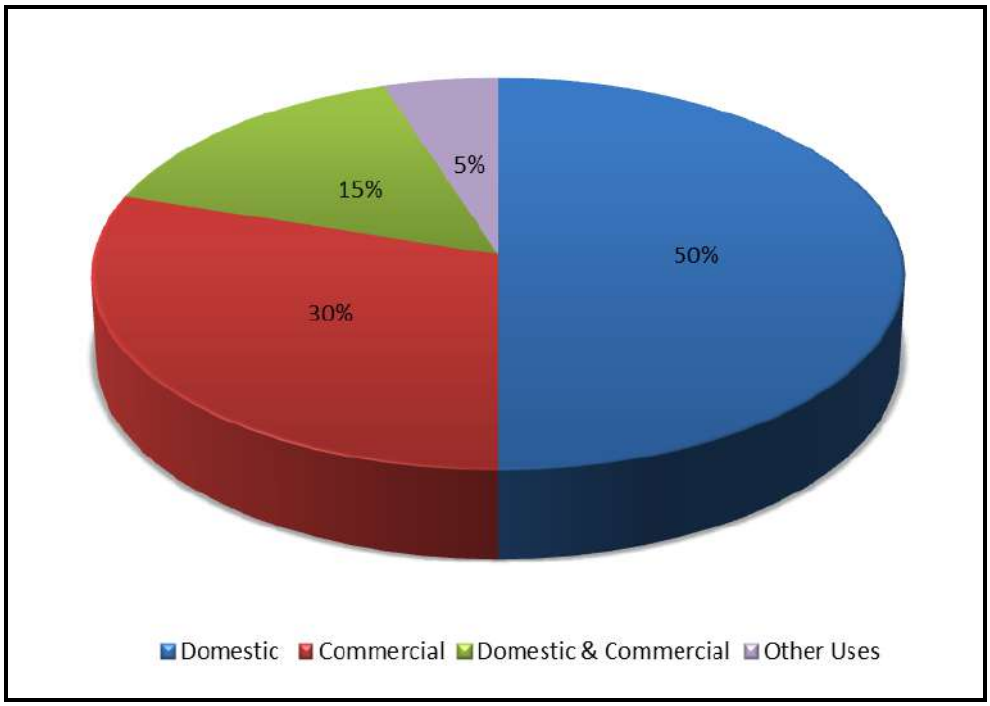
Crop farms were mainly observed to be small. As shown in Figure 5.2-10, over 80% of the farming families reported cultivating less than 5 acres of land every year compared with 13 percent that can afford to cultivate 5 or more acres. The current average yield per acre was estimated to range from 3 to 6 bushels for rice, although it can be enhanced with improved soil fertility. Cassava yields are reportedly high and comparatively better than rice yields. No use of farming inputs such as fertilizer was reported. The farms are cultivated within 1.5 to 4 km distance from the communities.

While rice is grown entirely for subsistence purposes, cassava was reported to be cultivated for both subsistence and commercial purposes. Cassava, which is mostly processed as 'Gari', serves as a major source of income for the farming households in the Project area. Vegetables are generally cultivated for subsistence purposes although surpluses are commercialised to meet the financial needs of the family.

b-ii) Tree / Cash Cropping

Oil palm is the most popular tree crop in the District. Unlike most parts in the Kenema and Kailahun Districts in the East where cocoa and coffee are the dominant tree crops, Moyamba district is not renowned for such tree crops. Consequently, coffee, cocoa and kola nuts, among others, were not visible on large scale plantations in the Project area. However, cocoa and coffee were found in isolated places such as Mokombay and Mosenegor,

Oil palm was both observed and reported to be the most important tree crop in the study Chiefdoms and along the proposed road alignment. All oil palm plantations are privately owned except for the plantation around Gbangbatoke town and its surrounds, which was reported to be publicly owned. All communities visited had farmers that owned oil palm plantation with size ranging from 2 acres to 15 acres.



Source: CEMMATS 2017

Figure 5.2-11: Uses of Oil Palm in the Project Area

Oil palm owners confirmed that oil palm contributes significantly to the economic wellbeing of their households (Cemmats, 2017). As shown in Figure 5.2-11, 50% of the respondents reported that oil palm products were mainly used for commercial purposes. That is, the products from oil palm produce are sold to generate income to meet household needs compared to 35% of them who stated that it was mainly for household consumption.

b-iii) Livestock

As is common with rural settlements in Sierra Leone, livestock were observed in all localities visited. Different kinds of livestock were seen with the most common in all communities visited being goats, sheep and poultry (comprising chickens and ducks). In Moselolo, almost every household was reported to own sheep, but no goats were observed. The traditional free-range method at household level, combined with tethering in areas close to the community, were adopted methods used to raise animals. Livestock are confined to household or family compounds for security reasons and preventing them from damaging crops during cropping season.

Livestock farming in the Project area is not well developed just as is the situation in the remainder of the country. According to Larbi (2013), the livestock sector is small and underdeveloped contributing 3% to national agricultural Gross Domestic Product (GDP) (SSL, 2010). In the Project area, livestock area reared mainly for subsistence and commercial reasons, and also for use in traditional and religious ceremonies.

c) Fishing

One important seasonal livelihood activity in the Project area is fishing. The two Chiefdoms making up the Project area are divided by River Gbangbaia and its tributary, the Kapui River. Lower Banta is also traversed by the River Jong and its tributaries. These rivers, and the many small rivers and streams in the Project area, offer fishing opportunities for communities within the study Chiefdoms. Fishing is a lucrative activity for both men and women, especially during the dry seasons. The use of dry dugout canoes, is common among male fishermen. Women normally use traditional fishing nets, characteristically elliptical in shape, to fish on the minor rivers in the dry season. Fishing for women is mostly for home consumption but for men and boys, fishing is mostly an economic venture. Mosenegor, Mano Kpaku, Gbangbaatoke, Kpandebu were identified as good fishing communities.

d) Hunting

Hunting in the Project area is limited to the use of trained dogs and local traps including hunting nets. These methods of hunting are in line with other rural settings of Sierra Leone although with slight regional variations. The use of shot guns is limited due to government restrictions, but it was not uncommon hearing gunshots in the evenings in some communities. Specific animal species hunted include grasscutters; deer; monkeys; and antelopes. Hunting is purely a male activity undertaken by men and boys and is both for home consumption and for income generating purposes.

e) Firewood

In rural Sierra Leone, wood otherwise known as firewood or fuel wood, is the only source of energy for cooking and sometimes lighting in the Project area. It is generally obtained from the farms (remaining wood after farm burning) and dead wood collected from forest or young farm bush. This is a common practice in rural communities where fuel wood is collected entirely for domestic purposes. Currently, the communities visited have no difficulties in fetching wood for cooking.

Charcoal production was localised in and around Mokombay, where 15 bags of charcoal were seen for marketing. The use of charcoal for cooking remains uncommon and was neither reported nor observed.

f) Forestry and Logging

There were no forest reserves in the study communities. However, mention was made of an estimated 7 acres forest reserve around Mokobay outside the Project area. It is thus safe to state that protected forests, forest reserves and agro-forestation are not typical of these communities safe for Mokombay area. However, forest gallery stretching along banks of Gbangbai and Kapui Rivers and surrounding settlement were apparent. Forests around settlements were the only forests and these were for secret societal activities. Logging was not observed but bush pole collection on large scale was seen between Ngeibu and Mano Junction.

g) Mining

No artisanal mining activity was observed in the Project area. However, gold mining was previously an economic activity in Moselolo, but this has now ceased.

5.2.6.2.6 Land Tenure, Land Rights and Access

An important factor in alleviating rural poverty and enhancing food security is having unhindered access to land. In particular, access to natural resources by poor farming families such as land, forests, water, fisheries, pastures, etc., is critical for sustainable poverty reduction (Unruh and Turay, 2006). Therefore, poor rural households that lack adequate access to land or lack land rights and by extension, inadequate access to natural resources, are highly vulnerable to food insecurity, hunger and general economic hardships. Consequently, advancing access to land for rural populations remains an essential element of State Policies which must be fully enforced. In an effort to improve access to land, various means of access to land are defined in the National Land Policy (2015) (GoSL, 2015).

The National Land Policy outlines two types of land tenure systems at the local levels that comprises the administrative Chiefdoms, sections, communities and families and or households within such communities. These are the communal and family land tenure systems. The communal land tenure system is the most common land tenure system in rural communities like the Project area. Its main feature is community and local authority ownership of land. Such local authorities include local Chiefs and community Council of Elders who are charged with the responsibility of exercising firm control over the land tenure system. Within the communal land tenure systems, every household or community member has the right of access to the land belonging to the community for annual or seasonal cultivation. However, access to land for tree or permanent cropping requires the approval of the community Chiefs or Council of Elders. Land could also be owned by families in the Chiefdom under the Family Tenure System of land ownership. The Family Tenure System is regarded as the system of ‘customary tenure in which title to certain lands within Chiefdom is claimed by various descent groups, each with a common ancestor’ (GoSL, 2015). In these two land tenure systems (communal and family tenure), it is hard if not impossible to draw

sharp boundaries between plots of community and family land, even though there are claims of clear knowledge of such boundaries. In the Project area, the existence of communal land and family land tenure systems were confirmed.

Equally, individuals and households could have permanent ownership of land where they have cultivated permanent economic crops. As the population of communities continues to grow, the demand for land is gradually becoming high and few of the communities visited claimed that the communal land tenure system will soon become difficult to manage.

a) Inheritance

Land inheritance is defined by the customary land tenure system in the Project area. The customary land tenure system comprises verification, protection and allocation of lands and land rights to the formal and full responsibilities of the male heads of households who represents their ancestors. Consequently, access to family lands for farming has to be granted by the head of the household or family although such approval is normally assumed granted especially if the land is not in conflict and has been constantly cultivated by the family member. The head of the family or households is also responsibility for ensuring that decisions on family land are in the best interest of the family, particularly when this relates to livelihood protection. Generally, it is expected that the authority of head of household remains intact unless he is too old or when he is dead. The eldest son assumes these responsibilities in any of these scenarios, taking possession of the family land. However, in case of disputes between the children and other relatives over the land, the likelihood for such land to be divided is high.

5.2.6.2.7 Land Use Dynamics

The earth's land cover has been changing for decades as a result natural phenomena and human interference. According to Briassoulis (2000), land-use and land-cover change of a location and a particular time is dictated by various biophysical and societal factors which works in complex and interrelated webs of place and time-specific relationships. The biophysical factors which comprise climate and weather, topography, bed rock and soil type influence the type of land use and land use change. Similarly, the choice of land use and the decisions to change it at an individual level dictated by the household's socioeconomic and demographic characteristics including, but not limited to household size, age, gender, education, employment, attitudes, values, and personal traits of family or household member. Other important determining factors of land use and land cover change are access to farm land, capital, transportation costs, size of farm size, production cost and product prices, type of land tenure and land management practices, etc. Factors such as population structure and dynamics, income and affluence, technology, socio-economic organization, culture, institutions, and political systems are influential in determining the demand for land, patterns of land-use and land use change (Ibid, 2000). These complex biophysical and socioeconomic interactions and relationships at individual and societal levels combined with their resultant land use and national and international land use and land cover policies, determine future land-use and land cover change.

In Sierra Leone, the nature and practice of 'bush fallow' which is associated with shifting cultivation remains a key factor affecting agricultural production and type land use (Renner-Thomas, 2010). Bush fallow requires that vast expanse of agricultural land is left to fallow without any form of active cultivation so as to regain soil fertility. This system of farming limits the amount of agricultural land available for farming families and individuals. It demands high human resource input particularly for land clearing and preparation at any one time relative to annual brushing of new patches of secondary bush.

According to Renner-Thomas (2010), increase in cash crop production and the advent of modern farming techniques, have witnessed reduction of fallow periods as lands once left under fallow, are progressively brought under permanent cash crop cultivation. Equally, the need to enlarge the traditional farm bush has played its part in shortening of the number of years the land can fallow. In some cases, farmers are forced to migrate to other sections or Chiefdoms in search of fresh farm land. Consequently, the high pressure on the upland ecology has not only amplified demand for IVS ecology, but also changed the pattern of land use. Linked to this is the changing land tenure system from the more traditional communal system to private ownership. This enables entrepreneurs who cannot secure adequate land from the communal land tenure system to purchase enough farm land for intensive investment and development.

As noted in CEMMATS 2014 ESIA study on the Moyamba Hydro Power Project, diverse and important drivers for land use exist in Bagruwa and Upper Banta Chiefdoms in Moyamba district. These factors are generally linked to the ever-increasing demand for farmland per household, expansion of settlement and living space per person, increased need for mobility and associated expansion of transport infrastructure, etc. Indications are that the biophysical environments, cultural context, demographic characteristics and socio-economic activities which are related to land use change of an area, typically varies in time and space. Therefore, the causes of land use change identification require accurate and adequate knowledge of how stakeholders and policies makers take decisions on land use and the way diverse factors relate in specific settings in influencing such decisions at different levels.

Factors like agricultural expansion through annual increase in farm size, the traditional slash and burnt system of farming and wood or bush pole extraction for domestic fuel-wood and construction respectively, smallholder permanent cultivation of oil palm, sometimes settlement expansion, bush fires and pests and food insecurity were identified as the proximate drivers of land use change. Other proximate factors such infrastructural extension especially roads, public markets, public services (water line and power lines for electricity) were not cited as significant factors influencing land use change in the Project area as is the case in many parts of rural Sierra Leone.

Equally, demographic factors which are determined by large household sizes and influenced by high fertility, polygamous marriages, extended family systems and the need for large family labour, was identified as important proximate causes of land use change. Large households are associated with large farm labour although they require more resources to feed these workers, resulting in large farm sizes and hence more deforestation. Socio-cultural

factors were also identified as key determinants of land use change in the Project area. The traditional values and cultural practices have given rise to forest patches around most settlements which assist in the maintenance of land cover in the affected areas. However, the annual festivities associated with these greatly influence the land use types and scale through the use of a large portion of household harvests and financial resources.

More importantly, the commercialisation of food crops, particularly cassava in the Project area, continues to be valued as a driver for land use change. The desire to market surplus farm produce to meet other household needs was established as a direct driver of land use change by imparting on farm size. Equally, the constant cultivation of cassava for commercial use is helping to increasingly reduce the fallow periods as young farm bush is normally required for its cultivation. This comes amidst absolute poverty in the area resulting from the lack of lucrative livelihood activities like artisanal mining. Consequently, household needs including healthcare, education, transport costs for periodic trips and secret societal / festive commitments etc. have to be paid for from sales of surplus food, especially cassava. These underlying factors have greatly dictated the household decisions on the scale of agriculture activities. They have also greatly influenced the type of land use and the level of land cover change in the Project area.

5.2.7 Traffic Management Assessment

The traffic study evaluated the nature of traffic along the existing route. A survey was conducted along the road network, to establish the existing traffic situation and evaluate the potential impact which traffic may have on the socio-economic situation and the environment.

Managing traffic during construction is an important part of ensuring the site is without risks to health and safety. Therefore, to effectively protect pedestrians, it will be required to minimise or eliminate all traffic hazards. This will be done by designing detailed traffic management measures for the construction and operational phases of the project.

5.2.7.1 Methodology

5.2.7.1.1 Classified Traffic Counts

A six-day bidirectional classified traffic volume count was carried out for 24 hours each day, in order to assess the traffic condition on the existing road from Mogbwemo to Gbangbatoke and from Gbangbatoke junction to Moselolo. The number of vehicles travelling was recorded by means of manual observation using the appropriate classifications (See Annex E of the appendices for Traffic Count Forms).

A simple vehicle classification was adopted in order to facilitate field data collection by using descriptions and vehicle types that the field enumerators used.

The traffic count was classified as follows:

- Private cars including Land Cruisers etc. carrying passengers;
- Taxis carrying passengers;
- Mini bus (Poda Poda carrying up to 18 passengers);

- Pick-ups and vans carrying goods (1 - 2 tonnes);
- Medium bus (comfort types carrying 22 – 35 passengers or more);
- Large bus (RTC type carrying 40 - 60 passengers);
- Light truck (2 axles carrying goods and passengers; 3 - 5 tons, 6 wheel, 4 wheel);
- Heavy truck (2 axis heavier goods / passenger trucks; 6-10 tons, 6 wheel, 8 wheel,);
- Truck (3 & 4 axles, 10 wheels, and trailers);
- Motorcycle / bicycle
- Pedestrians.

5.2.7.1.2 Origin and Destination Surveys

Origin and Destination (OD) surveys were undertaken in order to ascertain details of the movement of people and goods in the Project area. The purpose of transportation demand studies is to collect and analyse data relating to the present and future transport needs. They are an essential part of the transportation planning process. OD surveys are used to determine where trip makers are coming from (their origin), where they are going to (their destination) and the purpose of their journey.

An OD survey was carried out at the Gbangbatoke and Mogbwemo end of the road, as well as at the Gbangbatoke junction to Moselolo end, where passengers onboard various types of transport, were interviewed. The study involved driver / passenger interviews to establish trip patterns for a typical day in the Project area.

The following information was collected:

- Origin and destination of the trip;
- Passenger occupancy rates for different classes of vehicles;
- Purpose of trip, travel time;
- For people: frequency, transport mode used, products carried, and
- For goods: nature, weight, similar trip regularity.

5.2.7.2 Results

The tables below summarise the traffic counts conducted for Gbanbatoke Junction to Moseilolo and Gbanbatoke to Mogbwemo respectively. For each stretch of road evaluated, a 24-hour survey was conducted for six consecutive days. As per Annex E, traffic data was collated in sets of 4 hours and the totals per vehicle type and for the entire day recorded. The summary below (Tables 5.2-11 and 5.2-12) is a computation of the total of the 4-hourly counts per day. The full details of the traffic counts for all the days can be found in Annex E of the appendices and the variation on the activities can be clearly identified.

Table 5.2-11: Traffic Count Data – Gbangbatoke Junction to Moselolo

Traffic Count - Direction: Gbangbatoke Junction to Moselolo Weekly Average - Time Interval - 06:0am -06:00am							
Vehicle Type	WED	THUR	FRI	SAT	SUN	MON	TOTAL
Private Cars Including Land Cruisers etc. Carrying Passenger	2	2	0	0	0	2	6
Taxis carrying Passengers	0	0	0	0	0	0	0
Mini Bus (Poda Poda Carrying up to 18 Passengers)	0	0	0	0	0	0	0
Pick-up and Vans carrying Goods (1-2tonnes)	0	0	0	0	0	0	0
Medium Bus (Comfort Types Carrying 22-35passengers Plus	0	0	0	0	0	0	0
Large Bus (RTC type carrying 40-60 Passengers)	0	0	0	0	0	0	0
Light Truck (2 axles carrying Goods and Passengers; 3-5 tonnes, 6 wheel, 4 wheel	0	0	0	0	0	0	0
Heavy Truck (2 axis heavier goods/passenger trucks with 6 wheels, 8 wheel, 6-10 tons	0	0	0	0	0	0	0
Truck (3 & 4 axles, 10 wheels, and trailers)	0	0	0	0	0	0	0
Motorcycle/Bicycle	65	70	59	70	93	39	396
Pedestrians	9	11	2	14	23	11	70
Grand Total	**76**	**83**	**61**	**84**	**116**	**52**	**472**

Table 5.2-12: Traffic Count Data – Gbangbatoke to Mogbwemo

Traffic Count - Direction: Gbangbatoke – Mogbwemo Weekly Average - Time Interval - 06:00am -06:00am							
VEHICLE TYPE	WED	THUR	FRI	SAT	SUN	MON	TOTAL
Private Cars Including Land Cruisers etc. Carrying Passenger	47	56	48	50	79	85	365
Taxis carrying Passengers	40	48	45	36	55	82	306
Mini Bus (Poda Poda Carrying up to 18 Passengers)	65	48	65	82	119	147	526
Pick-up and Vans carrying Goods (1-2tonnes)	37	41	46	70	80	84	358
Medium Bus (Comfort Types Carrying 22-35passengers Plus	36	49	52	55	55	113	360
Large Bus (RTC type carrying 40-60 Passengers)	15	31	29	21	24	30	150
Light Truck (2 axles carrying Goods and Passengers; 3-5 tonnes, 6 wheel, 4 wheel	31	38	38	51	56	63	277
Heavy Truck (2 axis heavier goods/passenger trucks with 6 wheels, 8 wheel, 6-10 tons	34	35	33	32	45	50	229
Truck (3 & 4 axles, 10 wheels, and trailers)	23	31	36	22	23	100	235
Motorcycle/Bicycle	129	263	276	298	295	269	1530
Pedestrians	189	265	265	252	249	281	1501
Grand Total	**646**	**905**	**933**	**969**	**1080**	**1304**	**5837**

5.2.7.2.1 Interpretation

The following could be inferred from the detailed surveys (Annexure E):

- There are more activities during the day time than at night along the road alignment;
- Most of the vehicles are of the commercial type, far surpassing the number of private vehicles. There are a higher number of commercial motorbikes as they are considerably cheaper to purchase and operate, and are more versatile along these poorly maintained gravel routes. Large trucks are mainly SRL vehicles on operational duties;
- There are more activities (vehicular, motor bikes and pedestrian movement) on the Gbangbatoke – Mogbwemo axis (Southern half of route) than on the Gbangbatoke Junction and Moselolo axis. People come from all parts of the country to the Southern end of the route. As the Bonthe District is a particularly good agricultural area; coupled with the large number of residential SRL workers and their families good, regular income; attracts people and goods to the area. Economic activities of the area increase before, on and after the community market (Ndorwei) days on Sundays and Mondays. This is in contrast to the Sembehun end of the road where there are hardly any current activities;
- Cargo from the Project area to Freetown, Bo, Mogbwemo, Moyamba town and other parts of the country includes mostly agricultural products, such as palm oil, cassava, gari, fufu and fish. Most of the vehicles were overloaded;
- Cargo to the Project area includes products such as clothing, construction materials, beverages, provisions, electrical and electronics etc.; Due to the poor road network, shortage of vehicles, widespread poverty and high petroleum prices, a large portion of the population residing in the Project area prefer walking or using motor bikes as a mode of transportation, and
- On the Gbangbatoke – Mogbwemo axis, where the road condition is better, there is regular transportation to and from Freetown, Bo and Moriba Town carrying passengers and basic food stuff. Transportation on either side of the river is more frequent on assigned market days when the community market (Ndorwei) is held on Sundays and Mondays.

5.2.7.2.2 The Road Management and Safety Situation

The number of vehicles registered in Sierra Leone is between 60,000 and 70,000. Commercial motorcycles are a popular means of public transportation and is the main means of transport in provincial areas; it is however generally acknowledged that they are poorly regulated.

The road safety situation in Sierra Leone is poor. The accident rate per 10,000 vehicles is about 40. Passengers are the most vulnerable road user group (60% of all fatalities) followed by motorcyclists (20%), followed by pedestrians (15%). Though the political support for road safety is emerging, it is generally still low at both central and local government levels. Road safety coordination is entrusted to the SLRSA. Unfortunately, the SLRSA is not performing its coordination roles effectively for the expected results.

The following table highlights the various reasons recorded by the SLRSA for road traffic accidents and road traffic offences, from their Motor Traffic Report (2016).

Table 5.2-13: Categories of Road Traffic Accident Cases and Offences

1	Reckless driving	12	Disobeying stop signal
2	Dangerous driving	13	Failing to exhibit vehicle license
3	Careless driving	14	Obstruction
4	Exceeding speed limit	15	Defective brake
5	Using unauthorised route	16	Lack of necessary accessories
6	Unauthorised use of vehicle	17	Insufficient light
7	Unlicensed driver	18	Detail unpainted
8	Unlicensed vehicle	19	Overloading passengers
9	Failing to produce license	20	Overloading goods
10	Failing to report accident	21	Parking offence
11	Failing to give name and address	22	Other type of offence

5.2.7.2.3 Issues with National Road Safety Management

Table 5.2-14: Road Safety Management Issues

Issue	Comment
Road Safety Audits	There are currently no routine regular road safety audits in place on the entire road network and no compliance regimes.
Black Spot Management	SLRA undertakes black spot improvement works but they are not routine and as comprehensive as they ought to be.
Speed Management	The implementation and enforcement of speed along the road network is poor. The mechanical condition of the highway patrol vehicles is poor. The motorcycles are also in poor mechanical condition and therefore not particularly effective. In addition, there are no speed radars to assist in speed detection and management.
Alcohol Management	The implementation and enforcement of alcohol management is carried out without any equipment thereby limiting the effectiveness of alcohol management.
Seat Belt Enforcement	Overall, implementation and enforcement of seat belt management is poorly managed as some of the seatbelts are just of a formality and many of the seatbelts in public transport are not in good order.

Issue	Comment
Helmet Enforcement (Motorcycles)	The enforcement of helmet use in Freetown seems to be comparatively high with compliance of both the public transport operators and their passengers. However, outside the Freetown area, the compliance levels are less significant. In rural areas, where Police surveillance is poor, the helmet use compliance is said to be extremely poor. This implies the helmet management is only driven by enforcement action rather than voluntary compliance.
Focus on High-risk Groups	There is no focus on pedestrian facilities except for Zebra crossings found in the central business district (CBD) of Freetown.
Road Safety Standards - Vehicles	The implementation of vehicle standards is poorly managed. Sierra Leone has no vehicle assembly plants; all vehicles are imported. Most imported vehicles are used vehicles over 5 years old.
Vehicle Inspections	SLRSA is mandated to undertake vehicle inspections for motor vehicles in the country.

5.2.7.2.4 Safety Standards on Driver Training and Testing

There are no set standards for performance targets in driver training and testing whether for private, commercial or public transport drivers. There are no compliance regimes in place to deal with issues of high risk road users like the young, older, commercial and public transport drivers or riders.

a) Driver License Requirements

The Traffic Act 2007 stipulates the conditions for acquisition of a driving license.

b) Driver Training

Driver training standards are extremely poor. Many drivers in Sierra Leone are either trained by unqualified trainers or are self-trained. There are very few driving schools and these focuses mainly on small vehicles (Group B) and no opportunity for trucks or buses. Most driver instructors are self-trained and have never undertaken a professional driver instructor education.

c) Driver Testing

Driver testing in Sierra Leone is carried out by the SLRSA. Drivers are tested in regard to knowledge on traffic signs and vehicle manoeuvring. The testing involves practical and theoretical tests. Upon completion of testing, the candidates are given a Certificate of Competence, thereby leading to acquisition of a driving license. The driving licence is the conventional plastic card which is now used in many African countries. In order to improve driver testing, Government plans to develop a new test regime.

d) Enforcement

The strength of the Traffic Police Personnel is low and most are deployed in the Western Area where traffic concentration is highest. The Police have severe logistical challenges.

5.2.7.2.5 Recovery of Accident Victims

Sierra Leone has no dedicated post-accident rescue system that is dedicated for evacuation of road crash victims. Though health centres have Ambulances, they are not dedicated to emergency evacuation of road traffic victims.

a) Compliance Regimes

There are no standard compliance regimes in the recovery of accident victims.

b) Focus on High-Risk Groups

There have been efforts by the World Health Organisation (WHO) in conjunction with the Ministry of Health and Sanitation to advocate for setting up standards and also reducing the number of accident victims through proactive methods.

c) Compliance with International Good Practice

There is no compliance to the international good practice apart from the hospital which is guided by the WHO standards. Pillar 5 of the Decade of Action outlines the need for improvement in post-crash care.

5.2.7.2.6 Road Safety Awareness Campaigns

Government usually holds regional workshops in different parts of the country on an irregular basis. The first road safety committee was set up in 2001 and have since been established in a number of regions. The committees include the main stakeholders in road safety like the Police and Drivers Unions.

5.2.8 Visual and Topographic Assessment

5.2.8.1 Methodology

This assessment was carried out using a combination of a literature review and field observations.

5.2.8.2 Results

Topographically, Moyamba district can be divided into two topographical zones. The lowest part of the district is located along the south-west and rises gradually to a height of approximately 1,200 mamsl, which is the highest portion of the district.

The landscape of the proposed route is relatively flat and dominated by agricultural land. During the pre-construction stage, land rising, and land development activities will be impacted upon, and bring about changes in landscape and topographic features along the route.

The existing road is lined by vegetation on either side of the fairly narrow alignment. Visual impacts will mostly be permanent and result generally from the following issues:

- Clearing of vegetation within the right of way resulting in the widening of open spaces;
- Construction of the haul road with associated activities;
- Presence of construction machinery and equipment (temporary);
- Dust generation around active construction sites and from vehicular movement on the roads during the mining phase;
- Construction of the bridge across the Moselolo River;
- Construction of transmission line towers, and
- Increased vehicular activity.

Community consultations throughout the project implementation will aid in preparing community members for the changes which will take place at the various stages of the project. Pictoral explanations will further aid this process.

5.2.9 Ecology

5.2.9.1 Methodology

5.2.9.1.1 The Physical Environment

The assessment of the physical environment focused on two main characteristics:

- The topography and geomorphic features in relation to vegetation and ecology of the areas to be affected, and
- Siltation / sedimentation potentials along the river banks.

The topographic and geomorphic baseline was obtained from published literature (Birchall et al., 1979) and re-examined through direct observation and GPS information. Siltation / sedimentation potential was assessed by observation along the river banks of signs of erosion by water flow from communities and drainage systems and from the force of river flowing along the bank.

5.2.9.1.2 Biodiversity Survey Techniques

Data was obtained through various standard methods for the respective themes involved in this assessment. The methods range from actual field data collection to interviews with local communities, depending on the thematic area of interest. The extent and type of data collected was limited by the time and resource availability, but will not significantly affect the credibility of the assessment. Descriptions of the various methods used are given below under each thematic sub-heading.

a) Mammals

The mammalian diversity of the proposed Project area was assessed mainly through interviews with local hunters and farmers, who by experience have better knowledge of the species that exist and their respective abundance and distribution status. Information provided

by respondents was verified through triangulation methods during the course of interviews. Due to time and resource constraints, no trapping was done, but additional information was obtained by direct observation of species, foot imprints and faecal deposits. Therefore, the data is presented based on mere occurrence and some indications of the relative abundance of the species. Two or more people, inclusive of a hunter, were interviewed in each of the six villages visited across the Project area. The book: A Field Guide to Mammals of Africa (Kingdon, 1997), which has pictures of mammals, was used to help verify and properly identify species whose occurrence where indicated by respondents.

b) Avifauna (Birds)

Avifauna survey techniques were based on standard published methods applicable to the type of assessment required (Bibby et al., 2008). Data on bird diversity was collected mainly by walking through defined transect up to 1 km long, replicated in an adjacent transect at least 100 m apart, where appropriate. Such methods allow for traversing various sub-habitats within a particular zone, and thus the probability of encountering a good representation of the species that characterise the avifauna of the area. In addition, point surveys were employed for keen and focused observation at specific locations along transects, especially whenever species of conservation interest were encountered. Recording and play-back techniques were occasionally used to attract and identify shy and uncommon species. A field guide (Borrow and Demey, 2008) was used to verify species identification during the course of the survey.

Table 5.2-15: Name and Locations of Avifauna Observation Sites

Sites visited	GPS Coordinates	Sites visited	GPS Coordinates
Gbangbaia	N: 0750777 W: 01225511	Ngeihebu Village	N: 0755685 W: 01226715
Moselolo Village	N: 0750895 W: 01225684	Gbangbatoke IVS to streams	N: 0756250 W: 01227900
Bridge	N: 0750993 W: 01225369	Bamboo cane forest	N: 0756345 W: 01228580
Mosenogor Village	N: 0752169 W: 01225249	Gallery forest	N: 0756737 W: 01227899
Canopy forest	N: 0752176 W: 01225234	Komende Village	N: 0756762 W: 02127895
Raffia palm swamp	N: 0752286 W: 01225314	Momasa Village	N: 0750785 W: 01225353
Campbell's Monkey seen	N: 0752357 W: 01224824	Gallery forest	N: 0750743 W: 01225435
Mayasa village, farm	N: 0753540	Farmbush with wild palm	N: 0750372

Sites visited	GPS Coordinates
	W: 01226045
Primary forest	N: 0753356 W: 01225752
Fula town village	N: 0753856 W: 01226265
Raffia palm swamp/forest	N: 0754314 W: 01226923
Oil palm plantation	N: 0753850 W: 01226196
Pandebu Village	N: 0753883 W: 01226675
Forest	N: 0754090 W: 01226709
Gallery forest along stream	N: 0754378 W: 01227003
Gallery forest along stream	N: 0754390 W: 01226943
Gallery forest along stream	N: 0755217 W: 01227608
Farmbush with oil palm	N: 0755329 W: 01227599
Raffia palm	N: 0755450 W: 01227590

Sites visited	GPS Coordinates
	W: 01224472
Riparian forest and village	N: 0749347 W: 01224081
Primary forest	N: 0749435 W: 01224158
Community forest (BHWB)	N :0749484 W: 01224016
Gbangbatok Town	N: 0748363 W: 01223028
Palm kernel plantation	N: 0748684 W: 01223211
IVS	N: 0749109 W: 01223709
Swamp forest	N: 0749271 W: 01223920
Mogbwemo Village	N: 0748142 W: 01221504
Mokoba Village	N: 0749155 W: 01221277
Lago Village	N: 0748965 W: 01219195
Rock hyraxes seen	N: 0754548 W: 01226968

c) Reptiles and Amphibians

The survey method included visual and auditory monitoring, and focused on areas / habitats that have water bodies including swamps and riparian forests, and also forest patches in selected available habitats types (riparian forests, riverbank, forest patches, mixed old and new farm bushes and swamps). Leaf litters, logs and habitats for arboreal species, aquatic and fossorial amphibians were searched, and species recorded accordingly. Some of the sites were surveyed both during day and night time. All searches / surveys at specific sites lasted for at least two hours and were conducted by at least three persons in areas of 0.5 to 1 ha. A list of communities visited, and coordinates are presented in the following table. Garmin GPS Map 64s was used for recording site's GPS readings.

Table 5.2-16: Herpetofauna Survey Sites

Site	GPS Coordinates		Site Description
Moselolo	0783619	0868393	Forest along the Gbangbaya River
Mosenegor	0784610	0870849	Forest alongside a swamp
Moyassah	0782806	0873420	A large forest patch, farm bush & swamp
Fula Town	0782513	0873812	Forest along a stream and swamp
Gbandebu	0781824	0873886	Forest, farm bush and swamp
Kassama	0781215	0875106	Swamp, farm bush
Ngeibu	0779900	0877237	Matured farm bush and swamp
Mokumba	0778491	0883190	Farm along a swamp and plantation
Momassah	0784218	0868182	Riparian forest along Gbangbaya river
Moporhoi	0785501	0867434	Matured swamp, forest patch, plantation
Bengelo	0786643	0865538	Swamp, farm bush and plantation
Gbangbatoke Swamp	0789087	0863482	Swamp and grassland and planation
Mogbwemo	0791395	0863348	Swamp and vegetable garden
Mokombe	0791755	0865222	Forest and matured farm bush and swamp
Largo Junction	0795584	0864902	Swamp and grassland

All species encountered during the surveys were identified by means of field guides. The field guides included 'Rödel's Herpetofauna of West Africa (Rödel, 2000)'; pdf files of the 'Guide to West African Amphibians'; and 'Guide to West African Reptiles' (private documents provided by M.-O. Rödel and A. Hillers); 'Guide des Serpents d'Afrique Occidentale (Trape and Mané 2006)'; and 'Tree Frogs of Africa (Schiotz, 1999)'. Furthermore, call recordings were made for post-survey verification. Due to the timeframe of the survey and also the lack of facilities for specimen analysis in Sierra Leone, no representative specimens were collected.

In order to document more reptile species that occur along the proposed haul road, on-the-spot interviews were conducted through presentation of photos of reptile species known to occur in Sierra Leone. Results of the interviews are presented in the table of species recorded (Table 4, Annex A), and are not used to confirm the presence of the species by this study.

d) Fish Fauna

This survey characterized the fish species occurring in selected wetlands likely to be impacted by Project activities. These include two large rivers which catchments reduce to lower margin during the dries (Gbangbaia River, Gbenji River). Gbangbaia River runs through the Mosamah community and, thereafter through Moselolo, where it connects with the sea.

Gbenji River runs through Bamako settlement and then, Gbangbatoke, where it also connects the sea.

Sampling was also conducted in six other wetlands (characterised as streams), located in the 50 m corridor of the proposed road alignment. Based on information obtained from the local residents regarding the sources and connectivity of the streams, these were characterized into either 2nd or 3rd order streams (Table 5.2-17).

Table 5.2-17: Fish Sampling Locations

Settlement	Wetland	G.P.S Coordinates	
Lago Junction	IVS	795635	864603
Mosenesi-1	IVS	791978	863722
Mokombay	Gbenji River	791745	865433
	Bendui stream (2nd order)	791829	865243
Mogbwemo	Kumbuibu stream (3rd order)	791246	863458
Gbangbatoke	Gbenji River	788406	863884
Momasah	Gbangbaia River	784071	868106
Morpohoi	Kpitiyei stream (2nd order)	785557	867536
Bengeloh	Molimbi swamp	786849	865722
Moselolo	Gbangbaia River	783936	868163
Mosenegoh	Gbangbaia River	784996	870584
Moyassah	Morbaka stream (2nd order)	782713	873544
Fula Town	Morbaka stream (3rd order)	782713	873544
Kpandebu	Morgbabai stream (2nd order)	781366	872815
Kassama	Stream (3rd order)	781257	876832
Ngiebu	Morlanjoi stream (3rd order)	779222	876751

A representative specimen of each species caught was preserved in a 96% alcohol mixture for further identification. Identification of fish species was accomplished with the aid of published guides by Paugy *et al* (2003, 2004) and Payne *et al*, 2007.

Semi-structured interviews were conducted with indigenes in settlements in close proximity to the proposed road alignment. This was done mainly to confirm species recorded during sampling and also to obtain information on fisheries in the area.

5.2.9.1.3 Sampling Methods:

- Fish sampling during this survey involved the use of set nets of 2.5 and 3.5 cm mesh sizes, as well as hand dip nets. The use of gill nets allowed a fairly standard sampling unit of gill-net / night in rivers such as Gbenji and Gbangbaia Rivers at points where the river is accessible enough for sampling. In streams and swamp, most sampling had to be done by using a hand dip net. This had the added advantage of collecting some specific fauna adapted to live in such habitats which cannot be caught by gill nets. Fresh fish species were also purchased from fishermen encountered at some points.
- Where sampling could not be done due to high water currents and rapids, photos of fish species were shown to fishers to identify fishes occurring in the water bodies.

Figure 5.2-12: Fish Sampling

5.2.9.2 Results

5.2.9.2.1 Vegetation

The Project area is characterised by extensive flooding along the banks during the rains, covering a large area of riparian ecology that are interconnected with IVSs and raffia swamps. Riparian ecology includes all areas inundated by natural flooding cycles along the river course. It is affected by seasonality, precipitation levels and stream flow, and so the riparian ecology is flood-dependent. Flooding cycles causes natural disturbance regimes in the riparian ecology, thereby facilitating species diversity and dispersal of seeds and plant propagules. This mechanism ensures that species are distributed in regular fashion to effect optimal ecological functioning. In many instances observed, the riparian ecology is contiguous with gallery forest, establishing stable and nutrient-rich habitats that are protected from adverse conditions such as strong weather and siltation. Such healthy riparian ecologies were observed in most of the riverine sites visited.

The vegetation structure of the Project area is very similar to the general state of the vegetation in Sierra Leone. The landscape is a mosaic of various vegetation cover ranging from gallery forest along the river course, to farmbush (as the dominant land cover at

different stages of ecological succession), open land, farm land, small isolated patches of forest and human settlements. The general structure of the landscape is one that is dominated by farmbush and farmlands, as a result of considerable modification due to the widespread practice of the traditional slash-and-burn agriculture. The gallery forest is quite thin, in most cases between 20 and 50 meters from the edge of the river to its outer limits, depending on the location. The majority of the currently active farms, mostly cultivated cassava and some rice. Much of the bush fallows are between one and five years old, which is slightly lower than the estimated fallow periods in the country (Gleave, 1996; Okoni-Williams, 2013).

Figure 5.2-13: Gallery Forest

Figure 5.2-14: Farm Bush

Figure 5.2-15: Raffia Swamp

Small plantations of oil palm were encountered in and around nearly all settlements. Oil palm plantations are one of the key agricultural investments in traditional agro-economies. The plantations normally acts as a source of future or reserved income, on which the family or individuals can fall back in the event that substantial sums of money are required to address issues like funerals, birth and marriage, among others. There are few small plantations of cacao, coffee and citrus, in scattered locations, particularly around village settlements.

5.2.9.2.2 Mammals

Through interviews with local inhabitants, it was determined that the vegetation of the area was once dominated by closed canopy lowland forest, which historically would have supported a wide diversity of mammal species. During this investigation, a total of 32 species of mammals were recorded, most of which were through secondary information provided by the local hunters (Table 5.2-18).

Twelve (12) species of mammals listed in Table 5.2-18 were recorded through direct evidence as follows:

- Sightings (SGT) – Campbell's Monkey. Sooty Mangabey, Spot-nosed Monkey, Marsh Cane Rat, Giant Pouch Rat, Fire-footed Rope Squirrel, Stripped Ground Squirrel.
- Faecal matter (FCM) – Bushbuck, Maxwell Duiker, African Civet.
- Footprints (FPR) – Bushbuck, Maxwell Duiker, African Clawless Otter.

Table 5.2-18: Mammals Recorded During the Survey (including the source of data, IUCN status and local status)

English name	Scientific name	Source of data	IUCN	Local status
Western Chimpanzee	*Pan troglodytes verus*	INT	EN	Very rare
Callithrix monkey	*Cercopithecus sabaeus*	INT	LC	Rare
Campbell's Monkey	*Cercopithecus campbelli*	**SGT**	LC	Getting rare
Pied Colobus Monkey	*Colobus polykomus*	INT	VU	Rare
Sooty Mangabey	*Cercocebus atys*	**SGT**	VU	Getting rare
Olive Colobbus	*Poliocolobus verus*	INT	LC	Getting rare
Spot-nosed monkey	*Cercopithecus petaurista*	**SGT**	LC	Relatively common
Potto	*Perodicticus potto*	INT	LC	Rare
Bush Pig	*Potamochoerus larvatus*	INT	LC	Commom
Red-river Hog	*Potamochoerus porcus*	**FPR**	LC	Getting rare
Water chevrotain	*Hyemoschus aquaticus*	INT	DD	Rare
Bushbuck	*Tragelaphus scriptus*	**FPR /FCM**	LC	Relatively common
Maxwell's Duiker	*Cephalophus maxwelli*	**FPR /FCM**	LC	Getting rare
Bay Duiker	*Cephalophus dorsalis*	INT	LC	Rare
Red-flanked Duiker	*Cephalophus rufilatus*	INT	LC	Getting rare
Royal antelope	*Neotragus pygmaeus*	INT	LC	Getting rare
African Civet	*Civettictis civetta*	INT	LC	Getting rare
Forest Buffalo	*Sincerus caffer*	INT	LC	Getting rare
Tree Pangolin	*Phataginus tricuspis*	INT	NT	Very rare
Giant Pangolin	*Smutsia gigantea*	INT	VU	Very rare
Marsh Cane-rat	*Thryonomys swinderianus*	**SGT**	LC	Very common
Giant pouch rat	*Cricetomys gambianus*	**SGT**	LC	Very common
Fire-footed rope squirrel	*Funisciurus pyrropus*	**SGT**	LC	Very common
Stripped Ground Squirrel	*Euxerus erythropus*	**SGT**	LC	Very common
Crested porcupine	*Hystrix cristata*	INT	LC	Getting rare
Common Cussimanse	*Crossarchus obscurus*	INT	LC	Getting rare
Common Genet	*Genetta genetta*	INT	LC	Getting rare
Demidoff's Galago	*Galagoids demidoff*	INT	LC	Getting rare
African civet	*Civettictis civetta*	**FCM**	LC	Getting rare
Cape Hare	*Lepus capensis*	INT	LC	Getting rare
African Clawless Otter	*Aonyx capensis*	**FPR**	LC	Getting rare
Common Rabbit	*Oryctolagus cuniculus*	INT	LC	Getting rare
Rock Hyrax	*Procavia johnstoni*	INT	LC	Rare

Source of data: SGT – Sightings; FPR – Foot prints; FCM – Faecal matter

Three of these species are listed as threatened according to IUCN Red Data List (2017) as follows: Western Chimpanzee *Pan troglodytes verus* (EN), Pied Colobus Monkey *Colobus polykomus* (VU), Sooty Mangabey *Cercocebus atys* (VU) and Giant Pangolin (VU); one near threatened (NT) and one data deficient (DD) species were also recorded (Table 5.2-18). The sources of data for each of the species listed are also given in the table.

None of the species recorded through the direct evidences, as listed, are considered threatened, but some are getting rare as indicated in Table 5.2-18.

Among the species recorded by various methods, Spot-nosed Monkey *Cercopithecus petaurista*, Olive Colobus *Poliocolobus verus* and Campbell's Monkey *Cercopithecus campbelli* (all of which are of least conservation concern), were the most common primates. According to local respondent, chimpanzees encounter rates have declined considerably over the years. For antelopes, Maxwell Duiker *Cephalophus maxwelli* and Bushbuck *Tragelaphus scriptus* were relatively common, although they are getting rare generally. The Marsh Cane Rat *Thryonomys swinderianus* and Giant Pouch rat *Cricetomys gambianus* are generally common and mainly encountered in farmbush.

Monkeys are delicacies among the communities in this area and so these species are targets of hunting by both local people and non-indigenes. However, there was a general restriction on license for the use of shut guns, which has been lifted recently, thus allowing population recovery of some monkey species such as Campbell's Monkey and Callithrix Monkey in some places. Antelope species are also intensively hunted in the area and so despite their high reproductive rates, encounter rates have also declined. The Marsh cane rat (locally called cutting grass) is the most trapped of all bush meat species; it has a high rate of fertility and so population recovery rate is high. The species is commonly found in farmland and young farmbush and, so it is common to see fences and snares for trapping the animal in farms and farmbush.

5.2.9.2.3 Avifauna

Table 5.2-19 shows the diversity of avifauna of various biogeographic categories and status that occur in the Project area, expressed as a percentage of the totals for Sierra Leone.

The avifauna diversity indicates that the areas hold a total of 116 bird species belonging to 28 avian families (Annex A of the appendices). Among these, only two species of global conservation concern were recorded: Hooded Vulture *Necrosyrtes monochas* (CR) - two individuals of this species were sighted flying over a community forest (GPS - N: 756737; W: 1227899) near Komende village; and Black-headed Rufous Warbler *Bathmocercus cerviniventris* – one bird heard along a forest stream at Bengeloh (GPS – N: 786849; E: 865722). The remainder of the avifauna recorded comprises the following:

- 99 resident species of which 31 are of the Guinea-Congo forest biome assemblage;
- Afrotropical migratory species, and
- Four Palaearctic migratory species.

However, no Sudan-Guinea savanna biome and no Upper Guinea forest endemics were recorded.

Table 5.2-19: Diversity of Avifauna recorded in the proposed Project area and comparison with total for Sierra Leone

Species biogeographic category or status	No. of species recorded	Percentage of national total
Total no. of species	116	18.1
No. of families	28	27.4
Residents species (R)	99	29.7
Afrotropical migrants (AM)	6	12.7
Palaearctic migrants (PM)	4	4.3
IUCN Red List species (CR)	1	3.3
Guinea-Congo forest biome species (GC)	31	17.8

The data in Table 5.2-19 and Annex A, indicates that the avifauna diversity in the area did not perform well in terms of their comparison with the national totals, even with the total number of species (18.1%). Only two indicators show some appreciable level of diversity which should not be ignored:

- Considering the coverage, the number of avian families is quite encouraging, accounting for 27.4% of the national total. This shows that there is fair distribution of the species specific to the area, and
- The number of resident species (29.7%) can also be considered significant.

The representation of Guinea-Congo forest biome restricted species was low (17.8%) and no West African endemics were recorded. The more significant recording / sighting, was the occurrence of the endangered Hooded Vulture *Necrosyrtes monochas* (IUCN, 2017), which was recorded as two individuals atone of the 16 sites visited along the proposed haul road alignment.

In summary, the area lacks a significant diversity of species that could constitute an area of global conservation concern, or part of a significant network of species that are of significant biogeographic representation. Therefore, the Project area did not satisfy the necessary criteria for Important Bird Area designation (see Okoni-Williams et al, 2005).

5.2.9.2.4 Amphibians

During the survey, a total of 19 species of amphibians belonging to eight families including *Bufonidae; Astylosternidae; Arthroleptidae; Dicroglossidae; Conrauidae; Hyperoliidae; Phrynobatrachidae;* and *Ptychadenidae* were recorded along the proposed haul road (Annex A of the appendices).

Among the 19 species recorded include one Vulnerable (VU) species (*Conraua alleni)* and two Near Threatened (NT) species (*Hyperolius zonatus and Phrynobaytachus alleni*).

Conraua alleni was listed as Vulnerable in 2004, the status of which needs updating with more recent data. Factors that led to its categorization as VU, according to the IUCN Redlist (www.iucnredlist.org) included its dependence on streams in rainforests, and so its area of

occupancy is probably less than 2,000 km^2, and its distribution is severely fragmented. There is a continuing decline in the extent and quality of its forest habitat in West Africa. Its tadpoles were found in an IVS (28 N 791265, 863570) close to the Mogbwemo town, within a previously cultivated vegetable garden, and in a pond approximately 50 m from a secondary forest. At the same site, *Hyperolius zonatus* was recorded, while the *Phrynobatrachus alleni* was recorded in two communities (Moselolo and Mosenegor).

Almost all species, except the *Phrynobactrus sp; Conraua alleni;* and *Leptopelis spiritusnoctis*, recorded during the survey are tolerant to degraded habitats. However, the majority of the species were recorded from farm bushes, forests and swamps with appreciable vegetation cover. The main cause of habitat modification along the proposed haul road alignment is largely farming (cassava and rice). This situation contributed to the recording of only a few amphibian species at the sites.

Records on amphibian species that occur in Sierra Leone exist among which is a consolidation of sources (Zug, 1987; Hillers, 2009; AmphibiaWeb website, 2012; GBIF website, 2012; IUCN website, 2012) indicating the presence of 60 species (ERM, 2013). A local organisation, the Reptile and Amphibian Programme Sierra Leone (RAP-SL), over a period of 5 years, has so far recorded 65 species, including ten species that were not formerly on IUCN record for Sierra Leone. According to an IUCN record for Sierra Leone, 55 amphibian species occur in the country (Carr, 2012). Therefore, recording 19 species during a seven-day survey exercise indicates that with more survey effort, some species that are tolerant to degraded areas will be recorded.

Three of these species are shown below:

Figure 5.2-16: ***Conraua alleni***

Figure 5.2-17: ***Hyperolius zonatus***

Figure 5.2-18: ***Phrynobatrachus phyllophilus***

5.2.9.2.5 Reptiles

During the survey, a total of nine reptile species belonging to four families (Agamidae, Scincidae, Varanidae and Elapidae) were recorded within and along the proposed haul road alignment through search and screening. One-on-one interviews with locals resulted in documenting 19 additional species belonging to five families (Boidae, Colubridae, Elapidae, Viperidae and Chamaeleonidae). On the whole, 28 reptile species belonging to eight families (Annex A of the appendices), were noted to inhabit the Project area.

Among the 28-reptilian species recorded, eight have been assessed by IUCN as species of Red List Concern (IUCN, 2017), while 20 are on the list of life but not assessed by IUCN. Species recorded, that are tolerant to habitat modification include the *Agama agama; Agama africana; Trachylepis affinis; and Lepidothyris fernandi harlani.* Riparian related species include the *Varanus ornatus.*

In Sierra Leone, there is no comprehensive record of reptiles though there is an ongoing effort by the RAP-SL to document the species that occur in the country. The number of reptiles and the understanding of their distributions are therefore incomplete. Reviews of different reptile genera have been published and they include species occurring in Sierra Leone (e.g. Hoogmoed, 1974; Böhme, et al. 2000). Unlike the IUCN internet-based database for amphibians, there are several claims of lists of reptiles of Sierra Leone. For example, the internet based Wikipedia states that there are 67 reptile species while the ERM (2013) indicates the presence of 115 reptile species and since 2012, RAP-SL has also recorded 62 reptile species in Sierra Leone. Therefore, recording 9 species from the searching and screening effort and 19 from interviews during the seven days survey indicate that with more survey effort, more species may be recorded.

5.2.9.2.6 Fish Fauna

A total of 14 fish species belonging to 8 families were recorded during this survey (Annex A of the appendices).

Not much has been documented regarding the distribution of fish species in the water bodies within the Project area. The sampling conducted, and data collected during this survey, still remained inconclusive of species distribution considering the limited sampling period.

However, three (3) groups of itchyofauna of little or no economic value, adapted to inhabit small water bodies such as streams, creeks with vegetation, swamps in forested areas, as well as in pools (www.iucnredlist.org; Paugy et al, 2004; www.fishbase.org) were recorded. These have great significance for the general levels of biodiversity in an aquatic ecosystem.

This is the group of small fishes collectively known as cyprinodonts, top minnows or rivulins. The specimens collected were from the Aplocheilidae and Eleotridae families (Paugy et al, 2004; Payne et al, 2010; www.fishbase.org). Two species belonging to the genus *Epiplatys* and genus *Kribia* respectively, were recorded. *Epiplatys spp*. constituted the largest catch in numbers for this survey. *E. barmoensis* remained the most distributed species as it was recorded in all streams and swamps with an exceedingly larger catch in Mosenesie-1 (n=15). *E. fasciolatus josianae* (subspecies *of E. fasciolatus fasciolatus*), being the largest number of all recorded fish (n=20), remained the least distributed and was recorded only in Mosenesie-1 (IVS).

Kribia nana, being a fairly diverse species during this survey was recorded at only two or three specimens, except at Fula Town (Morbaka stream) where it attained its highest record (n=4). These species are rarely larger than 9cm and swim near the surface in shallow waters such as streams and swamps (www.iucnredlist.org; Paugy *et al*, 2004; Payne *et al*, 2010).

All other species were recorded in either two or three sampling locations and are Potamodromous - migrating within streams, migratory in rivers (Fermon and Gsegner, 2006). E.g. Hemichromis spp. Tilapia, Ctenopoma, Clarias, *Liza falcipinnis* and Barbus spp. These are likely to be recorded everywhere (eg. rivers and streams).

Notwithstanding, of the species recorded, only two (2) are of global conservation concern and listed in the IUCN Red List Status as Critically Endangered (CR) and Data Deficient (DD) and these species are *Epiplatys fasciolatus josianae* (recorded in one site, Morsenesie-1) and *Liza falcipinnis* (catadromous species – recorded in five sites; Morkombay, Gbangbatoke, Momasah, Moselolo and Mosenegoh). *Tilapia louka, Clarias laevicep, Epiplatys barmoiensis* and *Hippopotamyrus paugyi* in descending order were the most widely distributed species across the sites visited. Table 5.2-20 shows an annotated description of the photos of some of the key species recorded.

Table 5.2-20: Fish Species of Concern Recorded within the Project Area

	***Epiplatys fasciolatus josianae* (CR) -** Recorded in an IVS at Mosenesie-1(n=20): **None migratory. Little or no economic value**. This species is well known to exist in the rainforest of southeastern Sierra Leone (Paugy *et al*, 2004; www.fishbase.org), and is threatened by mining activities and deforestation leading to a decline in the quality of its habitat. The species is classified as Critically Endangered (www.iucnredlist.org; www.fishbase.org). It is a native species and is endemic only to Sierra Leone (www.iucnredlist.org; www.fishbase.org; Paugy *et al*, 2004). It is a benthopelagic fish and occurs in coastal rivers, brooks and swampy areas in forested savanna and under forest cover. It is not a seasonal killifish. It is difficult to maintain in an aquarium. Maximum size: male 85 mm TL, female 75 mm TL.

 Picture by Fishbase.org	***Sarotherodon occidentalis*** **(NT): Regional Endemic. Not caught.** Reported to occur in Gbenji and Gbangbaia Rivers which are largely influenced by sea water input**.** This species occurs in coastal areas, from the River Casamance in Senegal to the St. John in Liberia. Occurs in River Estuaries of Sierra Leone (Paugy et al, 2004).
 Picture by Fishbase.org	*Tilapia joka* **(VU): Regional Endemic. Not caught.** Reported to occur in Gbenji and Gbangbaia Rivers which are largely influenced by sea water input**.** This species occurs in the lower courses of rivers from Sierra Leone to Western Liberia (Paugy *et al*, 2004).
 	Epiplatys barmoiensis (LC): **Regional Endemic: Little or no economic value** Widely distributed and very common across sampling sites. Inhabits swampy areas and streams on the coastal plains, usually under forest cover, in Southern Guinea, Southern Sierra Leone and Southwestern Liberia (Paugy *et al*, 2004). Collected in all swamps and streams located in the core site sampled.

All other fish species including two other itchyofauna species of little or no commercial interest, *Epiplatys barmoiensis* and *Kribia nana* recorded during sampling, are listed as List Concern in the IUCN Red List Category. The occurrence of these species contributes a great deal to the overall biodiversity of the area.

5.2.9.2.7 Invertebrates

Two species of crustaceans belonging to two families were recorded. These include the river crab (Potamon Crab *Potamon fluviatile*) and Fresh Water Shrimp (*Macrobranchium vollenhoenii*.). These species were recorded in streams and swampy areas in the Project area (50 m corridor along the proposed road alignment) (Annex A of the appendices).

5.2.10 Hydrology, Hydrogeology and Water Quality

5.2.10.1 Methodology

This assessment involved a literature review on reports provided by the client on hydrological studies conducted by Golder Associates (2017) within the Project area. Field work was carried out along the proposed road alignment which involved collecting samples for laboratory testing, conducting a hydrocensus and undertaking observational analysis.

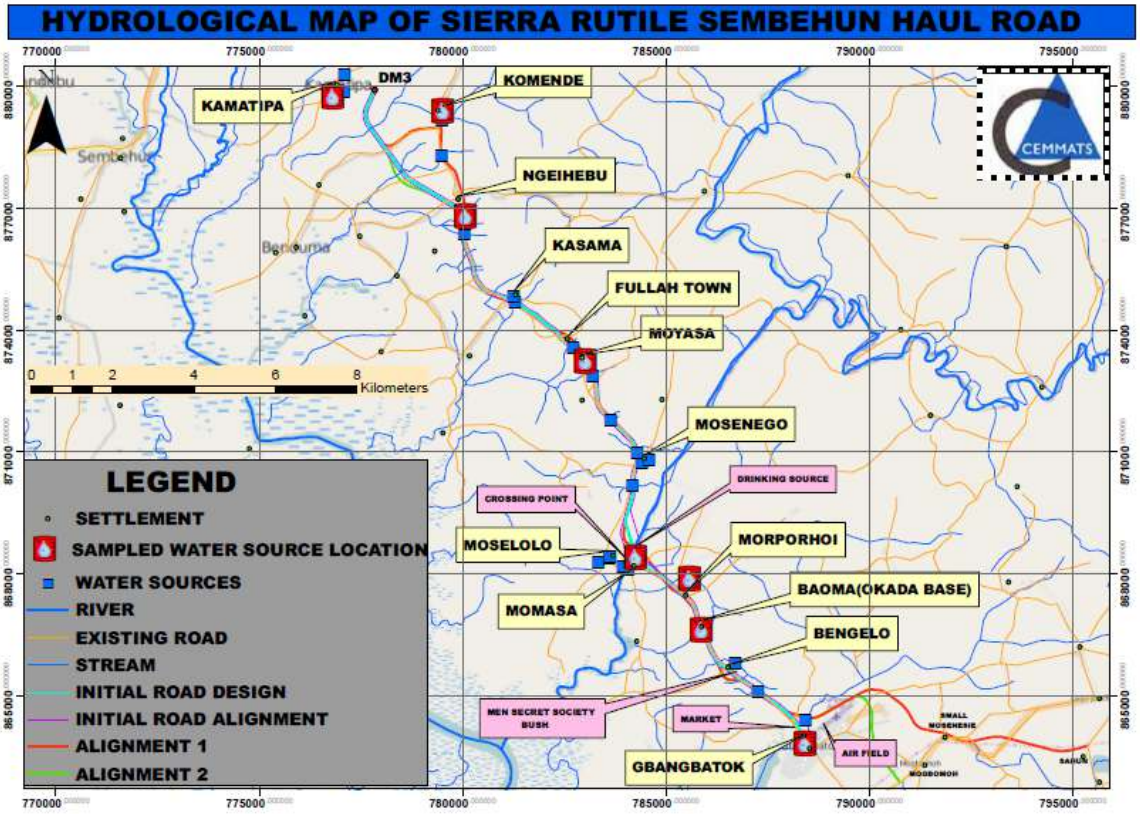


Figure 5.2-19: Hydrological Map of Project Area including Water Sample Points

5.2.10.1.1 Water Quality Assessment

Surface water quality is an essential component of the biophysical and human environment and is protected under the Water and Sanitation (*Sierra Leone Water Company Act (2001), Local Government Act (2004),* Sierra Leone Electricity and Water Regulatory Commission, 2011) and Water Quality and Pollution Control (*SLEPAA, 2008*). The physical and chemical

constituents of water are important in determining aquatic ecosystem productivity, fish and aquatic habitat quality, as well as environmental toxicity.

The baseline description includes:

- Water is used for diverse purposes (such as domestic, irrigation, livestock watering, etc.) by the settlements close to and along the proposed route alignment;
- Water for drinking is fetched from both protected and unprotect sources;
- Water for drinking which appears to be odourless, colourless and tasteless. No outbreaks of diseases were reported, and
- Creeks flowing across roads had poorly located and/or constructed culverts, resulting in turbidity increases in these areas and the deposition of sediment in the creek channels.

Water samples which were taken in October 2017 have been included in this description of baseline studies as is outlined in this section of the report. Historical surface water quality information was not available to supplement the site-specific water quality baseline survey. Eight (8) water samples were collected from representative locations along the proposed road corridor as is indicated in Figure 5.2-19. The physical, chemical and bacteriological parameters of each water source were evaluated through analysis at the National Water Quality Laboratory in Freetown. The following laboratory testing was undertaken:

a) Water Bacteriology

The determination of Feacal coliforms on all samples was done by the membrane-filtration technique using the WAGTECH *POTA –Lab kit*. One volume of water sample (100 ml) was measured and filtered through Millipore filter pads with pore size 0.45 µm in the pre-sterilized filtration unit assembly. These filter pads will trap any bacteria present in the water samples. These pads were then removed with forceps and placed on top of a filter membrane soaked in membrane Feacal coliform broth in pre-sterilized Petri dishes. The Petri dishes were later incubated for 18 – 24 hr at 44° C in between incubator of the WAGTECH *POTA – Lab kit* after 60 min resuscitation period. Feacal coliforms were identified by the formation of yellow colonies on the filter pads while non/total Feacal coliforms formed red colonies, E-coli formed blue colonies. These colonies are counted methodically, and results (CTU) expressed per 100 ml water sample.

b) Physical Water Analysis

This was done using portable laboratory instrumentation. The Aqua read multi-meter was used to test for water Electrical Conductivity (EC), pH, and Total Dissolved Solids (TDS). This instrument had been calibrated prior to using the measurements in the laboratory. The probe of this instrument was dipped into the water samples according to the instrument manual and measurements taken. These readings were also saved in the instrument's memory.

Turbidity measurement was done using the Turbidity meter. Readings were taken directly, and values entered into the monitoring forms provided.

c) Chemical Analysis

Chemical analysis was done by Spectrophotometric method using the HACH DR/2800 Spectrophotometer. Analytical procedures were in accordance with procedures outlined in the HACH Water Analysis Handbook, 4th Edition.

Spectrophotometry is a method to measure how much a chemical substance absorbs light by measuring the intensity as a beam of light passes through a sample solution. The basic principle is that each compound absorbs or transmits light over a certain range of wavelength.

It has to be noted however that previous and current studies conducted for the Area 1 (2001 ESIA; 2012 ESIA; and current ESHIA studies) analysed for metals in water via inductively coupled mass spectrometry (ICP-MS) and not via the Spectrophotometric method. ICP analysis are generally accepted by industry to be more accurate than Spectrophotometrics and differences in analytical methods have to be considered if comparisons are to be drawn between various baseline data.

Nitrate was determined using the cadmium Reduction method at light wavelength of 400 mm. A 20 ml water sample cell was filled with nitrate powder stand for 10 min, and a 10 ml sample cell from the 20 ml was filled with the water sample and another sample cell with deionised water. This was used as the sample blank. The contents of one Nitra Ver. 5 nitrate reagent powder pillow were added to the cell with the water sample. After a total of ten minutes reaction time, the sample cell with deionised water was used for zeroing the instrument before the prepared sample was measured in mg/l N-N.

Fluoride was determined using the SPADNS method at light wavelength of 580 nm. About 10 ml water sample was measured into one sample cell and 10 ml deionised water into the second sample cell. About 2 ml of SPADNS solution was measured into each sample cell and a one-minute reaction time allowed. The cell with the deionised water was used for zeroing.

5.2.10.2 Results

5.2.10.2.1 General Project Area Hydrology and Hydrogeology

The hydrology of the Project area is characterized by small, shallow lakes, creeks, rivers and wetlands which are most likely connected to the groundwater system and recharged by the large amount of annual rainfall. Moyamba district consists of two main river basins; these are the Kpangbaa and the Jong (Taia) Rivers. Although these rivers are seasonal, they have deep-sand filled river beds which hold a considerable amount of water, even long after the rainy season. The region is poorly drained and is characterized by several wetland areas.

Historical data (flow rates, seasonal variation, etc.) on hydrology is limited. A detailed hydrological study is currently underway which involves the establishment of a surface water baseline through the collection of flow and water quality data within the Moselolo River and Bagru Creek.

Most of the communities do not have properly constructed drainage systems; therefore, wastewater from households gathers in the gullies or flows into the streets during heavy rain storms.

Regionally, groundwater is relatively shallow and found within a few meters of the surface level, to approximately 6 meters below ground level (mbgl).

a) Hydrology

Hydrology is a key element of the aquatic environment because it is directly related to other ecosystem components, including surface water quality, fish habitat, and aquatic resources. The main objectives of this assessment include establishing the baseline qualitative and quantitative surface water conditions of the Project area, as well as determining the direct physical impacts of the project on the surface regime.

The baseline data consist of data from the following sources:

- Long-term daily rainfall and rainfall intensity-frequency-duration curves, and
- Results from preliminary investigations.

The baseline description is as follows:

- Approximately 29 water bodies were identified, including two distinct rivers (Moselolo and Gbendi Rivers), and 19 smaller streams. Stream flow is predominantly in an East-West direction across the alignment of the proposed route;
- Vast hectares of wetlands occur throughout the Project area, commonly referred to as inland valley swamps. These systems hold significant hydrological significance;
- Average annual rainfall for the Area 1 plant site which is estimated to be around 2,800 mm/yr and is highly seasonal with over 80% of rain occurring during June to October in the wet season, as is typical throughout Sierra Leone. The rainfall does, however, show a relatively low annual variability with a coefficient of variation (SD/mean) of only 0.14;
- Knowledge of precipitation amounts and patterns which helps;
- Plan drainage structures: through sizing of temporary culverts to handle storm events during period of operation
- Timing of operations: through exposure of soils during dry period when applicable.

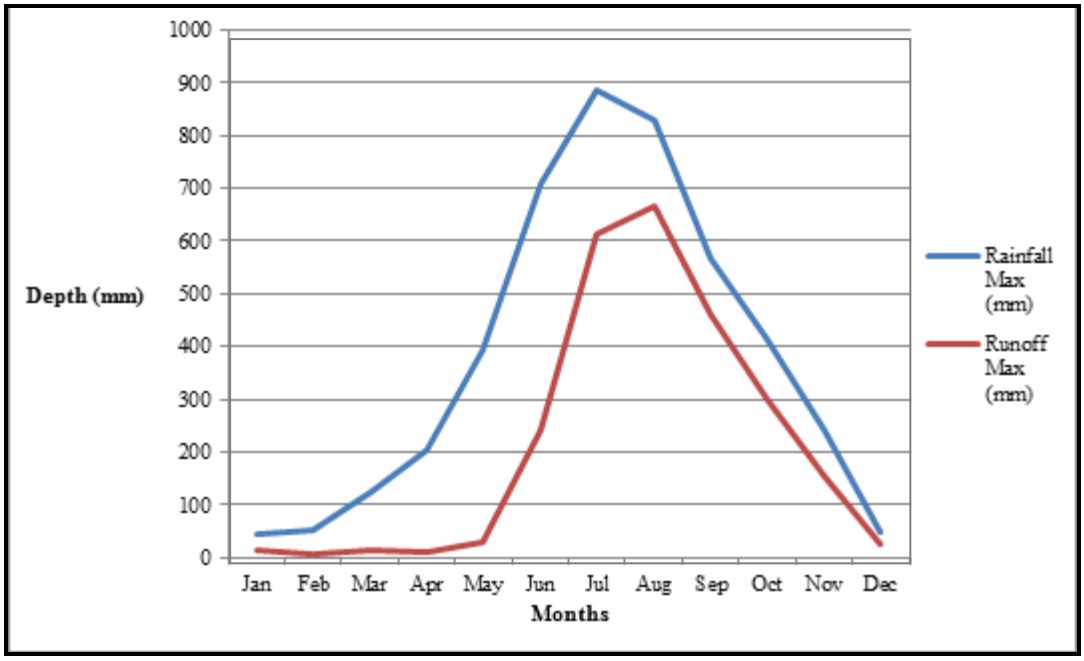


Figure 5.2-20: Monthly Runoff Averages between 2001 and 2017

Erosion and flood control are directly affected by not only monthly and annual rain volume, but the intensity of individual rainstorms as well. Storm analysis is an important aspect of rainfall evaluation. The rainfall-runoff relationship for any rainstorm depends on the dynamic interaction between rain intensity, soil infiltration and surface storage. Runoff occurs whenever rain intensity exceeds the infiltration capacity of the soil, providing there are no physical obstructions to surface flow.

b) Hydrogeology

Groundwater quantity and quality are an important environmental component that sustains the availability of surface waters, mainly during the dry seasons and provide water source suitable for commercial and domestic use. The assessment of the effects on groundwater is based on baseline information and hydro census conducted for the main study.

The baseline description includes:

- Boreholes which exist in seven communities: Mogbwemo, Moselolo, Mosenegor, Mosaya, Komende, Kamatipa and Gbangantok, but in Gbanbantok the boreholes have been out of use for over four decades. Some of these boreholes were either seasonal or perennial and their uses were mostly multipurposed, and
- Boreholes in the Mogbwemo community which are generally private owned that are not equipped with hand pumps. Water is being extracted from these boreholes by the rope-bucket method. Through the survey, it was determined that water levels in the Project area ranged between 5.3 to 5.9 mbgl. It was reported that most of these boreholes are perennial but the water could fall to as much as 7.5 mbgl.

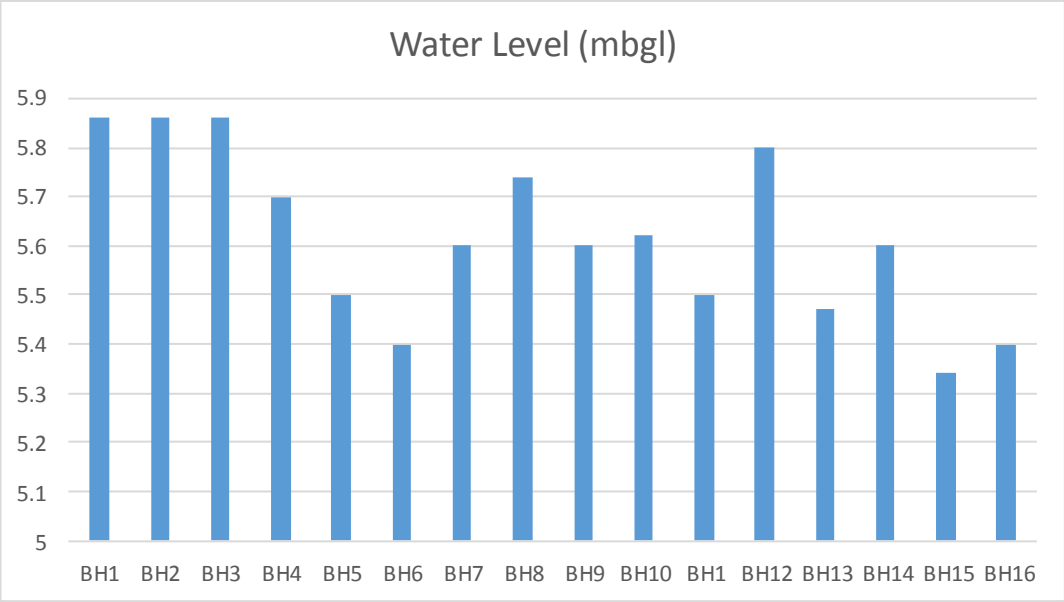


Figure 5.2-21: Water Levels (m below ground level) in Boreholes at Mogbwemo

Figure 5.2-22: Unequipped Boreholes at Mogbwemo

Table 5.2-21: Borehole Characterization

Location	N	E	Code Number	Depth (m) (bgl)	Ownership	Water availability	Uses	Equipment
Mogbwemo	791209	863293	BH1	5.86	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791226	863309	BH2	5.86	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791259	863282	BH3	5.86	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791235	863248	BH4	5.7	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791310	863267	BH5	5.5	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791293	863241	BH6	5.4	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791328	863268	BH7	5.6	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791290	863215	BH8	5.74	Private	Perennial	Multipurpose	Bucket-rope

Location	N	E	Code Number	Depth (m) (bgl)	Ownership	Water availability	Uses	Equipment
Mogbwemo	791319	863138	BH9	5.6	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791250	863180	BH10	5.62	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791190	863212	BH1	5.5	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791186	863229	BH12	5.8	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791111	863286	BH13	5.47	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791085	863297	BH14	5.6	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791082	863249	BH15	5.34	Private	Perennial	Multipurpose	Bucket-rope
Mogbwemo	791039	863318	BH16	5.4	Private	Perennial	Multipurpose	Bucket-rope
Gbangbatoke	788498	863803	BH17	-	Community	Not available	Not available	Hand pump
Moselolo	783599	868387	BH18	6	Private	Seasonal	Multipurpose	Hand pump
Moselolo	783619	868419	BH19	6.2	Community	Seasonal	Multipurpose	Hand pump
Mosenegor	784405	870733	BH20	5.6	Community	Seasonal	Multipurpose	Hand pump
Mosenegor	784583	870818	BH21	5.7	Community	Seasonal	Multipurpose	Hand pump
Moyasa	783022	873237	BH22	5.2	Borehole	Not available	Not available	Hand pump
Komende	779511	879378	BH23	5.7	Community	Perennial	Domestic	Hand pump
Kamatipa	776807	879748	BH24	5.9	Community	Perennial	Multipurpose	Hand pump

bgl = Below ground level

5.2.10.2.2 Water Quality Assessment Results

Table 5.2-22: Surface Water Quality Results

Parameters	Gbonbatutoke 1	Boama New settlement 2	Morporhai 3	Mamasa 4	Mayasa 5	Ngeihehu 6	Kamende 7	Kamatipa 8	WHO Standards
Location	Rutile end	Boama	Morporhai	Mamasa	Mayasa	Ngeihehu	Kamende	Kamatipa	
Source	River	Stream	Stream	Stream	Stream	Stream	Bore- H	Bore -H	
pH	6.9	6.7	6.8	6.8	6.8	7.0	6.5	6.7	6.5-8.5
TDS (mg/l)	8.5	15.4	15.2	10.7	10.9	9.3	24.3	26.9	<248
Turbidity (NTU)	1.2	0.3	0.3	1.7	1.1	1.2	0.8	0.1	<5.0
Chloride (mg/l)	0.4	3.2	1.0	7.8	0.6	6.8	12	3.1	<250
Copper (mg/l)	0.05	0.06	0.03	0.05	0.12	0.05	0.02	0.05	<1.0
Fluoride (mg/l)	0.89	0.05	0.05	0.05	0.45	0.01	0.74	0.04	<1.5
Iron (mg/l)	0.01	0.02	0.08	0.08	0.02	0.02	0.03	0.01	<0.3
Nitrate (mg/l)	1.0	1.0	1.0	1.0	2.0	1.0	10	15	<10
Nitrite (mg/l)	0.03	0.02	0.01	0.01	0.03	0.03	0.02	0.02	3.0
Sulphate (mg/l)	1	0.1	0	1	0	0	0	0	<400
Cyanide (mg/l)	0.0	0.0	0.0	0	0	0.0	0.01	0.01	-
Arsenic (mg/l)	0.00	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.01
Feacal Coliforms (*MPN / 100 ml)	25	25	25	18	12	16	10	12	Zero
Total coliforms (*MPN / 100 ml)	25	15	25	12	12	10	10	8	<10
Total bacteria (*MPN / 100 ml)	60	50	50	30	30	40	20	20	Zero
E-coli (*MPN / 100 ml)	10	5	Nil	Nil	2	10	Nil	Nil	Zero
Salmonella (*MPN / 100 ml)	10	5	Nil	Nil	4	4	Nil	Nil	Zero
G P S Coordinate X		783022	785582	784242	783022	780071	779511	776807	
G P S Coordinate Y		873237	867899	868407	873237	876786	879378	879748	

*MPN = Most Probable Number

The primary objective of drinking water quality monitoring is to assess the bacterial purity and chemical composition of the water sources. Results indicate that Water Turbidity and pH did not fluctuate much. TDS values of these water points were within the threshold values recommended by WHO. The concentrations of dissolved Chemicals are also below the threshold values, with the exception of Nitrate which is above the threshold in one area and in some cases minimal and within permissible limits recommended by the World Health Organization.

This survey indicates that some of the water points had levels of bacteriological pollution in excess of the WHO threshold values and it is therefore recommended to administer a complete chlorination process in boreholes as indicated to render it fit for human consumption.

6 SOCIO-ECONOMIC BASELINE DATA

6.1 Socio-Economic Status and Living Conditions

6.1.1 National Socio-Economic Context

Sierra Leone covers a total area of 71,740 km^2 and has a population of 7,075,641 according to the 2015 Housing and Population Census result. Historically, political instability and poor economic growth led to the brutal and destructive 10-year civil war, which officially ended in 2002.

According to the UNDP Report on Sierra Leone's progress in Human Development (2016), the country moved one position up the Human Development Index (HDI), placing the country in 181 out of 188 countries. According to this survey, Sierra Leone had a HDI value of 0.413, but was still below the 0.518 average for Sub Saharan Africa. Liberia is positioned at 177, Guinea at 182 and Ghana at 140 out of 188 countries.

The report further shows that 77.5% of the population of Sierra Leone (approximately 4,724,000 people) are multi-dimensionally poor even though income poverty (i.e. $1.2 per day) is 56.6%.

Sierra Leone's gender inequality remains very high with only 12.4 percent of Parliamentary seats held by women and only 10% of adult women having reached at least secondary level of education - compared to 21.7% for their male counterparts. Gender Inequality Index (GII) reflects gender based inequalities in the areas of reproductive health, empowerment and economic activity. Sierra Leone's GII value in 2014 is 0.650 (rank 145 out of 155 countries).

Table 6.1-1: Information on National Social Indicators

Key Social Indicators	Rate	Source
National Population	7,076,641	Statistic Sierra Leone, 2015 Census provisional result
GDP per capita	$497.89 in 2015	Trading Economics (2017). Sierra Leone GDP per Capita. [online] Available at http://www.tradingeconomics.com/sierra-leone/gdp-per-capita
Economic growth rate	-21.5% in 2015	African Development Bank Group (2017). *Sierra Leone Economic Outlook*. [online] Available at https://www.afdb.org/en/countries/west-africa/sierra-leone/sierra-leone-economic-outlook/
Human Development Index	0.413 in 2014	African Development Bank Group (2017). *Sierra Leone Economic Outlook*. [online] Available at https://www.afdb.org/en/countries/west-africa/sierra-leone/sierra-leone-economic-outlook/
Poverty rate	77.5 (estimated)	UNDP (2016). *About Sierra Leone*. [online] Available at http://www.sl.undp.org/content/sierraleone/en/home/countryinfo.html
Infant mortality rate (IMR)	94/1000 (2010-2015)	United Nations Statistics Division (2017). *Sierra Leone*. [online] Available at

Key Social Indicators	Rate	Source
		http://data.un.org/CountryProfile.aspx?crName=sierra%20leone
Life expectancy at birth	48 years	UNDP (2016) About Sierra Leone. [online] Available at http://www.sl.undp.org/content/sierraleone/en/home/countryinfo.html
Maternal Mortality ratio	1,100/100,000 in 2013	WHO (2014). *Sierra Leone*. [online] Available at http://www.who.int/maternal_child_adolescent/epidemiology/profiles/maternal/sle.pdf
Adult literacy race	41 %	UNDP (2016) About Sierra Leone. [online] Available at http://www.sl.undp.org/content/sierraleone/en/home/countryinfo.html
Primary school gross enrolment (f/m)	129.8/130.1 (2014)	United Nations Statistics Division (2017). *Sierra Leone*. [online] Available at http://data.un.org/CountryProfile.aspx?crName=sierra%20leone
Secondary School gross enrolment rate (f/m)	40/46.9	United Nations Statistics Division (2017). *Sierra Leone*. [online] Available at http://data.un.org/CountryProfile.aspx?crName=sierra%20leone

Basic water and sanitation facilities for the majority of Sierra Leoneans is extremely limited due to the limited functional infrastructure for water supply (PSRP II, 2008). The PRSP II document prepared by the GoSL, also states that approximately 70% of the population live in absolute poverty, with expenditure below 1 US$ / day. The average person's total consumption falls short of the minimum accepted level, by 27.5% of the poverty line (PRSP II, 2008).

Agriculture is the largest economic sector in the country. Nearly two-thirds of the population depends on it for their livelihood and it is responsible for almost half of the country's GDP. There has been a steady increase in domestic food production in the last number of years. For instance, for rice, which is the staple food and the most common crop cultivated by majority of Sierra Leoneans, production increased at an annual rate of 17.8% between 2000 and 2010 compared to -7.1% between 1990 – 1999 (FAO, 2013). Nonetheless, the living conditions continue to be difficult especially for rural villagers who struggle to remain at subsistence levels. Poor health indicators reflect the lack of access among the population to basic service notably – health services. Endemic diseases, especially malaria and HIV/AIDS, loom as a threat; in 1997, UNAIDS estimated the HIV prevalence among adults to be 3.2%. In 2002, a national prevalence survey estimated the rate at 5%, while a survey in 2010 revealed an increase of 1.5% (UNDP, 2013).

Sanitary conditions are very poor as sewage and refuse disposal systems do not function effectively in most places, or are non-existent. Urban living conditions are extremely difficult (PRSP II, 2008).

Less than 10% of Sierra Leone's total population has access to electricity, compared to 49% in Ghana, 46% in Nigeria, 96% in North Africa, 73% in Asia, 99% in China and 76% global average. Only around 1% of the rural population in Sierra Leone has access to electricity.

Of the 11,300 km of classified roads in the country, 8,148km are classified in the national road system. The remaining roads consist of urban roads, community roads, local roads and farm tracks. With respect to the regional distribution of roads, the Northern Province accounts for 41% of the roads followed by the Southern Province with 33%, and the Eastern Province with 23%. The Western Area accounts for only 3% (PRSP II, 2008).

6.1.2 District Socio Economic Context

6.1.2.1 Moyamba District

Moyamba district is in the Southern Province and borders the Atlantic Ocean in the west, Port Loko district and Tonkolili district to the north, Bo district to the east and Bonthe district to the south. Its capital and largest city is Moyamba. The other major towns include Njala, Rotifunk and Shenge. The district is the largest in the Southern Province by geographical area, and comprises of fourteen Chiefdoms. The ethnicity of the district is largely homogeneous with the Mende forming 60% of the population. Other ethnic groups comprise Sherbro, Temne and Loko.

6.1.2.1.1 Population

According to the 2015 Housing and Population Census, Moyamba District has an estimated population of 318,588 comprising 153,129 males and 164,889 females as shown in Table 6.1-2:

Table 6.1-2: Population of Moyamba District by Chiefdom

Chiefdom	Male	Female	Total
Bagruwa*	13,705	13,918	27,623
Bumpeh	17,826	19,619	37,445
Dasse	6,369	6,848	13,217
Fakunya	13,133	14,513	27,646
Kagboro	16,811	18,051	34,862
Kayamba	12,240	13,509	25,749
Kamajei	4,934	5,231	10,165
Kongbora	4,979	5,349	10,328
Kori	14,797	15,717	30,514
Kowa	4,642	5,110	9,752
Lower Banta*	18,129	19,188	37,317
Ribbi	15,730	17,435	33,165

Chiefdom	Male	Female	Total
Timdale	5,155	5,137	10,292
Uper Banta	5,249	5,264	10,513
District Total	**153,699**	**164,889**	**318,588**

*Chiefdoms within Project area

6.1.2.1.2 Livelihood and Economy

Agriculture remains the largest sector of economy in the Moyamba district, providing livelihoods for over 71% of the population. Crops grown in the district include oil palm, cereals (maize, rice, sorghum and millet) and starch food crops (yam, cassava and cocoa). In addition, cashew, black pepper, ginger, pineapple and sugarcane are popular farm products in the district. Despite the abundance of land and water resources, the majority of the farmers have smallholdings of 0.5 to 2 cropped hectares, operating as basic subsistence food production units. Livestock remains relatively small and underdeveloped such as household level owning poultry, goats and cattle. In the coastal Chiefdoms, salt production has also traditionally been an important economic activity. The port of Nitti in Banta Chiefdom provides the only deep-water port in the south for direct mechanical loading and off-loading. The major weekly trade activities are in Gbangbatoke of Banta Chiefdom, and goods are traded directly here with suppliers coming by boat from Freetown and Guinea. Sea fishing is a common livelihood in the coastal population. The main fish trading center is Shenge in Kagboro Chiefdom, which is also one of the main traditional boat building locations in the country. The Wealth Index (WI) indicates that 43% of the district households are in the two poorest quintiles. The Gini coefficient for the district is 0.25 (scale between 0 and 1).

6.1.2.1.3 Education

The district has over 560 schools, 86% of which are primary schools. The large majority (85%) of the schools are owned by missions, private and community while government owned schools are only 15%. Moyamba District Council is ranked second highest in privately owned schools. The net primary enrolment rate in 2013 was 64%.

6.1.2.1.4 Food Security

47% of the district population are food insecure (11% severe and 36% moderate).

On an average 62% of household expenditure accounts for food purchases, which leaves the households vulnerable whilst prioritizing other essential family needs. Moyamba and three other districts (Pujehun, Kailahun and Kenema) exceed the 40% “critical” WHO threshold of chronic malnutrition.

6.1.2.1.5 Health

The Moyamba district has two Government and two Mission hospitals. In addition to this, other healthcare support systems include Community Health Centers (CHC), Community Health Posts (CHP), Maternal and Child Health Posts (MCHP) and clinics. On average one health facility covers 2,512 people with 2,350 people per bed.

66.4% of children aged between 12-23 months have completed a full course of vaccinations against the most common diseases (BCG, DPT, Polio and Measles), while 4.7% of children of the same age group did not have any vaccinations. Acute Respiratory Infection (ARI), fever and diarrhoea are the most common illnesses among children under the age of 5.

For protection from Malaria, 72% of families were reported to have at least one mosquito net, though on average, each family has 1.5 nets which is not sufficient to cover the entire family's needs.

The overall HIV prevalence rate is 1%, the rate among women is higher (1.3%) compared to men (0.6%).

6.1.2.1.6 Gender Issues

Gender equity in governance is still a challenge in the Moyamba district where the role of women continues to be relegated to household chores and childbearing.

There is no female Paramount Chief in any of the 14 Chiefdoms in the Moyamba district and representation in the local government council is insignificant.

In Moyamba district, there is a sharp division of gender labour roles, which is similar to most other districts of the country. Women are engaged in all aspects of subsistence farming except for the more energy-demanding jobs such as land clearing and digging - which are entirely the responsibilities of men. Women have additional responsibilities in the preparation of food for the family and also caring for the younger members of the family.

6.1.2.2 Bonthe District

Bonthe district is in the Southern Province, and borders the Atlantic Ocean to the west, Moyamba district to the northwest, Bo district to the southeast and Pujehun district to the south. The district comprises of several islands including eleven chiefdoms, with the mainland being next to the Atlantic Ocean. The capital is Mattru Jong town. The largest city Bonthe, is on Sherbro Island. Bonthe district is the least populous in Sierra Leone. Inhabitants mainly belong to the Mende ethnic group and the Sherbro people (native residents of the district).

6.1.2.2.1 Population

According to the 2015 Housing and Population Census, the total population of Bonthe was 200,730; comprising 98,770 males and 101,960 females as shown in Table 6.1-3.

Table 6.1-3: Population of Bonthe District by Chiefdom

Chiefdom	Male	Female	Total
Bendu-Cha	3,436	3,573	7,009
Bum	11,594	12,437	24,031
Dema	3,812	3,700	7,512
Imperri	17,215	16,557	33,772
Jong	16,326	17,198	33,524
Kpanda Kemo	5,097	5,345	10,442
Kwamebai Krim	6,988	7,448	14,436
Nongoba Bullon	9,843	9,904	19,747
Sittia	10,653	11,162	21,815
Sogbeni	5,283	5,666	10,949
Yawbeko	3,644	3,874	7,518
Bonthe Urban	4,879	5,096	9,975
District Total	98,770	101,960	200,730

6.1.2.2.2 Livelihood and Economy

Fishing and farming are the two main livelihood activities of the large majority of the district population. Palm oil plantations have been on the rise and more people are engaged in this livelihood in recent years. Bonthe district has one of the world's largest deposits of titanium ore (rutile) in the world which is operated by SRL. The district suffered the mass exodus of IDPs when SRL, the largest employer of mine workers terminated its operations during the civil war.

The Wealth Index7 (WI) indicates that 36% of district households are in the poorest quintile and 20% are among the medium poor. The overall poverty level is 50% with the Gini coefficient 0.3**(scale between 0 and 1).

6.1.2.2.3 Education

The district has over 280 schools of which 77% are primary schools. The district has a relatively high net primary enrolment (70%) compared to other districts. According to the Ministry of Education (2013), 76% of the schools in the district are community, mission or privately owned, while only 24% of schools are owned by the government.

The number of students in junior school is only 13% of the number at the primary level of education and 57% lower still in the senior level as compared to junior level – this mirrors the general declining trend between different levels of education across the districts in the country.

6.1.2.2.4 Food Security

According to the Emergency Food Security Assessment (World Food Programme, 2015), Bonthe district has one of the lowest rates of food insecurity (1% severe and 19% moderate food insecurity) among all districts in the country. 55% of household expenditure is used to buy food for the family, also one of the lowest compared to other districts.

During the harvest and plantation season, substantial household income comes from labour hire and labour exchange. The prevalence of chronic malnutrition among children aged 6 - 59 months, measured by stunting was 38.4%, while malnutrition was 19.2% as measured by being underweight for the same age group. The highest prevalence of acute malnutrition among adult women was found in Bonthe (5.8%).

6.1.2.2.5 Health

The government general hospital is located in the district capital town. There are 58 other health facilities of the district. According to the Ministry of Health and Sanitation (MoHS) there is one health facility for over an average of 2,800 people and almost 3,000 people per bed.

Malaria is endemic and a major public health problem in the country. It is also the leading cause of morbidity and mortality in children under age 5 and pregnant women. The Sierra Leone Demographic and Health Survey 2013 indicated that 77% of Bonthe households have mosquito nets.

Over 77% of children aged between 12 - 23 months have been vaccinated against BCG, DPT, Polio and Measles.

The district overall HIV prevalence rate is 0.9%, while the prevalence rate among the women (1.3%) is higher compared to men (0.5%).

6.1.2.2.6 Gender Issues

There is a fair representation of females in the governance of Bonthe District. The Local Government District Council is headed by a woman and the position of Chief Administrator of the District Council is also occupied by a woman. In addition to this, two of the 11 Paramount Chiefs in the District are women.

There is however still a sharp division of gender labour roles. Women are engaged in all aspects of subsistence farming except for the more energy-demanding jobs such as land clearing and digging which are entirely the responsibilities of men. In common with other districts in the country, women have additional responsibilities in the preparation of food for the family and also caring for the younger members of the family.

6.2 Socio-Economic Baseline Assessment

6.2.1 Methodology

The social baseline study involving a review of available data and appropriate literature materials on the Project area of influence was conducted, followed by a reconnaissance visit to the project site.

Field investigations by various social experts was carried out during the period during October 2017, in order to ascertain ground-truth facts contained in the literature, and to obtain primary data for this report.

The social study was carried out using participatory techniques and aimed at facilitating and enhancing awareness, mutual understanding, trust and capacity building. Information was collected on the following issues:

- Socio-economic conditions and land use patterns of affected communities;
- Formal and informal governing structures;
- Local infrastructure (transport, housing, health);
- Farming, fishing and other socio-economic activities and relevant statistics, and
- Income and expenditure trends.

Data analysis was carried out for both primary data collected at the focus group meetings and household surveys, as well as the secondary data collected by means of a desktop review of existing data sources to gather relevant socio-economic baseline information at a national, district, and local level.

6.2.1.1 Study Design

A total of 12 communities were covered in the study, which includes all the communities located within the Project area.

The study employed a mixed approach that combined quantitative and qualitative data collection methods to attain the studies objectives. The study also employed the use of desk review, covering secondary data collection and analysis, qualitative and quantitative (primary) data gathering, and triangulation of data from the different data sources.

6.2.1.2 Data and Data Sources

6.2.1.2.1 Secondary Data

The study has utilised several key data sources and indicators to present the socio-economic status of communities visited including the 2015 Population and Housing Census Report, UN Office for the Coordination of Human Affairs, 2015 District Profiles Report and various reports from the World Bank and the WHO. These have been cited within the report.

6.2.1.2.2 Primary Data

Data collection has been facilitated through the use of checklists for use in Focus Group Discussions and Household Questionnaires used to collect first-hand information on socio-economic conditions and livelihood activities of Project area population and communities. Data was collected electronically using the Kobo Collect mobile data collection application.

217 household questionnaires were administered randomly to sampled household heads by trained enumerators in both Krio and Mende Languages.

The minimum sample size was calculated by dividing the population of each target community by the national average for the number of residents per house (8.8) (Statistics Sierra Leone, 2016) and multiplying by 0.05 (5%).

The following table shows the minimum sample size calculated and the actual number of questionnaires administered.

Table 6.2-1: Household Survey Sample Size Determination

No	Chiefdoms	Village	Houses	Pop.	App. Households (Pop/8.8)	Min. Sample Size (5% app HH)	Actual Sample Size
1	**Lower Banta**	Gbangbatoke	750	8,000	909	45	52
2		Bengelow	84	800	90	5	15
3		Moporhoi	32	230	26	2	12
4		Momassa	31	95	11	1	6
5	**Bagruwa**	Mosielolow	**74**	**400**	**46**	**3**	**22**
6		Mosenegor	**69**	**380**	**43**	**2**	**24**
7		Moyasa	24	230	26	2	12
8		Fula Town	28	200	23	2	9
9		Ngiebu	18	190	22	2	6
10		Kasama	13	100	11	1	6
11		Komende	73	520	60	8	32
12		Kamatipa	86	800	90	5	21
Total			**1,282**	**11,945**	**1,357**	**78**	**217**

Qualitative data and information was collected on relevant parameters such as the communities' livelihood activities, main sources of income, occupations, availability and access to social facilities, infrastructure and public services.

6.2.1.2.3 Data Analysis

Socio-economic data from the household surveys was analysed using the SPSS application as has been previously mentioned. Charts and tables were generated most of which are presented and discussed in the baseline study findings of this report.

ESRI's Arc Map version 10.4, background Image, Google Earth Professional and Sierra Leone's 50K map were utilised spatially represents features of interest.

6.2.2 Results

6.2.2.1 Focus Group Discussions

Focus Group Discussion Meetings were held in each of the communities (12 in total) closest to the proposed road alignment as shown in Figure 6.2-1.

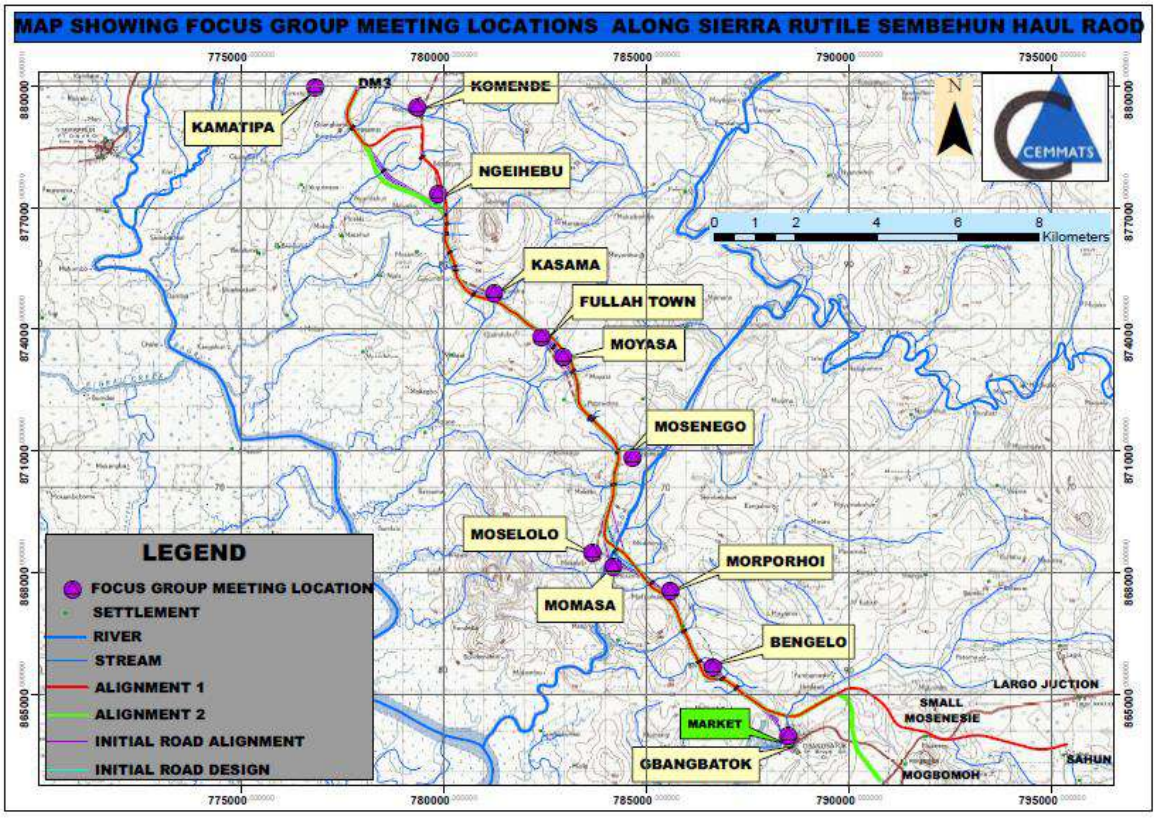


Figure 6.2-1: Focus Group Discussion Meeting Locations

The following table presents a summary of responses from participants during the 12 meetings:

Table 6.2-2: Summary of Responses from Focus Group Discussion Meetings

Checklist Issue	Summary of Responses
What is the main livelihood activity?	The main livelihood activity within the Project area is farming, practised in every community. Farming is at subsistence level and rudimentary tools are used such as cutlasses, hoes, axes etc. Crops popularly grown include rice, cassava, potato, beans, corn and maize. Cash crops such as coffee, cocoa, and oil palm are grown by a few farmers within the communities.
What are the secondary livelihood activities?	Participants reported having secondary livelihoods including fishing, hunting and petty trading.
Community awareness of SRL's proposed haul road development project.	All 12 communities confirmed having knowledge of the project. The awareness was reportedly due to the series of community consultative meetings and engagements organised by the Company within the Project

Checklist Issue	Summary of Responses
	area.
Community perceptions regarding the project	11 communities responded positively and welcomed the proposed project. Participants from Komende however stated that they would not allow the road to pass through their community as they had not been paid surface rent for the land occupied by SRL for the past 7 years.
Positive expectations from project	Perceived benefits from the project highlighted by the 12 communities include: • Transportation to Freetown and nearby villages and towns will be easier; • Employment opportunities will become available; • Educational and health facilities will be improved; • Improved social facilities; • Reduction in transport fares; • Reduction in drowning incidents in the Gbangbaia River; • Business activities within the communities will increase, and • Improved access to the communities by NGOs and other developmental organisations.
Perceived negative impacts of project	Potential negative impacts of the project listed by participants include: • Increased crime rates; • Increased accident rates; • Loss of farm land; • Loss of crops; • Increased dust along the road; • Increased noise levels in the affected communities; • Loss of cemeteries, sacred shrines, and other cultural features, and • Influx of people into the communities in search of jobs and business opportunities resulting in encroachment on the limited social facilities and contributing to the incidence of STIs in the affected communities.
Community suggestions for mitigation of perceived negative impacts	Participants proposed the following mitigation measures for the perceived negative impacts: • SRL should collaborate with government and other security agencies to increase security in the affected communities; • Put up road signs indicating speed limits, and erect speed bumps at appropriate places along the road; • SRL should pay adequate compensation for loss of crops and land; • SRL should make adequate compensation for pouring libation ceremony to facilitate the relocation of any sacred sites; • SRL should spray water on the road when necessary to suppress dust along the haulage road; • SRL to help improve the limited social facilities in the affected communities and embark on sensitisation programmes aimed at creating awareness in the communities on protection against incidents of STIs; • SRL should plant trees at edge of the road to suppress dust, and • SRL to provide training facilities to affected community members to make them easily marketable in the area of employment.
Community development needs	Participants were asked what issues within their communities they most required external assistance with. The responses are as follows: • Development of educational and health facilities;

Checklist Issue	Summary of Responses
	• Provision of portable drinking water sources; • Assistance in agricultural activities including provision of improved planting materials, fertilisers and tools; • Provision of a cold storage room for produce; • Provision of storage facilities for produce; • Provision of electricity, and • Construction of community centre.

After discussing all the points on the checklist, participants were given the opportunity to ask questions or make comments on the project. The following is a summary of the questions which came up during these sessions.

Table 6.2-3: Question and Answer Session

Community Questions	CEMMATS Responses
If crops are destroyed as a result of the project, will SRL pay for them?	Yes. SRL will conduct a crop assessment in the presence of crop owners before project implementation. Payment for the assessed crops will be calculated using rates set by the Ministry of Agriculture, Forestry and Food Security.
If the road passes through sacred shrines, what will SRL do?	SRL will meet the appropriate authorities in the communities and negotiate with them on the cost of the libation ceremony for the relocation of such sacred shrines. Destruction of such shrines will only take place after the necessary ceremonies have been done and the permission to proceed has been given by the authorities concerned.
What will SRL do about our economic trees that are likely to be destroyed during the haulage road construction?	Like all other crops, SRL will make the necessary arrangements for the assessment of such economic trees in the presence of the tree owners for subsequent payment.
Will educational assistance be given to the affected communities?	A CDAP will be prepared by CEMMATS to address the development needs of the affected communities and also to mitigate the negative impacts of the construction project on these communities. Support to education could be one of the projects in the CDAP.
If dwelling houses are affected, how will SRL handle this?	There will be no resettlement of households as a result of the project as the road alignment is designed to avoid all settlements.
What are the chances for employment of youths in the affected communities?	Road construction is a highly technical job that requires highly skilled labour. If there are such skilled personnel in the affected communities, they will be given preference over people that are not indigenes of the affected communities. In the case of non-skilled jobs, indigenes of the affected project communities will also definitely be given preference.
If our clinic or other community facility has to be destroyed as a result of the road construction project, how will SRL handle this?	As stated earlier, there will be no destruction of public or private structures as a result of the project.
Why is the road bypassing towns, shrines and cemeteries?	SRL wishes to reduce as much as possible the negative impacts of the haulage road construction project on the affected communities.
Where will SRL recruit people from for the construction of the road?	SRL will assign the project to a private construction contractor. Opportunities will however be given where possible for employment of

Community Questions	CEMMATS Responses
	local labour.
What benefits has SRL planned for the project affected communities?	Based on the development needs of the affected communities which have been noted during the ESIA study, a CDAP will be developed that will address some of the needs of the project affected communities.
What will be the route of the haulage road within the affected communities?	The final alignment of the proposed haulage route has not been decided on as it is still being determined.
When will construction start?	The project is scheduled to take off during the first quarter of 2018.

6.2.2.2 Household Surveys

Questionnaires were administered to 217 participants representing households within the communities surveyed.

6.2.2.2.1 Nature of Respondents

Questionnaires were administered to household heads or any close representative such as a spouse. 62% of the questionnaires were administered to household heads, 17% to spouses of household heads and the remainder were to their parents, siblings or children.

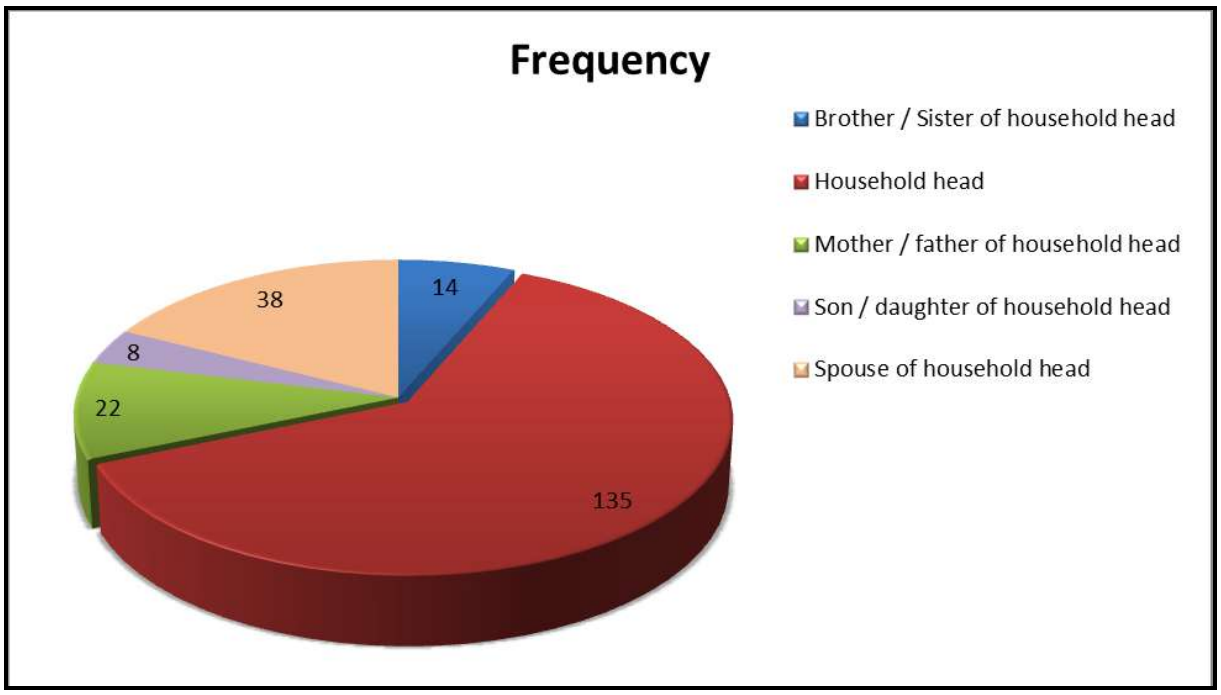


Figure 6.2-2: Nature of Respondents in Project Area

6.2.2.2.2 Gender of Respondent

70% of questionnaire respondents are male.

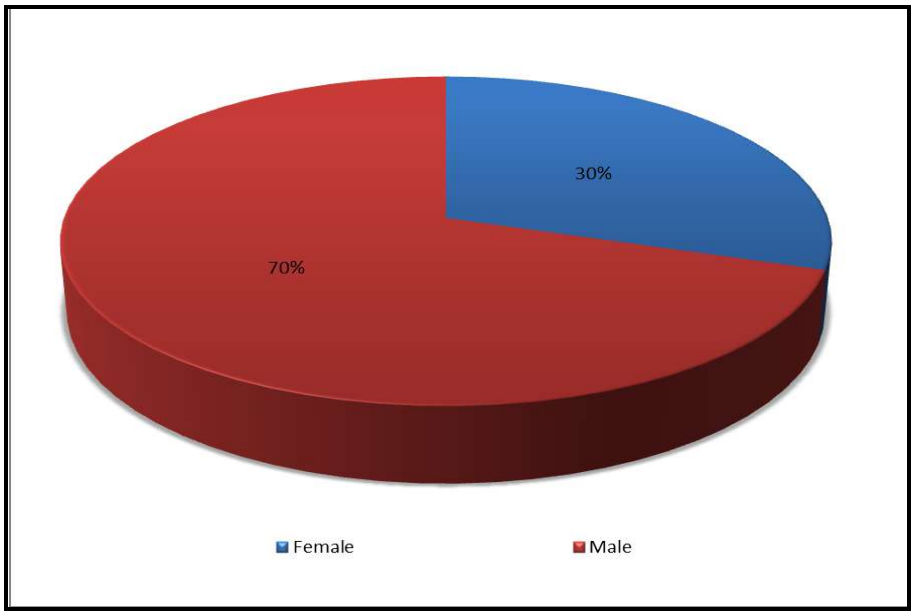


Figure 6.2-3: Gender of Respondent in Project Area

6.2.2.2.3 Age of Respondent

The age brackets of respondents are shown in the following graph. Over half (51.4%) of respondents fell between the age bracket of 30 – 49.

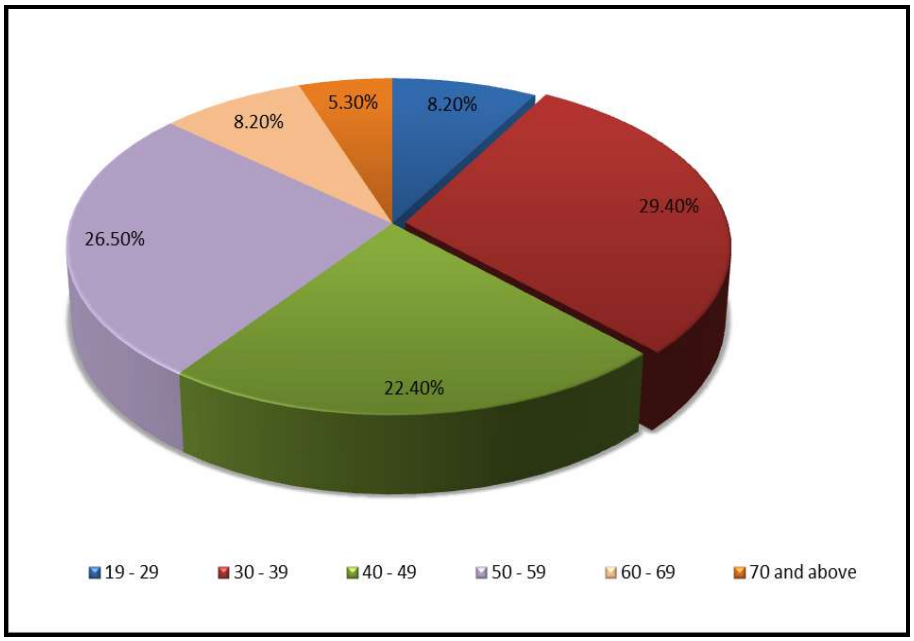


Figure 6.2-4: Age of Respondent

6.2.2.2.4 Marital Status of Respondent

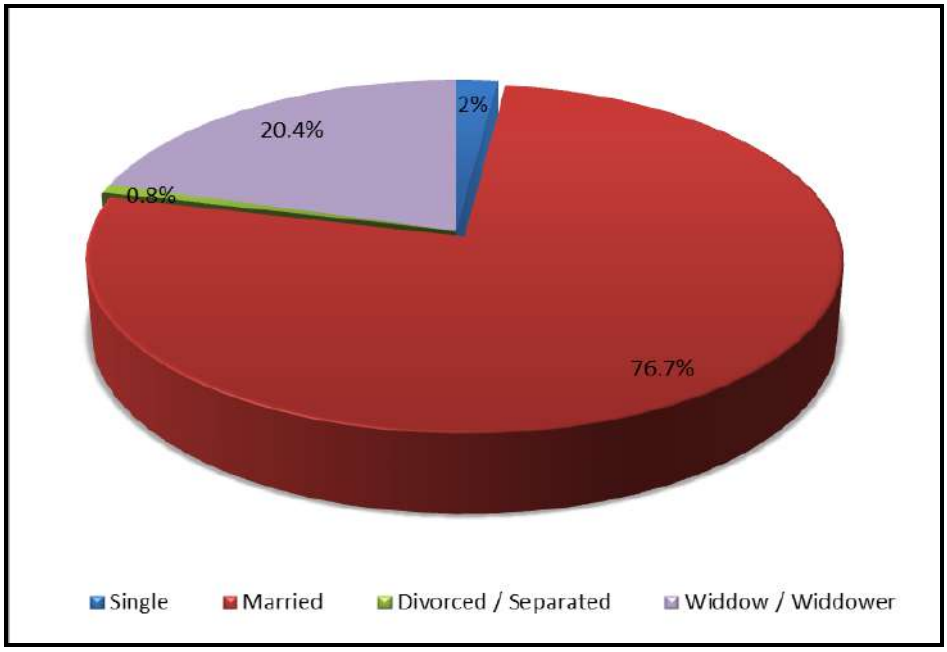


Figure 6.2-5: Marital Status of Respondent in Project Area

6.2.2.2.5 Ethnicity and Religion

The majority of respondents (84.8%) are Mendes, followed by Temnes (6.5%).

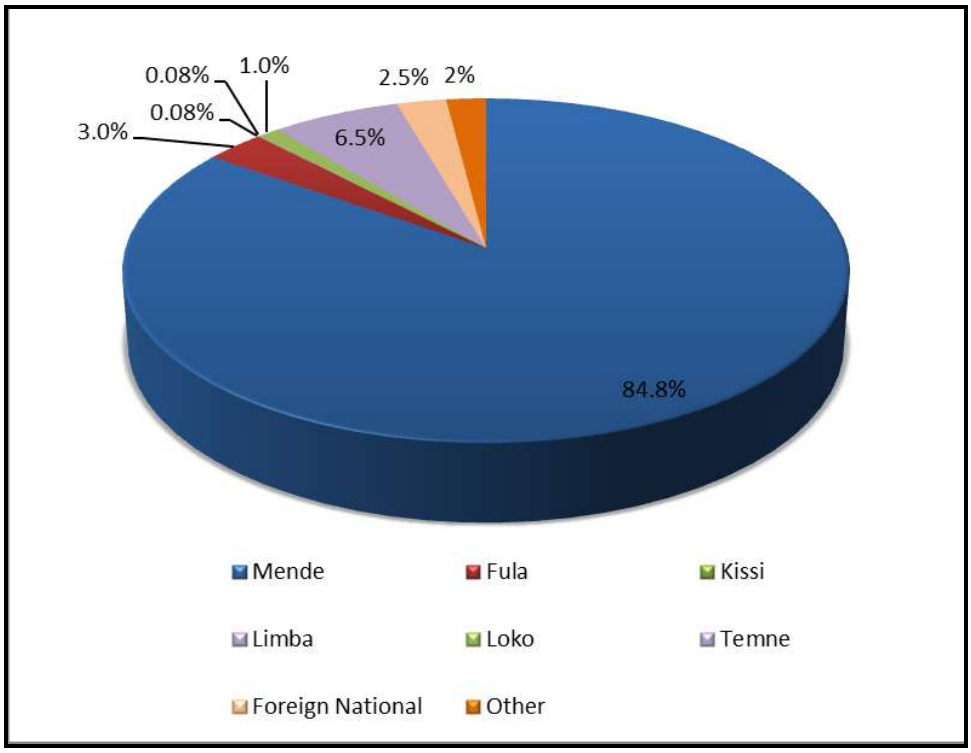


Figure 6.2-6: Ethnicity of Respondent in Project Area

The predominant religion is Islam:

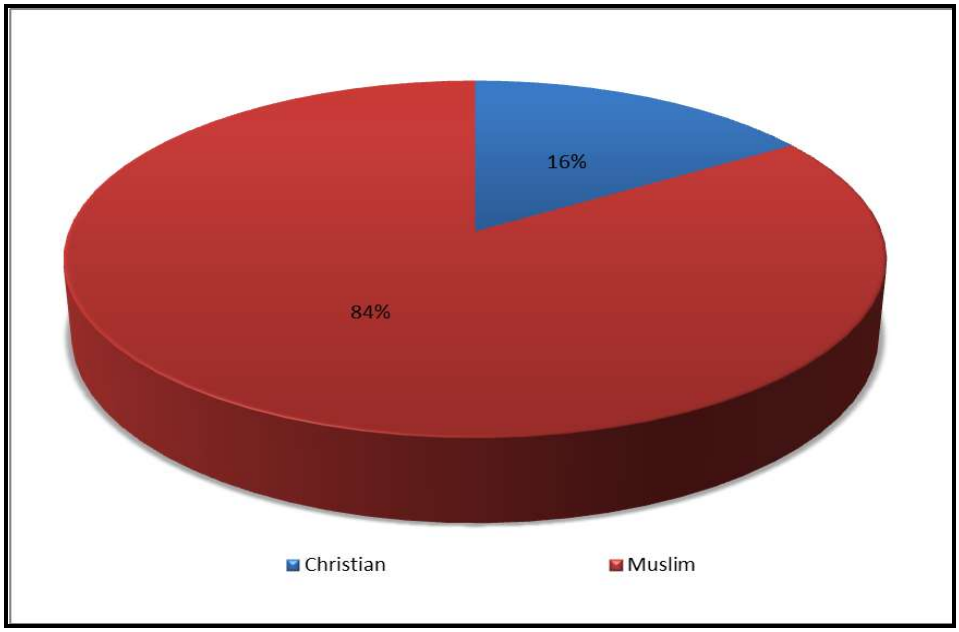


Figure 6.2-7: Religion of households in Project Area

6.2.2.2.6 Respondents' Geographic Origin and Reasons for Migrating

82% percent of respondents are reportedly indigenes of the Project area, with the remaining 18% having moved in from other regions of Sierra Leone.

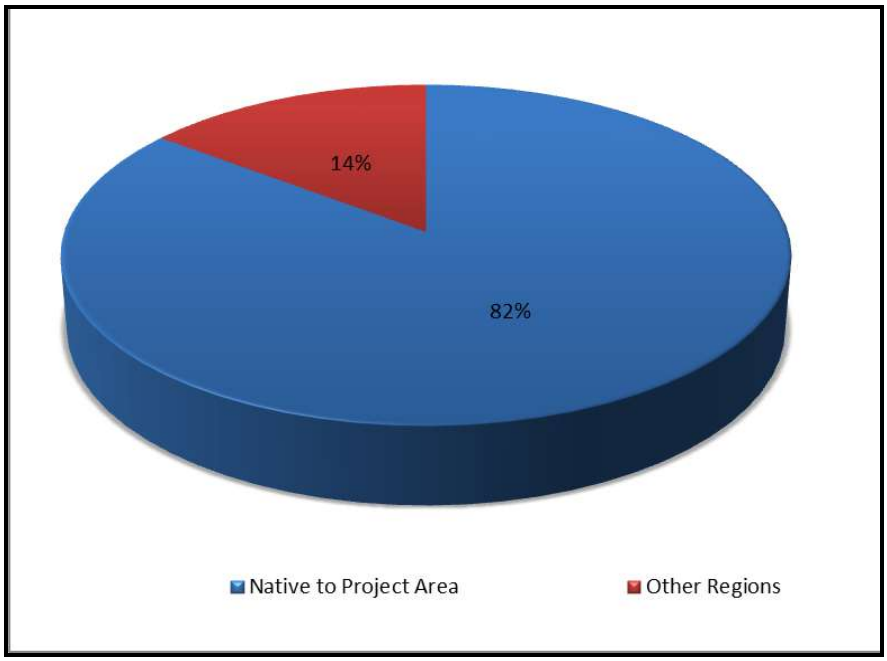


Figure 6.2-8: Respondents who are Indigenes of the Project Area

Respondents who are not indigenes of the Project area indicated the following areas of origin

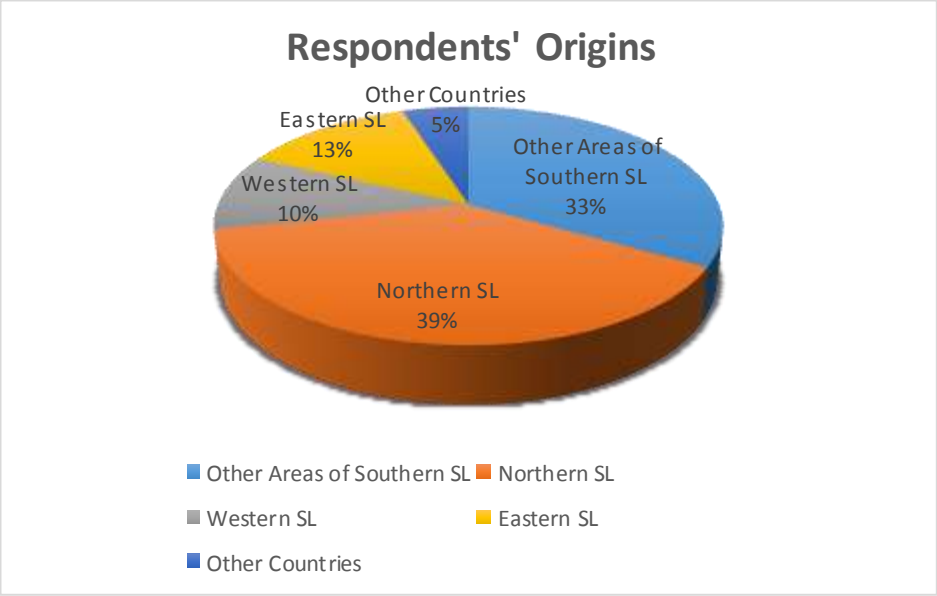


Figure 6.2-9: Region of Origin of Respondents

Reasons given for migrating to and settling in the Project area were predominantly for business and employment opportunities as shown in the following graph:

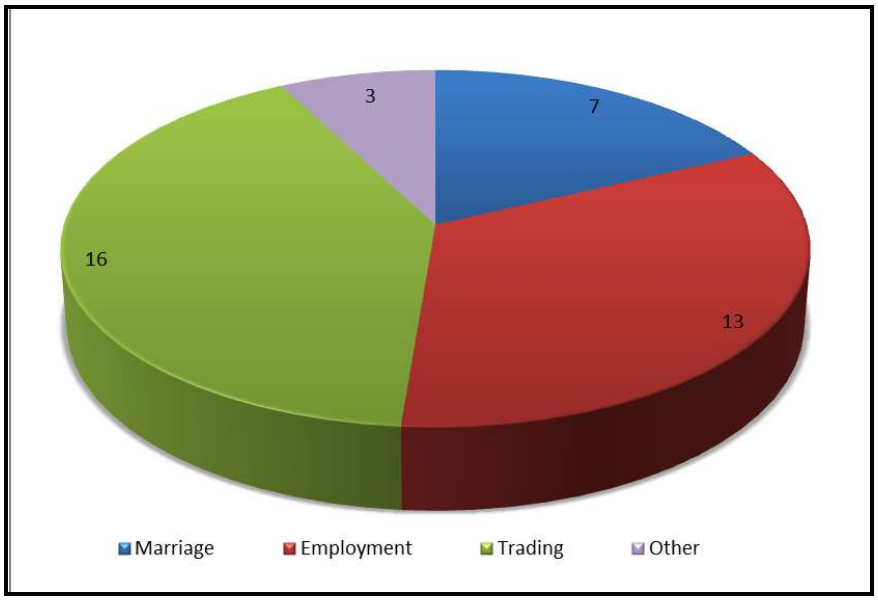


Figure 6.2-10: Reasons for Settling in Project Area

6.2.2.2.7 Education and Literacy

Over half of respondents (55%) never received any kind of formal education. Less than 3% attained tertiary educational levels.

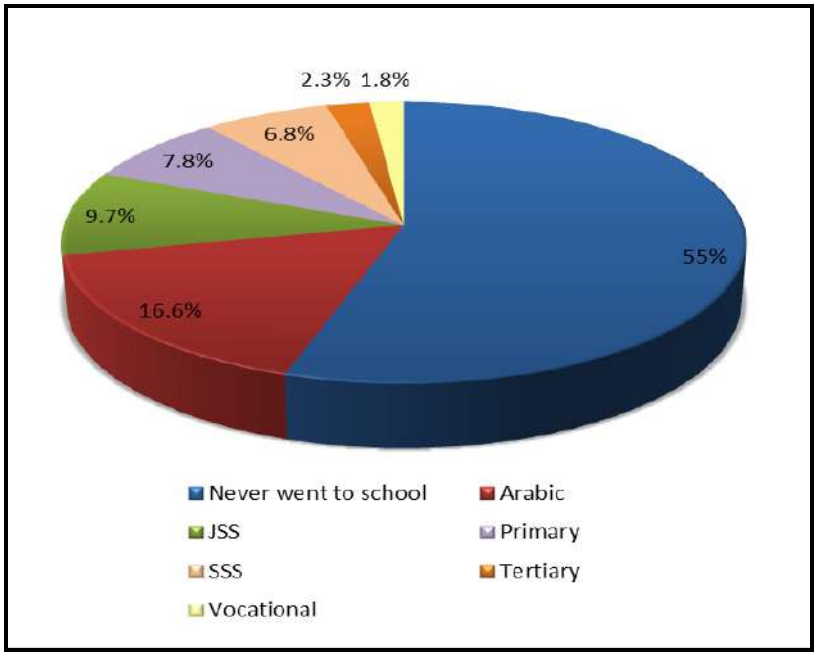


Figure 6.2-11: Educational levels attained by respondents in Project Area

Households with children of primary school going age were asked whether their children were enrolled in primary school. 80% reported that their children were.

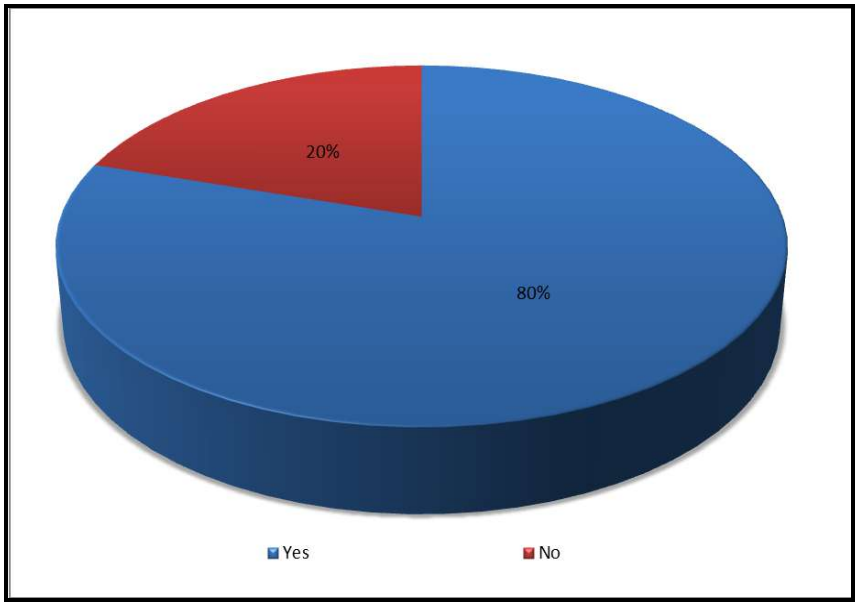


Figure 6.2-12: Households with children aged 6-13 enrolled in Primary School in Project Area

Those who reported that their children were not in school were asked to give reasons:

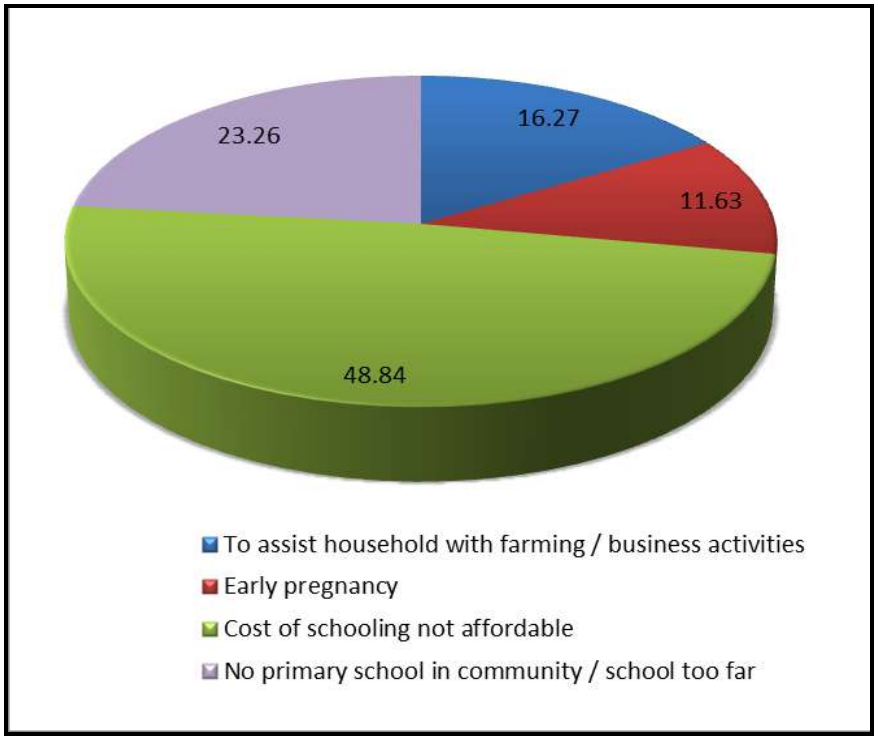


Figure 6.2-13: Reasons children were not enrolled in Primary School in Project Area

Households with children of secondary school going age (13 – 19) enrolled in secondary school were as follows:

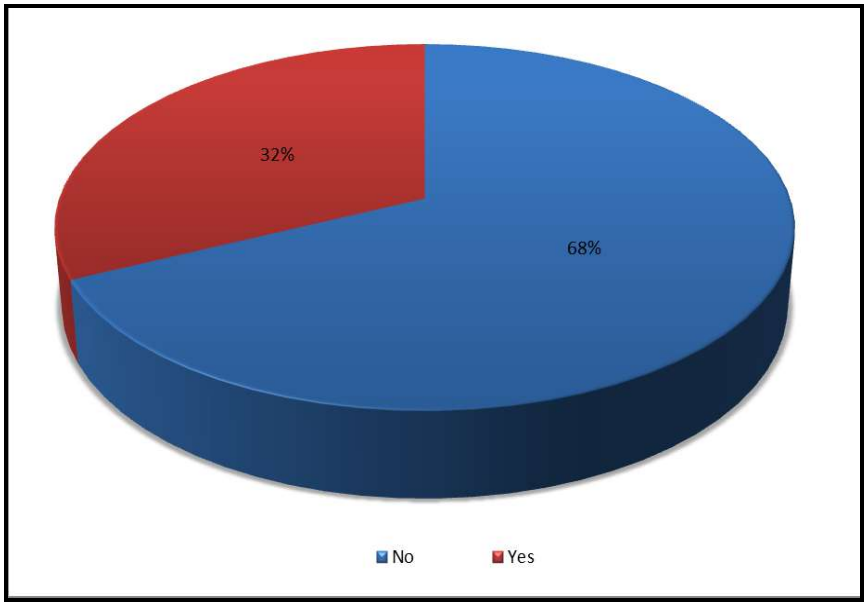


Figure 6.2-14: Households within the Project Area with Children aged 13 – 19 which are enrolled in secondary school

Reasons why children within this age bracket were not enrolled in secondary school were given as follows:

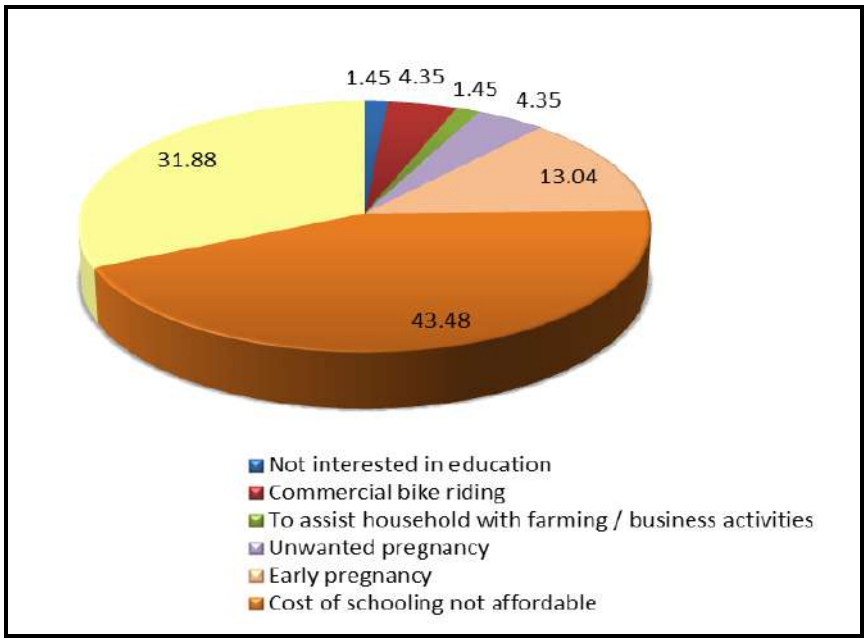


Figure 6.2-15: Reasons why Children of Secondary School going Age were not enrolled in Project Area

6.2.2.2.8 Primary Livelihoods and related Income

Farming was reportedly the main primary livelihood activity of respondents:

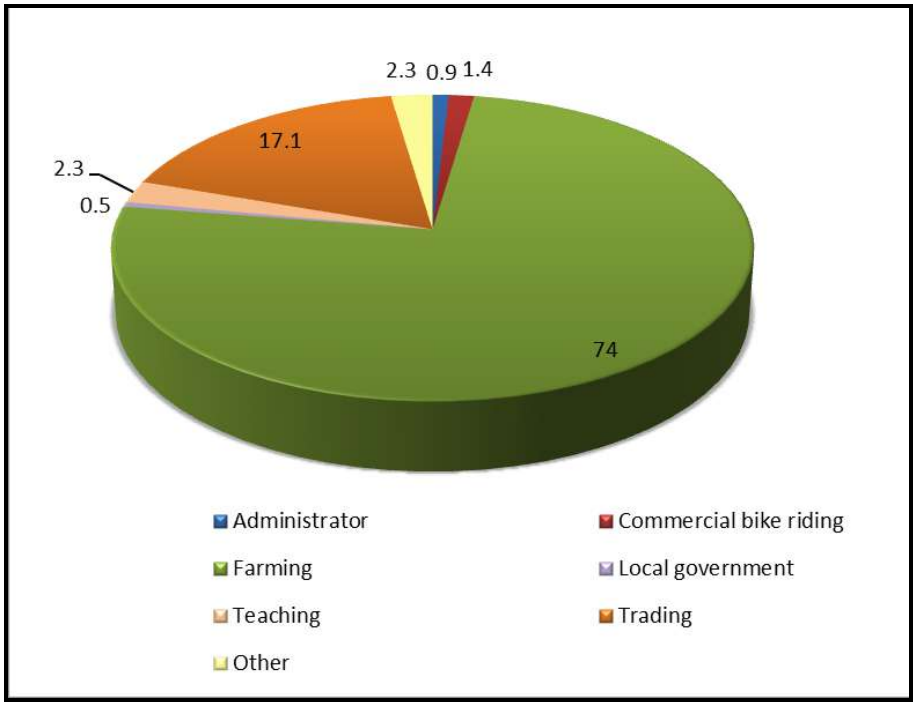


Figure 6.2-16: Primary Livelihoods in Project Area

Average monthly incomes obtained from these activities were investigated.

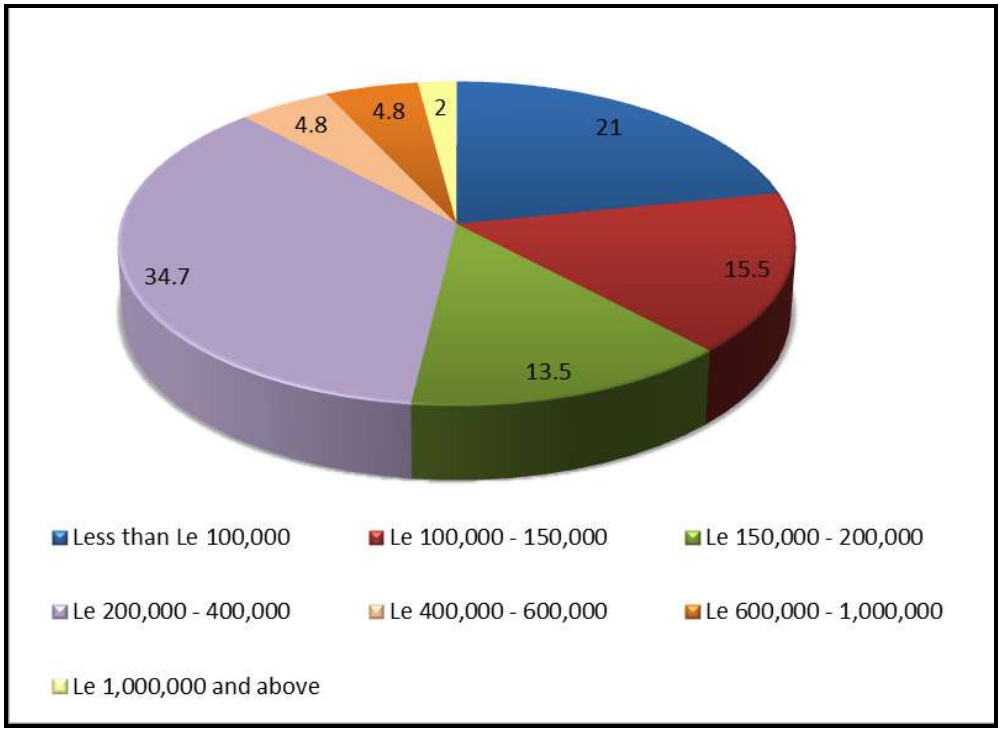


Figure 6.2-17: Average Monthly Income from Primary Livelihoods in Project Area

6.2.2.2.9 Housing Infrastructure

90% of respondents reportedly lived in houses owned by the household head.

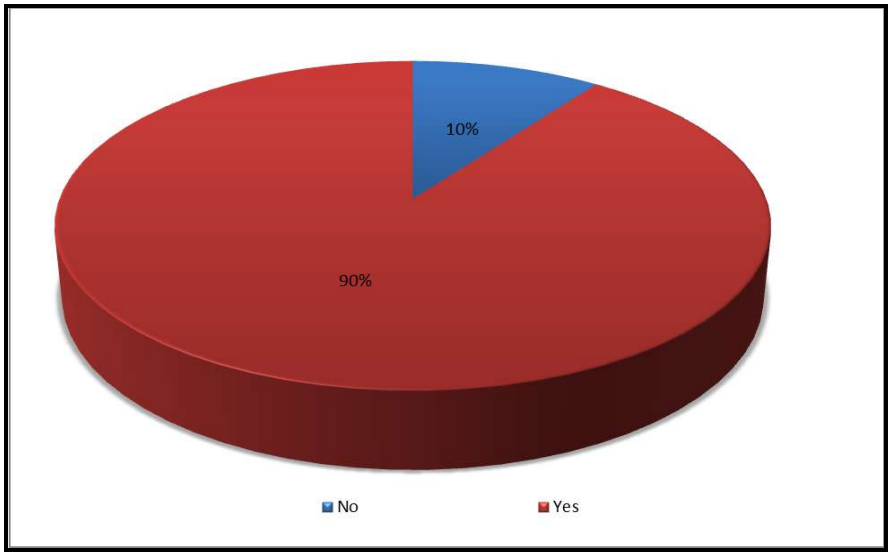


Figure 6.2-18: Ownership of House in Project Area

6.2.2.2.10 Type of House

Typical dwelling houses in the Project area are made of mud, plastered with cement and roofed with corrugated iron; this was the type of dwelling inhabited by 60% of respondents.

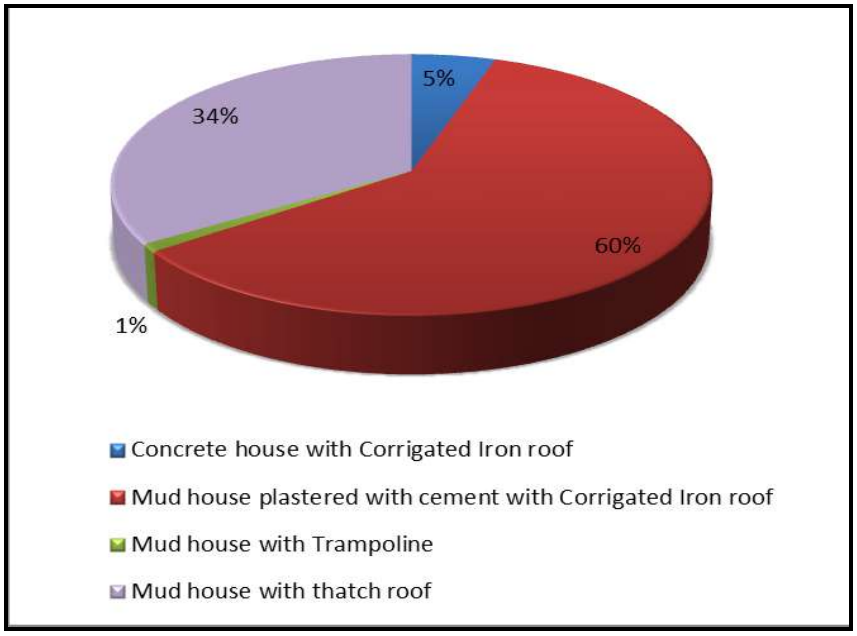


Figure 6.2-19: Type of Dwelling / House in Project Area

6.2.2.2.11 Ownership of Agricultural Land

All respondents reportedly owned a portion of land for farming.

6.2.2.2.12 Source of Energy Lighting and Cooking

Battery operated LED Lights are the most popular light source among respondents.

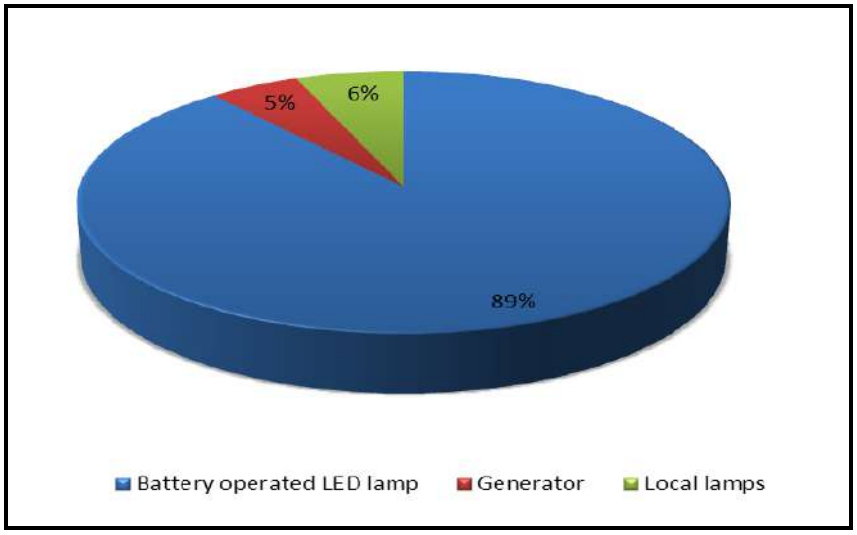


Figure 6.2-20: Primary Source of Energy for Lighting in Project Area

Energy for cooking is mostly firewood as reported by 95% of respondents, while the remaining percentage use either charcoal or a combination of both.

6.2.2.2.13 Water and Sanitation

Respondents were asked to indicate their primary source of drinking water. The majority drink from surface water sources (stream / river):

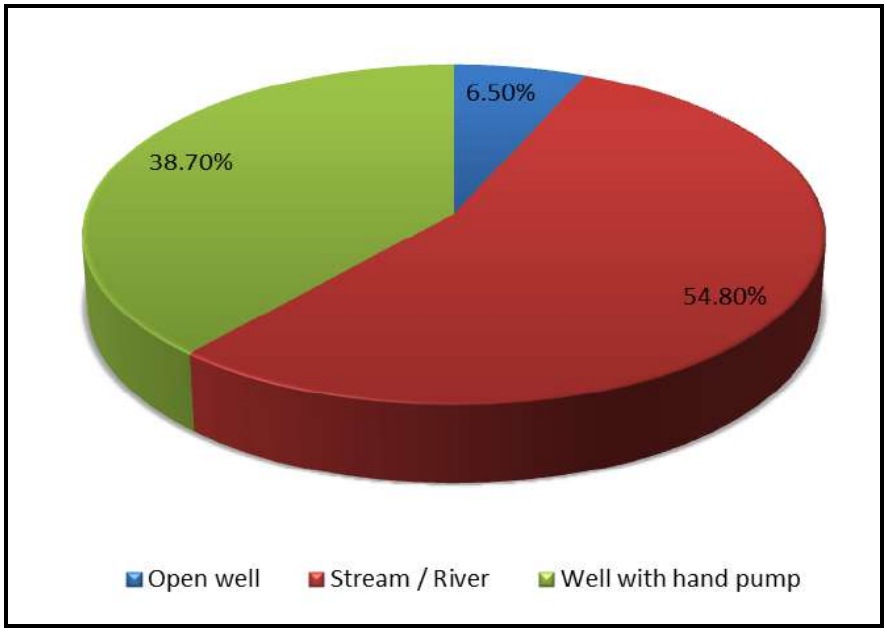


Figure 6.2-21: Primary Source of Drinking Water in Project Area

Respondents were asked whether they were satisfied with the quality of their drinking water. 96% were not:

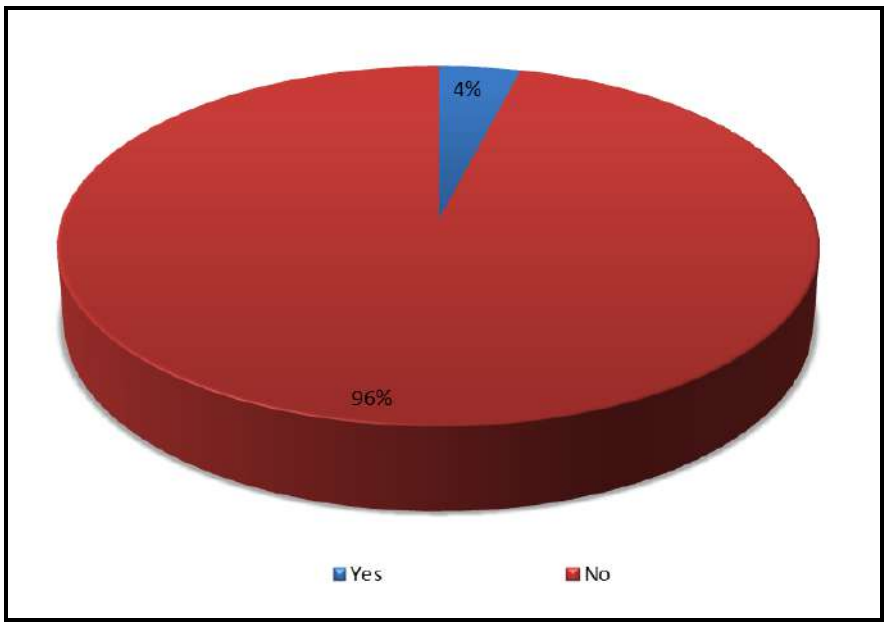


Figure 6.2-22: Satisfaction with quality of drinking water in Project Area

Problems with drinking water quality were identified as follows:

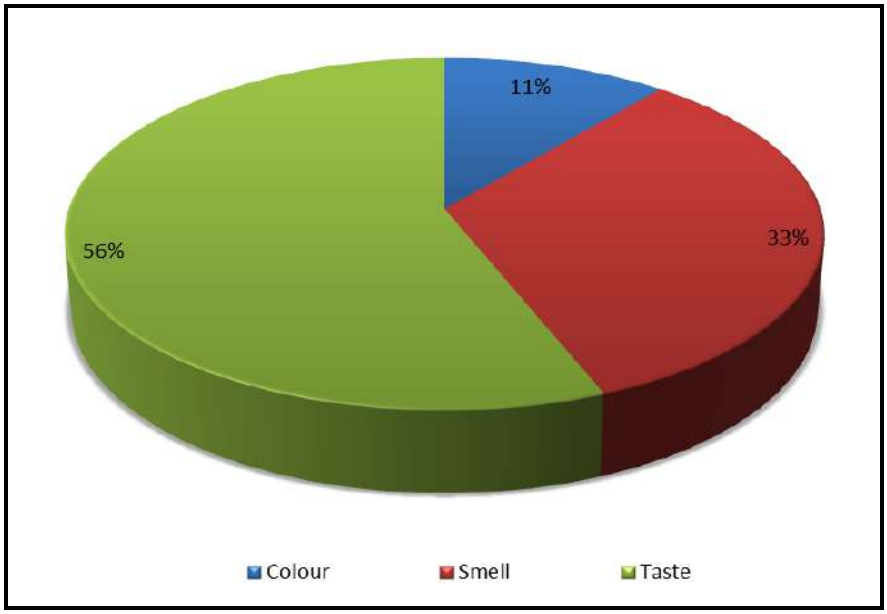


Figure 6.2-23: Problems with Drinking Water in Project Area

6.2.2.2.14 Type of Toilet Facilities

The traditional pit latrine is the most common type of toilet facility within the Project area, reportedly used by 71.9%:

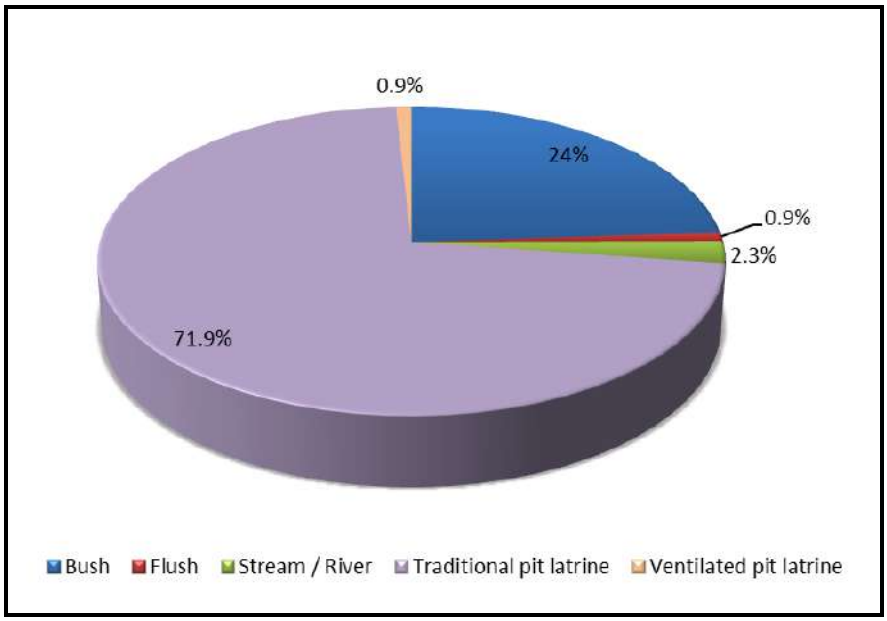


Figure 6.2-24: Type of Toilet Facilities available to households in Project Area

6.2.2.2.15 Waste Management

Over three quarters of respondents admitted to waste disposal through open dumping (in bushes); a small percentage reportedly used their waste to form compost heaps.

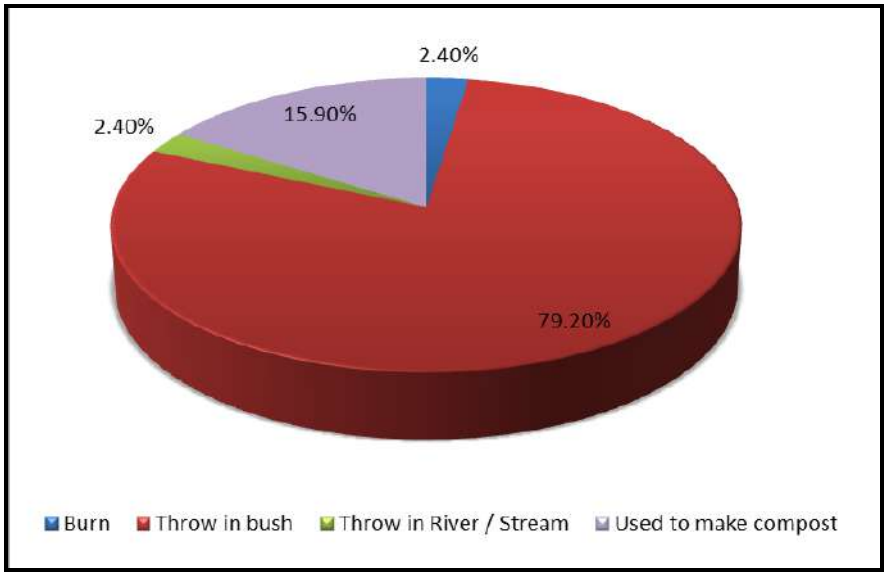


Figure 6.2-25: Method of waste disposal in Project Area

6.2.2.2.16 Community Health

Respondents were asked what illnesses had been experience by household members in the two weeks prior to the survey. More than one illnesses were reported in most cases. The following chart shows the number of respondents who indicated that their households had been affected by the listed illnesses:

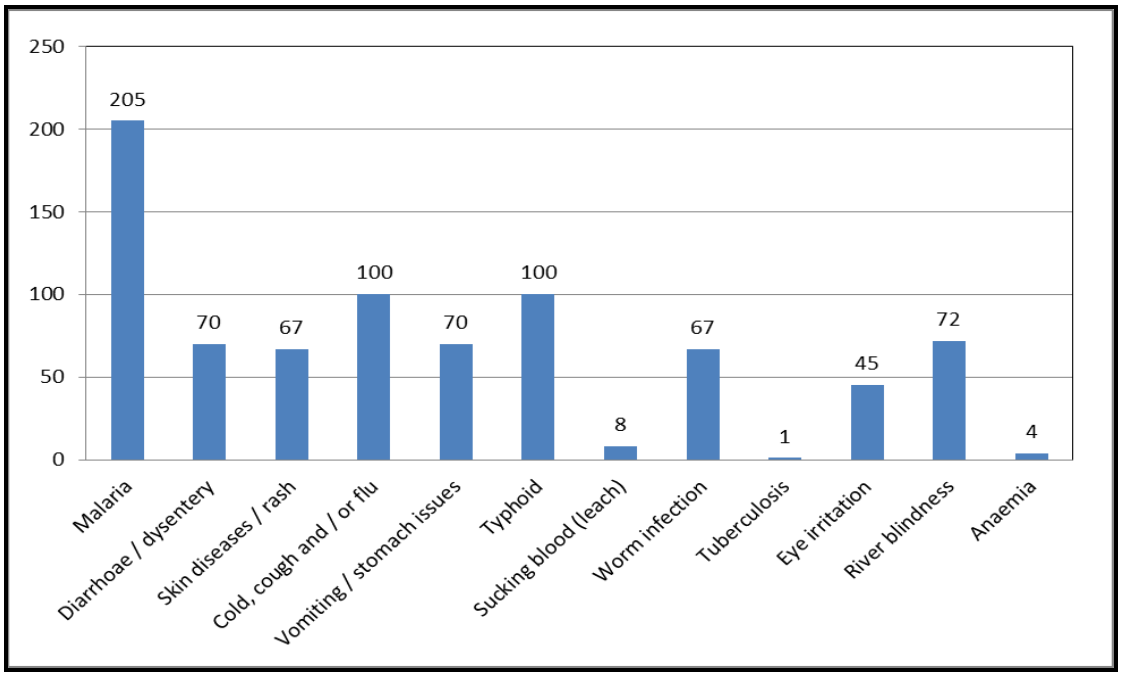


Figure 6.2-26: Illnesses experienced by households in the 2 weeks prior to the survey in Project Area

Households' sources of health care treatment were investigated, with 94% reportedly relying on their community health centres:

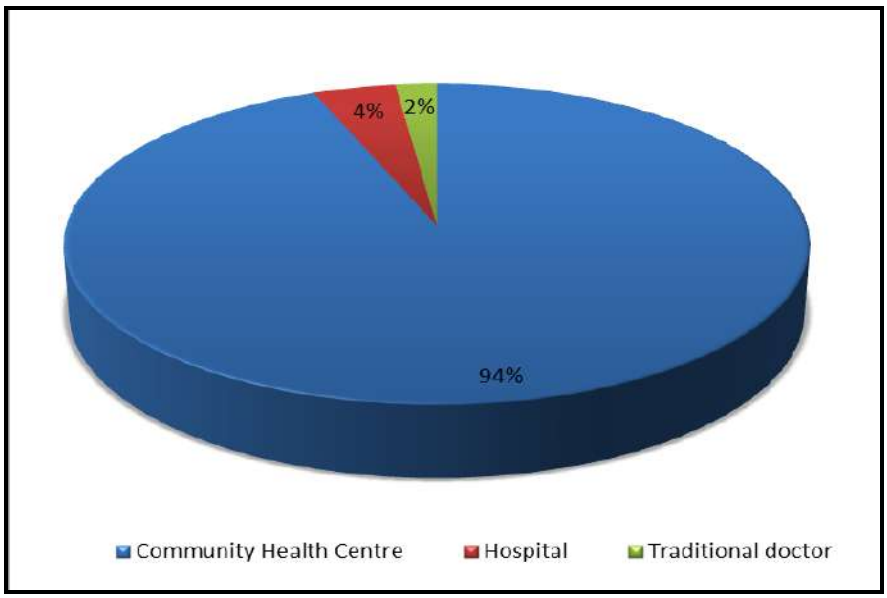


Figure 6.2-27: Household's source of Healthcare in Project Area

Awareness of HIV/AIDS was investigated. 82% claimed to have heard about the disease:

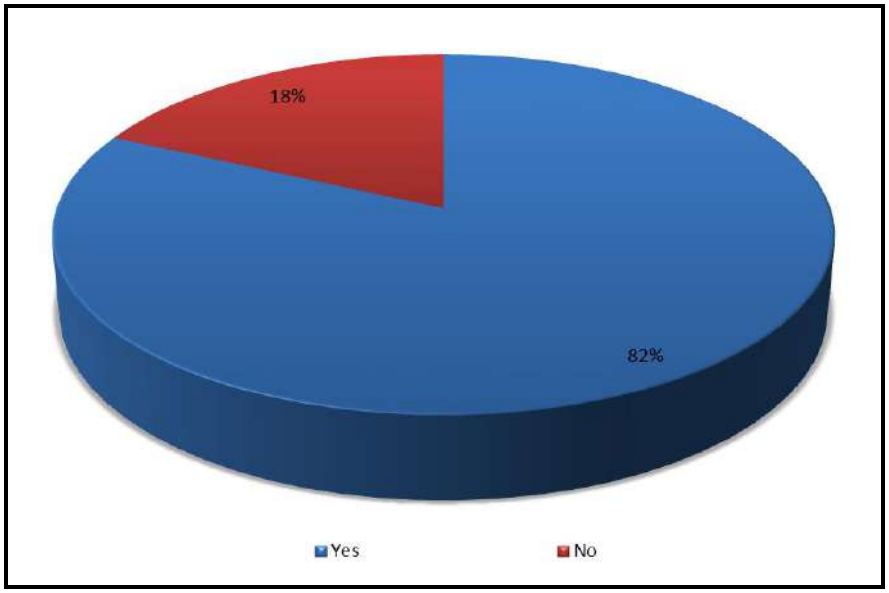


Figure 6.2-28: Respondent's awareness of HIV/AIDS in Project Area

55.5% reported that they had heard about the disease through the media (radio, TV and/or newspaper:

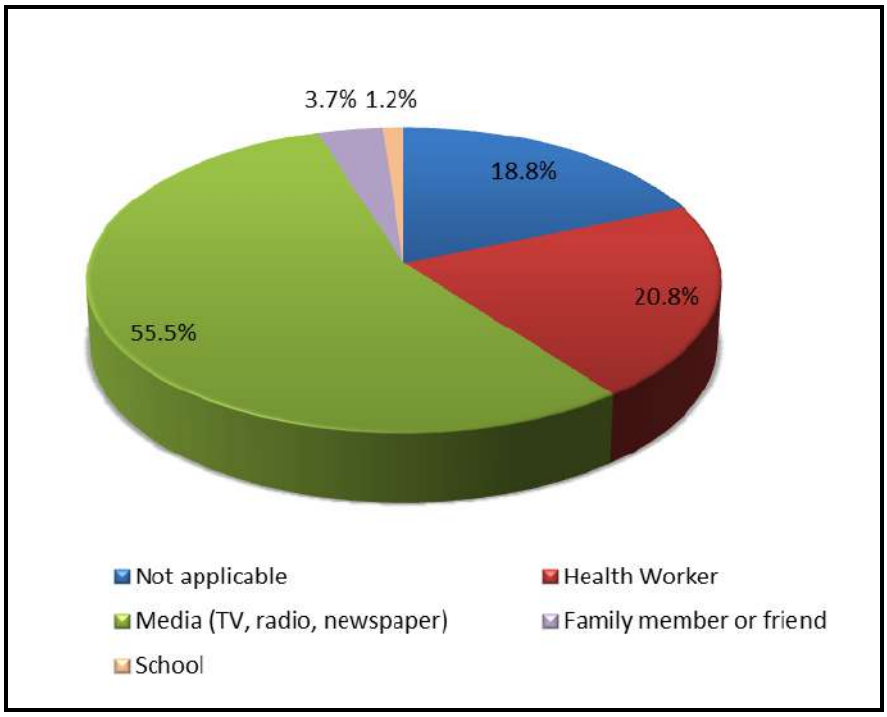


Figure 6.2-29: Source of Information on HIV/AIDS in Project Area

Respondents' knowledge on HIV/AIDS transmission modes was tested:

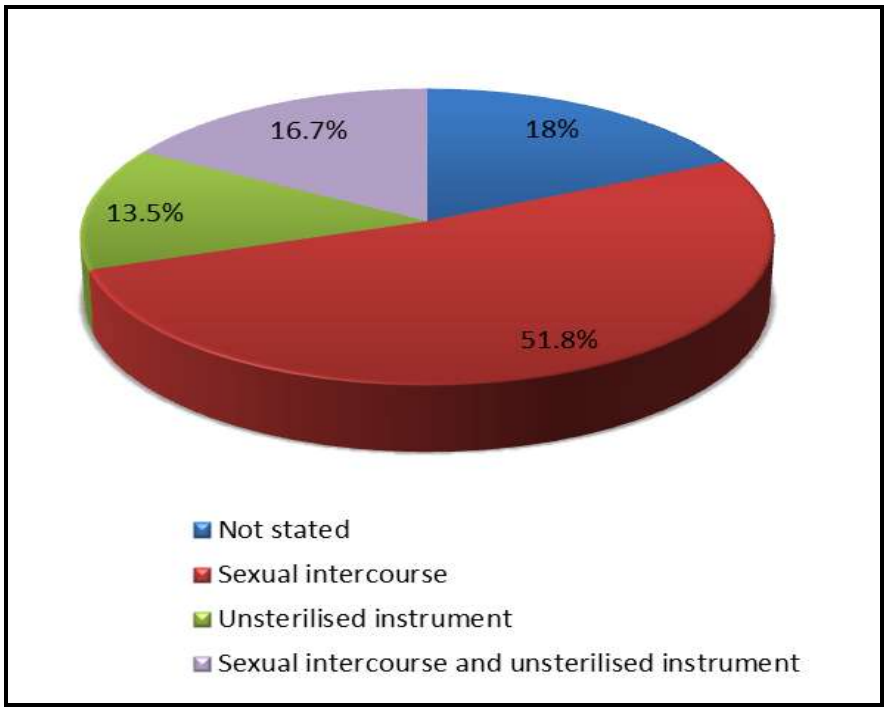


Figure 6.2-30: Respondents' knowledge on modes of HIV/AIDS Transmission in Project Area

Respondents were asked whether any members in their households had been tested for HIV/AIDS:

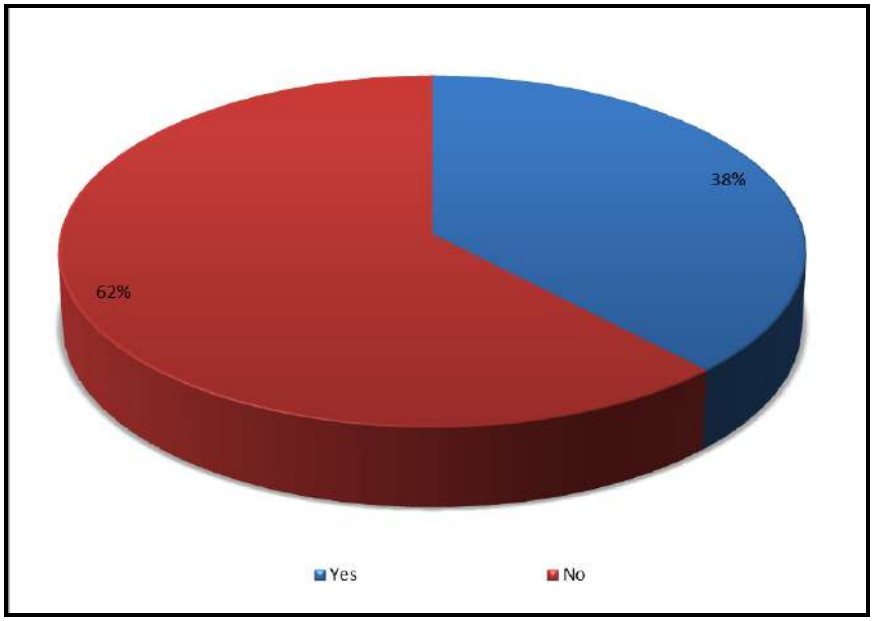


Figure 6.2-31: Households with members tested for HIV/AIDS in Project Area

6.2.2.2.17 Respondents' Awareness and Perception of Haul Road, Bridge and Transmission Line in the Project Area

All respondents reported being aware of the proposed project, and when asked how they felt about the proposed project almost all respondents were optimistic.

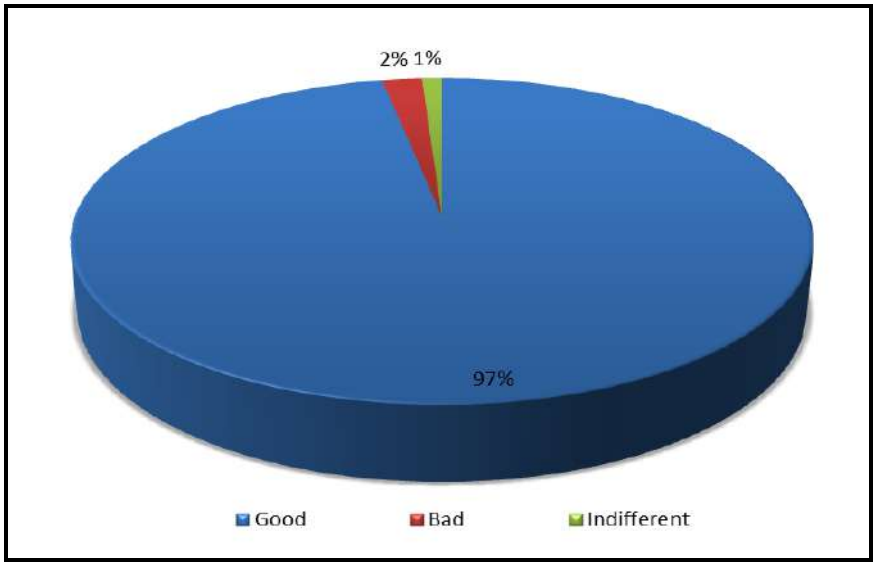


Figure 6.2-32: Perception of Haul Road and Transmission Line Project

Respondents were asked to give two (2) positive outcomes they envisaged from the proposed project. Responses ranged from anticipated boom in trade, improvements in agricultural

activities and community benefits such as construction of schools as shown in the following figure:

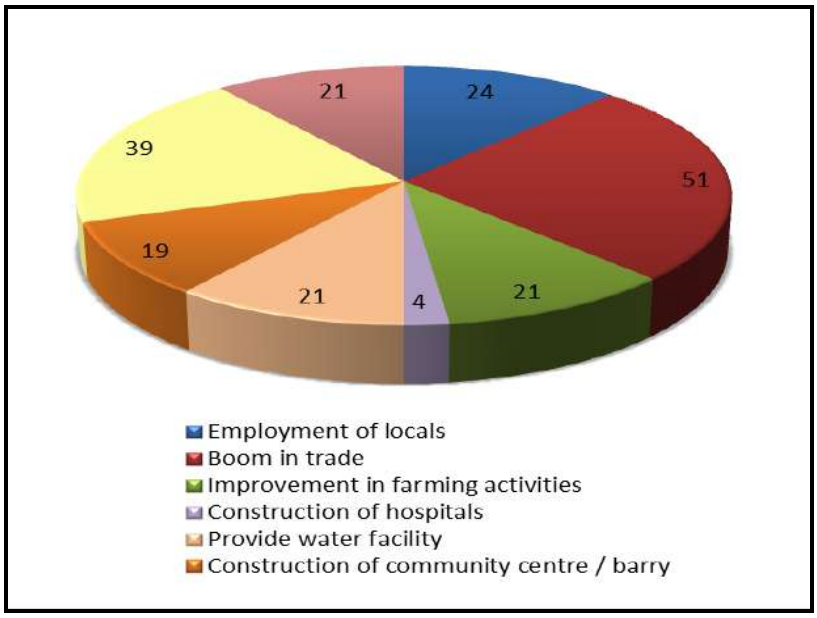


Figure 6.2-33: Reasons for Positive Outlook on Project

Respondents were asked to list possible negative impacts of the project. Most respondents (25%) feared the possibility of accidents. Other reasons given included loss of agricultural land and the possibility for relocation:

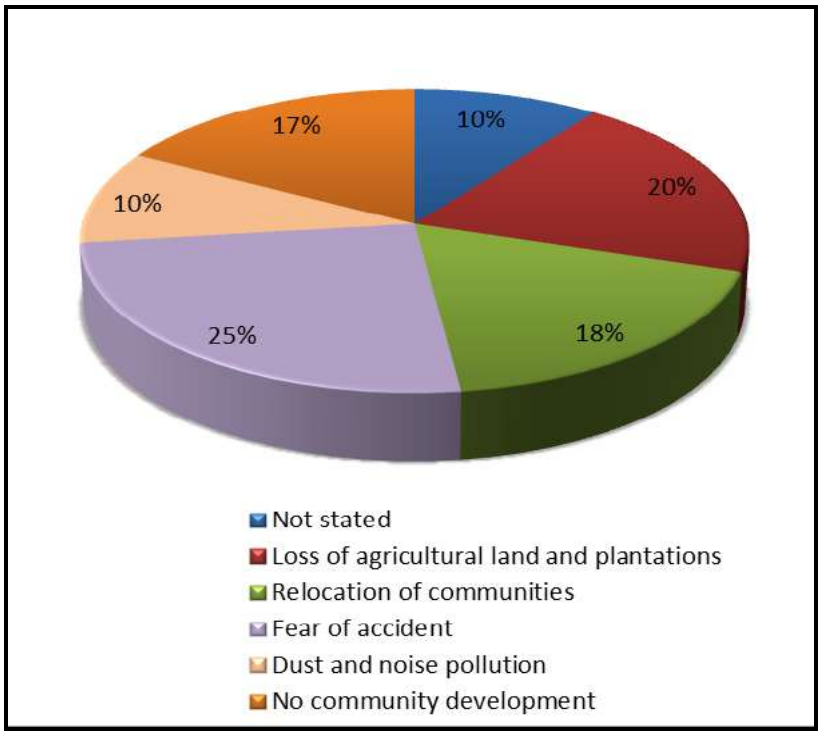


Figure 6.2-34: Perceived negative impacts

Mitigation measures suggested by respondents for these perceived negative impacts were given as follows:

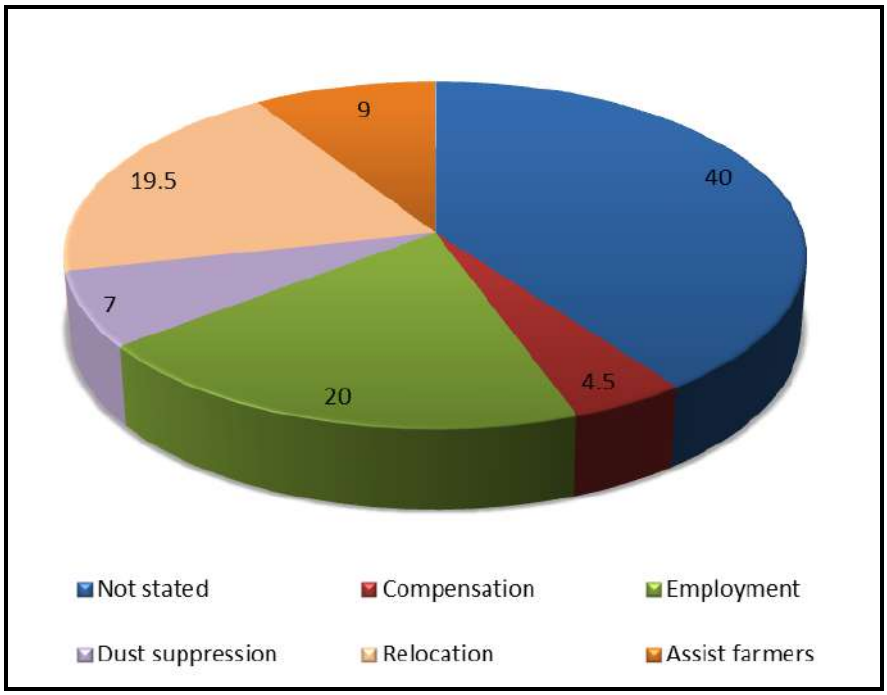


Figure 6.2-35: Suggested Mitigation Measures

6.3 Heritage Study

6.3.1 Methodology

Data for this study was obtained from two main sources:

- *Desktop / internet research* of relevant secondary literature to identify known cultural heritage and archaeological sites in the Project area.
- *Fieldwork*: Visit to communities situated on or near the proposed haul road alignment between SRL Area 1 and Sembehun.

6.3.1.1 Communities Visited

The communities listed below were visited and fruitful discussions held with community leaders.

Lower Banta Chiefdom	*Bagruwa Chiefdom*
Largo and Largo Junction	Moselolo
Mosenesie 1	Mosenegor
Nyandhun Kugba	Moyasa
Mokombay	Fula Town
Mogbwemo	Kpandebu
Momasa	Kasama
Moporhoi	Ngeibu
Bengelor	

The objective of the visits was to gather enough information on, and to locate, the cultural sites in each community. In addition, the consultant was interested in knowing what needed to be done in the event that a cultural site was adversely affected by the construction and use of the proposed haul road between Mogbwemo and Sembehun.

The following ethical issues were observed:

a) *Consent and voluntary participation*: The purpose of the research was clearly explained to the respondents in their community language and they voluntarily agreed to participate without any financial remuneration.

b) *No harm*: The consultant did not put the respondents in a situation where they were at risk of being harmed as a result of their participation in the discussion.

c) The *privacy, anonymity and confidentiality* of the respondents were duly respected.

6.3.2 Results

6.3.2.1 The Cultural Heritage Environment

The cultural heritage study involved communities in two Chiefdoms in Moyamba District: Lower Banta and Bagruwa Chiefdoms. Historically, Lower Banta is the home of the Banta, an offshoot of the Temne who had established an empire around present-day Taiama (Kori Chiefdom) before the 18th century. A sub-group of the Mende, the Kpaa Mende, subsequently dislodged the Banta and pushed them towards the southwestern coast of Sierra Leone, in their present location.

The Banta have over the decades been influenced linguistically by the Mende, although they have retained certain aspects of Temne culture. A similar development has taken place in Bagruwa Chiefdom which historically, is a Sherbro-speaking community. Today, most people in Bagruwa speak Mende.

The activities of the people, like those of many other Sierra Leonean communities, are sustained somewhat by religious beliefs and practices. Ancestor worship is still relatively significant. There are shrines, burial grounds and artifacts like sacred rocks where some communities occasionally congregate to offer sacrifices to their ancestors. Basically, the ceremonies involve animal sacrifice and the preparation of large amounts of food which is communally shared. Diviners and elders (including women) perform the ceremonies for a variety of reasons, including:

- To placate the spirits in case, for example, of a bad harvest or some calamity that has befallen the community such as, flood or fire disaster, and
- To keep the settlement in constant communion with the ancestors, whose blessing and protection are considered necessary for success and harmony in the community.

The sacred and religious sites form a very strong bond between the living, the dead and future generations. They are the soul or glue that bind the community together and these sites are

generally immovable unless absolutely necessary. In modern times, for example, large-scale mining ventures have often led to the relocation of settlements and their cultural sites.

There are also traditional (non-formal) educational institutions like the Poro (for men) and Bondo / Sande (for women). Initiation into these societies is still considered an important rite of passage. Foreign religions and particularly Islam, have over the years had a very strong if negative influence on especially the Poro in the Project area. Islamic teachings seem to be at odds with Poro practices to the extent that initiation into the Poro is now largely for symbolic value.

It is in this context that this cultural heritage study was undertaken in the Lower Banta and Bagruwa Chiefdoms.

6.3.2.2 Literature Review

There are a few ethnographical works relevant to the study. They include McCulloch's (1950) *The People of Sierra Leone* and Clifford (1974) *The Land and People of Sierra Leone* who both give general accounts of the cultures of most of Sierra Leone's ethnic groups. Little (1949), *The Mende of Sierra Leone*, concentrates on the origin, social and economic organisations of the Mende, while Sawyerr (1964) "Ancestor Worship – The Mechanics" and Sawyerr & Harris (1968) *The Springs of Mende Belief and Conduct*, give detailed accounts of the religious life of the Mende. Little (1949) "The Role of Secret Society in Cultural Specialization" discusses the Poro as an important rite of passage.

More recent unpublished works on cultural heritage surveys in Sierra Leone and elsewhere include Alie (2013), "Cultural Heritage Survey of London Mining Operational Areas in Tonkolili District" (Environmental Resources Management, UK), Alie (2012), "Cultural Heritage Survey of London Mining Operational Areas in Port Loko District" (Environmental Resources Management, UK), Wheelhouse & Alie (2012), "Baseline Cultural Heritage Environment Report" (New Liberty Gold Mine, Liberia) and Alie (2001), "Historical White Paper on Communities in Sierra Rutile Operational Areas in Southwestern Sierra Leone" (Knight Piesold, USA).

6.3.2.3 National Cultural Heritage Preservation

National cultural heritage preservation is still in its infancy in Sierra Leone. The Sierra Leone Monuments and Relics Commission which is the main agency for the protection, preservation and promotion of the country's cultural heritage has so far proclaimed less than 20 national monuments. All except two relate to the transatlantic slave trade and European colonisation (Basu 2008). There are at the moment, no cultural sites in the SRL MLAs area that are of national or regional significance.

Archaeological surveys in Sierra Leone are also rather limited. All of the archaeological work done to date has been concentrated mainly in the northern and some parts of the southeastern region of the country.

In summary, the available literature suggests that although cultural practices are prevalent among many Sierra Leonean communities including those in the SRL MLAs. Many communities are protective of their shrines and other sacred places, such places do not tend to stand in the way of general development. Put differently, these sites can be relocated following proper sacrificial rites to appease the ancestors.

6.3.2.4 Identified Heritage Sites

All the communities visited had one or more of the following cultural heritage sites:

- General cemeteries;
- Secret society bushes for men and women, and
- Ceremonial meeting places for ancestral worship and divination (shrines). They were all community shrines and therefore open to all adult members of the community. There were, however, separate meeting places for the men and women.

Most of the sites are generally located very close to the village (often less than a kilometre) and the secret society bushes and ceremonial sites are found within thick forests surrounding the villages. The Poro and Sande ceremonies usually take place during the dry season and often on a yearly basis.

The strong influence of Islam in most settlements has seriously impacted cultural practices like Poro initiation rites.

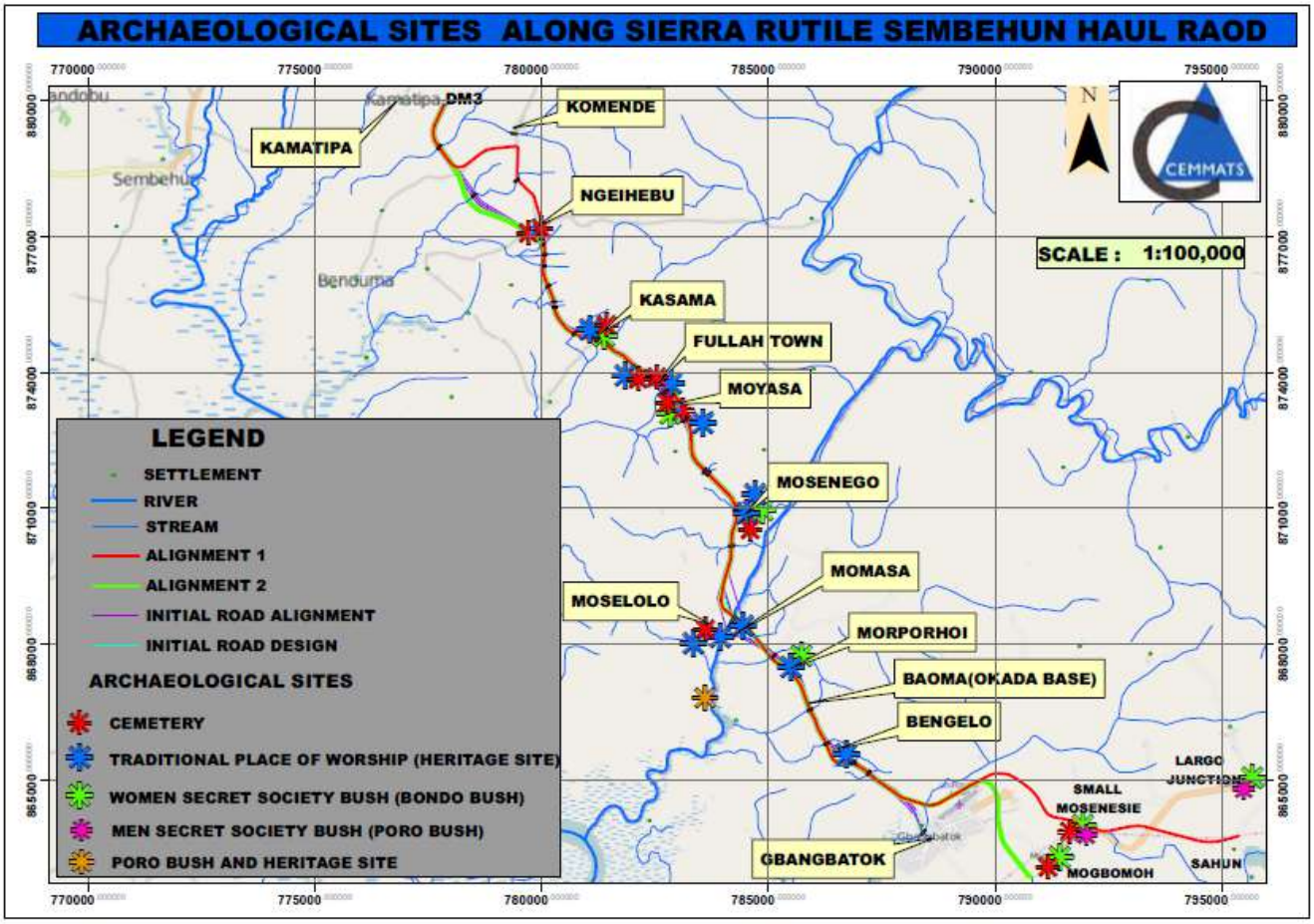


Figure 6.3-1: Map Showing Cultural and Heritage Sites along the Proposed Road Alignment

Details of the cultural heritage sites identified within the Project area are presented in the following table:

Community	Type of Cultural Site	Remarks
Lower Banta Chiefdom		
Largo and Largo Junction	• Poro bush • Sande bush • Cemetery	The Poro and Sande bushes are used for annual initiation ceremonies. Although the bushes may appear sacred, their relocation should not be a problem. This is because any thick forest near the village can serve such purposes. The same applies to the cemetery. There are no special burial grounds whose relocation may be problematic.
Mosenesie 1	• Poro bush • Sande bush • Cemetery	May be easily relocated as described above.
Nyandehun Kugba	• Cemetery	May be easily relocated as described above.
Mokombay	• Poro bush, • Sande bush • Cemetery	May be easily relocated as described above.
Mogbwemo	• Sande bush • Cemetery	May be easily relocated as described above.
Momasa	• Sande bush,	The ancestral worship ceremony is usually held in January.

Community	Type of Cultural Site	Remarks
	• Bush for ancestral worship • Cemetery	May be easily relocated as was previously described.
Morporhoi	• Sande bush • Cemetery • Sacred ancestral worship ground	The ceremonies are performed usually every three years. There is also a *Kpekei* bush and stone where herbalists and diviners claim to cure certain ailments affecting children, e.g. kwashiorkor. May be easily relocated previously described.
Bengelor	• Poro bush • Sande bush • Cemetery • Ancestral worship shrine	May be easily relocated previously described.
Bagruwa Chiefdom		
Moselolo	• Sande bush • Cemetery • Ancestral Worship Bush	May be easily relocated as previously described.
Mosenegor	• Sande bush • Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Moyasa	• Poro bush • Sande bush • Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Fula Town	• Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Kpandebu	• Cemetery • Ancestral worship shrine	May be easily relocated as previously described.
Kasama	• Sande bush • Cemetery • Ancestral worship ground	May be easily relocated as previously described.
Ngeib	• Ancestral worship shrine (infrequently used)	May be easily relocated as previously described.

6.4 Crop Compensation Assessment

6.4.1 Methodology

The process of estimating crop areas along the proposed road alignment included primary and secondary data collection, processing and mapping, involving both quantitative and qualitative methodologies. Activities included high level desktop studies and secondary spatial data processing and mapping, and field visits during which complementary qualitative data were collected through town hall meetings, focus group discussions and key informant interviews. The following subsections provide an overview of these approaches.

6.4.1.1 Data Sources

Crop location and extent relative to the proposed road alignment were estimated using the following datasets:

- GPS Datasets which were collected during the field work which helped with locational identification and verification of crop types wherever this was possible;
- Chiefdom hydrological and road shapefiles for Bagruwa and Lower Banta: these offered a source of essential information on accessibility of the communities. Their alignments relative to alignment of the proposed new road were helpful in estimation of the spatial extent of some crops;
- ESRI's ArcMap version 10.5 background image together with Google Earth Map Datasets provided locational information for various crops especially tree crops;
- Sierra Leone's 50K map offered some indication of the topography, and
- Local knowledge provided by key informants was also very resourceful in defining the study locations in line with crop type.

6.4.1.2 Desktop Studies

An analysis of Google Earth Image Landsat (US dept. of State Geographers, 2016/17), ESRI's ArcMap version 10.5. background image and Sierra Leone's 50K Topography was conducted. The overall aim of secondary spatial data analysis was to gain initial understanding of secondary information on crop distribution, especially tree crops. These secondary data were characterised by high spatial resolution which was capable of deriving 3D information relative to canopy height and terrain elevation. These helped in defining existing conditions of crops especially oil palm plantation which is easily identifiable through its evergreen broadleaf tree.

Literature on crop compensation in Sierra Leone was also consulted, for instance, the SLIEPA client Charta 2016.

6.4.1.3 Primary Data Collection

Focus group discussions: Focus group discussions with stakeholders including farmers, community leaders and or local authorities in both Chiefdoms making up the Project area

were conducted. Discussions were conducted with different categories of people in the community including women, youth, men, farmers, farmer's organisations and local authorities. Focus group discussion meetings were conducted in each of the affected 4 towns / villages in the Lower Banta Chiefdom while eight focus group discussion meetings were conducted in each of the affected eight towns / villages in the Bagruwa Chiefdom.

Key informant interviews: Key informant interviews were conducted with four key stakeholders in both Chiefdoms. Two (2) key informant interviews were conducted in each Chiefdom.

Geographic Information Systems (GIS) Use

Ground surveys were conducted along the proposed road alignment. The surveys provided the opportunity to collect point samples of crop area using Garmin GPS version 60Cs. For each crop along the proposed road alignment, GPS coordinates were collected.

The GPS points from the field were imported into Google Earth Maps to give an indication of their location and spatial extent. These crop features were digitised using an on-screen digitising approach. The digitised features were exported into ArcMap version 10.5 and a 50 metres buffer on both sides of the proposed road alignment were developed for each crop to facilitate the estimation of their coverage. Estimates of crops within such areal extents were estimated based on the set standards. In Sierra Leone, for instance, it is a standard that for every acre of land there are 60 oil palm trees and one (1) bushel of rice. Based on the estimate provided, combined with the information relating to crop compensation as prescribed within the laws of Sierra Leone, compensation estimates were made which should serve as an initial guide for SRL.

6.4.2 Results

A total of 708 acres of land exists within a 50-meter buffer of the proposed road alignment. Out of this total, an estimated 96.5 acres were noted to have various crops. A rapid assessment of these crops was undertaken in the field and four categories of crops were identified along the proposed road alignment as presented in the following table.

Table 6.4-1: Estimated Costs of Assessed Crops

Sr. No	Crop	Acre
1	Cassava	10
2	Rice - Upland	1
3	Rice - IVS	0.5
4	Oil Palm	85

It should also be noted that the estimation of costs for vegetables and other tree crops that existed in isolation or in backyard gardens and fallow bush were out of the scope of this

assignment mainly due to time and resource constraints. It is strongly recommended that provision be made for such seasonal, annual and permanent crops of this nature.

SRL already has a compensation system with an established team and procedures in place. It is expected that this system will be maintained and utilized for this project. The company will have to liaise with officers from the Ministry of Lands, Country Planning and the Environment (MLPCE), the Ministry of Agriculture, Forestry and Food Security (MAFFS), community Chiefs and land / crop owners to undertake a more detailed crop assessment within the specified right of way. It is also recommended that crop assessment and associated compensation payment are completed before commencement of construction work. Where necessary, a Livelihoods Restoration Plan may be implemented for some of the affected farmers.

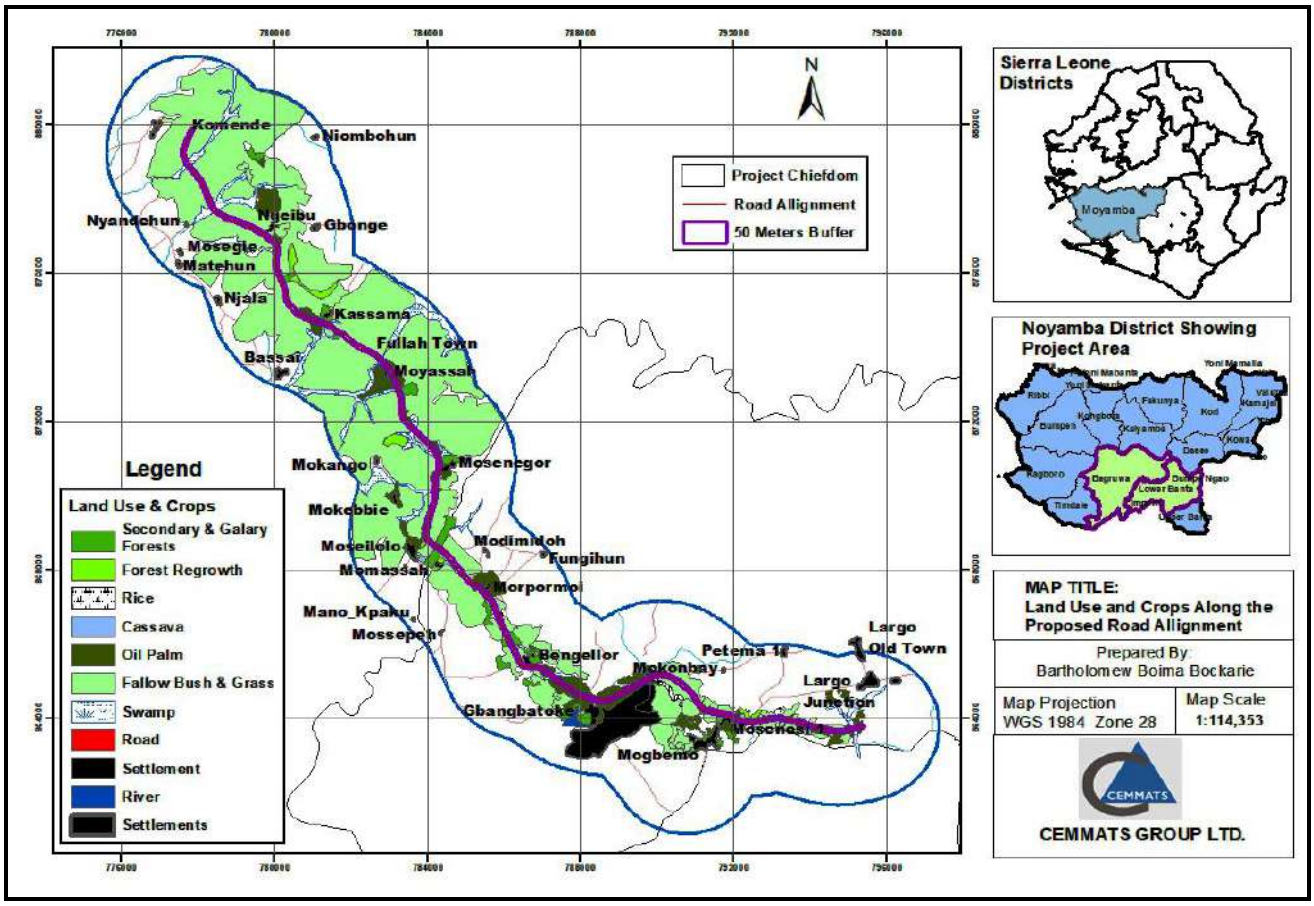


Figure 6.4-1: Land Use and Crops Grown within the Project Area

7 IDENTIFICATION OF POTENTIAL IMPACTS

7.1 Introduction

This chapter identifies and describes the potential environmental and social impacts of the project components on the biophysical and socio-economic conditions of the environment and communities. Where applicable, it also identifies mitigation measures that will reduce adverse impacts and that will enhance positive ones. The assessments carried out in this chapter are on potential impacts on overall environmental and social receptors caused by the project activities in the various phases of the project, with mitigation measures recommended accordingly.

7.2 Environmental and Social Impact Assessment

7.2.1 Background

An ESHIA study (informed by a combination of desktop studies and on-site observations by the project team) was carried out of the potential environmental and social impacts identified at the time of the study. This was done in order to first, determine the potential for such impacts, and secondly, to identify and propose mitigation measures that would enable avoidance or reduction of severity should the potential impacts occur or to increase the benefit of potential positive impacts.

7.2.2 Methodology

A number of steps were followed in developing the impact assessment process:

- A matrix of important project-specific impact categories was prepared;
- The level of significance, achievability of mitigation steps measured against practicality and cost-effectiveness were discussed in workshop / meeting setting, and
- An impact assessment scale was then developed.

Table 7.2-1: Degree of Certainty of Impact

Certainty of Impact	Description
Certain	The incidence of this impact is unavoidable and to be expected.
Very Likely	There is a high percentage of possibility for this impact to occur, and measures need to be put in place to mitigate it.
Likely	There is an even chance that the impact will may occur
Unlikely	The possibility of this impact occurring is remote, however it must be considered

Table 7.2-2: Environmental and Social Significance Scale

Significance scale	Description
Very High	Major or permanent alteration of environmental or social dynamics, with severe or very severe consequences, or (in the case of benefits), beneficial or very beneficial effects.
High	Long term effect on the social or natural environment. This category should be treated with a significant degree of importance at the project decision making stage.
Moderate	Medium to long term effects on the social or natural environment. This category should also be taken into cognizance in decision making as constituting a fairly important degree of threat. The threat is real but not substantial.
Low	These would have medium to short term ramifications on the social or natural environment; these are relatively unimportant and pose very little real threat.

Table 7.2-3: Degree of Difficulty to Mitigate

Degree of Difficulty	Description
Very Difficult	The impact can be mitigated in theory, but the extent of financial or technical involvement militates against its application or effectiveness
Difficult	The impact can be mitigated, but there is a significant degree of difficulty in implementing the proposed measured.
Achievable	The impact can be mitigated without much technicality or cost.
Easily Achievable	The impact can be easily and effectively mitigated

Table 7.2-4: Impact Assessment Matrix

Mitigation Potential	Impact Significance				Certainty of Impact
	Low	Moderate	High	Very High	
Very Difficult	Medium	Major	Extreme	Extreme	Certain
Difficult	Minor	Medium	Major	Extreme	Very likely
Achievable	Minor	Minor	Medium	Major	Likely
Easily Achievable	Minor	Minor	Minor	Medium	Unlikely

Table 7.2-5: Categories of Impact

Impact	Description
Extreme	Very significant action would be required to avoid or reduce these impacts. In certain instances, such impacts would prevent the action or option concerned from being taken or approved; and alternatives would have to be considered.
Major	These impacts are significant, meaning that if effective mitigation measures are not taken, a project may be hindered from commencing or continuing. Such option would require effective management and monitoring, or abandoned altogether for other options.
Medium	These impacts though important, are of less serious nature; in such a case, the Best Available Technology (or Practice) Not Entailing Excessive Cost (BATNEEC) should be employed. Such impacts alone are usually not significant enough to prevent a project from commencing or proceeding.
Minor	These impacts fall within the acceptable limits of the impact of a project on the environment, and mitigation in desirable but not necessary. This does not preclude 'Best Practice' as a means of avoiding cumulative impacts.
Positive	A beneficial impact to the bio-physical and/or socio-economic environment.

7.2.3 Results

The environmental impacts identified during the various phases of the project (development, operations and closure), and their mitigation measures are presented in the following table (Table 7.2-6).

7.2.3.1 Environmental and Social Impacts during the Planning and Construction Phase

Impacts at this stage are often temporary. At the planning stage, the main concern will be ensuring that designs for the haul road and transmission lines are done in such a way as to limit the negative environmental and social impacts that could occur during both the construction and operational phases of the project.

During the construction stage, traffic accidents, occupational safety incidents, as well as environmental impacts are paramount. Risks can be reduced by strict adherence to best construction management practices. The impacts anticipated at the construction stage, their recommended mitigation measures and residual impacts are shown in the following table.

Table 7.2-6: Environmental and Social Impacts and Mitigation Measures During Construction Phase

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Soil Erosion	Soil erosion is likely to occur as a result of earthworks including the exposure of loose soil as a result of vegetation clearing, creation of embankments, etc. Eroded material can block drains and also end up in watercourses, affecting water quality.	Certain	High	Extreme	- Slope stability measures will be incorporated such as benching and installation of erosion protection features such as silt barriers and sedimentation ponds. - Area to be cleared will be kept to the minimum necessary to prevent disturbance of soils outside the boundary. - Develop Sediment and Erosion Control Management Plan, to minimise risk of soil erosion and ensure dispersion of sediment into aquatic environments are avoided where possible. - Drainage channels to be constructed to divert uncontaminated surface run-off away from construction work areas. - Where possible, drainage outlets will discharge into vegetated areas and not to exposed soil. - Vegetation along drainage lines and gullies will be protected where practicable to provide natural attenuation of flows. - Construction activities and movement of construction vehicles outside designated areas and transport routes will be minimised. - In areas of ground clearance, topsoil will be stripped and salvaged as much as possible	Achievable	High	Medium
Hydrogeology	Excavation, land clearance and development of roads could give rise to interruption of hydrogeological conditions and groundwater flows.	Likely	High	Medium	- Design roads to avoid intrusion below the water table where possible; maintain ground water flows; and avoid significant impacts on hydrogeological conditions. - Avoid, as far as possible locations where springs occur, or the water table is close to the surface.	Achievable	Low	Minor
Water Quantity	Water abstraction from local water sources may result in reduced water	Likely	High	Medium	- Potable water will primarily be obtained from SRL's water reservoir and water treatment facility. - Water for construction will be abstracted from nearby surface water	Achievable	Moderate	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	availability to local communities and ecosystems.				sources. - No water will be abstracted without the prior approval of relevant authorities. - In the event that there is any valid dispute regarding water extraction by communities, alternative water sources will be provided to those affected (e.g. boreholes) - Water use will be monitored and recorded to maximise efficiency of water use and minimise waste. - Recycling of water will be undertaken where practical and safe. - Preventative maintenance and regular inspection of water tanks will be undertaken to minimise the risk of leaks and remedial action implemented as soon as possible.			
Water Quality	Pollution of water resources may arise at or close to the base camps and work-sites as a result of inadequate provision of sanitary and waste facilities, and accidental spillage or leakage of polluting materials. Pollution may also occur during construction operations carried out within the Gbangbaia River. Such pollution adversely affects those who depend on local water resources.	Very likely	High	Major	- All machinery and equipment are to be maintained in a good condition and serviced according to the OEM specifications. - Refuelling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies, and provided with secondary containment measures. - Adequate controls for the storage, use and handling of hazardous chemical substances must be in place at all times. Safety Data Sheets (SDSs) will be available at the point of use and all hazardous materials will be clearly labelled. Personnel should be trained in the use of such hazardous substances and adequate spill prevention (including the availability of spill kits) and emergency response plans will be adopted. - The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills / leaks, and take necessary measures to prevent materials from falling into the river. - If necessary, alternative water sources will be provided to downstream users of the Gbangbaia River as disturbance of the water during construction cannot be entirely avoided. - The Environmental Management Plans including spills and waste	Difficult	Moderate	Medium

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category

					management measures will be implemented.
					- Work to be undertaken close to surface water bodies will be limited as far as possible. Where not possible, e.g. at water crossings, additional measures will be taken to ensure that pollution of water resources does not occur, including minimising disturbance of river banks.
					- For construction of the Moselolo bridge:
					  - The duration of construction activities will be as short as practicable, and will be undertaken in the dry season;
					  - The construction of the bridge will take into account the hydraulics of the watercourse in the design to consider stability and flow disruptions, and
					  - The isolation and controlled dewatering of areas where pylons will be installed using a suitable method.
					- Sewage produced at the construction sites will be collected and transported to the Area 1 sewage treatment system for suitable treatment.			

Hydrology	Potential effects of road construction on surface water hydrology and hydraulics include:
	- Temporary increased surface runoff due of vegetation loss, topsoil removal and soil compaction on land adjacent to watercourses, and
	- Alterations in flow
		Likely	High	Medium	- Road construction will be carried out in a way that minimises the disturbance in waterways.
					- The bridge, all culverts and other stream crossing infrastructure will be designed in accordance with international standards, and to accommodate expected stream flows.
					- Temporary fencing off of areas around waterways to prevent unnecessary disturbance should be employed. To facilitate this, erosion and sediment control structure, stormwater and management techniques will be used such as:
					  - Sediment fencing;
					  - Erosion control mats;
					  - Energy dissipaters, and
					  - Sediment basins should be implemented prior to any works upstream or within waterways commencing.
					- Land susceptible to flooding will be avoided where possible.
						Achievable	Moderate	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	velocities, increased erosion and subsequent changes in bed and bank stability as a result of works within or adjacent to watercourses.				- Disturbance of soils will be avoided during heavy rainfall and the activities with the potential to cause significant erosion will be carried out during the dry season where possible. - Design road drainage to collect and control the flow of run-off from the road surface and minimise changes in established hydrological regimes, taking into account gradient, catchment size, expected flows, and upstream and downstream uses of receiving watercourses.			
Aquatic Ecology	Aquatic flora and fauna may be affected as a result of pollution from soil and other contaminants being carried into water ways by surface runoff, as well as construction activities occurring directly in water ways (installation of bridges and culverts). Organisms may die or have their mating, migration and other activities interrupted.	Likely	Moderate	Minor	- The construction contractor will implement waste management and environmental health and safety plans to limit water pollution. - The bridge, all culverts and other stream crossing infrastructure will be designed in accordance with international standards. - Working within watercourses, or on their banks, will be restricted, except where necessary to construct a bridge / particular structures. If work in watercourses is required, measures will be implemented to ensure significant impacts on aquatic habitats do not occur. - Sensitive species habitat will be avoided as far as practicable. - Install suitable culverts at small streams to allow for the movement of aquatic species. - Water required for the project will only be obtained from sustainable water sources avoiding adverse impacts on aquatic ecosystems.	Easily achievable	Low	Minor
Terrestrial Fauna	Mammals and birds will be impacted mainly from vegetation clearance and loss of forest cover, which is the key habitat for most of the species that are not tolerant to forest loss. This may result in forced migration and	Certain	Moderate	Major	- Vegetation clearing will be strictly confined to the areas where their presence would otherwise affect the construction work, or operations (in relation to transmission lines). - Where possible, the road, borrow pits, construction camps and power transmission line corridor will be designed to avoid and maintain a buffer zone around areas of conservation interest. - Disturbed habitats will be rehabilitated on completion of construction including creation of wildlife corridors to mitigate fragmentation as required. - Project personnel will be strictly forbidden from engaging in	Achievable	Low	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	potentially death. The road construction will also allow additional access of humans and vehicles to previously un-disturbed areas. The construction of power line infrastructure may result in increased bird collisions with the lines.				hunting, selling or purchasing bushmeat during work hours or within the project work areas or facilities. - Induction training for all project personnel will include communication of relevant information regarding bushmeat hunting and important local resources. Project personnel will engage local stakeholders to manage potential impacts in this regard. - Trenches or holes created during site works will be rendered safe for animals when unattended through covering or provision of an egress ramp. - Measures will be taken to minimise the risk of collisions between animals and vehicles. Signposts and speed limits will be established where necessary. Non-essential travel at night and driving off road will be prohibited. - During construction, install bird collision avoidance measures on the powerlines, as well as perch deterrents and alternate elevated perches, as well as raptor hoods. - Implement an appropriate fauna monitoring programme.			
	Disruption of sensitive faunal communities.	Likely	Very high	Major	- Where endangered species habitats are identified during the construction phase, a suitably qualified specialist shall be contracted to develop and implement a species-specific relocation management plan.	Difficult	Moderate	Medium
Vegetation	A major unavoidable impact of road works and transmission line installation is the effect on the terrestrial vegetation in the vicinity of the construction works. Loss of vegetation which in some cases will be permanent (removal of trees which	Certain	Moderate	Major	- Route selection has taken sensitive terrestrial vegetation locations into consideration, and these areas were avoided where practicable as part of the design process. - Avoid such areas if feasible / clear the minimum footprint required. - In general, the contractor will ensure that clearing of vegetation will be restricted to work areas only, to prevent excessive loss of vegetation. - Plant species of conservation interest will be avoided wherever possible. If they cannot be avoided, they will be relocated if possible to other suitable locations that will not be disturbed. - Harvest seed / fruit from species of importance and establish on site nursery to propagate these species for later use. Once construction	Achievable	Moderate	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	could affect transmission lines) is unavoidable.				has been completed, replant native species. - Vegetation clearance is to be undertaken using mechanical means. - Only where absolutely necessary, shall bio-degradable herbicides be used.			
	Disruption of agricultural activities where the route alignment passes through agricultural fields.	Certain	High	Extreme	- Follow the existing road infrastructure where feasible, and clear the minimum footprint required. - Avoid routing through the croplands where possible. - Undertake crop compensation well in advance of construction commencement. - Assist affected persons with livelihoods restoration.	Achievable	Moderate	Minor
	Removal of natural riverine vegetation, including potentially sensitive local ecosystems. This will be a very localised impact at the bridge construction site, and at small stream crossings.	Certain	Moderate	Major	- Route selection has taken riverine vegetation locations into consideration, and these areas were avoided where practicable as part of the design process. - Avoid such areas if feasible, clear the minimum footprint required and minimise the disturbance of adjacent habitats limited. - Where practicable, relocate species of importance prior to commencement of construction. - No herbicides are to be used within 100 meters of a riverine environment. - Appropriate culverts will be installed to minimise secondary and/or ongoing impacts. - Construction shall be conducted as far as possible during the dry season. - Once construction has been completed, replant native species.	Difficult	Moderate	Medium
	Localised disruption of ecosystem functions, such as ecosystem connectivity and fragmentation.	Certain	High	Extreme	- Clear the minimum footprint required. - Where practicable, enlarged culverts shall be installed to minimise impacts on aquatic environs.	Difficult	Moderate	Medium
	Ingress of alien and/or	Very	High	Major	- Implement an appropriate alien / invasive species monitoring and	Achievable	Moderate	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	invasive species.	likely			management plan.			
Spoils Disposal	Disposal of spoils in unsuitable areas such as hilly terrain could result in environmental impacts including erosion, water pollution, obstruction of drainage patterns, etc.	Likely	Moderate	Minor	- The contractor will be required to locate spoils sites as far as possible from productive land (e.g. vegetated or subject to some other land use) in designated areas, subject to approval of the project manager. In as far as practicable, spoils will be backfilled into the borrow pits as part of the rehabilitation of these borrow pits. - Side tipping of spoils in any hilly locations will be strictly prohibited. - Roads designed to achieve a balance between the amount of spoil produced from cuttings and that required for fill to minimise the need for disposal of surplus.	Easily achievable	Low	Minor

Waste Management	Improper management of waste may result in environmental and human health hazards such as pollution and disease.	Likely	High	Medium	- Waste bins will be stationed at designated points (e.g. in the construction camps) for the disposal of the various types of wastes generated by the project. These bins will be clearly marked to facilitate segregation of waste.
					- Separation of domestic and hazardous waste at the source shall be strictly enforced.
					- Domestic waste shall be collected, transported to and disposed of at the Area 1 landfill site. Hazardous waste shall be securely stored in a designated hazardous waste storage facility at Area 1.
					- Where possible, wastes will be re-used or recycled.
					- Burning of waste will not be permitted except in appropriate incineration facilities (Planned Area 1 Engineered Landfill Facility with incineration capabilities)
					- Medical wastes will be incinerated at the Area 1 Clinic incineration facilities.
					- A Waste Management Plan (WMP) will be established and will include:
					  - Clear objectives and targets with respect to waste management;
					  - An analysis of types/quantities of waste to be produced by the Project;
					  - An analysis of potential opportunities to reduce, reuse or
						Achievable	Low	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
					recycle waste in accordance with the Waste Management Hierarchy (reduction, re-use, recycling, disposal) and a description of how this will be achieved; - A description of roles, responsibilities and resources to ensure that the objectives and targets are achieved, and - procedures governing the handling, treatment and disposal of all wastes. - All personnel will be trained in the appropriate management of waste according to the WMP. - Waste materials that can be safely reused or recycled may be donated to local communities following an appropriate risk assessment by EHS personnel.			
Noise and Vibration	Noise and vibration result from construction activities such as the operation of heavy machinery, concrete mixing plants, blasting in areas of rock excavation, stone crushing, traffic etc. Noise and vibrations will be a source of disturbance to communities close to the road alignment and if excessive could cause health complaints	Certain	Moderate	Major	- Activities producing excessive noise levels (such as crushing and screening at the borrow pits, as well as blasting), will be restricted to the day-time, and equipment normally producing high levels of noise should be suppressed or screened when working within a distance of some 200 m from any sensitive noise receptors. - Near places of worship, construction producing nuisance level noise be minimised or rescheduled so as not to occur on locally recognised religious day. - Work areas, will be organised and operated strive to restrict noise levels to not exceed World Bank thresholds at the nearest sensitive receptor during normal activities. If existing noise levels exceed these threshold values, the Project will not cause more than a 3dB increase in measured ambient levels during normal activities.	Difficult	Moderate	Medium

<table>
<tr><th>Environmental Aspect</th><th>Impact Description</th><th>Certainty of Impact</th><th>Significance</th><th>Pre-Mitigation Impact Category</th><th>Mitigation / Enhancement Measure</th><th>Mitigation Potential</th><th>Significance</th><th>Post-Mitigation Impact Category</th></tr>
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<table>
<tr><th rowspan="2">Receptor</th><th colspan="2">Noise level
One Hour L_{Aeq} (dBA)</th></tr>
<tr><th>Daytime
07:00 – 22:00</th><th>Night-time
22:00 – 07:00</th></tr>
<tr><td>(Type of district)</td><td></td><td></td></tr>
<tr><td>(a) Residential; institutional; educational</td><td>55</td><td>45</td></tr>
<tr><td>(b) Industrial; commercial</td><td>70</td><td>70</td></tr>
</table>
- Advance notice will be given to communities if short-term noisy construction activities are to take place, which could cause these levels to be exceeded. Communities in proximity to blasting activities will be given warning prior to blasting occurring.
- Measures to minimize noise during construction will include:
  - locating and orientating equipment to maximise the distance, and to direct noise emissions away from, sensitive areas;
  - using buildings, earthworks and material stockpiles as noise barriers where possible, and
  - turning off equipment when not in use.
- A preventative maintenance program established for equipment and vehicles to not emit excessive noise or vibration due to inadequate maintenance or damage
- Personnel will be made aware of the importance of minimising noise and the measures that are required in this regard.
- The road will be constructed in such a way as to by-pass all communities thereby reducing noise and vibration impacts from traffic.
- Explosives magazines will be constructed and managed in accordance with legal and international best practice standards. The magazines will be located in secured locations.
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Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
					- Blasting will be undertaken in a manner which minimises vibration in as far as practicably possible.			

Road Safety	During the construction phase, traffic levels are not unlikely to be high enough to give rise to problems of crossroad access for pedestrians. However, vehicle traffic and average speeds will be slightly higher in construction areas than at present. Pedestrians and livestock are likely to continue to use the road and will be at increased risk of road accident.	Very likely	High	Major	- Training of drivers and machinery operators will be conducted; community consultations and meetings on road safety will be held.
					- Where practicable, pedestrian paths will be created.
					- Road safety initiatives will be developed and implemented, including:
					  - Ensuring that only qualified (licenced) drivers operate machinery;
					  - Implementing speed limits and traffic control measures in appropriate locations;
					  - Implementing road safety signage;
					  - Avoiding dangerous routes and times of day to reduce the risk of accidents;
					  - Installing speed control devices such as governors on trucks, and
					  - Remote monitoring of driver behaviour.
						Achievable	Moderate	Minor

OHS	Injuries at construction work-sites, falling objects, as well as from the use of equipment and tools, cuts from stepping on sharp objects such as nails and other metal off-cuts are likely to occur. OHS issues related to the transmission line construction include exposure to live current and electromagnetic waves.	Likely	High	Medium	- An appropriate OHS management system will be implemented, which is consistent with the SRL standards and requirements. - Workers will be provided with all the required PPE. - Toolbox talks will be carried out daily on safe work practices and other OHS issues. - Only trained and qualified technicians will be involved in the electrical installations. Regular training will be conducted for electrical technicians as well as road construction workers to ensure they are aware of the safe work practices required when working with or in the vicinity of transmission line equipment.	Achievable	Moderate	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Land Use	Community land will be required for the establishment of worksites, borrow areas, etc. to be used during construction, resulting in a permanent loss of access to these areas by community people.	Certain	High	Extreme	- Land lease arrangements will be made for any land community land to be utilised during this phase. - The route has been designed to avoid villages to mitigate the need to relocate / displace people. - Crop compensation will be undertaken in advance of the construction process. Where necessary, Livelihood Restoration Plans may be implemented for some farmers. - Once the construction phase is concluded, the contractor will be required to ensure that any land affected outside of the right of way, are returned to the state in which they were before use. This will include removal of all wastes, demolition and removal of unwanted structures, clearing away of any contaminated soils.	Achievable	Moderate	Minor

Crops	Loss of farmlands and crops will occur during clearing of the road and transmission line corridor, resulting in loss of livelihood to community owners.	Certain	High	Extreme	- The contractor will ensure that clearing of vegetation will be restricted to work areas only, to prevent excessive loss of vegetation.
					- Compensation will be made to owners of crops lost during construction. Where necessary, Livelihood Restoration Plans may be implemented for some of the affected farmers.
					- Designs will be developed to minimise displacement of resources of importance to communities and livelihoods including:
					  - High quality agricultural land including rice fields;
					  - Community forests, and
					  - Other significant community resources.
						Achievable	Moderate	Minor

Heritage	Loss of heritage and other cultural sites which fall along the route will occur, depriving communities in various ways.	Certain	High	Extreme	- Necessary arrangements will be made with the Paramount Chiefs and other local authorities for conducting the required rites and ceremonies for the relocation of cultural heritage sites. - All project personnel will be required to respect local cultural traditions and religious festivals, funerals and other traditional events. Induction training for all personnel will include appropriate cultural awareness training. - A chance finds procedure will be developed and implemented.	Achievable	Moderate	Minor
STDs,	The risk of the	Very	High	Major	- Sensitization and awareness raising will be provided among workers	Difficult	Moderate	Medium

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
HIV/AIDS and Teenage Pregnancy Issues	prevalence of STDs, HIV/AIDS and teenage pregnancy in nearby communities is increased with the interaction of construction workers with community youth.	likely			and communities. - All Project personnel will be provided with appropriate induction training communicating health hazards, including HIV/AIDS, STDs and malaria along with the prevention and mitigation measures required. - Inappropriate behaviour by Project personnel will be carefully managed through relevant human resources processes, to minimise the potential spread of illnesses and infective diseases.			
Community Health	Pollution of air, water or soils and the release of hazardous substances or inappropriate management of waste could adversely impact on the health and welfare of the community or lead to increased occurrence of pest species (vermin, flies, mosquitoes).	Very likely	High	Major	- Community health and safety will form an integral part of the construction management plan. - Populations of pest species and vectors of disease will be carefully managed to minimise the potential spread of illnesses and infective diseases. - A high standard of housekeeping will be maintained at all times in all construction work areas. - Pools of standing water will be avoided to minimise the availability of breeding grounds for mosquitoes. - An appropriate hazardous chemical substances management plan will be implemented.	Achievable	Moderate	Minor
Air Quality	Dust generated from construction machinery can cause considerable nuisance to communities close to the road alignment, and can cause health problems including respiratory complaints / diseases.	Certain	High	Extreme	- Dust minimization measures shall be implemented including watering of the construction areas, including the road surfaces under construction. - Soil stockpiles and stores of friable material will be covered or vegetated to reduce the potential for fugitive emissions of dust where possible. - Speed controls will be implemented where appropriate to minimise dust creation by vehicles travelling on un-made roads. - Vehicles carrying friable materials will be enclosed or sheeted. - Driver training will include awareness-raising regarding appropriate driving speeds to minimise dust emissions during different weather conditions. - Loading, unloading and handling of dusty materials will only be	Achievable	Moderate	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
					carried out in designated areas.			
	Emissions from construction activities like fuel combustion, power generators, concrete batching plant, operational vehicles could cause adverse impacts on air quality affecting the health and welfare of people, crops and sensitive natural fauna and flora	Very likely	Moderate	Medium	- Effective preventative maintenance established to ensure all construction equipment and electricity generators are maintained in good working order and do not adversely impact air quality due to inadequate maintenance or damage. - Concrete batching, crushing and screening plants will be fitted with dust extraction and / or suppression systems where necessary. - Use of ozone depleting substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, trichloroethane and halogenated hydrobromofluorocarbons (HBFCs) will not be permitted. - Speed controls will be implemented where appropriate to minimise dust creation. - Driver training will include awareness-raising regarding appropriate driving speeds to minimise air emissions during different weather conditions.	Achievable	Low	Minor

	Project activities could introduce new ignition sources associated with equipment and workers and therefore could contribute to an increase in the risk of bushfires	Very likely	High	Major	- Strict controls will be in place to minimise the risk of bushfires being caused accidentally by Project activities including:
					  - A ban on unauthorised open fires;
					  - Storage of flammable substances in accordance with good international standards for fire safety including fitting flame arresting devices to vents, segregation of incompatible substances, engineered earthing and lightning protection;
					  - Fitting of earthing and lightning protection to other structures vulnerable to lightning strike;
					  - Control of hot work using a strict permit to work system, and
					  - Creation of firebreaks around work areas and mobile field camps, where appropriate.
					- Emergency response plans and fire-fighting arrangements will be put in place to facilitate response to fire including natural bushfires, where there is a direct threat to assets. Trained fire crews will be available. All personnel will be provided with appropriate training
						Achievable	Low	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
					regarding fire-related hazards and first response. Adequate water supplies for use in the case of a fire will be available in critical locations.			
Community Benefits from Project	Job Opportunities for skilled and unskilled members of the community Business opportunities to provide goods and services to workers (e.g. food and drink)	Positive likely	Positive moderate	Minor positive	- Although labour recruitment is a matter for the contractor, who has the right to determine whom to employ, he will be formally encouraged to hire locally wherever possible, in order to maximise the benefit distribution and social acceptability of the project. - An employment plan will be developed to define requirements and procedures to be followed when identifying and developing project employment opportunities. This employment plan and any local employment opportunities will be communicated in a transparent and culturally appropriate manner. - Unskilled labour will be preferentially hired from the local communities. - A vocational training plan will be prepared to provide training to local people to increase their eligibility for employment. In addition, selected community employees will receive skills training to allow them to progress from unskilled to semi-skilled / skilled positions. - Opportunities for sustainable local procurement of goods and services to support road construction will be identified wherever possible and measures will be devised to maximize the potential for these opportunities.	Positive easy	Very high	Extremely positive

7.2.3.2 Environmental and Social Impacts during the Operations Phase

During the operations phase, impacts considered during the planning and development phase would have been be realised. Mitigation measures to minimise these impacts would be implemented and as the project progresses, modifications and inclusions will be made to better address issues based on experience. This section describes the impacts likely to occur during the operations phase of the Project.

Table 7.2-7: Environmental and Social Impacts and Mitigation Measures during Operations Phase

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Soil Erosion	Ongoing soil erosion along the constructed infrastructure.	Likely	Minor	Minor	- Implement a soil monitoring programme in accordance with the Sediment and Erosion Control Management Plan, involving regular inspections along all constructed infrastructure. - Remediate any soil erosion. - Where necessary, implement additional preventative measures as may be required.	Easily achievable	Low	Minor
Water Quality	Erosion around pylons and culverts may cause increased sediment load in water.	Unlikely	Moderate	Minor	- Monitor areas around pylons, culverts and other installed infrastructure for signs of erosion and implement suitable mitigation measures where required.	Easily achievable	Low	Minor
Hydrology	Obstruction drainage leading to creation of puddles of stagnant water	Likely	Moderate	Minor	- Road drainage systems inspected and cleaned as necessary and maintained.	Easily Achievable	Low	Minor
Aquatic Ecology	Infrastructure in streams may limit the movement of aquatic species.	Likely	High	Medium	- Maintain culverts and other structures in waterways to ensure that impacts on aquatic species are minimised, including where necessary, removing sedimentation build up / other blockages in such culverts.	Achievable	Low	Minor
Terrestrial Fauna	Mammals and birds will be impacted by the	Likely	Moderate	Minor	- Company drivers will be taught safe driving techniques which involve accident prevention including collisions with animals.	Difficult to mitigate	Low	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	haul road and transmission line operations including collisions with vehicles, birds colliding with transmission lines and towers, forced migration to other areas as a result of noise and other human activities.				- Monitor animal – vehicle interactions and retrain drivers if needed. Where necessary, consider the implementation of appropriate animal crossings. - Maintain elevated perches, perch deterrents, raptor hoods and marker balls / flappers. - Maintain the right of way area vegetation in an appropriate manner, including ongoing eradication of alien / invasive species. Continue with the monitoring of faunal species occurrence.			

Vegetation	Controlling vegetation in the right of way area.	Certain	Low	Medium	- Continuously maintain vegetation in the right of way area including:
					  - From the edge of the road to the boundary of the right of way, ensure that vegetation is structured with smaller plants near the road, and larger shrubs further away to provide habitats for a variety of plants / animals;
					  - Removing trees which may interfere with the powerlines;
					  - Maintaining vegetation by mowing, pruning and slashing to the extent necessary to ensure safe conditions, but avoid unnecessary over maintenance to limit the ingress of invasive species and continual reestablishment of pioneer species;
					  - Eradicating alien / invasive species;
					  - Continue to maintain fire breaks, and
					  - Continue to avoid the use of chemical herbicides.
						Easily achievable	Low	Minor

Waste Management	Poor waste management systems along the route will result in littering from road users which could end up in drainages, causing pollution of waterways, blocked gutters,	Likely	Moderate	Minor	- Waste bins will be stationed at the drivers start and end points. Truck drivers will have to transport waste in trucks until such a time as appropriate disposal into bins can take place. Regular emptying of these bins will be required, and waste shall be disposed of at the Area 1 landfill site. - Environmental health and safety training for drivers will include waste management systems and responsibilities. - Waste receptacles shall be provided at drivers start and end points.	Achievable	Low	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	flooding, etc				- Community awareness programmes will include some waste management awareness issues.			
Noise and Vibration	Communities may be affected from the noise and vibrations emanating from the mining vehicles and machinery utilizing the road.	Certain	Moderate	Medium	- Communities have been avoided and by-passed during the planning and construction phases and impacts from noise and vibrations should be minor due to distance from road. - Continue to conduct noise monitoring at sensitive receptors, and implement additional traffic calming measures if found to be necessary.	Achievable	Low	Minor
Road Safety	Road accidents resulting in personal injury or death may occur due to the fact that there will be an increase in vehicular activities following the upgrade, which surrounding communities were not previously used to.	Likely	High	Medium	- Training of drivers including road safety issues will be conducted regularly; community consultations and meetings on road safety will be held to help raise awareness among community residents. - Drivers will be required to remain within the 80 km/hr speed limit, and any other more localized speed limits implemented based on the road design and risk assessment. - Other traffic calming measures may be incorporated into the road's final design. - Speed monitoring will be conducted using SRL's GPS tracking system. - Segregated pedestrian access will be provided along the length of the bridge and where necessary along the road. - Community members will be made aware of hazards associated with increased traffic, and provided with appropriate information regarding safety provisions. - Adverse impacts on people and communities will be avoided through appropriate road maintenance, driver training and ongoing communications with communities and local authorities.	Achievable	Moderate	Minor
OHS	Drivers are prone to OHS hazards related during their daily activities that could result in destruction of	Likely	High	Medium	- Drivers will be given road safety training including observation of speed limits, safety signage, etc. on a regular basis. - Only licenced drivers will be employed. - Shift systems are in place to ensure that drivers are not operating vehicles when sleepy or tired.	Achievable	Low	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	vehicles, personal injury and even death.				- Drivers will be subjected to random alcohol tests.			
	Road maintenance workers will be subject to OHS hazards similar to construction hazards. Personal injury could occur from use of equipment and tools, dust and noise generation, etc.	Likely	High	Medium	- Only trained road repair technicians will be used for road maintenance. - They will be provided with PPE required for the nature of the work. - Toolbox safety talks will be conducted daily. - First aid and medical facilities will be made available.	Achievable	Low	Minor
	Transmission line maintenance workers will be subjected to related OHS issues such as working at heights, exposure to live current and electromagnetic frequencies.	Likely	High	Medium	- Only trained electrical technicians will be used for transmission line repairs. - Appropriate OHS safety practices will be implemented and enforced. - A task specific risk assessment will be conducted prior to commencement of transmission line repairs. - They will be provided with PPE required for the nature of the work. - Toolbox safety talks will be conducted daily. - First aid and medical facilities will be made available.	Achievable	Low	Minor
Dust Pollution	Communities and pedestrians may be affected from the dust generated from the road from vehicular activities.	Likely	Moderate	Minor	- This will be an impact only during the dry season; the road will be regularly watered during this period. If practicable, commercially available dust palliatives will be applied to the road surfaces. - Community grievances will be recorded through SRLs formal grievance procedure. - Dust fall out monitoring will be conducted, and any additional measures required, will be implemented.	Achievable	Low	Minor
Exposure to Electromagnetic Fields	Communities may be exposed to electromagnetic fields emanating from the	Unlikely	Low	Minor	- The strength of electromagnetic fields fades with distance from the source. Due to the height of the towers to be erected and the distance between communities and the haul road alignment, the likelihood of this occurring is low.	Easily Achievable	Low	Minor

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	transmission lines resulting in possible health impacts.				- Regular monitoring of the strength of EMF will be undertaken and suitable mitigation measures implemented as / when needed.			
STDs, HIV/AIDS and Teenage Pregnancy Issues	The risk of the prevalence of STDs, HIV/AIDS and teenage pregnancy in nearby communities is increased through interactions with company drivers and the increased number of road users.	Likely	Moderate	Minor	- Sensitization and awareness raising will be provided among workers, drivers and community members. - All project personnel will be provided with appropriate induction training communicating health hazards, including HIV/AIDS, STDs and malaria along with the prevention and mitigation measures required. - Inappropriate behaviour by Project personnel will be monitored and managed.	Achievable	Low	Minor
Community Benefits from Project	Improved transport availability and reduction in transportation costs for passengers and goods due to reduction in vehicle operating costs as a result of improved road conditions. Construction of a bridge across the Gbangbaia River, linking the Moyamba and Bonthe Districts thereby greatly enhancing access to agricultural products and trade. Improved access to job and business opportunities, medical facilities, schools and other social amenities.	Certain	Positive very high	Extremely positive	- Ensure that the road and bridge are well maintained to ensure safe use of this infrastructure to the public. - Linking the Moyamba and Bonthe Districts would greatly enhance access to agricultural products and trade. - Improved access to job and business opportunities, medical facilities, schools and other social amenities. This will translate into improved socio-economic conditions within surrounding communities. - Better administration and co-ordination of government activities with improved road network. - Ensure that ongoing and transparent communication is maintained between SRL and the communities.	Easily achievable	Very high positive	Extremely positive

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	This will translate into improved socio-economic conditions within surrounding communities. Better administration and co-ordination of government activities with improved road network.							
Unrealistic Expectations	Communities may develop unrealistic expectations in relation to the project which may develop into grievances and community disturbances.	Likely	High	Medium	- Regular meetings and communication with communities to keep them accurately informed and limit the potential for unrealistic expectations to develop. - Implementation of community development activities.	Achievable	Low	Minor
Influx	Influx of individuals to the project area for business, jobs and other opportunities made available due to the newly constructed bridge and improved road networks. This could put a strain on the local community facilities, e.g. health, education, water and sanitation, etc.	Likely	High	Medium	- It will be difficult to restrict influx into the project area during the operational phase. However, regular communication between SRL and the stakeholders will be implemented to ensure that SRL are aware of challenges faced by the communities.	Difficult to Mitigate	High	Medium
Increase in Crime	With increase in movement to and within the project area, and development of new	Likely	High	Medium	- Management of crime will remain the responsibility of the Sierra Leone Police Service. - Where crime is directly related to SRL's activities, contractors	Difficult to Mitigate	High	Medium

Environmental Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	businesses, etc. there is a potential for crime to increase.				and/or employees, relevant disciplinary processes will be followed.			

8 SUMMARY AND CONCLUSION

8.1 Summary

8.1.1 Components of the ESHIA

The principal objective of the ESHIA is to satisfy the requirements of the local environmental regulatory body, EPA-SL for the issuance of the EIA license for the project to commence. The study involved predicting the social and environmental impacts of the project as described, and suggesting mitigation measures where impacts are adverse and enhancement measures where impacts are positive.

This report comprises the result of an ESHIA study based on primary and secondary information obtained through field and desktop studies.

The investigations of impacts on the social environment were a crucial part of the study, since the operation will affect the livelihoods of the communities that reside closest to the proposed haul road alignment. The investigation of social impacts has involved the following:

- A baseline socio-economic study of communities surrounding in and around the Project area involving desktop studies and household surveys, and
- Undertaking stakeholders' focus group discussions to sensitise stakeholders and the potentially affected communities regarding the Project.

Discussions and meetings with stakeholders during the public consultation and disclosure process indicated general acceptability for the project with demonstrated enthusiasm at the local level. Local authorities within the Project area expressed their opinions, concerns and general willingness for full co-operation and support during the survey and these were evident during the field investigations.

8.1.2 Key Assessment Findings

8.1.2.1 Physical Environment

There are potential impacts relating primarily to air quality, hydrology and water quality, biodiversity and soil erosion. Mitigation measures to limit the extent of all impacts have been highlighted and will be implemented.

8.1.2.2 Biological Environment

There will be some displacement and/or loss of flora and fauna species during land clearing and preparation, however it is not expected that any species will be permanently eliminated from the region as a result. Mitigation measures have been presented to ensure that minimal clearing is carried out to limit the extent of biodiversity loss.

8.1.2.3 Socio-Economic Environment

Perhaps the most critical aspect of the project is the potential loss of crops or reduction of farm lands, potential conflict from issues related to labour, unrealistic expectations held by the communities with regard to benefits created by the project, as well as vehicular traffic and safety risks. The selection of the road alignment was done primarily to avoid the need for community relocation. As such resettlement is not going to be an issue.

The project is likely to have positive impacts in the area of job creation, improving the quality of life of some of the locals and, on the regional scale, provide improved access for job, business and socio-economic facilities.

8.2 Conclusions and Recommendation

The nature of the haul road and transmission line project is such that many of the adverse impacts which are associated with road projects are not expected to occur in connection with the road project. This is because, apart from a few by-passes, it is an existing road requiring upgrading primarily within the existing centre-line, thus avoiding or reducing many of the adverse effects which are normally associated with new road construction. The transmission line also follows the road alignment, thus having largely the same environmental and social impacts. No adverse direct or indirect impacts are anticipated in respect of environmentally sensitive areas like National Parks, Wildlife Reserves, National Forest Priority Areas, land prone to erosion, wetlands of national or international importance or archaeological or heritage sites.

During the operational phase, traffic levels will be much higher, especially with haul trucks plying the route and with more public forms of transportation making use of the route, given the enhanced access created. This will give rise to complications of noise, air pollution, cross-road access for pedestrians and safety. Electrical safety will also be of particular concern for workers involved in the transmission line installation. Measures have however been outlined in the mitigation and management measures to address these.

However, the construction and operation of the road and transmission line will lead to a variety of changes in the local and wider environment. Many of the effects will be beneficial, particularly the impact at a regional level of increasing the reliability of road transport and the potential to develop the local economy through improved infrastructure and employment opportunities. The potential beneficial impacts associated with project implementation are also expected to lead to improved quality of life, particularly for those communities who live in proximity to the road.

The new upgraded road will provide good opportunity for goods and services to move along the route. In addition, the increased flow of traffic and goods will ignite economic opportunities for the benefit of the people along the road. The study has also shown that road communities are poor, but blessed with rich potential, which if properly nurtured, can lift the communities up to higher incomes.

The construction of the bridge across the Gbangbaia River means essentially linking two distinct parts of the country, thereby providing a shorter link between the Moyamba and Bonthe Districts. This, apart from easing human access will greatly enhance access to agricultural products.

There will nevertheless be adverse effects, which result from increasing the carriage width and at some locations, due to alignment improvement. Many of these effects will be short-term and reversible in nature and stem from ground disturbance, operation of equipment and housing of the labour force, but very few that will lead to permanent change. There will also be a need to pay compensation for crops destroyed as a result of the road construction.

These adverse impacts are capable of being controlled within acceptable limits, provided that the recommended mitigation measures are adopted. Therefore, if the mitigation and benefit enhancement measures recommended in this ESHIA report are implemented properly, there are no environmental and/or social grounds for not proceeding with implementation of the project in the form in which it is presently envisaged, since the long-term benefits of project implementation outweigh the largely short-term adverse impacts associated with road and transmission line construction, all of which can be mitigated satisfactorily.

REFERENCES

Alie, Joe A.D. (2001), "Historical White Paper on Communities in Sierra Rutile Operational Areas in Southwestern Sierra Leone" (Knight Piesold, USA).

Alie, Joe A.D. (2012), "Cultural Heritage Survey of London Mining Operational Areas in Port Loko District" (Environmental Resources Management, UK).

Alie, Joe A.D. (2013). "Cultural Heritage Survey of London Mining Operational Areas in Tonkolili District" (Environmental Resources Management, UK).

Anderson, et al, (1976), A land use and land cover classification system for use with remote sensor data. U.S.Geological Survey Professional

Basu, Paul (2008). "Confronting the Past? Negotiating a Heritage of Conflict in Sierra Leone." *Journal of Material Culture*, Vol. 13 (2):233-347.

Bibby, C., Jones, M & Marsden, S. (2000). Expedition Field Techniques. Bird Surveys. Expedition Advisory Centre. Royal Geographic Society (with The Institute of British Geographers). London, UK.

Böhme, W, Schmitz, A. & T. Ziegler (2000). A review of the West African skink genus *Cophoscincopus* Mertens (Reptilia: Scincidae: Lygosominae): Resurrection of C. simulans (vaillant, 1884) and description of a new species. *Rev. Suisse Zool.*, **107** (4): 777-791

Böhme, W., H. Meinig & M.-O. Rödel (1996). New records of amphibians and reptiles from Burkina Faso and Mali. - *British Herpetological Society Bulletin, London,* No. **55**: 7-26.

Borrow, N. and Demey, R. (2008). Field Guide to the Birds of Western Africa. Christopher Helm. London.

Braima, S. J., Amara, P. S., Kargbo, B. B. and Moseray, B., 2006. Republic of Sierrra Leone 2004 Population and Housing Census. Analytical Report on Employment and Labour Force. UNFPA, SSL and EU. November 2006.

Briassoulis, H. (2000). Factors influencing Land Use and Land Cover Change Encyclopedia of Life Support System, EOLSS (Vol. 1, pp. 1-9).

Bury, R. B. (1983). Differences in amphibian populations in logged and old growth redwood forest. Northwest Science. 57:167-178.

Carr Jamie and Foden, Wendy, *Climate Change Unit IUCN Global Species Programme Cambridge, UK*

CEMMATS (2014) Environmental and Social Impact Assessment Study for Moyamba SMALL Hydroelectric Project in Moyamba District. Executive Summary and Main Report. Volume 1. Freetown, Sierra Leone.

Clifford, Mary (1974). *The Land and People of Sierra Leone*. New York.

Duhamel C (2012). Land use, Land cover, including their classification. Encylopedia of life support system. Online. Accessed on 30/04/2017. Available from: http://www.eolss.net/sample-chapters/c19/E1-05-01-01.pdf

Eurostat (2001). *Manual of Concepts on Land Cover and Land Use Information Systems*; Office for Publications of the European Communities: Luxembourg, Available online:

FAO (1993b). FESLM: an international framework for evaluating sustainable land management, Smyth, A.J., & J. Dumanski, J. (eds.) (year). World Soil Resources Report 73, FAO, Rome. 74 p.

Feintrenie, L. (2014). Agro-industrial plantations in Central Africa, risks and opportunities. Online. Accessed on 12/05/14. From: http://link.springer.com/article/10.1007%2Fs10531-014-0687-5

Fermon, Y and C. Gsegner (2006). A guide of the Fresh Water Fish of the Bong County, St Paul and St John Rivers, Liberia.

Foley, J. A. Et al., (2005). Global Consequences of Land Use. S*cience* 22 July 2005: Vol. 309, Issue 5734, pp. 570-574 DOI: 10.1126/science.1111772

Gleave, M. B. (1996). The Length of the Fallow Period in Tropical Fallow Farming Systems: A Discussion with Evidence from Sierra Leone. *The Geographical Journal* Vol. 162, No. 1 pp. 14-24.

Government of Sierra Leone (2015). Draft National Land Policy of Sierra Leone version 6. Online. Accessed 05/08/2016. Available from:

Gunarso, P, E al, (2013). Oil palm and land use change in Indonesia, Malaysia and Papua New Guinea. file:///C:/Users/bocka/AppData/Local/Temp/4_oil_palm_and_land_use_change_Gunarso_et_al.pdf

Hillers, A. (2009): Herpetological survey in the Gola Forest, South-eastern Sierra Leone

Hillers, A., A. Barrie, J. Johnny & M.-O. Rödel (2007): Amphibian survey of mountainous areas of north-eastern Sierra Leone. Report for the Critical Ecosystem Partnership Fund/Conservation International.

Hoogmoed, M. S. (1974). Ghanese lizards of the genus Mabuya (Scincidae, Sauria, Reptilia). *Zool. Verhandelingen* **138**: 1-62.

http://ec.europa.eu/eurostat/ramon/statmanuals/files/KS-34-00-407-__-I-EN.pdf (accessed on 25/08/2016).

INTOSAI WGEA (2013). Land Use and Land Management Practices in Environmental Perspective. http://www.environmental-auditing.org/LinkClick.aspx?fileticket=NiwOS89K5Jk%3D&tabid=128&mid=568

IUCN (2012). IUCN Red List of Threatened Species. Gland, Switzerland.

IUCN (2017). IUCN Red List of Threatened Species. Gland, Switzerland.

Junjie W. (2008). Land Use Changes: Economic, Social and Environmental Impacts. Online. Accessed 08/08/2016. Available from:

Karl-Heinz ERB, Et Al., (2016). Land management: data availability and process understanding for global change studies. Global Change Biology (2017) 23, 512–533, doi: 10.1111/gcb.13443 http://onlinelibrary.wiley.com/doi/10.1111/gcb.13443/epdf?r3_referer=wol&tracking_action=preview_click&show_checkout=1&purchase_referrer=onlinelibrary.wiley.com&purchase_site_license=LICENSE_DENIED

Kingdon, J. (1997). The Kingdon field guide to African mammals. Academic Press, San Diego.

Larbi, A. (2012). Country Pasture/Forage Resource Profile http://www.fao.org/ag/agp/AGPC/doc/Counprof/Sierraleone/Sierraleone.htm

Laurance, W.F., Camargo, J.L.C., Luiza˜ o, R.C.C., Laurance, S.G., Pimm, S.L., Bruna, E.M., Stouffer, P.C., Bruce Williamson, G., Benı´tez-Malvido, J., Vasconcelos, H.L., et al. (2011). The fate of Amazonian forest fragments: a 32-year investigation. Biol. Conserv. 144, 56–67.

Laurance, W.F., Goosem, M., and Laurance, S.G.W. (2009). Impacts of roads and linear clearings on tropical forests. Trends Ecol. Evol. 24, 659–669.

Laurance, W.F., Laurance, S.G., Ferreira, L.V., Rankin-de Merona, J.M., Gascon, C., and Lovejoy, T.E. (1997). Biomass collapse in Amazonian forest fragments. Science 278, 1117–1118.

Lee, J.S.H., et al. (2013). Oil palm smallholder yields and incomes constrained by harvesting practices and type of smallholder management in Indonesia. Online. Accessed on 10/05/2017. From: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0159668

Little, Kenneth (1949). *The Mende of Sierra Leone*. London.

Little, Kenneth (1967). "The Role of Secret Society in Cultural Specialization." *American Anthropologist, Vol. 51, No. 2.*

Logistics Capacity Assessment (2016). Sierra Leone Road Assessment. [online] Available at http://dlca.logcluster.org/display/public/DLCA/2.3+Sierra+Leone+Road+Assessment;jsessionid=71E3E89E00BC0A8FD5505EB23AF79CB8 [Accessed 06/11/17]

Maconachie R, Hilson GM. 2011. Artisanal Gold Mining: A New Frontier in Post-Conflict Sierra Leone? Journal of Development Studies 47(4): 595–616.

Maitima, et al., (2009).The linkages between land use change, land degradation and biodiversity across East Africa. http://www.wec.ufl.edu/faculty/giulianob/private/wis3401/Maitima%20landuse%20change%20and%20biodoversity.pdf

Malupattu P. K. and Reddy, J.R.S. (2013). Analysis of Land Use/Land Cover Changes Using Remote Sensing Data and GIS at an Urban Area, Tirupati, India. Online. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3679719/

Martinez, S. and Mollicone, D. (2012). From Land Cover to Land Use: A Methodology to Assess Land Use from Remote Sensing Data. Online. Available from: http://www.mdpi.com/2072-4292/4/4/1024/pdf.

McCulloch, M (1950). *Peoples of Sierra Leone*, London: International African Institute.

McGarigal, K., Romme, W.H., Crist, M., and Roworth, E. (2001). Cumulative effects of roads and logging on landscape structure in the San Juan Mountains, Colorado (USA). Landscape Ecol. 16, 327–349.

Ndulue, et al. (2015). Assessment of land use/cover impacts on runoff and sediment yield using hydrologic models: A review. Online. Accessed on 30/04/2017. Available from: http://www.academicjournals.org/journal/JENE/article-full-text-pdf/31E49D450989

Okoni-Williams, A.D. (2013). Vegetation, carbon and nutrient cycling in the bush fallow system: the implications to the environment and local farming communities in Sierra Leone. PhD. Thesis submitted to the niversity of Sierra Leone. December 2013.

Okoni-Williams, A.D., Thompson, H.S., Koroma, A.P. and Wood P. (2005). Important Bird Areas in Sierra Leone: Priorities for biodiversity Conservation. Conservation Society of Sierra Leone and Forestry Division, GOSL.

Paper 964, U.S. Geological Survey, Reston, VA, USA

Paugy, D., Lévêque, C., &Teugels, G.G. (2004).The Fresh and Brackish Water Fishes of West Africa Vol.2. Publications scientifiques du Muséum, Paris, France.

Payne, A.I., Wakeford R. and E.T. Ndomahina (2006). Bumbuna Hydroelectric Project Baseline Biodiversity Surveys.Final Draft Baseline Fish Survey.Nippon Koel U.K.

Payne, A.I., Wakeford, R.C., &Ndomahina, T.E. (2010). Fish distribution and zonation along a tropical African river, the Rokel/Seli River, Sierra Leone, West Africa.*Smithinana Bulletin* 12: 25–38.

Pirker, J. et al (2016). What are the limits to oil pal expansion? Online. Available from: http://ac.els-cdn.com/S0959378016300814/1-s2.0-S0959378016300814-main.pdf?_tid=a8d33a14-3995-1

Ramjohn, K. (2008) Sustainable land use and impact assessment. Entropy and energy: toward a definition of physical sustainability (paper). Online. Accessed 04/08/2016. From: https://sustainablelanduse.wordpress.com/

Randolph, J. (2003). Environmental Land Use Planning and Management.

Reed, R.A., Johnson-Barnard, J., and Baker, W.L. (1996). Contribution of roads to forest

Renner-Thomas, A. (2010). Renner-Thomas, A. Land Tenure in Sierra Leone: The Law, Dualism and the Making of a Land Policy. Author House, London, United Kingdom

Rödel, M.-O. & Ernst, R. (2004): Measuring and monitoring amphibian diversity in tropical forests. I. An evaluation of methods with recommendations for standardization. Ecotropica 10: 1-14.

Rödel, M.-O. (2000). Herpetofauna of West Africa, Vol. I: Amphibians of the West African savanna. – Edition Chimaira, Frankfurt/M., 335 pp.

Rödel, M.-O., M. Gil, A.C. Agyei, A.D. Leaché, R.E. Diaz, M.K. Fujita & R. Ernst (2005). The amphibians of the forested parts of south-western Ghana. - *Salamandra*, Rheinbach **41**: 107-127.

Rödel, M.-O., M.A. Bangoura & W. Böhme (2004). The amphibians of southeastern Republic of Guinea (Amphibia: Gymnophiona, Anura). – *Herpetozoa*,

Sawyerr, Harry A.E. (1964). "Ancestor Worship – The Mechanics." *Sierra Leone Bulletin of Religion*, Vol. 6, No. 2.

Schiøtz, A. (1999). The Treefrogs of Africa. Chimaira, Frankfurt.

Trape, J-F. &Mane, Y (2006): Guide des serpents d'Afrique occidentale, savane et desert

Trombulak, S.C., and Frissell, C.A. (2000). Review of ecological effects of roads on terrestrial and aquatic communities. Conserv. Biol. 14, 18–30.

UNESCO (2007). *Cultural Heritage Protection Handbook 3: Documentation of Artefacts' Collections.* Paris: France.

UNESCO (2012). *Cultural Heritage Protection Handbook 6: Securing Heritage of Religious Interest.* Paris: France.

Valin et al., (2014). The future of food demand: understanding differences in global economic models. On line. Accessed 06/05/2017. Available from: http://onlinelibrary.wiley.com/wol1/doi/10.1111/agec.12089/full

Wakeford R and Payne A.I. (2007). A Photo Guide to the fish species of the Rokel/Seli River, Sierra Leone. MRAG London. 89pp.

Wheelhouse, Paul & Joe A.D. Alie (2012). "Baseline Cultural Heritage Environment Report" (New Liberty Gold Mine, Liberia).

Wien, **17** (3/4): 99-118.

Young, A. (1998). Land Resources; Now and For the Future. Cambridge University Press, 319p

Zug, G. (1987). Amphibians and Reptiles of the Outamba-Kilimi Region, Sierra Leone. *Journal of Herpetological Association of Africa.* **33**:1-4.

APPENDICES

Annex A: Lists of Ecology Species

Table 1: Diversity of mammals observed or indicated to occur along the road corridor; their IUCN status and the local status are indicated

Species	Scientific names	IUCN	Comment
Western Chimpanzee	*Pan troglodytes verus*	EN	Very rare
Pied Colobus Monkey	*Colobus polykomus*	VU	Rare
Callithrix Monkey	*Cercopithecus sabaeus*	LC	Rare
Campbell's Monkey	*Cercopithecus campbelli*	LC	Getting rare
Sooty Mangabey	*Cercocebus atys*	VU	Getting rare
Olive Colobbus	*Poliocolobus verus*	LC	Getting rare
Spot-nosed monkey	*Cercopithecus petaurista*	LC	Relatively common
Potto	*Perodicticus potto*	LC	Rare
Bush Pig	*Potamochoerus larvatus*	LC	Commom
Red-river Hog	*Potamochoerus porcus*	LC	Getting rare
Water chevrotain	*Hyemoschus aquaticus*	DD	Rare
Bushbuck	*Tragelaphus scriptus*	LC	Relatively common
Maxwell's Duiker	*Cephalophus maxwelli*	LC	Getting rare
Bay Duiker	*Cephalophus dorsalis*	LC	Rare
Red-flanked Duiker	*Cephalophus rufilatus*	LC	Getting rare
Royal antelope	*Neotragus pygmaeus*	LC	Getting rare
African Civet	*Civettictis civetta*	LC	Getting rare
Forest Buffalo	*Sincerus caffer*	LC	Getting rare
Tree Pangolin	*Phataginus tricuspis*	NT	Very rare
Giant Pangolin	*Smutsia gigantea*	VU	Very rare
Marsh Cane-rat	*Thryonomys swinderianus*	LC	Very common
Giant pouch rat	*Cricetomys gambianus*	LC	Very common
Fire-footed rope squirrel	*Funisciurus pyrropus*	LC	Very common
Stripped Ground Squirrel	*Euxerus erythropus*	LC	Very common
Crested porcupine	*Hystrix cristata*	LC	Getting rare
Common Cussimanse	*Crossarchus obscurus*	LC	Getting rare
Common Genet	*Genetta genetta*	LC	Getting rare
Demidoff's Galago	*Galagoids demidoff*	LC	Getting rare
African civet	*Civettictis civetta*	LC	Getting rare
Cape Hare	*Lepus capensis*	LC	Getting rare
African Clawless Otter	*Aonyx capensis*	LC	Getting rare
Common Rabbit	*Oryctolagus cuniculus*	LC	Getting rare
Rock Hyrax	*Procavia johnstoni*	LC	Rare

Table 2: List of bird species recorded from survey

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16
Gbangbatok	**Mogbomo**	**Mosenesie**	**Mokoba**	**Lago**	**Bengelo**	**Morporhoi**	**Momasa**	**Maselolo**	**mosenegor**	**Moyasa**	**Fullah Town**	**Pandebu**	**Kasama**	**Ngeihebu**	**Komende**

Scientific names	English names	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Ecol	Biome
ACCIPRITRIDAE																			
Haliaeetus vocifer	African Fish Eagle																	AM	
Milvus migrans	Yellow-billed Kite	x	x	x		x												AM	
Gypohierax angolensis	Palm-nut Vulture											x						R	
Necrosyrtes monachus	Hooded Vulture (CR)							x								x		R	
Accipiter melanoleucus	Black Sparrow Hawk											x						R	
Polyboroides typus	African Harrier Hawk	x				x			x	x	x	x	x	x	x	x	x	R	
Kaupifalco monogrammicus	Lizard Buzzard		x	x		x			x		x	x		x	x			R	
PHASIANIDAE																			
Francolinus bicalcaratus	Double-spurred Francolin									x		x		x	x		x	R	
Numida meleagris	Helmeted Guineafowl										x			x				R	
RALLIDAE																			
Sarothrura pulchra	White-spotted Flufftail		x				x					x		x	x			R	GC
COLUMBIDAE																			
Treron calvus	African Green Pigeon			x						x								R	
Turtur tympanistria	Tambourine Dove	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	R	
Turtur afer	Blue-spotted Wood Dove		x	x	x		x	x		x		x	x	x		x		R	
Streptopelia semitorquata	Red-eyed Dove		x	x		x	x		x	x		x			x		x	R	
MUSOPHAGIDAE																			
Corythaeola cristata	Great Blue Turaco				x	x		x	x	x	x	x		x	x	x		R	
Tauraco persa	Green Turaco									x								R	GC
Crinifer piscator	Western Plantain-eater						x					x	x	x			x	R	
CUCULIDAE																			

Scientific names	English names	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Ecol	Biome
Chrysococcyx cupreus	African Emerald Cuckoo	x		x							x			x	x	x		R	
Chrysococcyx caprius	Dedrick Cuckoo	x				x	x			x			x	x			x	AM	
Chrysococcyx klaas	Klaas's Cuckoo	x	x	x		x	x			x								AM	
Ceuthmochares aereus	Yellowbill										x							R	
Centropus senegalensis	Senegal Coucal									x	x	x	x	x	x		x	R	
Centropus grillii	Black Coucal							x										AM	
APODIDAE																			
Cypsiurus parvus	African Palm Swift	x		x					x							x		R	
Apus affinis	Little Swift					x				x	x		x	x		x	x	R	
ALCEDINIDAE																			
Halcyon malimbica	Blue-breasted Kingfisher		x									x						R	
Halcyon senegalensis	Woodland Kingfisher					x			x									R	
Halcyon leucocephala	Grey-headed Kingfisher																	R	
Alcedo cristata	Malakite Kingfisher			x						x						x		R	
Ceyx pictus	Pygmy Kingfisher						x											R	
Alcedo quadribrachys	Shining Kingfisher									x								R	
MEROPIDAE																			
Merops persicus	Blue-cheeked Beaeater																	R	
Merops albicollis	White-throated Bee-eater		x				x							x	x			R	
Merops pusillus	Little beeeater																	R	
Merops muelleri	Blue-headed bee-eater				x				x										GC
Phoeniculus purpureus	Green Wood Hoopoe		x															R	
BUCEROTIDAE																			
Bycanistes fistulator	Piping Hornbill			x		x			x	x				x				R	GC
Tockus fasciatus	African Pied Hornbill	x		x	x	x		x	x	x		x		x	x	x	x	R	GC
CAPITONIDAE																			
Gymnobucco calvus	Naked-faced Barbet		x								x							R	GC
Tricholaema hirsuta	Hairy-Breasted Barbet				x		x							x				R	
Pogoniulus scolopaceus	Speckled Tinkerbird		x					x	x							x		R	GC

Scientific names	English names	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Ecol	Biome
Pogoniulus atroflavus	Red-rumped Tinkerbird						x			x	x	x	x	x	x			R	GC
Pogoniulus subsulphureus	Yellow-throated Tinkerbird			x		x			x									R	GC
Pogoniulus bilineatus	Yellow-rumped Tinkerbird				x	x				x		x		x	x	x	x	R	
PICIDAE																			
Dendropicos gabonensis	Gabon Woodpecker	x						x								x		R	GC
Dendropicos pyrrhogaster	Fire-bellied Woodpecker		x							x								R	GC
Dendropicos goertae	Grey Woodpecker				x		x										x	R	
Cossypha niveicapilla	White-Crowned Robin-Chat			x														R	
Cossypha niveicapilla	Snowy-Crowned Robin-Chat		x			x												R	
HIRUNDINIDAE																			
Psalidoprocne nitens	Square-tailed Saw-wing									x			x	x		x		R	GC
Psalidoprocne obscura	Fanti Saw-wing					x	x				x				x		x	R	GC
Hirundo leucosoma	Pied-Winged Swallow			x	x													R	
Hirundo daurica	Red-rumped Swallow		x		x			x		x				x	x				
Hirundo lucida	Red-Chested Swallow	x	x	x	x	x				x		x	x	x	x		x	AM	
Hirundo rustica	Barn Swallow	x		x				x		x	x	x	x		x			PM	
Delichon urbicum	Common House Martin					x												PM	
MOTACILLIDAE																			
Macronyx croceus	Yellow-Throated Longclaw			x							x			x	x		x		
Motacilla aguimp	African Pied Wagtail								x									PM	
PYCNONOTIDAE																			
Andropadus virens	Little Greenbul		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	R	
Andropadus gracilirostris	Slender-billed Greenbul						x		x	x					x		x	R	
Andropadus latirostris	Yellow-whiskered Greenbul	x						x	x	.x			x				x	R	
Criniger barbatus	Western Bearded Greenbul					x												R	
Baeopogon indicator	Honeyguide Greenbul						x											R	GC
Chlorocichla simplex	Simple Leaflove										x	x						R	GC
Thescelocichla leucopleura	Swamp Palm Bulbul									x	x	x			x			R	GC
Bleda eximius	Green-Tailed Bristlebill				x								x						

Scientific names	English names	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Ecol	Biome
Pycnonotus barbatus	Common Bulbul	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		R	
Nicator chloris	Western Nicator	x		x	x	x				x		x	x		x			R	GC
TURDIDAE																			
Stizorhina finschi	Finsch's Flycatcher Thrush						x								x			R	GC
Turdus pelios	African Thrush								x				x					R	
SYLVIIDAE																			
Bathmocercus cerviniventris	Blacked-Hded Rfs Warbler (NT)						x											R	GC
Melocichla mentalis	African Moustached Warbler						x	x					x				x	R	
Cisticola cantans	Singing Cisticola														x		x		
Cisticola lateralis	Whistling Cisticola		x	x				x	x	x	x	x	x					R	
Prinia subflava	Tawny-flanked Prinia	x	x	x		x	x	x	x	x			x	x	x		x	R	
Camaroptera brachyura	Grey-backed Camaroptera	x		x		x				x		x		x	x			R	
Camaroptera chloronota	Olive-green Camaroptera									x								R	GC
Sylvietta virens	Green Crombec	x																R	GC
Sylvietta denti	Lemon-bellied Crombec			x		x				x								R	GC
Sylvia borin	Garden Warbler									x								PM	
Hylia prasina	Green Hylia	x	x	x	x	x		x	x	x			x		x		x	R	GC
Apalis sharpei	Sharpe's Apalis								x									R	GC
MUSCICAPIDAE																			
Melaenonnis edolioides	Northern Black Flycatcher									x								R	
MONARCHIDAE																			
PLATYSTEIRIDAE																			
Bias musicus	Black-and-white Flycatcher											x						R	
Dyaphorophyia castanea	Chestnut Wattle-eye						x											R	GC
Platysteira cyanea	Common Wattle-eye			x		x					x		x					R	
TIMALIIDAE																			
Illadopsis fulvescens	Brown Illadopsis																	R	GC
NECTARINIIDAE																			
Cinnyris cupreus	Copper Sunbird			x	x	x							x					R	

Scientific names	English names	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Ecol	Biome
Cyanomitra olivacea	Olive Sunbird				x		x		x	x			x		x			R	
Hedydipna collaris	Collared Sunbird								x						x		x	R	
Cyanomitra verticalis	Green-Headed Sunbird								x							x	x	R	
Cinnyris coccinigastrus	Splendid Sunbird									x								R	GC
Cinnyris johannae	Johannas Sunbird								x	x								R	GC
Cinnyris minullus	Tiny Sunbird														x			R	GC
Cinnyris chloropygius	Olive-bellied Sunbird					x							x					R	
Cinnyris venustus	Variable Sunbird	x	x	x	x	x	x	x	x	x		x	x	x	x		x	R	
MALACONOTIDAE																			
Dryoscopus gambensis	Northern Puffback	x		x															
Malaconotus sulfureopectus	Sulphur-breasted Bush-shrike							x										R	
Tchagra senegalus	Black-crowned Tchagra		x	x						x			x	x				R	
DICRURIDAE																			
Dicrurus modestus	Velvet-mantled Drongo							x										R	
CORVIDAE																			
Corvus albus	Pied Crow	x		x		x							x	x	x	x	x	R	
PLOCEIDAE																			
Ploceus nigerrimus	Vieillot's Black Weaver	x				x					x	x	x	x			x	R	GC
Ploceus cucullatus	Village Weaver	x	x	x	x	x			x	x	x	x	x	x	x	x	x	R	
Quelea quelea	Red-Headed Quelea																x	R	
Malimbus scutatus	Red-Vented Malimba		x	x	x					x	x	x		x	x			R	
Pachyphantes superciliousus	Compact Weaver												x			x		R	
Ploceus nigricollis	Black-necked Weaver	x							x					x				R	
Euplectes hordeaceus	Black-Wing Bishop		x	x															
Passer griseus	Northern Grey -Headed Sparrow						x	x										R	
VIDUIDAE																			
Vidua macroura	Pin-Tailed Whydah	x	x	x		x					x	x	x	x			x	R	
ESTRILDIDAE																			

Scientific names	English names	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Ecol	Biome
Nigrita canicapillus	Grey-headed Negrofinch			x		x	x	x	x	x	x	x		x	x	x	x	R	
Nigrita bicolor	Chestnut-breasted Negrofinch							x					x					R	GC
Estrilda melpoda	Orange-cheeked Waxbill		x															R	
Spermophaga haematina	Western Bluebill										x			x				R	GC
Spermestes cucullatus	Bronze Mannikin	x	x	x		x	x		x		x	x	x	x	x			R	
Spermestes bicolor	Black-and-white Mannikin		x	x	x	x				x	x			x			x	R	

Table 3: Amphibians species recorded in the areas visited for rapid survey. Key: LC = Least Concern, EN = Endangered

Family	Common Name	Scientific Name	IUCN Status
Bufonidae		*Amietophrynus maculatus*	LC
Bufonidae	African Common Toad	*Amietophrynus regularis*	LC
Astylosternidae		*Astylosternus occidentalis*	LC
Arthroleptidae		*Arthroleptis sp.*	
Arthroleptidae		*Leptopelis spiritusnoctis*	LC
Arthroleptidae		*Leptopelis viridis*	LC
Dicroglossidae	African Grove-crowned Frog	*Hoplobatrachus occipitalis*	LC
Corauidae	Allen's Slippery Frog	*Conraua alleni*	Vu
Hyperoliidae	Savanna Banana Frog	*Afrixalus vittiger*	LC
Hyperoliidae	Lamotte's Reed Frog	*Hyperolius lamottei*	LC
Hyperoliidae		*Hyperolius concolor*	LC
Hyperoliidae	Nimba Reed Frog	*Hyperolius zonatus*	NT
Hyperoliidae	Plain Reed Frog	*Hyperolius nitidulus*	LC
Phrynobatrachidae	Allen's River Frog	*Phrynobatrachus phyllophilus*	NT
Phrynobatrachidae		*Phrynobatrachus tokba*	LC
Ptychadenidae	Broad-banded Grass Frog	*Ptychadena bibroni*	LC
Ptychadenidae	Mascarene Grass Frog	*Ptychadena mascareniensis*	LC
Ptychadenidae		*Ptychadena pumilio*	LC
Ptychadenidae	Sharp-nosed Frog	*Ptychadena oxyrhynchus*	LC

Table 4: Reptile species recorded during the survey and interviews with local respondents

Key: EN = Endangered, VU = Vulnerable, LC = Least Concern, NA = Not Assessed

Family	Common Name	Scientific Name	IUCN Status
Agamidae	Common Agama	*Agama agama*	NA
Agamidae	Forest Agama	*Agama africana*	LC
Scincidae	Senegal Skink	*Trachylepis affinis*	NA
Scincidae	Western Forest Skink	*Trachylepis paucisquamis*	LC
Scincidae	Orange-flanked Skink	*Trachylepis perroteti*	NA
Scincidae	Red-flanked Skink	*Lepidothyris fernandi harlani*	NA
Scincidae	Vaillant's Keeled Water Skink	*Cophoscincopus simulans*	LC
Varanidae	Ornate Monitor-lizard	*Varanus ornatus*	NA
Elapidae	West Green Mamba	*Dendroaspis viridis*	LC
Result of Interviews			
Boidae	Royal Python	*Python regius*	LC
Boidae	Rock Python	*Python sebae*	NA
Colubridae	Brown Water Snake	*Afronatrix anoscopus*	LC
Colubridae	Common Herald Snake	*Crotaphopeltis hotamboeia*	NA

Family	Common Name	Scientific Name	IUCN Status
Colubridae	Boomslang	*Dispholidus typus*	NA
Colubridae	Striped Olympic Snake	*Dromophis lineatus*	NA
Colubridae	Ornate Olympic Snake	*Dromophis praeornatus*	NA
Colubridae	Smith's Water Snake	*Grayia smithi*	NA
Colubridae	Striped House Snake	*Lamprophis lineatus*	NA
Colubridae	Black House Snake	*Lamprophis fuliginosus*	NA
Colubridae	Irregular Green-snake	*Philothamnus irregularis*	LC
Colubridae	Spotted Green-snake	*Philothamnus semivarigatus*	NA
Colubridae	Elangant Sand Snake	*Psammophis elegans*	NA
Elapidae	Forest Cobra	*Naja melanoleuca*	NA
Elapidae	Black-necked Spitting Cobra	*Naja nigricollis*	NA
Viperidae	Puff Adder	*Bittis arietans*	NA
Viperidae	West African Night Adder	*Causus maculatus*	NA
Viperidae		*Bittis gabonica*	NA
Chamaeleonidae	Slender Chameleon	*Chamaeleo gracilis*	LC

Table 5a: Fish species and approximate abundances (n) recorded-October,2017 Legend: LC-List Concern; NT-Near Threatened; CR-Critically Endangered; E-Endangered; V-Vulnerable; DD-Data Deficient

Family	Species	IUCN status	Abundance	No. of sites recorded
Notopteridae	Notopterus afer	LC	11	5
Mormyridae	Brienomyrus brachystius	LC	20	8
Mormyridae	Hippopotamyrus paugyi	LC	18	9
Anabantidae	Ctenopoma kingslayae	LC	10	5
Applocheilidae	Epiplatys barmoiensis	LC	75	11
Applocheilidae	Epiplatys fasciolatus josianae	CR	20	1
Eleotridae	Kribia nana	LC	12	5
Cichlidae	Hemichromis bimaculatus	LC	14	6
Cichlidae	Pelvicachromis humilis	LC	6	5
Cichlidae	Tilapia louka	LC	33	12
Claridae	Clarias laevicep	LC	24	11
Mugilidae	Liza falcipinnis	DD	7	5
Cyprinidae	Barbus ablabes (red fins)	LC	7	3
Cyprinidae	Barbus sacratus	LC	7	4
Invertebrates				
	Potamon crab		10	6
	Machrobranchium vollenhoenii		17	8

Table 5b: List of fish species recorded from actual sampling

Family	Species	Lago Junction	Morsenesie-1	Morkombay	Morgbomoh	Gbangbatoke	Momasah	Morpohoi	Bengeloh	Moselolo	Mosenegoh	Moyassah	Fula Town	Kpandebu	Kassama	Ngiebu	IUCN Redlist status
Notopteridae	*Notopterus afer*			3		1	2			1	4						LC
Mormyridae	*Brienomyrus brachystius*	*5*	*2*	*6*	1			1				3	1	1			LC
Mormyridae	*Hippopotamyrus paugyi*	*2*	*1*	*4*	2			2	2			1		3		1	LC
Anabantidae	*Ctenopoma kingslayae*	*3*	*1*	*2*						1	3						LC
Applocheilidae	*Epiplatys barmoiensis*	*10*	*15*	*6*	5			7	4			3	4	5	7	9	LC
Applocheilidae	*Epiplatys fasciolatus josianae*		*20*														CR
Eleotridae	*Kribia nana*	*2*	*3*		2								4			1	LC
Cichlidae	*Hemichromis bimaculatus*	*2*	*4*		1							3			2	2	LC
Cichlidae	*Pelvicachromis humilis*	*1*	*1*	*1*										2		1	LC
Cichlidae	*Tilapia louka*	*4*	*2*	*3*	1	5	4	1	1	6	1	3		2			LC
Claridae	*Clarias laevicep*	*3*	*5*		1	2	1	4		1	1		3		1	2	LC
Mugilidae	*Liza falcipinnis*			*1*		1	1			3	1						DD
Cyprinidae	*Barbus ablabes (red fins)*							1		2	4						LC
Cyprinidae	*Barbus sacratus*							3	1	2	1						LC
Invertebrates																	
Potamon crab		1	2	1								3		1		2	
Machrobranchium vollenhoenii		3	4	1								2	1	4	1	1	

Table 5c: List of fish species recorded from local interviews

Family	Species	Lago Junction	Morsenesie-1	Morkombay	Morgbomoh	Gbangbatoke	Momasah	Morpohoi	Bengeloh	Moselolo	Mosenegoh	Moyassah	Fula Town	Kpandebu	Kassama	Ngiebu	IUCN Redlist status
Notopteridae	*Notopterus afer*			x		x	x			x	x						LC
Mormyridae	*Brienomyrus brachystius*	*x*	*x*	*x*	x	x	x	x		x	x	x	x	x	x	x	LC
Mormyridae	*Hippopotamyrus paugyi*	*x*	*x*	*x*	x	x	x	x	x	x	x	x	x	x	x	x	LC
Anabantidae	*Ctenopoma kingslayae*		*x*	*x*	x	x	x		x	x	x	x	x	x	x	x	LC
Applocheilidae	*Epiplatys barmoiensis*	*x*	*x*	*x*					x			x	x	x	x	x	LC
Applocheilidae	*Epiplatys fasciolatus*		*x*	*x*													LC
Eleotridae	*Kribia nana*	*x*	*x*		x								x		x	x	LC
Cichlidae	*Hemichromis bimaculatus*	*x*	*x*	*x*	x	x	x	x	x	x	x	x	x	x	x	x	LC
Cichlidae	*Pelvicachromis humilis*	*x*	*x*	*x*	x			x			x			x		x	LC
Cichlidae	*Tilapia louka*	*x*	*x*	*x*	x	x	x	x	x	x	x	x		x			LC
Cichlidae	*Sarotherodon caudomarginatus*		*x*	*x*		x	x			x	x						LC
Cichlidae	*Sarotherodon occidentalis*	*x*	*x*	*x*		x	x			x	x		x		x		NT
Cichlidae	*Tilapia joka*		*x*	*x*		x	x	x									VU
Cichlidae	*Tilapia buttikoferi*		x	x						x	x	x		x			LC
Cichlidae	*Tilapia walteri*																NT
Characidae	*Brycinus longipinnis*																LC
Bagridae	*Chrysicthys maurus*		x	x						x	x	x		x	x		LC
Bagridae	*Chrysichthys nigrodigitatus*		x	x	x		x			x	x	x	x	x		x	LC
Bagridae	*Auchenoglanis occidentalis*		*x*	*x*						x	x	x					LC
Claridae	*Clarias laevicep*	*x*	*x*	*x*	x	x	x	x	x	x	x	x	x	x	x	x	LC
Claridae	*Heterobranchus isopterus*	*x*	*x*	*x*	x	x	x	x	x	x	x	x	x	x	x	x	
Mugilidae	*Liza falcipinnis*		*x*	*x*						x	x	x					DD
Cyprinidae	*Barbus ablabes (red fins)*	*x*	*x*	*x*	x	x	x	x	x	x	x	x	x	x	x	x	LC
Cyprinidae	*Barbus sacratus*																LC

Family	Species	Lago Junction	Morsenesie-1	Morkombay	Morgbomoh	Gbangbatoke	Momasah	Morpoloi	Bengeloh	Moselolo	Mosenegoh	Moyassah	Fula Town	Kpandebu	Kassama	Ngiebu	IUCN Redlist status
Mastacembelidae	Mastacembelus liberiensis	x					x		x					x	x	x	LC
Estuarine Species																	
Cynoglossidae	*Cynoglossus senegalensis* (Sole)					x				x	x	x					NT
Scianidae	Pseudotolithus elongatus(Lady)					x				x	x	x					LC
Polynemidae	*Galeiodes decadactylus*					x				x	x	x					NT
Clupeidae	Sardinella Maderensis(Herring)					x				x	x	x					VU
Ariidae	*Arius latiscutatus*					x				x	x	x					DD
Drepanidae	*Drepane africana*					x				x	x	x					LC
Invertebrates																	
Crabs	*Callinectes marginatus*					x				x	x	x					
	C. pallidus					x				x	x	x					
	C. amnicola																
	Potamon (River crab)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Shrimps	*Peneaus notialis*					x				x	x	x					
	Machrobranchium	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

Annex B: Minutes of Focus Group Discussion Meetings

Annex C: Participants at Focus Group Discussion Meeting

Annex D: Heritage Study Site Record Sheet

Site Record Sheet

Name of Community .....

Types of Cultural Heritage Site (e.g. Poro, Sande bush. Shrine)

a) ..... GPS Point .....
b) .....GPS Point .....
c) .....GPS Point .....
d) .....GPS Point .....

Purpose of the Site (what it is used for)

a) .....
b) .....
c) .....
d) .....

Level of importance (to family/clan members/community)

a) .....
b) .....
c) .....
d) .....

How often ceremonies/sacrifices are held and what is involved?

a) .....
b) .....
c) .....
d) .....

Implications for relocating the Site

a) .....
b) .....
c) .....
d) .....

Any other useful information

.....

.....

ANNEX E: Traffic Count Assessment Data

Traffic Count Direction: Gbangbatoke Junction to Moseilolo: 06:00 am to 06:00 am							
Wednesday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	1	1					2
Taxis carrying Passengers							
Mini Bus (Poda Poda Carrying up to 18 Passengers)							
Pick-up and Vans carrying Goods (1-2 tonnes)							
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)							
Large Bus (RTC type carrying 40-60 Passengers)							
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel							
Trucks (3 & 4 axles; 10 wheels; and trailers)							
Motorcycle / Bicycle	33	32					65
Pedestrians	7	2					9
Grand Total	**41**	**35**					**76**

Traffic Count Direction: Gbangbatoke Junction to Moseilolo: 06:00 am to 06:00 am							
Thursday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	1	1					2
Taxis carrying Passengers							
Mini Bus (Poda Poda Carrying up to 18 Passengers)							
Pick-up and Vans carrying Goods (1-2 tonnes)							
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)							
Large Bus (RTC type carrying 40-60 Passengers)							
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel							
Trucks (3 & 4 axles; 10 wheels; and trailers)							
Motorcycle / Bicycle	35	35					70
Pedestrians	7	4					11
Grand Total	**43**	**40**					**83**

Traffic Count Direction: Gbangbatoke Junction to Moseilolo: 06:00 am to 06:00 am							
Friday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers					1		1
Taxis carrying Passengers							
Mini Bus (Poda Poda Carrying up to 18 Passengers)							
Pick-up and Vans carrying Goods (1-2 tonnes)							
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)							
Large Bus (RTC type carrying 40-60							

Passengers)							
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel							
Trucks (3 & 4 axles; 10 wheels; and trailers)							
Motorcycle / Bicycle	20	21	12	4	2	0	59
Pedestrians	2						2
Grand Total	**22**	**21**	**12**	**4**	**3**	**0**	**61**

Traffic Count Direction: Gbangbatoke Junction to Moseilolo: 06:00 am to 06:00 am							
Saturday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers							
Taxis carrying Passengers							
Mini Bus (Poda Poda Carrying up to 18 Passengers)							
Pick-up and Vans carrying Goods (1-2 tonnes)							
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)							
Large Bus (RTC type carrying 40-60 Passengers)							
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel							
Trucks (3 & 4 axles; 10 wheels; and trailers)							
Motorcycle / Bicycle	20	12	15	18	5	0	70
Pedestrians	5	4	2	0	3	0	14
Grand Total	**20**	**12**	**15**	**18**	**5**	**0**	**84**

Traffic Count Direction: Gbangbatoke Junction to Moseilolo: 06:00 am to 06:00 am							
Sunday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers							
Taxis carrying Passengers							
Mini Bus (Poda Poda Carrying up to 18 Passengers)							
Pick-up and Vans carrying Goods (1-2 tonnes)							
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)							
Large Bus (RTC type carrying 40-60 Passengers)							
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel							
Trucks (3 & 4 axles; 10 wheels; and trailers)							
Motorcycle / Bicycle	29	50	10	4	0	0	93
Pedestrians	5	11	3	4	0	0	23
Grand Total	**29**	**50**	**10**	**4**	**0**	**0**	**106**

Traffic Count Direction: Gbangbatoke Junction to Moseilolo: 06:00 am to 06:00 am							
Monday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc.	2						2

Traffic Count Direction: Gbangbatoke Junction to Moseilolo: 06:00 am to 06:00 am							
Carrying Passengers							
Taxis carrying Passengers							
Mini Bus (Poda Poda Carrying up to 18 Passengers)							
Pick-up and Vans carrying Goods (1-2 tonnes)							
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)							
Large Bus (RTC type carrying 40-60 Passengers)							
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel							
Trucks (3 & 4 axles; 10 wheels; and trailers)							
Motorcycle / Bicycle	17	13	6	3	0	0	39
Pedestrians	10		1				11
Grand Total	**19**	**13**	**6**	**3**	**0**	**0**	**50**

Traffic Count Gbangbatoke - Mogbwemo: 06:00 am to 06:00 am							
Wednesday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	9	12	14	6	4	2	**47**
Taxis carrying Passengers	12	12	3	4	4	5	**40**
Mini Bus (Poda Poda Carrying up to 18 Passengers)	13	19	13	10	7	3	**65**
Pick-up and Vans carrying Goods (1-2 tonnes)	9	13	6	5	2	2	**37**
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)	10	11	5	7	2	1	**36**
Large Bus (RTC type carrying 40-60 Passengers)	3	4	4	2	1	1	**15**
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel	10	5	6	4	4	2	**31**
Heavy Trucks	9	10	6	4	3	2	**34**
Trucks (3 & 4 axles; 10 wheels; and trailers)	5	5	5	4	3	1	**23**
Motorcycle / Bicycle	65	58	2	2	1	1	**129**
Pedestrians	55	65	35	30	3	1	**189**
Grand Total	**200**	**214**	**99**	**78**	**34**	**21**	**646**

Traffic Count Gbangbatoke - Mogbwemo: 06:00 am to 06:00 am							
Thursday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	18	16	14	7	1	0	56
Taxis carrying Passengers	10	11	12	11	4	0	48
Mini Bus (Poda Poda Carrying up to 18 Passengers)	7	16	13	10	2	0	48
Pick-up and Vans carrying Goods (1-2 tonnes)	6	12	8	10	5	0	41
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)	6	10	23	8	2	0	49
Large Bus (RTC type carrying 40-60 Passengers)	4	6	9	8	3	1	31
Light Truck (2 axles carrying Goods and	5	9	11	10	2	1	38

Passengers: 3-5 tones; 6 wheel; 4 wheel							
Heavy Trucks	5	10	7	8	4	1	35
Trucks (3 & 4 axles; 10 wheels; and trailers)	5	4	12	6	4	0	31
Motorcycle / Bicycle	33	40	75	70	45	0	263
Pedestrians	29	51	70	70	45	0	265
Grand Total	**128**	**185**	**254**	**218**	**117**	**3**	**905**

Traffic Count Gbangbatoke - Mogbwemo: 06:00 am to 06:00 am							
Friday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	10	16	14	7	1		48
Taxis carrying Passengers	7	11	12	11	4		45
Mini Bus (Poda Poda Carrying up to 18 Passengers)	9	16	22	13	5		65
Pick-up and Vans carrying Goods (1-2 tonnes)	5	16	9	11	5		46
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)	9	10	23	8	2		52
Large Bus (RTC type carrying 40-60 Passengers)	3	6	9	8	3		29
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel	6	9	11	10	2		38
Heavy Trucks	4	10	7	8	4		33
Trucks (3 & 4 axles; 10 wheels; and trailers)	4	7	15	6	4		36
Motorcycle / Bicycle	35	51	75	70	45		276
Pedestrians	29	51	70	70	45		265
Grand Total	**121**	**203**	**267**	**222**	**120**		**933**

Traffic Count Gbangbatoke - Mogbwemo: 06:00 am to 06:00 am							
Saturday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	8	11	10	13	4	4	50
Taxis carrying Passengers	4	10	10	6	5	1	36
Mini Bus (Poda Poda Carrying up to 18 Passengers)	11	9	17	30	13	2	82
Pick-up and Vans carrying Goods (1-2 tonnes)	6	15	17	20	11	1	70
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)	9	14	9	17	4	2	55
Large Bus (RTC type carrying 40-60 Passengers)	3	5	4	4	4	1	21
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel	11	9	11	19	1	0	51
Heavy Trucks	5	2	7	12	6	0	32
Trucks (3 & 4 axles; 10 wheels; and trailers)	4	5	6	3	3	1	22
Motorcycle / Bicycle	51	75	85	67	20	0	298
Pedestrians	51	65	64	53	19	0	252
Grand Total	**163**	**220**	**240**	**244**	**90**	**12**	**969**

Traffic Count Gbangbatoke - Mogbwemo: 06:00 am to 06:00 am

Sunday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	11	20	25	13	10		78
Taxis carrying Passengers	5	16	13	14	7		55
Mini Bus (Poda Poda Carrying up to 18 Passengers)	12	30	22	40	15		119
Pick-up and Vans carrying Goods (1-2 tonnes)	6	17	25	21	11		80
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)	9	14	9	19	4		56
Large Bus (RTC type carrying 40-60 Passengers)	3	6	5	5	5		24
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel	12	9	12	23	0		56
Heavy Trucks	7	7	11	13	7		45
Trucks (3 & 4 axles; 10 wheels; and trailers)	5	5	5	5	3		23
Motorcycle / Bicycle	51	75	81	68	20		295
Pedestrians	49	65	64	53	18		249
Grand Total	**170**	**264**	**272**	**274**	**100**		**1080**

Traffic Count **Gbangbatoke - Mogbwemo: 06:00 am to 06:00 am**							
Monday							
Vehicle Type	6-10am	10am-2pm	2-6pm	6-10pm	10pm-2am	2-6am	**TOTAL**
Private Cars including Land Cruisers etc. Carrying Passengers	21	22	16	21	2	3	85
Taxis carrying Passengers	31	20	15	9	2	5	82
Mini Bus (Poda Poda Carrying up to 18 Passengers)	41	33	38	27	5	3	147
Pick-up and Vans carrying Goods (1-2 tonnes)	25	21	23	9	3	3	84
Medium Bus (Comfort Types Carrying 22-35 Passengers Plus)	40	26	16	27	2	2	113
Large Bus (RTC type carrying 40-60 Passengers)	3	7	7	9	2	2	30
Light Truck (2 axles carrying Goods and Passengers: 3-5 tones; 6 wheel; 4 wheel	23	13	12	10	2	3	63
Heavy Trucks	20	15	5	7	1	2	50
Trucks (3 & 4 axles; 10 wheels; and trailers)	7	7	80	4	1	1	100
Motorcycle / Bicycle	56	81	76	50	3	3	269
Pedestrians	53	77	75	70	3	3	281
Grand Total	**320**	**322**	**363**	**243**	**26**	**30**	**1304**

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