ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY (ESIA)

FOR

ORANGE (SL) LTD'S MOBILE TELECOMMUNICATIONS OPERATIONS IN SIERRA LEONE

EXECUTIVE SUMMARY & MAIN REPORT

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Freetown, Sierra Leone

On Behalf of

Orange SL Ltd

February 2018

DOCUMENT HISTORY

Version History	Date	Reviewer

Title	Environmental and Social Impact Assessment for Orange SL Ltd's Telecommunications Operations in Sierra Leone: Executive Summary and Main Report
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Date	February 2018
Subject	Environmental and Social Impact Assessment
Publisher	CEMMATS Group Ltd
Type	Client Report
Description	ESIA for Orange SL Ltd
Contributors	
Format	Microsoft™ Word 2013
Source	Text
Rights	© CEMMATS Group Ltd
Identifier	
Language	English
Relation	
Coverage	Sierra Leone, 2018

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ACKNOWLEDGEMENTS

We wish to extend our appreciation to various government of Sierra Leone (GOSL) ministries, departments, agencies, institutions, statutory bodies, organisations and individuals whose assistance, either directly or indirectly, made this Environmental and Social Impact Assessment (ESIA) of Orange Sierra Leone Ltd's Operations in Sierra Leone successful.

We are particularly grateful to the assistance availed to us by the Environment Protection Agency Sierra Leone (EPA-SL) and its staff, especially for providing us with useful take off guidance to carry out the ESIA study.

We acknowledge the cooperation of various staff of Orange SL Ltd who availed us relevant documents and information, to successfully carry out this study.

We are thankful to the local authorities and members of the various communities visited within the various operational areas, for their diverse assistance during the main field visit.

Last but not least, we would like to thank all those who, in one way or another contributed to making this ESIA study successful.

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LIST OF ACRONYMS

0^C Degrees Celsius

% Percentage

CBO community-based organisation

CDAP Community Development Action Plan

CEMMATS Construction Engineering Maintenance, Manufacturing and Technical Services

CI Corrugated Iron

dB decibels

EPA-SL Environment Protection Agency Sierra Leone

ESIA Environmental and Social Impact Assessment

ESMP Environmental and Social Management Plan

ERP Emergency Response Plan

GoSL Government of Sierra Leone

GPS Global Positioning System

IFC International Finance Corporation

MDA Ministries, Departments and Agencies

MLCPE Ministry of Lands, Country Planning and the Environment

MWHI The Ministry of works, Housing and Infrastructure

N North

NGO Non-Governmental Organization

PAC Project Affected Communities

PAPs Project Affected Persons

PCDP Public Consultation and Disclosure Plan

PRSP Poverty reduction Strategy Paper

PS Performance Standard

SLEPAA, 2008 Sierra Leone Environment Protection Agency Act, 2008

TOR Terms of Reference

TPL Traditional pit latrine

VPL ventilated pit latrine

WHO World Health Organization

WMP Waste Management Plan

GLOSSARY

Board of EPA-SL	This is a board of directors that form the governing body of EPA-SL; it is headed by the Executive Chairperson and consists of representatives of a number of line ministries and three other members of society
Client	One who uses the services or advice of a professional person or organization
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 host communities of the operational areas.
EPA-SL "checklist"	A list of procedures developed and provided by EPA-SL to be systematically followed by a client for the conduct of ESIA and 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
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
Potable Water	Water that is used for drinking, cooking, dishwashing, or other domestic purposes requiring water that is suitable for human consumption
Project interested and affected persons	Any person who, as a result of the implementation of a project, loses the right to own, use, or otherwise benefit from a built structure, land (residential, agricultural, or pasture), annual or perennial crops and trees, or any other fixed or moveable asset, either in full or in part, permanently or temporarily

Project Proponent	An individual or organization that together with others, each of which is also a project proponent, has over all control or responsibility for the project
Runoff	Water that moves across (or through) soils on the land during snowmelt or rainstorms
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
Stakeholders	Any and all individuals, groups, organizations, and institutions interested in and potentially affected by a project or having the ability to influence a project

EXECUTIVE SUMMARY

This Executive Summary serves to provide an overview of the results of the environmental and social impact assessment studies carried out for Orange SL Ltd's Telecommunications Operations in Sierra Leone, by CEMMATS Group Ltd. CEMMATS is a multidisciplinary Engineering and Environmental consultancy, contracted by Orange. The results of the ESIA study are presented in two volumes:

- Volume1: ESIA Main Report and Executive Summary
- Volume 2: Environmental and Social Management Plan (ESMP)

Introduction

Orange is one of the world's leading telecommunications operators with sales of 40.9 billion Euros in 2016 and 154,000 employees worldwide. Present in 29 countries, the Group has a total customer base of 265 million customers worldwide, including 3.3 million fibre customers, 202 million mobile customers, 29 million Orange money customers and 18 million fixed broadband customers. Orange operates a 4G network in 18 countries, owns a 450,000km undersea cable and 6,930 patents in portfolio and has invested 732,000 in research and innovations. Orange is the No 1 best mobile network in France for 7th time in a row and is the 51st brand in the world according to 2017 global brand ranking.

Orange in Sierra Leone provides extensive coverage in the Sierra Leonean capital and other major towns and is set to expand mobile connectivity and internet access to customers living outside major urban areas. At the time of this study, Orange operates 2 offices, 6 shops and 249 active network sites.

The Company's operation requires an Environmental and Social Impact Assessment (ESIA) including the development of an Environmental and Social Management Plan (ESMP) in order to obtain an Environmental Impact Assessment (EIA) Licence in line with requirements of the Environment Protection Agency of Sierra Leone (EPA-SL).

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 February 2018.

Summary of Scope of Work

In summary, the scope of work comprised:

- Collection of primary and secondary environmental and social data from relevant literature on the various operational areas;

- Undertaking field visits to obtain baseline data of prevailing environmental and social conditions, and
- Preparation of a Scoping Report
- Preparation of an ESIA and ESMP report.

Assumptions

- The EIA study has been done to meet the local requirements for securing the EIA license. The Sierra Leone Environment Protection Agency Act, (SLEPAA) 2008 and the EIA Supplementary Acts, 2010, stipulate an Environmental Impact Assessment (EIA) must be undertaken before the commencement of any project that may affect the surrounding environment and communities. It should be remembered that the term 'environment' in the context of an EIA refers to the biological, physical, economic and social environments.
- Given the timeframe within which the study will be carried out, seasonal variations have not been observed, however desk studies have be done on available historical climatic data and other records obtained at various times during previous years.
- Due to the number of operational areas (particularly the network sites) site visits were not conducted at all locations. Visits were made to all offices and shops, and twenty eight (28) network sites countrywide.

Notwithstanding the aforementioned assumptions, the ESIA Team employed an evidence-based approach and included scientific information relevant to the operational areas within the stated limited options. Where possible the ESIA Team sought quality data and information from other sources at a level of detail adequate to conduct the ESIA study.

Description of Operations

Mobile telecommunications is the process of sending, transmitting and receiving information over a distance with the purpose of communicating. It involves the transmission of signs, signals, messages, words, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems. It is transmitted either electrically over physical media, such as cables, or via electromagnetic radiation.

The main benefit of mobile telecommunications is the ability to perform point-to-point or point-to-multipoint transmissions using either a digital or digitized analogue signal.

The various protocols utilized in mobile telecommunications require specific actions taken at certain times in order for two devices to connect and receive information. Each of these protocols take the form of physical layering, which is transmitted in a specific manner and ultimately deciphered by the receiving device.

Cellular technology makes the most notable use of the mobile telecommunications technology. The concept utilizes a series of base stations, a land-based facility or tower designed to propagate the signal from one location to another, and satellite technology. This allows the technology to spread to further locations, providing service to those across a country. Mobile cellular telecommunications began in the late 1970s, evolving in public access, cost and quality over the years.

The process of sending, transmitting and receiving information, rendering it possible to make phone calls across the country involves the use of various types of equipment, machinery and processes. Some of the main components of Orange SL Ltd's communication network include the following:

- ***Mini Link Traffic Node:*** The MINI-LINK Traffic Node (an Ericsson Product) is a microwave transmission system used by mobile networks.
- ***Switched-Mode Power Supply (SMPS, or switcher***): An indispensable part of a telecom network is the telecommunication power supply which directly affects the stability, reliability and smoothness of the network.
- ***Radio Base Station:*** The Radio Base Station is the equipment that facilitates wireless communication between user equipment (phones, modems, etc.) and a mobile network.
- ***Cell Towers:*** A cell tower is a cellular telephone site where antennae and electronic communications equipment are placed typically on a tower or other raised structure to create a cell in a cellular network.

Analysis of Alternatives

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

Orange SL Ltd is the leading telecommunications company in Sierra Leone, providing extensive coverage in the Sierra Leonean capital and other major towns and is set to expand mobile connectivity and internet access to customers living outside major urban areas. The "no project" option was therefore determined not to be a beneficial option, with the pros of the Company's operations outweighing the environmental, social and economic cons.

Selection criteria for the location of network sites and facilities were described highlighting the technical, environmental, legislative and social considerations taken in choosing a location.

In relation to choice of technology, the Company is currently in the process of replacing technical features from inherited infrastructure (installed by previous operators) with more recent and advanced technology. These new technology come with improved health and safety benefits in relation to radiation levels, radiation protection/exposure risk minimisation.

Policy, Legal, Regulatory and Institutional Context

Policies and Plans

National Environmental Policy, 1994

This 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 man and his environment. It also promotes efforts which will prevent or eliminate damage to the environment and biosphere and 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.

Draft National Lands Policy, 2013

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.

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.

Forestry and Wildlife Sector Policy for Sierra Leone (Draft), 2003

The goal of the document is to support the development and reduce the exploitation of forests and wildlife of Sierra Leone in a sustainable manner for the material, cultural and aesthetic benefit of the people of Sierra Leone in particular and mankind in general.

The Conservation and Wildlife Policy

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.

Disaster Management Preparedness Plan, 2006

As part of its post-war recovery effort, the Government of Sierra Leone 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.

Legislations

The Telecommunications Act, 2006 (Amended in 2009 and 2015)

This Act serves to establish the National Telecommunications Commission and to provide for the licensing and regulation of telecommunications operators. It also serves to promote universal access to basic telecommunication services, fair competition for the benefit of investors in, and the users of telecommunication networks and services, to improve the national, regional and global integration of Sierra Leone in telecommunications and to provide for other related matters. The 2015 amendment terminated the monopoly of the Sierra Leone Telecommunications Company (SierraTel) in the operation of the international gateway and other related matters

Environmental Protection Agency Act, 2008

The EPAA 2008 is the government of Sierra Leone's overarching legislation that deals with the protection of the environment. The Environment Protection Agency 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.

Part IV of the EPAA, 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 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.

Wildlife Conservation Amendment Act, 1990

The Wildlife Conservation Act, 1972 and the Forestry Act, 1988 are the main legislations 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.

Factories Act, 1974

This Act became effective on the 30th May, 1974. It basically deals with health and safety measures as they concern the factory worker. It protects the worker through demands for all aspects of cleanliness, reports of all injuries, accidents, diseases and death.

A Factories Appeal Board is in operation and has the duty of hearing and determining any appeal submitted by factory owners, thus giving right where it is due. Going by the interpretation of the word factory, as stipulated in this Act, industrial companies are factory based companies, and are therefore covered by any legislation pertaining to this aspect.

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.

Land Tenure and Ownership

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

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.

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.

Institutional Context

The Ministry of Information and Communication

The Ministry of Information and Communications is responsible for ensuring that every citizen has access to timely, accurate, clear and objective information on national and international issues of relevance. The Ministry aims 'to develop all segments of the information and communications sector in order to keep all citizens well informed, educated and sensitized.

The mandate of the Ministry relevant to the telecommunications sector includes the following:

- Provide internal and external information services
- Develop communications strategy and introduce improved methods of communication

The National Telecommunications Commission (NATCOM)

The National Telecommunications Commission (NATCOM) was established by an Act of Parliament in 2006 to regulate the Sierra Leone telecoms sector, protect consumer interest and ensure fair competition among service providers.

The major policy direction of the Commission is:

- the establishment of an effective, sound and dynamic licensing regime that is responsive to industry demands;
- the regulation of the activities of telecoms operators aiming at promoting efficiency and fair competition;
- ensuring expansion in investment in the sector; and adopting rules and procedures that guarantee and protect the rights of users of telecoms services.

The Commission in essence started the process of restructuring by setting a sound legal and regulatory framework, reviewing the licence conditions of new and existing operators and service providers and providing an interactive forum (The Consumer Parliament) for the Consumers and Service Providers to meet with the Regulator and discuss issues pertinent to the industry.

Sierra Leone Cable Ltd (SALCAB)

Sierra Leone Cable Limited (SALCAB) was incorporated as a limited liability company with 100% shareholding from the Government of Sierra Leone in 2012. The company is being supervised by the Ministry of Information and Communication on behalf of the Government of Sierra Leone. The company was set up to manage the fiber optic backbone of Sierra Leone and to provide affordable fiber optic capacity to Telecommunication companies.

The company's mission is to provide ICT Service providers with equal access to service portfolios under an open and non-discriminatory access regime in order to promote broadband internet access at affordable prices nationwide (SALCAB, 2015).

Environment Protection Agency Sierra Leone

The Environment Protection Agency was set up to replace the National Commission for Environment and Forestry (NaCEF), which was mandated to oversee issues pertaining to the environment and forestry. The Environment Protection Agency was established with a Board of Directors set up as its governing body. This Board consists of a Chairman and representatives from the various line Ministries and a Unit as stated in section 3 of part II of the Environmental Protection Agency Act. Subject to this Act, the Board shall have the control and supervision of the Agency. The Agency shall act in liaison and co-operation with government agencies to control pollution and the general protection of the environment. The Agency, subject to this Act, shall promote effective planning in the management of the

environment and coordinate and monitor the implementation of national environmental policies, relating to Sierra Leone.

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

Collaboration with relevant Government Ministries and with national and international organisations and Institutions.

Ministry of Works, Housing and Technical Maintenance

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:-

Public Works Division

This division is responsible for:

- The Sierra Leone Road Authority (SLRA);
- Regulation of civil Building and Civil Engineering Standards;
- Registration of civil work contractors;
- Seaface Protection;

Baseline Survey and Condition

General Overview of Physical and Biological Environment

Western Area

The average annual rainfall is about 3060mm. Rainfall along the coast can reach 4950mm per annum. The normal temperature range is 22.1ºC to 32ºC although it can drop during the Harmattan season to as low as 10ºC.

The Freetown Complex is a major intrusion characterized by prominent layering of repeated sequences of troctolitic, gabbroic and anorthositic rocks. Differential resistance of these rocks to weathering and erosion has given rise to the parallel range of mountains from which Sierra Leone derived its name "Sierra Leona", - the Lion Mountain.

The oceanic tidal movement on the West African coast is driven by an amphidromic system centred in the West Indies. The resulting tidal wave is propagated in a northerly direction along the West African coast, such that the coastal tidal streams off Sierra Leone flow southward on the ebb and northwards on the flood.

Southern Province

Generally, the climate is described as wet tropical monsoon with a single wet season each year. The average annual rainfall is about 2738 mm overall. The greater part of this rain falls between mid-May and mid-November and the wettest month is usually August, even though rivers attain maximum discharge in mid-September. There is very little or no rain in December, January and February

Most of Sierra Leone is underlain by a series of ancient, folded, crystalline rocks of varying lithology, belonging to the Archean subdivision of the Precambrian period. The regional geology of Bo is referred to as the granit-greenstone terraine. The granite/greenstone complex comprises a series of iron and magnesium-rich rocks metamorphosed to the amphibolites facies (Sula Group) over a quartz-rich basement of granitic composition.

This region has gently undulating plains with isolated hill remnants, dissected by well-defined valley swamps. The hills are usually pointed and rise with an extremely low relief from fairly broad interfluves. The gently to moderately sloping interfluves side slopes have commonly been dissected by broad gullies giving rise to narrow crests.

The major land use activities in this region are mining (gold and diamond) and agriculture (coffee, cacao and oil palm). Agriculture is carried out mainly in the upland and valley swamps where small to large scale plantations can be found. Other land use activities include fishing and trading.

The biogeographic characteristic of this area is that it falls within the western extent of the Guinea-Congo forest biome and the western edge of the Upper Guinea forest. Therefore, the vegetation is historically closed canopy forest, which is thought to have been 60% of the cover of Sierra Leone. However, in recent times, farmbush ecology is the dominant cover,

with few isolated and small patches of secondary forest confined to the vicinity of villages and along streams and tributaries.

Eastern Province

This is the Rain Forest Agro-climatic Region of Sierra Leone, characterized by a high mean annual rainfall of 2500 -3000 mm and moderately low (290+/-30mm) water deficit spread over some 100 - 200 days (Kowal, et. al. 1980).

This area is part of the Archaean age West African Craton comprising an infracructal basement of migmatitic gneisses and granitoids overlain by supracrustal rocks of the Kambui Supergroup. These rocks were subject to two major orogenic episodes/thermotectonic events during the Leonean (>2700 million years) and Liberian (~2700 million years) events.

The region consists of a variable dissected complex of plains and rocky hills of low to moderate relief and also irregularly dissected high-lying plains of low relief and isolated rocky hills and narrow valleys.

Agriculture and Mining are the main land use activities carried out in this region.

The Eastern Province falls within the Guinea-Congo forest biome which can generally be described as a mosaic of closed forest, degraded forest, farmbush, farmlands and open areas.

Northern Province

This area is classified as being in the transitional rainforest savannah woodland agro climatic region of Sierra Leone (UNDP/FAO, 1980).

It contains the Sula Mountains greenstone belt which is divided in a western and western-eastern branch. The central part is governed by the older granitiods. Former researchers considered the greenstone belt as a geosynclinals sequence deformed and metamorphosed during subsequent Liberian Episode.

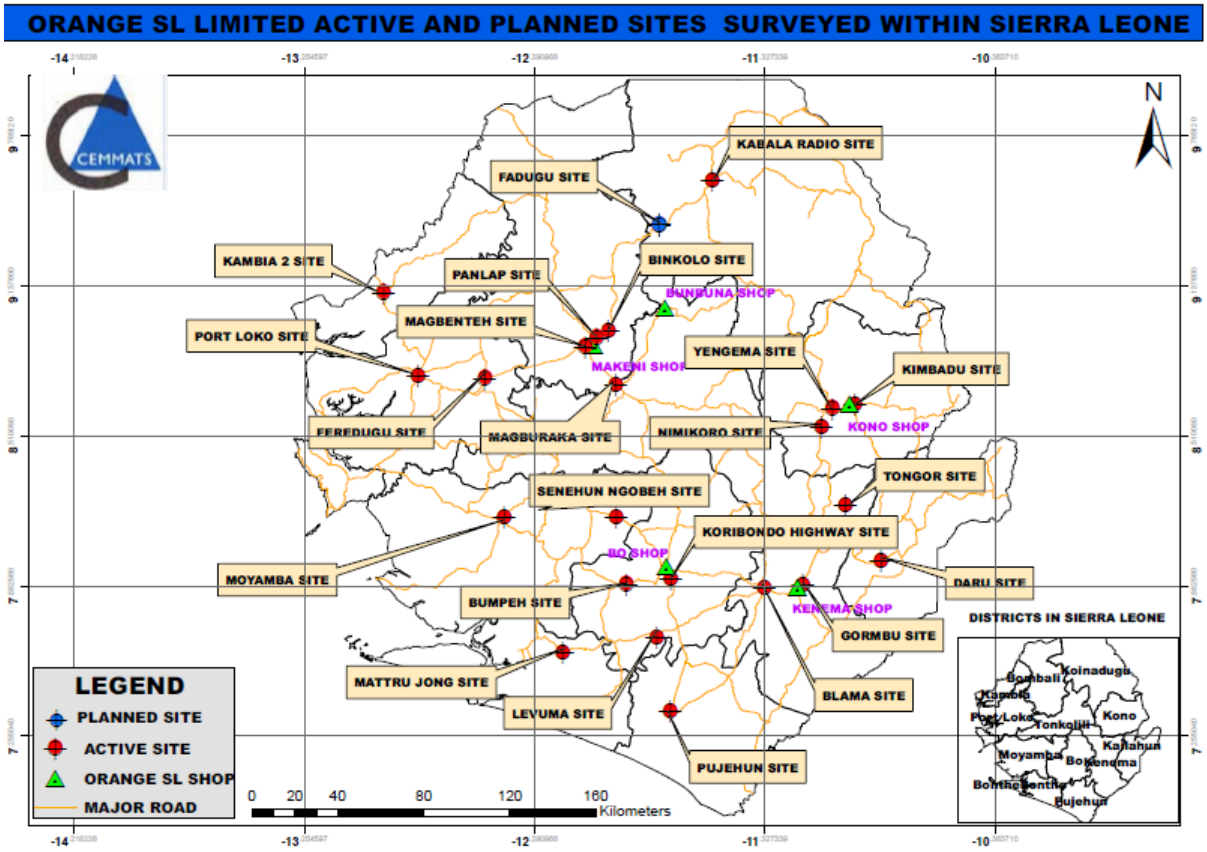
Hills range from moderate to high relief, and there are dissected plains of extremely low relief. There are also small hills and common terraces with valleys swamps.

Populations within this region depend on the natural resources available to them for both their livelihood and income. Specifically, agriculture (rice farming and mix cropping) and mining (artisanal gold mining) are the fundamental land use activities defining the livelihood of this population.

The vegetation of this region comprises of elements of forest and savanna conditions at various locations, which has naturally resulted from the occurrence of the mosaic of Guinea-Congo forest and the Sudan-Guinea savanna biomes.

Primary Data Collected from Operational Areas

Primary biophysical data was collected in 28 operational areas (shops and network sites) in the provinces during the studies conducted in February 2018. The following map shows the sites visited.



Wind Speed

The figures indicate that wind speeds for this time of the year are generally ranging from calm air (0.1m/s) to light breeze (3.1m/s) (according to the beaufort scale) and are moving in various directions depending on the elevation and the open spaces. Higher wind speeds were recorded in elevated areas and open spaces.

Noise Levels

Most sites surveyed are located within communities and as such, noise threshold considered are those prescribed for residential areas, which prescribe 55dB during the day and 45dB at night. Noise measurements were taken between 9:00am and 6:00pm daily.

The maximum recorded noise level was 75dB recorded at the Koribondu Highway network site. Elevated noise levels exceeding prescribed thresholds cannot however be attributed solely to Orange's operations and result from a number of external factors including nearby highways/roads and community activities at the time of measurement.

Air Quality

Maximum and average values were recorded, with average values ranging between 0.001 mg/m^3 and 0.018 mg/m^3 and maximum values also ranging from 0.009 mg/m^3 to 0.353 mg/m^3.

Exceedances were determined to be due to external factors as no dust generating activities or were being conducted or point sources identified at Orange's facilities at the time of measurements. Likely causes include to the movement of vehicles as some of the sites are close to unpaved roads, and other community activities.

Ecology

Vegetation in the immediate surroundings of the operational areas visited during the study is relatively limited, with typically a few trees outside the facility boundary.

Within the larger vicinity of the various facilities, vegetation could generally be described as a variety of different landscape features, dominated by farmbush (agricultural fallow land) community farmlands.

Hydrology

Surface water bodies were found to be a distance away from all the operational areas visited, but boreholes equipped with hand pumps existed in the majority of host communities.

Boreholes identified within the operational areas are categorized into perennial and seasonal. Seasonal boreholes usually yield water for a shorter period during the crucial months of December to March. The water quality in these water wells and boreholes is good, and water uses according to community residents are generally for drinking and domestic purposes.

Socio-economic Baseline Data

Sierra Leone covers a total area of 71,740 km^2 and has a population of 7,092,113 according to the 2015 Housing and Population Census result.

The following table presents information on national social indicators:

Information on National Social Indicators

Key Social Indicators	Rate	Source
National Population	7,092,113	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/sie

Key Social Indicators	Rate	Source
		rra-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	129.8/130.1	United Nations Statistics Division (2017). *Sierra Leone*. [online]

Key Social Indicators	Rate	Source
(f/m)	(2014)	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

Socio-Economic Context of Operational Areas

Western Area

Education in Sierra Leone is legally required for all children for six years at primary school level and three years in junior secondary school. A shortage of schools and teachers has made implementation impossible, although the number of children in primary education has greatly increased since the end of the civil war. Recently, the outbreak of Ebola led to the closure of schools for a prolonged time period from July 14 to April 2015. In Western Urban after the Ebola outbreak 1,120 schools were operational. As of October, 2015, 540 schools were open in Western Rural district.

The total number of people food insecure in Western Urban Area is 203,659 and the percentage of household food insecure (severe and moderate) is 23.0%. While in the Western Slum Area the total population food insecure is 24,142 and the percentage of household food insecure (severe and moderate) is 40.3%.

District Health Management Team (DHMT) has registered a total of 538 staff medical and non-medical staff working in health facilities in Western Urban Area. In addition, the facilities available in Western Rural Area are 20 Community Health Center (CHC), 20 Community Health Post (CHP), 13 Maternal Child Health Post (MCHP) and 9 hospitals.

Water is rationed in many areas in Freetown with almost no customers receiving a 24-hour supply and as a consequence there is limited access to safe drinking water.

Southern Province

Bo District

Bo district is in the Southern Province, and borders with Kenema district to the east, Tonkolili district to the north, Moyamba district to the west, Bonthe district to the southwest and Pujehun district to the south. It is the second most populous district in Sierra Leone (after the Western Area Urban district), with over 60% of the population being the Mende ethnic group.

During the May-October rainy season, the district receives an average of 292cm rainfall annually.

The major economic activities of the district population are gold and diamond mining, other activities include trading, agricultural production of rice and root crops, cash crops such coffee, cacao and oil palm plantation.

Bo has the second highest school enrolment (78%) after the Western Area (83%), and district has one of the highest literacy rates in the country.

According to the Emergency Food Security Assessment in Sierra Leone 2015, over 57% of the district population experienc severe (10%) to moderate (47%) food insecurity.

Bonthe

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 and with mainland being next to the Atlantic Ocean. The capital is Mattru Jong town. Bonthe district is the least populous in Sierra Leone where the inhabitants mainly belong to the Mende ethnic group and the Sherbro people (native residents of the district). During the rainy season (May-November) an average 168 days have rain with annual rainfall of 366cm.

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.

The district has over 280 schools of which 77% are primary schools. The district has a relatively high net primary enrollment (70%) compared to other districts.

According to the Emergency Food Security Assessment 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.

The government general hospital is 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.

Moyamba

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, the other ethnic groups comprise Sherbro, Temne and Loko.

Agriculture remains the mainstay of the District residents and the largest sector of economy in the district, providing livelihoods for over 71% of the population.

The district has over 560 schools in the district, 86% of which are primary. The large majority (85%) of the schools are owned by missions, private and community while government owned schools are only 15%.

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

The district has two Government and two Mission hospitals; in addition to this other healthcare support systems including Community Health Centers (CHC), Community Health Posts (CHP), Maternal and Child Health Posts (MCHP) and clinics.

Pujehun

Pujehun district is in the Southern Province and third largest district in the country. It borders the Atlantic Ocean in the southwest, the Republic of Liberia to the southeast, Kenema district to the northeast, Bo district to the north and Bonthe district to the west. The town of Pujehun is the capital of the district. The population is predominantly Muslim mainly belonging to the Mende ethnic group. Pujehun was destroyed during the country's civil war, and still visibly carries the marks of war.

Diamond mining is a major economic activity; a number of internationally owned mining corporations are operating in the district.

The district has over 300 schools in the district, 90% of which are primary schools. Only 17% of these schools are owned by the Government while the rest are mission, community, or privately owned.

30% of the district population are food insecure of which 2% are severe and 28% are moderately food insecure. According to the Emergency Food Security Assessment 2015, Pujehun is the third lowest food insecure district in the country.

The district has 74 health facilities, only one of which is a government hospital. Like many other districts in the country, the only hospital in Pujehun has provision of one bed per approximately 4,433 persons.

Eastern Province

Kenema

Kenema district is in the Eastern Province of Sierra Leone, the capital and the largest city is Kenema, which is the third largest city in Sierra Leone. The city is located on the railway line, in a valley of the Kambui Hills. The district is ethnically diverse, and the Mende people make up the largest ethnic group.

Politically, Kenema is a stronghold of the Sierra Leone People's Party (SLPP), the main opposition party in Sierra Leone.

Kenema city is the centre of the Alluvial Diamond Mining Scheme Area and the site of the Government Diamond Office. Kenema is an important agricultural market town and the centre of the timber industry in Sierra Leone.

The District has over 739 schools 82% of which are primary schools.

It is one of the most food insecure districts in the country. The State of Food Security and Nutrition in Sierra Leone (2010) report confirmed the percentage of household as food insecure was 33.8%, exceeding the 40% critical threshold of chronic malnutrition set by WHO.

Kono

Kono district is in the Eastern Province, and borders with Kenema district to the southwest, the Republic of Guinea to the east, Koinadugu district to the northeast and Kailahun district to the southeast. Its capital and the largest city is Koidu town. The population is religiously mixed between Muslim and Christians and home to many ethnic groups. During the decade long civil war (1991-2002), heavy fighting caused many people to flee their homes and there was widespread looting. The rich reserves of diamonds in the area were one of the main reasons for the fighting.

It is the largest diamond producer in Sierra Leone, gold and alluvial diamond mining are important economic activities of the residents. Although agriculture has not been the main source of livelihood of the majority (less than 30% rely on farming), in some areas rice, cassava, corn, and beans are grown and small groups of residents grow coffee, cacao and palm oil.

There are over 480 schools in the district 73% of which are primary schools. Only 12% of these schools are government owned. The number of students enrolled in higher level of education is considerably low at only 12 % compared to enrolment rates in primary schools (57%).

According to the Emergency Food Security Assessment 2015 report, 44% of the district population falls under severe (10%) and moderate (34%) food insecurity.

The district has one Government General Hospital, and several other health facilities including Community Health Centers (CHC), Community Health Posts, Maternal and Child Health Posts and Health Clinics.

Kailahun

Kailahun is a district in the Eastern Province of Sierra Leone. Its capital and largest city is Kailahun town. Other major towns in the district include Segbwema, Koindu, Pendembu and Daru. Kailahun district is subdivided into fourteen chiefdoms. The border of the district with Guinea is formed by a section of the Moa River. The population in the district is predominantly Muslim. Rainfall in this area is 2,001 to 3,000 mm per year and vegetation is a mix of savannah, forest and secondary growth.

Kailahun has a mixed economy with small-scale mining and agricultural production of coffee, cacao and rice. After years of civil war (1991-2002), with a slow recovery, this district remains one of the poorest in the country.

There are 400 schools 84% of which are primary schools . The outbreak of Ebola led to the closure of schools for a prolonged period from July 2014 to April 2015. Many of the schools are in dire need of repair and do not have adequate access to water and toilet facilities.

In June 2015, an emergency food security assessment identified Kailahun as a district with one of the highest prevalence rates of both moderate and severe food insecurity in the country (59% and 16% respectively).

Northern Province

Bombali

Bombali district is located in the northern province of Sierra Leone. Bombali is the second largest district in Sierra Leone and its capital and largest city is Makeni, which is the largest city in the north. It compromises thirteen chiefdoms. The population of Bombali district is ethnically diverse, although the Temne and Limba form the largest ethnic groups.

Bombali is a political stronghold of the All Peoples' Congress (APC), the current ruling party in Sierra Leone; and one of the two major political parties in the country. During the war (1991-2002), Bombali was a principal former rebel stronghold and experienced considerable displacement, destruction, and trauma as a result of the conflict. While progress has been made since the conflict, particularly in restoration of state authority, the level of social services and economic recovery remains unsatisfactory throughout the district.

The provincial importance of Makeni is in contrast with its lack of basic services, such as water and power supply. The poor road network and large distances in the district have meant that limited intervention has been made in chiefdoms outside of the Makeni area, particularly in the far north. Savannah woodland is mostly found in Bombali. Approximately 90% of the cattle in the country are found in the Northern Province, predominantly in Koinadugu and Bombali districts. Range or pasture management is limited; bush fires continue to affect about 200 000 hectares of savannah woodlands annually.

Port Loko

Port Loko district is in the Northern Province, and is the fourth most populous district in the country. Port Loko borders the Western Area to the west, Kambia district to the North, Bombali district to the East and Tonkolili district to the South. Lunsar is the district's largest Town, and other major towns are Masiaka, Rokupr, Lungi, Gbinti and Port Loko town. The population is predominantly Muslim (80%) and the largest ethnic group is Temne.

Production of food crops, such as rice, cassava and sweet potato, are the main livelihood sources for over 80% of the population. Small scale mining also takes place. The city of Port Loko is a major trade center in the Northern Province.

Port Loko has over 680 schools, 75% of which are primary schools. Port Loko has the second highest number of schools in the country after Freetown. The majority (63%) of schools are missionary, community or private schools, with the remaining 27% government schools.

The Emergency Food Security Assessment 2015 report shows that over 52% of the District's residents are moderate to severely food insecure, while 40% are marginally food insecure. 92% of the District's residents are facing some form of food insecurity.

The Port Loko Government Hospital and Lungi Government Hospital are the two main heath facilities in the district. On average, one health facility serves 477,611 people, and the population per hospital is 151,249.

Kambia

Kambia District is in the Northern Province, and borders with the Republic of Guinea to the North, Port Loko district to the South and Bombali district to the East. Kambia town is the largest town, and the district capital. The district population is ethnically diverse; the largest and most prominent ethnic groups are Temne, Susu, Limba, Fula, and Mandingo. The district provides a vital trade route between Sierra Leone and the neighboring Republic of Guinea. The average household size is 7 people per family. There is a wide variation in different indicators between urban and rural populations, such as the number of livelihood activities, access to education and health facilities, mortality and morbidity rates, etc.

The livelihood activities of the district residents are mainly farming (rice and roots crops - cassava and yam), followed by cross-border trade with neighboring Guinea.

Educational achievement is higher among boys compared to girls. The literacy rates among men and women for the district vary widely and are respectively 43% and 20%. There is a large percentage of people with no education (52% male and 64% female) while 0.9% male and 0.02% female have attained post-secondary education.

Emergency Food Security Assessment 2015 findings indicated that the Ebola outbreak has negatively impacted the district population, affecting the vital livelihood activities of crop production (mainly rice). 71% of the district residents are moderate to severely food insecure. The report anticipated that 2015 rice production would reduce to 85 compared to 129 in 2014.

The main hospital is in the district capital of Kambia town; each of the 7 chiefdoms has a Health Center or Health Post. In Kambia district, the inability to pay for treatment, distance to health facilities and unwillingness to visit health facilities alone are three major barriers for women aged 15-49 years old seeking health services when they are sick.

Koinadugu

Koinadugu district is in the Northern Province, and borders Bombali district to the west, Tonkolili district to the south-west, Kono district to the south and the Republic of Guinea to the North East. This is the largest district in terms of geographical area, with the least population density in the country. The district capital is Kabala, which is among one of the

major cities in Northern Sierra Leone. The population is ethnically diverse and the major ethnic groups are the Fula (mainly in the district capital Kabala), Kuranko, Mandingo, Limba and Yalunka. May to October marks the rainy season with an average of 147 rainy days where an average of 208 cm of rainfall is recorded.

Agriculture is the main livelihood of more than 84% of the district population. The district has over 440 schools, 85% of which are primary schools. The district does not have any vocational or home economics institute. Government owned schools account for 19% while the remaining are owned by mission, community and private owners.

The Emergency Food Security Assessment 2015, reported some 48% of the district residents are moderate (38%) to severely (10%) food insecure.

According to the Ministry of Health and Sanitation (MoHS), there are 71 health facilities in the district including one government hospital, while the rest are Community Health Centres (CHC), Community Health Posts (CHP), Maternal and Child Health Post (MCHP) and clinics. The data indicate that on an average one health facility caters for 4,606 people and one bed per 2,181 persons.

Tonkolili

The district comprises eleven chiefdoms, with Magburaka as the capital, and Mile 91, the commercial center. The population of the district are predominantly Muslim, with a Christian minority. Tonkolili is strategically located in the center of Sierra Leone, and is crossed by many rivers including the Pampana River and Sierra Leone's longest river, the Rokel.

The district has both highlands and lowlands. The highlands rise up to 700 feet, and are the highest in Sambaia Bendugu chiefdom. It is from these hills that the major rivers in the district have their sources. The rest of the district is lowland which occupies a greater part of the district and is appropriate for rice production.

Roads in this region are particularly poor, as is access to markets.

In the past, the district was covered with thick forests, but due to increased farming activities, and the use of slash and burn methods of cultivation, the forests have gradually given way to grass lands.

Tonkolili has over 630 schools, 83% of which primary schools. The district suffered significant losses during the civil war in terms of educational facilities, with 66% of schools in the district completely destroyed during this period.

The percentage of people who are subject to food insecurity (severe and moderate) is 74.1%. Tonkolili has a high prevalence of acute malnutrition in women (4.6%).

Identification of Potential Impacts

An ESIA study (informed by a combination of desktop studies and on-site observations) was carried out on 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 construction and designs requirements are met and done in such a way as to limit the negative environmental and social impacts that could occur during operations.

During the construction stage, 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.

Environmental and Social Impacts and Mitigation Measures during Construction of New Sites

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Air Quality	Dust generated from construction machinery can cause considerable nuisance to communities close to construction sites, and could cause health problems including respiratory complaints / diseases.	Likely	Moderate	Medium	- Dust minimization measures shall be implemented including watering of the construction areas. - Vehicles transporting construction aggregate will be enclosed or sheeted. - Loading, unloading and handling of dusty materials will as best as possible be done furthest away from the most immediate neighbours.	Achievable	Low	Minor
	Emissions from construction activities like fuel combustion from generators and vehicles could cause adverse impacts on air quality worker/ community health and air quality	Likely	Low	Minor	- 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.	Achievable	Low	Minor
Noise	Noise generated from construction activities include the operation of machinery, stone crushing, hammering and other, etc. This will be a source of disturbance to communities close to the construction site.	Certain	Moderate	Medium	- Construction activities producing excessive noise levels will be restricted to the day-time. - Locating and orientating equipment to maximise the distance, and to direct noise emissions away from the closest neighbours where possible; - Turning off equipment when not in use. - Maintenance of equipment and vehicles to prevent emission of excessive noise or vibration - Workers will be provided with noise protection PPE when operating noise generating machinery	Achievable	Moderate	Medium
Vegetation	Loss of vegetation	Certain	Moderate	Medium	- In general, the contractor will ensure that clearing of vegetation will	Achievable	Moderate	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	which in some cases will be permanent is unavoidable.				be restricted to work areas only, to prevent excessive loss of vegetation. - Vegetation clearance is to be undertaken using mechanical (not chemical) means.			
Soil Erosion	Soil erosion is likely to occur as a result of site preparation and vegetation clearing in new construction areas, resulting in the exposure of loose soil. Eroded soil can block drains and also end up in watercourses, affecting water quality.	Likely	Moderate	Medium	- Area to be cleared will be kept to the minimum necessary to prevent disturbance of soils outside the facility boundary. - Vegetation along drainage lines and gullies will be protected where practicable to provide natural attenuation of flows. -	Achievable	Low	Minor
Hydrogeology	Excavation, land clearance and development of construction sites could give rise to interruption of hydrogeological conditions.	Unikely	High	Medium	- Avoid, as far as possible locations where springs occur, or the water table is close to the surface.	Achievable	Low	Minor
Water Quality	Pollution of water resources may arise at construction sites due to accidental spillage or leakage of polluting materials (fuel, paints, chemicals, etc). Pollution may also occur as a result of poor waste	Likely	High	Major	- The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills / leaks. - The Waste Management Plans will be implemented including effective housekeeping and waste storage measures.	Easily Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	management with waste being carried off into nearby water sources by surface water, wind, etc. Such pollution adversely affects those who depend on local water resources.							
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.	Likely	High	Major	- The construction contractor will implement waste management and environmental health and safety plans to limit water pollution. - 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. The construction of communication towers may result in increased bird collisions.	Certain	Moderate	Major	- Vegetation clearing will be strictly confined to the areas where their presence would otherwise affect the construction work. - Construction workers will be strictly forbidden from killing animals or engaging in hunting, selling or purchasing of bushmeat during work hours around the project area.	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 all construction sites 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. - Where possible, wastes will be re-used.	Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
					- Burning of waste will not be permitted - Construction personnel will be trained in the appropriate management of waste. - Waste materials that can be safely reused or recycled may be donated to local communities following an appropriate risk assessment.			
Visual Impacts	Changes in landscape due to construction and installation of facilities could be a cause for concern or dissatisfaction in surrounding communities.	Likely	Moderate	Medium	- Community consultations will be carried out so that they understand what the development will involve to prepare them for the visual impact.	Difficult	Low	Moderate
Occupational Health and Safety	Injuries at construction work-sites include falling from heights, getting hit by 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 installation of communication towers and electrical components include exposure to live current and electromagnetic waves.	Likely	High	Medium	- An appropriate OHS management system will be implemented. - 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 and communications infrastructure installations.	Achievable	Moderate	Minor

Environmental / Social 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 new operational areas, resulting in a permanent loss of access to these areas.	Certain	High	Major	- Land lease arrangements will be made for any community land to be utilised during this phase. - Crop compensation will be undertaken where required in advance of the construction process. - Once the construction phase is concluded, the contractor will be required to ensure that the project area around the new facility is made safe, including the removal of all wastes, demolition and removal of unwanted structures, clearing away of any contaminated soils, etc	Achievable	Moderate	Minor
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)	Likely	Moderate	Minor	- 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. - Unskilled labour will be preferentially hired from the local communities. - Opportunities for sustainable local procurement of goods and services to support construction will be identified wherever possible and measures will be devised to maximize the potential for these opportunities.	Easily achievable	High	Positive

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 operations.

Operational Stage Environmental and Social Impacts and Mitigation Measures

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Air Quality	Emissions from generators and vehicles could cause adverse impacts on air quality worker/ community health and air quality	Likely	Low	Minor	- 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.	Achievable	Low	Minor
Noise	Noise generated from operations will mostly emanate from generators which may be a source of annoyance to immediate neighbours.	Likely	Moderate	Medium	- Turning off generators when not in use. - Maintenance of Generators to prevent emission of excessive noise or vibration	Achievable	Moderate	Medium
Water Quality	Pollution of water resources may arise during operations from accidental spillage or leakage fuel/oil. Pollution may also occur as a result of poor waste management with waste being carried off into nearby water sources by surface water, wind, etc. Such pollution adversely affects those who depend on local water resources.	Likely	High	Major	- Workers in operational areas (office/ shop/ network site) will be required to take all reasonable precautions to prevent and clean up all spills / leaks. - The Waste Management Plans will be implemented including effective housekeeping and waste storage measures.	Easily Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
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 in all operational areas for the disposal of the various types of wastes. These bins will be clearly marked to facilitate segregation at source. - Separation of domestic and hazardous waste at the source shall be strictly enforced. - Arrangements will be made with a local waste management company for collection and disposal of domestic wastes. Hazardous wastes e.g. waste/ used oil, used batteries, electrical and electronic wastes will be safely stored in designated storage areas until a suitable disposal option becomes available. - Burning of waste will not be permitted - Company personnel will be trained in the appropriate management of waste. - Waste materials that can be safely reused or recycled may be donated to local communities following an appropriate risk assessment.	Achievable	Low	Minor
Occupational Health and Safety	Occupational health and safety issues during operations include exposure to electric current, electromagnetic fields, trips, falls, and other activities related to operation and maintenance of facilities.	Likely	High	Medium	- An appropriate OHS management system will be implemented. - Company personnel involved in technical operations 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 maintenance of equipment and machinery.	Achievable	Moderate	Minor
Community Health and Safety (Exposure to EMF - Microwave and Radio Frequency	Health risks associated with the exposure of humans to EMF from telecommunications equipment.	Unlikely	Low	Minor	- The consensus of the scientific community is that the power from these mobile base stations antennas is far too low to produce health hazards as long as the general public are kept away from direct access to the antennas (Dawoud, 2003). - Orange equipment are sourced from reputable telecommunications manufacturers and are designed to emit EMF within prescribed	Easily Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Radiation)					industry standards. - Network sites will be restricted to communities; related signage and security is in place to prevent unauthorised access.			
Community Grievances	Grievances may be generated in host or neighbouring companies as a result of company activities, unrealistic expectations about the company's presence in communities, etc. If allowed to continue, these grievances could escalate and into physical/ legal action which could interrupt or affect operations.	Likely	Moderate	Medium	- Regular community consultation to ensure that communication lines are open between communities and the company - Creation of a grievance mechanism which will serve as a means through which complaints can be relayed and handled by Orange. - Implementation of Community Development Action Plan activities will help mitigate	Achievable	Low	Minor
Community Benefits from Project	Job Opportunities for skilled and unskilled members of the community Business opportunities to provide goods and services to employees (e.g. food and drink) Benefits from community development activities	Likely	Moderate	Medium	- Management will seek to hire locally wherever possible, in order to maximise the benefit distribution and social acceptability of the Company's operations. Unskilled labour will be preferentially hired from the local communities. - Opportunities for sustainable local procurement of goods and services to support operations will be identified wherever possible and measures will be devised to maximize the potential for these opportunities. - Implementation of the CDAP	Easily Achievable	High	Positive

Environmental and Social Management Plan (ESMP)

The Environmental and Social Management Plan (ESMP) presents the environmental management, mitigation, monitoring and institutional measures to be taken to reduce adverse environmental and social effects to acceptable levels. It specifically defines what actions must be taken and who is responsible to reduce impacts. The ESMP also includes several component plans defining specific action programs for waste management, emergency response, closure, community development, and public consultation and disclosure. The ESMP highlights the issues and concerns that are presented in the ESIA 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.

Management Plans featured in the ESMP

Waste Management Plan (WMP)

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

Environmental Health and Safety Plan

The Environmental Health and Safety (EHS) Plan identifies the principles, approach, procedures and methods that will be used to control and minimize the environmental and social impacts of all the company's developmental and operational activities. It is intended to complement the Company's Environmental and Social Impact Assessment (ESIA) and ensure that commitments made to minimize operations-related adverse environmental and social impacts are upheld.

Emergency Response Plan (ERP)

The Emergency Response Plan (ERP) provides employees and managers with specific instructions that will enable them to respond quickly and efficiently to any foreseeable emergencies likely to occur during operations. 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.

Community Development Action Plan (CDAP)

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.

Public Consultation and Disclosure Plan (PCDP)

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 with the management and the affected stakeholders. The main objective of the PCDP is to establish a program for multi-directional communication between the company management and stakeholders.

Closure Plan (CP)

The Closure Plan documents plans required to restore the site to a pre operational activities state, ensuring that the land can be used in beneficial post-operation land use.

Summary and Conclusion

Summary

The principal objective of the ESIA is to satisfy the requirements of the local environmental regulatory body, EPA-SL for the issuance of the EIA license for the Company's operations to continue. The study involved predicting the environmental impacts of Orange's operations as described, and suggesting mitigation measures where impacts are adverse and enhancement measures where impacts are positive.

The investigations of impacts on the social environment were a crucial part of the study, since Orange's operations may impact on host communities. The investigation of social impacts has involved the following:

- A baseline socio-economic study of districts and communities hosting Orange's facilities through desk studies and literature review.
- Undertaking stakeholders' focus group discussions to sensitise community stakeholders about the company's operations.

The study reports are presented in two volumes comprising:

- Results of the Environmental and Social Impact Assessment (ESIA) of the company's facilities, methodologies and activities;
- An Environmental Management Plan based on mitigation measures proposed in the ESIA entailing the following:

- Formulation of a Community Development Action Plan (CDAP) from socioeconomic analysis and stakeholder discussions;
- Description of the stakeholder, interested and affected parties' engagement process in a Public Consultation and Disclosure Plan.

Key Assessment Findings

Physical Environment

There are potential impacts during daily operations relating primarily to air quality and noise. During the construction of new facilities, other construction-related impacts are likely to occur including impacts on soil and water quality. Mitigation measures to limit the extent of all impacts have been highlighted and will be implemented.

Biological Environment

There will be some loss of flora and fauna species during land clearing and preparation of sites for new facilities. However, the scale of these impacts in any one location is quite small, and it is not expected that any species will be permanently eliminated in any area as a result. During daily operations, impacts on ecology is negligible. Mitigation measures have been presented to ensure that minimal clearing is carried out to during any construction activities, to limit the extent of biodiversity loss.

Socio-Economic Environment

Perhaps the most critical aspect of the operations on communities is the visual impact, loss of land (construction of any new facility), potential conflict from issues related to job opportunities, and unrealistic expectations held by residents of host communities with regards to benefits created by the company's operations in their communities. Potential impacts on communities from exposure to electromagnetic fields is extremely unlikely, with the Company's use of equipment designed and maintained to emit radiation within industry prescribed radiation thresholds. Additional measures to keep communities away from Company facilities, through signage and security further limits the potential for community exposure.

The implementation of the Community Development Action Plan and Public Consultation and Disclosure Plan will ensure limit the likelihood of grievances developing and keep communities informed about any new operational developments.

Occupational Health and Safety

Inimical hazards exist mainly in relation to exposure to electric current and radiation. These risks are however minimised through various mitigation measures including the use of

advance technology with lower radiation emissions, regular training of engineers and technicians, provision of required personal protective equipment and job safety analyses.

Conclusion

During the study, no adverse impacts were identified which would render it unadvisable for the Company's operations to continue. Impacts observed and predicted can be contained or minimised through the implementation of mitigation measures outlined in these reports.

A monitoring system must however be put in place to ensure that management practices for mitigating negative impacts and enhancing those that are positive be effected. It must however be ensured that recommendations made in the Environmental Management Plans are followed through.

1 INTRODUCTION

1.1 Background

Orange is one of the world's leading telecommunications operators with sales of 40.9 billion Euros in 2016 and 154,000 employees worldwide. Present in 29 countries, the Group has a total customer base of 265 million customers worldwide, including 3.3 million fibre customers, 202 million mobile customers, 29 million Orange money customers and 18 million fixed broadband customers. Orange operates a 4G network in 18 countries, owns a 450,000km undersea cable and 6,930 patents in portfolio and has invested 732,000 in research and innovations. Orange is the No 1 best mobile network in France for 7th time in a row and is the 51st brand in the world according to 2017 global brand ranking.

Orange in Sierra Leone provides extensive coverage in the Sierra Leonean capital and other major towns and is set to expand mobile connectivity and internet access to customers living outside major urban areas.

1.2 National Perspective

The telecommunications industry in Sierra Leone is regulated by the National Telecommunication Commission (NATCOM) which was established in 2006 by an act of Parliament, "the telecommunications Act 2006 as amended in 2009". The Commission's primary functions amongst others in PART III of the said Act is to …. (1)." Promote Efficiency" ……ensure (2)" the expansion of investment in the telecommunications sector" and also ensure (3) the progressive development of the telecommunications industry technology in Sierra Leone.

The overall telecom market is approximately $200 million per year, with data contributing to approximately 20% of the overall market. During the Ebola epidemic the markets shrunk by approximately 15%. The telecom penetration is close to 50%, with a very significant level of multi simming. Sierra Leone has approximately 1 million Data users engaging primarily in social networking. Orange (SL) Ltd, ("The Company"), is a leading mobile telecommunications operator in Sierra Leone.

1.3 Operational Areas

Orange operates offices, shops and numerous network sites throughout the country. The following tables and maps highlight the various operational areas countrywide at the time of this study.

Table 1.3-1: Office Locations

Office Location	Coordinates
The Company Headquarters – Hill Station	8.44874, -13.23572
Old Company Headquarters – Wilberforce (currently being phased out)	8.4739, -13.2617

Table 1.3-2: Shop Locations

Shop Location	Coordinates
Freetown – Rawdon Street	8.489458, -13.2325
Bo	7.965541, -11.73922
Kenema	7.878694, -11.19064
Makeni	8.889, -12.04356
Kono	8.6447623, -10.974077
Tonkolili (Bumbuna)	11.75007, -9.045477

Table 1.3-3: Active Network Sites (249)

Site Name	Longitude	Latitude		Site Name	Longitude	Latitude
Aberdeen	-13.28731	8.48977		Lungi Rosint	-13.1636	8.555892
Addax	-12.23101	8.71274		Lungi Madina	-13.15086	8.53898
IMATT	-13.230578	8.446272		Lumley	-13.26786	8.45219
OAU	-13.252478	8.457768		Lungi	-13.204624	8.615977
Kambia Town	-12.92438	9.11057		Lungi Lol	-12.99828	8.688222
AIC	-13.236694	8.489441		Lunsar	-12.53081	8.68692
Allen Town	-13.15491	8.416212		Mabanta	-12.05763	8.89403
AML	-11.70872	8.990989		Mambolo	-13.02854	8.90677
Bagbo Hill	-11.74022	7.950167		Mabonto	-11.81565	8.85966
Baiama	-11.87501	8.13658		Magburaka	-11.95123	8.72257
Bailor	-13.21882	8.81671		Madina	-12.67057	9.29012
Baiama II	-11.83647	8.09219		Magbomo	-12.81656	8.325
Bama Konta	-11.3297	8.34822		Lungi II	-13.18702	8.60146
Bandajuma	-11.6557	7.59234		Marjay Relief	-13.27575	8.44114
Barmoi Luma	-12.9057	9.03726		Makali	-11.68906	8.63387
Bauya	-12.57125	8.18889		Makeni	-12.05488	8.87519
Brookfields	-13.24828	8.468861		Makoth	-12.21245	8.83832
Binkolo	-11.982413	8.950471		Malema	-11.38843	7.02457
Bintumani	-13.289169	8.497326		Malema Repeater	-11.37436	7.15569
Bintumani II	-13.2825	8.49394		Malon	-11.8892	8.66785
Blama	-11.327361	7.875555		Mamawarie	-11.95771	9.2056

Site Name	Longitude	Latitude		Site Name	Longitude	Latitude
Bo 3	-11.74272	7.976778		Mange	-12.863972	8.936972
Bo 4	-11.76433	7.939917		Mano Dasse	-12.089194	8.040138
Bo 5	-11.72974	7.945511		Mapotolon	-13.2719	9.05872
Bo 6	-11.739606	7.95773		Marampa	-12.49859	8.67648
Boajibu	-11.34375	8.18617		Marjay Town	-13.271425	8.43402
Bojon Street	-11.73928	7.96557		Masiaka	-12.757687	8.491092
Bonthe	-12.51244	7.52744		Masingbi	-11.47787	8.63709
Buedu	-10.36672	8.28364		Masuba	-12.040111	8.89097
Buedu Repeater	-10.47482	8.26319		Matoir	-12.39533	8.47683
Bumbuna	-11.73683	9.05914		Mattru6	-12.18061	7.61086
Bumpeh	-11.90711	7.89108		Mattru	-12.174306	7.602718
Bunumbu	-10.838389	8.146611		Calaba Town II	-13.16695	8.43063
Calaba Town	-13.1672	8.436195		Durba 1 Relief	-11.72888	7.97722
Campbell Street	-13.23921	8.476113		Imperial	-11.72169	7.94947
Candy Hill	-11.755361	7.977111		Mesima 2 Relief	-11.7154	7.94768
Regent	-13.1949	8.42124		Mile 91	-12.215114	8.465835
Circular Road	-13.229352	8.477869		MMCET	-13.28739	8.420772
Citizen Radio	-13.186246	8.463857		Mobai	-10.7538	7.99242
Cline Town 2 Relief	-13.209	8.4852		Mobimbi	-12.32571	7.730133
Cline Town	-13.210476	8.489666		Mokanji	-12.19059	7.90092
Cockerill	-13.277654	8.46966		Mongo	-10.95731	9.4897
Colisee	-13.2321	8.4901		Rutile 1 Relief	-12.2977	7.7852
Congo Town	-13.253249	8.481942		Moyamba	-12.418583	8.169921
Youyi Building II	-13.243615	8.47195		Moyamba Relief	-12.431265	8.15904
Dama Road	-11.18675	7.859196		Moyamba Junction	-12.16726	8.31884
Bo6 II	-11.72963	7.95737		Mountain Cut	-13.22231	8.48721
Daru	-10.84124	7.9876		Murray Town	-13.265906	8.488774
Durba Ground	-11.73025	7.96742		Murray Town II	-13.26037	8.48136
Dwarzack	-13.255097	8.467879		Musaia	-11.56497	9.75442
Electricity House	-13.2363	8.486009		Hangha Relief	-11.1837	7.88765
Fadugu	-11.76657	9.35832		Nafaya House	-13.232206	8.487771
Falaba	-11.34129	9.82705		Candy II	-11.7579	7.9695
FBC	-13.21428	8.46853		Nimikoro	-11.08964	8.546441
FBC Campus	-13.22158	8.477868		Njala	-12.07398	8.11229
Ferengbeya	-11.71391	9.01114		Choithram	-13.24759	8.45442
Foamex I	-13.160409	8.440673		Panguma	-11.1287	8.18472
Foamex II	-13.15903	8.42714		Pendembu	-10.64561	8.12398

Site Name	Longitude	Latitude		Site Name	Longitude	Latitude
Youyi Building 3 Relief	-13.2557	8.47369		Pendembu Chiefdom	-10.69605	8.10053
Fudia Terrace	-13.26003	8.45792		Penduma	-11.007753	8.656385
MMCET1R	-13.28046	8.42859		Pepel	-13.05593	8.59056
Gbalamuya	-12.95403	9.17317		Portee	-13.17732	8.46539
Gbandi	-11.46345	7.93654		Potoru	-11.482888	7.510583
Gbangbatoke	-12.360863	7.802197		Port Loko Market	-12.791	8.77028
Gbindi	-11.44305	9.90914		Port Loko	-12.78013	8.76101
Gbinti	-12.60064	8.96821		Pujehun	-11.722391	7.358725
Gerihun	-11.57763	7.93048		Loko Hill 1 Relief	-13.1743	8.46241
Godama Barracks	-11.71227	7.86119		Kissy Road II	-13.21401	8.48303
Gbondapi	-11.84851	7.31888		Hangha Road III	-11.19534	7.87495
Goderich Street	-13.22895	8.48671		Rocklyn Street	-13.22662	8.48206
Gondama	-12.13882	7.76861		Rogbere	-12.691138	8.691138
Gorahun	-11.23816	7.45802		Rogbin	-12.23563	9.20483
Guala Dodo	-11.237688	8.12503		Rokel	-13.09306	8.37065
Hanga Village	-11.14205	7.94035		Rokupr	-12.946361	9.01975
Hangha Road	-11.190531	7.878302		Rotifunk	-12.71775	8.29567
Hangha Road II Relief	-11.18576	7.87553		Rutile	-12.29588	7.76567
Hastings	-13.139841	8.381456		Calaba Town 1 Relief	-13.16355	8.43914
Hastings 3 Relief	-13.15468	8.392022		Sahn Malen	-11.84194	7.43393
Head Quarter	-13.261576	8.474227		Devil Hole	-13.077981	8.305072
Hill Cut Road	-13.2535	8.4653		Segbwema	-10.953	8.00813
Hill station	-13.234987	8.455193		Sembenhun	-12.53606	7.939444
Henry Street	-13.23697	8.47895		Bo5 II	-11.73001	7.94011
Jeneh	-11.28717	8.00092		Serabu	-12.049733	7.783974
Jimmi	-11.8125	7.60213		Sewafe	-11.24261	8.54738
Jojoima	-10.7792	7.8733		Shenge	-12.939972	7.912388
Joe Town	-13.039735	8.335824		Kissy Town 1 Relief	-11.18192	7.88188
Juba	-13.27666	8.453135		Signal Hill	-13.265542	8.482572
Jui	-13.13123	8.40963		Dama Road III	-11.193821	7.860516
Kabala Radio	-11.54798	9.57703		Smart Farm	-13.269261	8.476279
Kabala Radio 1 Relief	-11.55332	9.58332		Songo	-12.947889	8.389024
Kainkordu	-10.71672	8.61673		Pipe Line	-13.2686	8.46405
Kailahun	-10.56604	8.28499		St. John	-13.242882	8.479124
Kalangba	-12.16259	9.0316		St. Michael's	-13.2624	8.393442
Kamakwe	-12.23846	9.49509		Durba 3 Relief	-11.73287	7.9626

Site Name	Longitude	Latitude		Site Name	Longitude	Latitude
Makeni I	-12.04982	8.88332		Sulima	-11.57538	6.96848
Kamasassa	-12.54194	9.39202		Sumbuya	-11.957472	7.648944
Bo6 3 Relief	-11.74893	7.95594		Sussex	-13.2319	8.345
Kamabai	-11.960528	9.148222		Syke Street	-13.245553	8.482191
Kambia	-12.907945	9.127334		Tekoh Road	-12.0355	8.88046
Kamboi Hill	-11.21724	7.85709		Tiama	-12.059	8.20031
Kamayama	-13.256305	8.448888		Tinkonko	-11.7808	7.8818
Kasire	-13.11008	8.945917		Tokeh	-13.18676	8.29835
Kayima	-11.15862	8.89134		Tormabum	-12.00541	7.4151
Kissy Brook II	-13.195743	8.4715559		Tongor	-11.01846	8.2156
Kissy Brook	-13.197376	8.476534		UpGun	-13.20793	8.48141
Kissy House	-13.2382	8.4841		Upgun II	-13.205743	8.478387
Kingtom	-13.25022	8.48893		Whale Bay	-13.16305	8.26111
Sefadu	-10.99451	8.62186		Waoma	-10.9278	8.54772
Koidu 3 Relief	-10.98395	8.63748		Warlie	-13.087985	8.220685
Koidu Town Council	-10.975111	8.645836		Waterloo Market	-13.07155	8.33078
Koidu 2 Relief	-10.9681	8.63849		Waterloo Market Relief	-13.05955	8.32804
Koindu	-10.34322	8.46268		Wellington	-13.1674	8.4485
Komba Yendeh	-10.70912	8.78241		Wilberforce	-13.262365	8.46567
Conakry Dee	-13.22752	8.71884		Wellington 1 Relief	-13.17166	8.45226
Koribondo	-11.69386	7.71858		Wusum Field	-12.04455	8.89231
Kissy Road	-13.217968	8.48491		Yagbea	-11.183864	8.641749
Kissy Shell	-13.188086	8.47418		Yara	-11.56605	9.25439
Kissy Town	-11.179	7.873		Yele	-11.84287	8.41715
Kukuna	-12.67603	9.3686		Yele II	-11.8186	8.44612
Kurubola	-10.92442	9.18194		Yengema	-11.04388	8.62479
Landofeh	-10.8209	8.37962		Yomandu	-11.10555	8.75027
Mano Junction	-11.104194	8.041472		Youyi Building	-13.248337	8.476241
Leicester Peak	-13.22355	8.44968		Zimmi	-11.30975	7.31173
LokKo Hill	-13.177685	8.458129		Country Lodge	-13.25569	8.456677
Loko Hill 3 Relief	-13.181544	8.458024				

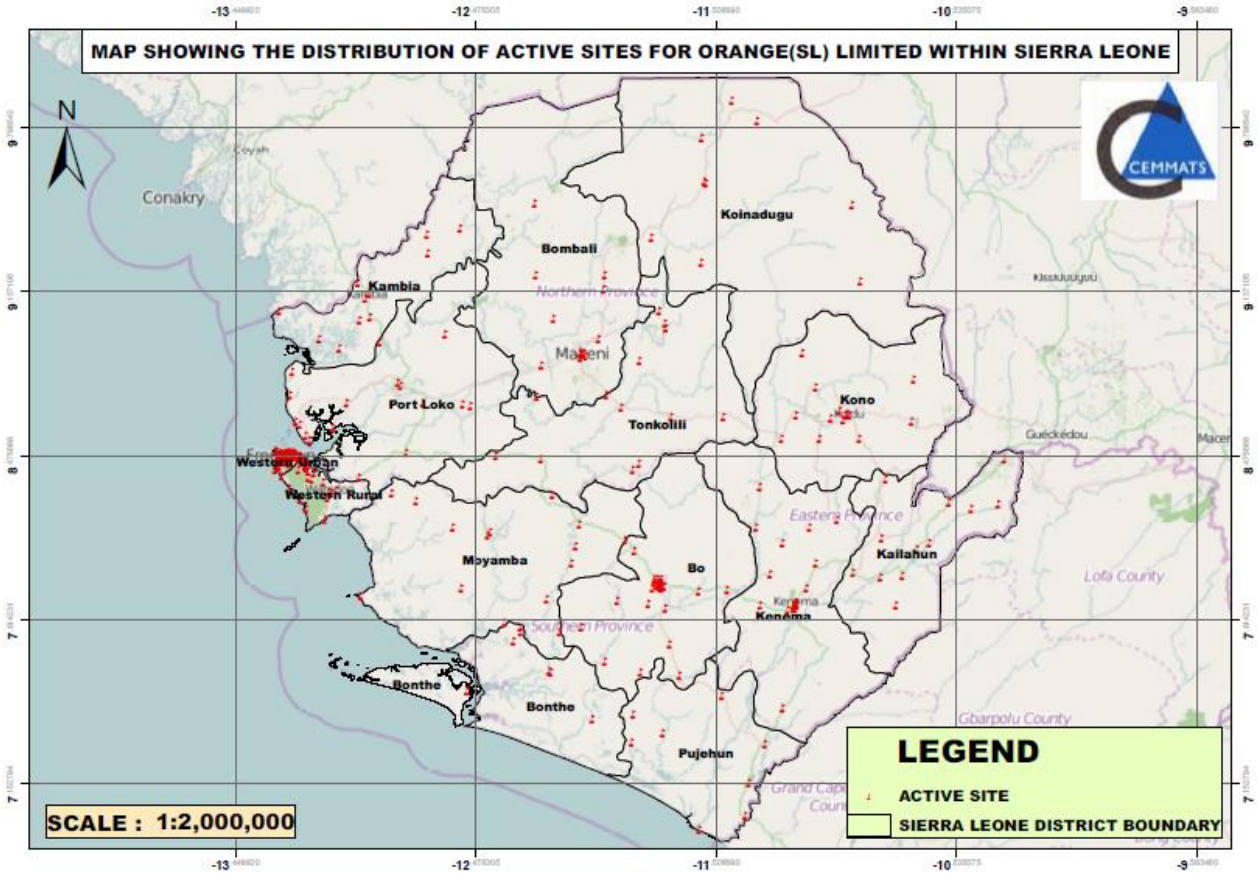


Figure 1.3-1: Locations of 249 Active Network Sites Countrywide

Table 1.3-4: Planned Network Sites (67)

SiteName	Longitude	Latitude		SiteName	Longitude	Latitude
Tellu Bongor	-11.640046	7.809643		Gegbwema	-11.15	7.5908
Babarah	-13.12554	8.81762		Senehun Ngobeh	-11.95	8.169
Baomahun	-11.676826	8.422961		Joru	-11.06	7.698
Newton	-13.00627	8.33706		Gba	-11.25	7.2736
Kimbadu Section	-10.95092	8.63937		Matta Camp	-12.3	7.8092
Levuma	-11.779484	7.665433		Masanga	-11.84	8.7491
Tree Planting	-13.225678	8.465371		Fadugu Town	-11.77	9.393
Koribondo Highway	-11.72189	7.91313		Feredugu	-12.49	8.7579
Mondema	-11.43611	8.47778		Mile 38	-12.87	8.4474
Gberia	-11.109053	9.705403		Laoma	-10.98	8.2266
Magbenteh	-12.07845	8.88269		Njala Komboya	-11.44	8.1999
Adonkia	-13.26557	8.41077		Bewabu Gao	-10.56	8.1131
Pamplap	-12.03279	8.92184		Ponduru	-11.29	8.4835
Gormbu	-11.16845	7.8866		Nyadehun	-10.48	8.2039
Alikalia	-11.39038	9.16059		Bandajuma Yaweh	-10.84	8.3026

SiteName	Longitude	Latitude		SiteName	Longitude	Latitude
Jui Highway	-13.17518	8.40841		Mano Sewalu	-10.49	8.3317
Gbentu	-11.639723	9.931788		Ndambadu	-10.4	8.3894
Yiffin	-11.2386	9.120319		Manowa	-10.75	8.1713
Sama Bendugu	-11.496597	9.066816		Wordu	-11.09	8.9389
Kangama	-11.061042	8.41077		Tefeya	-11.22	8.7068
Yondu	-12.87066	8.00768		SS Camp	-13.224732	8.438983
FIB Bank	-13.234015	8.489637		UN Drive	-11.17107	7.910794
Gloucester	-13.216054	8.458568		Kossoh Town	-13.153935	8.377826
Giehun	-10.645668	8.199273		Mambo Area	-13.255724	8.379237
Dambala	-11.70065	8.121703		Tintafor	-13.2122	8.63912
Grammar School	-13.265338	8.494274		Presidential Lodge	-11.548	9.5906
Parliament Building	-13.232511	8.481645		Yarms Farm	-13.12278	8.38399
Amadu Lane	-13.271004	8.458791		Lower Faculty	-13.22326	8.48249
Mongere	-11.748144	8.354047		Arabic College	-11.933689	8.721147
Kent	-13.15765	8.172269		Tongor	-11.057629	8.216965
Kamalo	-12.24206	9.40103		Allen Town	-13.1431	8.40635
Kombrabai	-13.11176	8.69986		Data Center	-13.269888	8.467901
Moyowa Jong	-12.10172	7.64422		Beach Road	-13.286789	8.482649
Bomaru	-10.63	8.0102				

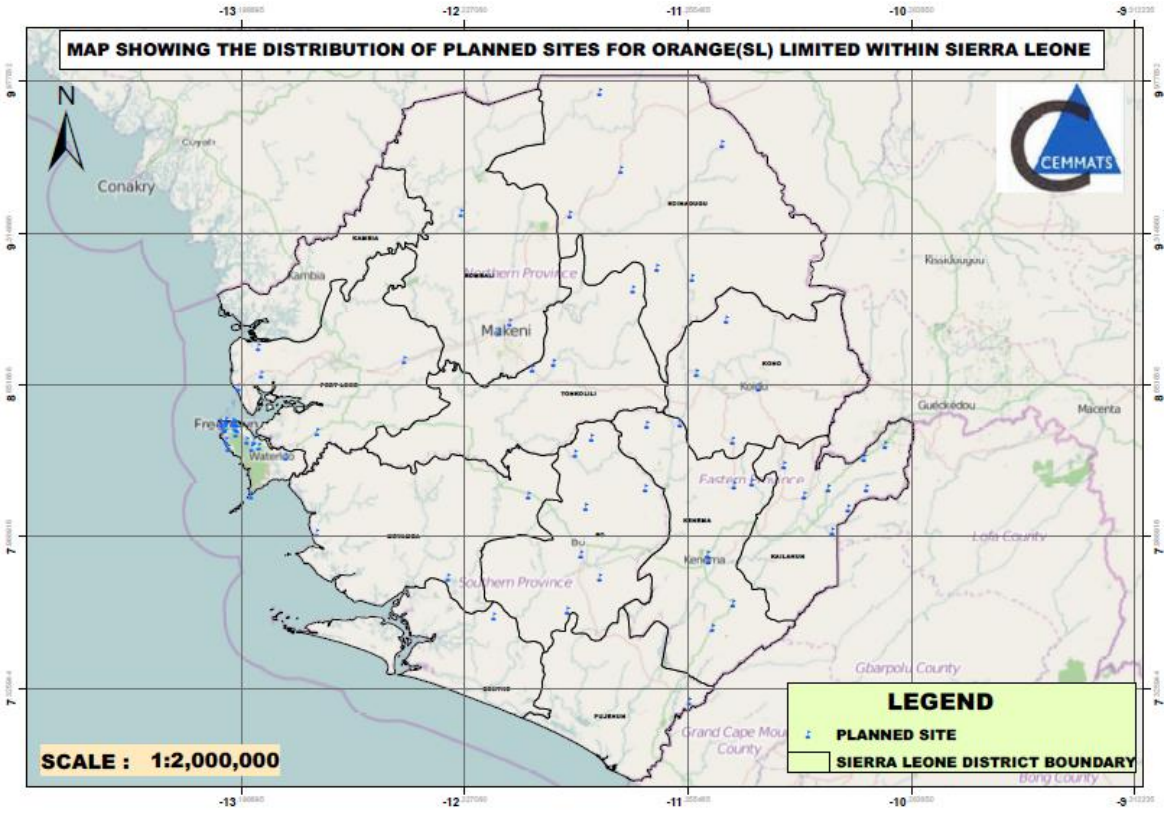


Figure 1.3-2: Locations of 67 Planned Network Sites

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 Environmental and Social Impact Assessment (ESIA) study be done, and, upon approval by EPA-SL, a licence is secured.

The Sierra Leone Environment Protection Agency Act, (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, Environment Protection Agency, Sierra Leone (EPA-SL) for an EIA licence. EPA-SL requires that a screening form be filled and submitted with the application letter, after which a decision is made on the category of the project; this is followed by a scoping report. EPA-SL will then decide on the terms of reference (TOR) to be drafted by the project proponent or an independent consultant hired by the proponent.

On the approval of the agency, the consultant carries out an assessment of the environmental and social impacts of their planned operations on ecosystems and communities in the project area. A report is prepared at the end of the study and submitted to EPA-SL for review. 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 issue of the licence.

1.4.2 Purpose of the ESIA Study

The purpose of the environmental impact assessment is to identify and to mitigate potential negative environmental impacts and enhance positive ones. This is done through the conduct of desktop and field studies to

- Obtain secondary and primary biophysical and socio-economic data
- Anticipate the potential impact of the Company's operations on the environment and communities
- Propose an environmental management plan that mitigates adverse impacts whilst enhancing positive ones.
- These were achieved by employing a methodology that consists of a literature review, field investigations and the administration of questionnaires.
- The purpose and findings of the study will be disclosed to interested and affected persons (I&APs) 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 facility.

1.4.3 Objectives of the ESIA Study

The objectives of the study were as follows:

- To assess the potential positive and negative impacts of the Orange's operations on society and the environment.
- To recommend mitigation measures to avoid or mitigate negative impacts and enhance benefits
- To recommend an environmental management plan that integrates mitigation measures into Company management
- To recommend an environmental monitoring plan (EMP) and a community development action plan (CDAP) as part of the management plan
- To develop relevant environmental and social management plans for sustainable operations as follows:
    1. Waste Management Plan (WMP)
    2. Community Development Action Plan (CDAP)

3. Emergency Response Plan (EPP)
4. Public Consultation and Disclosure Plan (PCDP)
5. Closure Plan

- To conduct public disclosure and consultation meetings on the findings and recommendations of the EIA study.

1.4.4 ESIA Consultants and Teams

In response to this, a number of specialists were identified to undertake the investigations and address these issues during the ESIA phase. A team was formed of the ESIA consultants required to complete the task.

The terms of reference for each of these studies are outlined in the next section. The specialist studies were undertaken during the ESIA phase. This Environmental and Social Impact Assessment (ESIA) report is a compilation of their findings and information gathered during these studies. The recommendations and mitigation measures developed from these studies have also been pulled together to generate an Environmental and Social Management Plan (ESMP) which will be adhered to during operations.

Table 1.4-1: ESIA Teams and Consultants

Team Member	Responsibility	Company
Andrew Keili	Project Director, Legal and Administrative Framework, Report Review	CEMMATS
Vanessa James	Project Coordinator/ Technical and Operational Issues/ Environmental Impact Assessment	CEMMATS
Josephine Turay	Environmental Health and Safety	CEMMATS
Sylthea Redwood-Sawyerr	Electrical/Technical Issues	CEMMATS
Arthur Chinsman-Williams	Hydrology	CEMMATS
Arnold Okoni-Williams	Ecology	CEMMATS
Leonard Buckle	Environmental baseline assessment - soils, landform, air quality, noise, meteorology	CEMMATS

Anthony Mansaray	Environmental baseline and impact assessment	CEMMATS
Rashidu Sinnah	Social Baseline and Impact Assessment	CEMMATS
Joseph Gbassa	GIS Specialists	CEMMATS

1.5 Description of the Terms and References (TOR)

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

The study consists of biophysical and socio-economic baseline data collection and impact assessments, conducted in the Company's operation areas by an inter- and multi-disciplinary team of professionals during February 2018.

Table 1.5-1: ESIA Terms of Reference

Activity	Objectives	Methodology
General Issues		
Institutional, Legal and Regulatory Framework	Determine the legal and regulatory issues to be taken into consideration in running an operation of this nature and ensure that these are being adhered to.	This will be done through desk studies and literature reviews; legal and regulatory issues relevant to the operations will be included in the report and relevance highlighted.
Organisational Structure and Management	Provide a description of Orange SL Ltd's operational structure and management style to give an idea of how the company is run and also aid in the allocation of responsibilities in the development of Management Plans.	This aspect depends entirely on information provided by the client, specifically organograms and brief job descriptions.
Management of Environmental Health and Safety Issues/ EHS Policies and Procedures	Review of the company's existing EHS policies and procedures to determine effectiveness/adequacy. Development of management plans to provide effective mitigation against potential hazards.	Review of information provided by client; review of best practices used internationally; development of management plans.
EHS Record Keeping	Review of record keeping procedures used in reporting on the job accidents/incidents/ medical health cases; development of an effective system of reporting and record keeping.	Review of information provided by client; review of best practices used internationally;
Geographic Information Systems	Extensive use will be made of aerial survey maps-GIS team will prepare maps showing location of areas and various features. Some of these maps will be very useful for various experts-eg identifying reserve forests, giving idea about ecology of areas etc. Even though a few sites will be analysed in detail, physical features of all	This will be done using data collected at the various sites as well as data (coordinates) provided by the client.

Activity	Objectives	Methodology
	the sites (coordinates are available) will be examined through satellite imagery and relevant conclusions drawn for inclusion in the report. The extensive use of GIS is therefore highly essential. Assistance may also be sought from Airtel in case they have additional satellite information that we may use	
Issues to be Addressed at Network Sites		
Terrestrial Habitat	<u>Planned Sites</u> Terrestrial habitats may be altered primarily during the construction of communications infrastructure depending on the type of infrastructure component and proposed location. Potential impacts to habitat which may occur during construction and installation of linear infrastructure, (such as long distance fixed line cables, as well as access roads to other types of infrastructure along previously undeveloped land) will be identified. <u>Planned and Active sites</u> The height of some transmission towers can pose a potentially fatal risk to birds mainly through collisions. Avifauna present within these areas will be listed and possible mitigation measures proposed.	Observational assessment and review of related secondary ecological information on the various operational areas.
Aquatic Habitat	Depending on their location, the installation of fixed line components and access roads to transmission towers and other fixed infrastructure, may require construction of corridors crossing aquatic habitats with the potential to disrupt watercourses, wetlands, coral reefs, and riparian vegetation. These issues will be investigated.	Observational assessment, review of plans (for planned sites) and layouts (of active sites), identification of suitable locations for the construction of corridors as necessary.

Activity	Objectives	Methodology
Visual Impacts	The visual impacts from tower and antennae equipment may depend on the perception of the local community as well as the aesthetic value assigned to the scenery (e.g. scenic and tourism areas). Taking into account public perception about aesthetic issues by consulting with the local community during the siting process of antenna towers is important.	Observational assessments and consultation with host and neighbouring communities will be used to determine the extent of visual impact.
Hazardous Materials and Waste	Telecommunications processes do not normally require the use of significant amounts of hazardous materials. However, the operation of certain types of switching and transmitting equipment may require the use backup power systems consisting of a combination of batteries (typically lead-acid batteries) and diesel-fueled backup generators for electricity. Use of these options will be investigated. Related operations and maintenance activities which may also result in the generation of electronic wastes (e.g. nickel-cadmium batteries and printed circuit boards from computer and other electronic equipment as well as backup power batteries), used tires, waste oils/ used filters etc will also be identified.	
Electric and Magnetic Fields	Electric and Magnetic Fields (EMF) are invisible lines of force emitted by and surrounding any electrical device, such as power lines and electrical equipment. Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of electric current and increase in strength as the current increases. Radio waves and microwaves emitted by transmitting antennas are one form of electromagnetic energy. Radio wave strength is generally much greater from radio and television broadcast stations than from cellular phone communication base transceiver stations. However, while the evidence of	This will be carried out based on technical information received by client on voltages and other related data.

Activity	Objectives	Methodology
	adverse health risks is weak, it is still sufficient to warrant limited concern. Evaluating potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) is necessary. Average and peak exposure levels should remain below the ICNIRP recommendation for General Public	
Air Emissions	Typical air emissions include exhaust gases from vehicles and machinery used in industrial operations. Dust agitation from their movement and other activities, particularly in unpaved areas also contribute to reduced air quality in a location. Transportation and exposure of construction aggregates to wind and other agents of dispersal can contribute to dust emissions. Point sources of emissions will be identified and measures to limit or reduce emissions proposed.	The main purpose for conducting a dust assessment is to collect baseline data and identify problem areas to be mitigated. In situ measurements will be taken using a portable aerosol air monitor. This will consist of observational assessments and review of information provided on vehicles, equipment and machinery.
Noise	The principal source of noise in telecommunications facilities is associated with the operation of backup power generators. Noise management action will be recommended including the use of noise suppression shields and mufflers, as well as the location of noise generating sources away from residential or other noise-sensitive receptors to meet the noise emission levels provided in the Equipment, generators etc	• Preliminary survey and identification of measuring points for readings. • Noise survey at the identified measuring sites using a handheld noise measuring device. • Identification of point sources of excessive noise generation and

Activity	Objectives	Methodology
		recommend mitigation measures.
Occupational Health and Safety	Occupational health and safety issues in telecommunications projects primarily include the following: • Electrical safety • Electromagnetic fields (occupational) • Optical fiber safety • Elevated and overhead work • Fall protection • Confined space entry • Motor vehicle safety Occupational health and safety hazards which may arise during construction at planned sites will be described, along with measures for their prevention and control, in the Environmental Management Plan. Excavation, construction, and repair of some components of a telecommunications system may result in workers' exposure to existing aboveground or underground utilities.	Desk studies and literature reviews
Community Health and Safety	Examples of community health and safety issues include exposure to construction vehicles and transports, and exposure to dust, noise and vibrations caused by constructions works. These hazards are common to most typical construction sites.	Observational assessments, desk studies.

Activity	Objectives	Methodology
	Operational phase occupational hazards associated with telecommunications projects include: • Structural and site access issues • Aircraft navigation safety • Driver safety and cellular phones Communities' exposure to construction issues and structural safety issues in the event of structural failure of masts or towers will be investigated. Safety concerns in relation to the sites' attracting unauthorized persons interested in climbing these structures, presenting a risk to their safety and others will be considered.	
Utility Usage and Fuel Storage	Utility consumption at the sites will be detailed in the report, providing weekly/monthly consumption figures for water, electricity, fuel, etc. Fuel storage areas will also be inspected for spills or other potential hazards within the vicinity.	Observational assessment; review of information provided by client.
Socio-Economic Status and Living Conditions	General socio-economic data will be provided to reflect the various geographical locations in the country.	
Issues to be Addressed at Offices and Shops		
Water	Investigation into water usage, source, management etc.	Review of information provided by client and discussions with company representatives at each location.
Waste Management	Determine Adequacy of the company's waste management processes.	Literature review of information provided by

Activity	Objectives	Methodology
	• General waste reception • Waste water management • Solid waste management • Disposal of hazardous materials • Management of Oils/grease • Management of sewage	client on policies and arrangements for the minimization of waste generation, storage, transportation and distribution. An analyses of current methods will be carried out to determine adequacy and corrective measures proposed in deficient areas. A Waste Management Plan will be developed for use.
Technical works/implementation plan/Risk Assessment	Review of the company's technical operations in order to determine which activities may pose environmental/ occupational/ community health and safety risks. Development of Management Plans to mitigate potential impacts.	This will be conducted through literature review of information provided by the client, and observational assessments at the visited sites. Particular attention will be paid to the following: • Operations management (including, staff training) • Environmental training for employees • Health, Safety, Emergency Response policies, procedures, safe guards.

Activity	Objectives	Methodology
		• Fire safety considerations • Spill prevention and containment • Record keeping on accidents/incidents • Utility consumption and management (Electricity, Water, fuel) • Usage of chemicals and refrigerants Risks associated with these activities and other activities identified in description of operations provided by client, will be assessed.
Utility Usage	Usage of utilities (water, electricity and fuel) will be described	Review of information provided by client.
Security and Safety Issues	Assessment of safety and security features and procedures at the different locations	Observational assessment and review of company's policies on safety in the work place.
Occupational Hazards	Identify potential risks within the workplace and how to eliminate them	Observational assessment and review of company's policies on safety in the work place.

1.6 Assumptions

- The EIA study has been done to meet the local requirements for securing the EIA license. The Sierra Leone Environment Protection Agency Act, (SLEPAA) 2008 and the EIA Supplementary Acts, 2010, stipulate an Environmental Impact Assessment (EIA) must be undertaken before the commencement of any project that may affect the surrounding environment and communities. It should be remembered that the term 'environment' in the context of an EIA refers to the biological, physical, economic and social environments.
- Given the timeframe within which the study will be carried out, seasonal variations have not been observed, however desk studies have be done on available historical climatic data and other records obtained at various times during previous years.
- Due to the number of operational areas (particularly the network sites) site visits were not conducted at all locations. Visits were made to all offices and shops, and twenty eight (28) network sites countrywide.

Notwithstanding the aforementioned assumptions, the ESIA Team employed an evidence-based approach and included scientific information relevant to the operational areas within the stated limited options. Where possible the ESIA Team sought quality data and information from other sources at a level of detail adequate to conduct the ESIA study.

1.7 Organisation of the ESIA Report(s)

1.7.1 The ESIA Report

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

Volume 2 – Environmental and Social Management Plan (ESMP) presents the environmental management, mitigation, monitoring and institutional measures to be taken during operations to reduce adverse environmental and social effects to acceptable levels. It specifically defines what actions must be taken and who is responsible to reduce operational impacts. The ESMP also includes several component plans defining specific action programs for waste management, emergency response, closure, community development, and public consultation and disclosure. The ESMP highlights the issues and concerns that are presented in the ESIA 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 Government of Sierra Leone environmental laws and regulations as well as international policies and guidelines.

1.7.2 Management Plans featured in the ESMP

1.7.2.1 Waste Management Plan (WMP)

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

1.7.2.2 Environmental Health and Safety Plan

The Environmental Health and Safety (EHS) Plan identifies the principles, approach, procedures and methods that will be used to control and minimize the environmental and social impacts of all the company's developmental and operational activities. It is intended to complement the Company's Environmental and Social Impact Assessment (ESIA) and ensure that commitments made to minimize operations-related adverse environmental and social impacts are upheld.

1.7.2.3 Emergency Response Plan (ERP)

The Emergency Response Plan (ERP) provides employees and managers with specific instructions that will enable them to respond quickly and efficiently to any foreseeable emergencies likely to occur during operations. 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.

1.7.2.4 Community Development Action Plan (CDAP)

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.

1.7.2.5 Public Consultation and Disclosure Plan (PCDP)

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 with the management and the affected stakeholders. The main objective of the PCDP is to establish a program for multi-directional communication between the company management and stakeholders.

1.7.2.6 Closure Plan (CP)

The Closure Plan documents plans required to restore the site to a pre operational activities state, ensuring that the land can be used in beneficial post-operation land use.

2 DESCRIPTION OF OPERATIONS

Mobile telecommunications is the process of sending, transmitting and receiving information over a distance with the purpose of communicating. It involves the transmission of signs, signals, messages, words, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems. It is transmitted either electrically over physical media, such as cables, or via electromagnetic radiation.

The main benefit of mobile telecommunications is the ability to perform point-to-point or point-to-multipoint transmissions using either a digital or digitized analogue signal.

The various protocols utilized in mobile telecommunications require specific actions taken at certain times in order for two devices to connect and receive information. Each of these protocols take the form of physical layering, which is transmitted in a specific manner and ultimately deciphered by the receiving device.

Cellular technology makes the most notable use of the mobile telecommunications technology. The concept utilizes a series of base stations, a land-based facility or tower designed to propagate the signal from one location to another, and satellite technology. This allows the technology to spread to further locations, providing service to those across a country. Mobile cellular telecommunications began in the late 1970s, evolving in public access, cost and quality over the years.

2.1 Telecommunications Technology Utilised

The process of sending, transmitting and receiving information, rendering it possible to make phone calls across the country involves the use of various types of equipment, machinery and processes. Some of the main equipment and their functions, used by Orange SL are described in the following sections.

Mini Link Traffic Node

The MINI-LINK Traffic Node (an Erricsson Product) is a microwave transmission system used by mobile networks. The following description was obtained from their Technical Description manual (2004).

The node provides a ten-fold increase in aggregated transport capacity, while enhancing network quality, flexibility and control, and reducing site space by up to 70 percent. This method of traffic routing minimizes the use of cables (safety feature), improves network quality and facilitates control from a remote location.

The equipment can be divided into 2 parts: the indoor part and the outdoor part. The indoor part consists of an Access Module Magazine (AMM) with plug-in units interconnected via a

backplane. It is connected to the outdoor part through coaxial cables carrying full duplex traffic, DC supply voltage, as well as operation and maintenance data. The outdoor part consists of an antenna, a Radio Unit (RAU) and associated installation hardware.

The antennae used are 0.6m diameter microwave antennae with a frequency of 15GHz.

The equipment is designed in compliance with the following standards and recommendations:

CEN	-	European Committee for Standardization
CENELEC	-	European Committee for Electrotechnical Standardization
ETSI	-	European Telecommunications Standards Institute
ITU	-	International Telecommunication Union
IEC	-	International Electrotechnical Commission
IEEE	-	Institute of Electrical and Electronics Engineers
IETF	-	Internet Engineering Task Force

Switched-Mode Power Supply (SMPS, or switcher)

An indispensable part of a telecom network is the telecommunication power supply which directly affects the stability, reliability and smoothness of the network. Orange utilises the SMPS which is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. The SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as the telecommunications equipment, while converting voltage and current characteristics.

Ideally, a switched-mode power supply dissipates no power and voltage regulation is achieved.

Radio Base Station

The Radio Base Station is the equipment that facilitates wireless communication between user equipment (phones, modems, etc.) and a mobile network. Its main function is to provide connection with mobile stations over the air interface and includes all radio and transmission interface equipment needed on site to provide radio transmission for one or several cells.

The RBS is also responsible for the processing of signals before transmission and after reception.

Cell Towers

A cell tower is a cellular telephone site where antennae and electronic communications equipment are placed typically on a tower or other raised structure to create a cell in a cellular network.

Figure 2.1-1: Orange SL Ltd Cell Tower in Mattru

2.2 Microwave and Radio Frequency Radiation

Telecommunications Antennas and related equipment which transmit information, emit radiofrequency radiation (which includes microwave radiation).

Mobile phone base stations may be considered as relatively low-power multi-channel two way radio systems. They comprise transmitter and receiver systems and transmit-receive antennas. These antennas produce radio frequency radiation that is generally low. The consensus of the scientific community is that the power from these mobile base stations antennas is far too low to produce health hazards as long as the general public are kept away from direct access to the antennas (Dawoud, 2003). It is also important to differentiate between the antennas that produce the RF radiation and the towers (or masts), which are the structures that support the antennas.

Safety guidelines for exposure of the public to the RF radiation from transmitting antennas are set by different organizations all over the world. The most widely accepted standards are those developed by the Institute of Electrical and Electronics Engineers (IEEE) and American National Standards Institute (ANSI), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the National Council on Radiation protection and Measurements (NCRP). These standards are expressed in power density in (milli watts per square centimeters - mW/Cm^2).

Organization	Exposure Standards for General Public
1992 ANSI/IEEE/NRCP	**1.2 mW/Cm^2** for antennas operating in the 1800- 2000 MHz range
	0.57 mW/Cm^2 for antennas operating in the 900 MHz range

In the presence of multiple antennas, these standards apply to the total power produced by all antennas.

Telecommunications technicians are however at a higher risk of exposure, due to their proximity while working on cellular antennae or related equipment. The Occupational Safety and Health Administration threshold for Radio Frequency Radiation exposure (Specific Absorption Rate) for 6 minute periods is 1mW/cm^2 between the frequencies of l0MHz and 400MH (Chan, n.d.).

Health problems related to microwave and radio frequency radiation include damage to reproductive organs, eyes and even the brain. Studies have even drawn links to birth defects and central nervous system damage (CWA, 2017).

Orange uses fibre cables in the installation of its telecommunications equipment which are preferable for a number of technical as well as safety reasons including the elimination of spark hazards and electromagnetic interference, need for fewer and smaller sized cables, reduced risk of radiation exposure. Older model equipment which are now being phased out are insulated to prevent radiation exposure to technicians. Technicians are also trained to do regular checks on cable connectors to ensure their tightness, as slack connectors could indicate radiation leakage.

2.3 Electrostatic Discharge

Electrostatic discharge (ESD) is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short, or dielectric breakdown. ESD can occur on human contact with sensitive electrical devices.

To guard against electric shock to technicians working on electronic devices, the ESD Wrist Strap is worn, which grounds the person wearing it, to provide protection against the build-up of static charges.

The higher the resistivity of an antistatic wrist-strap the less susceptible it is to higher voltages.

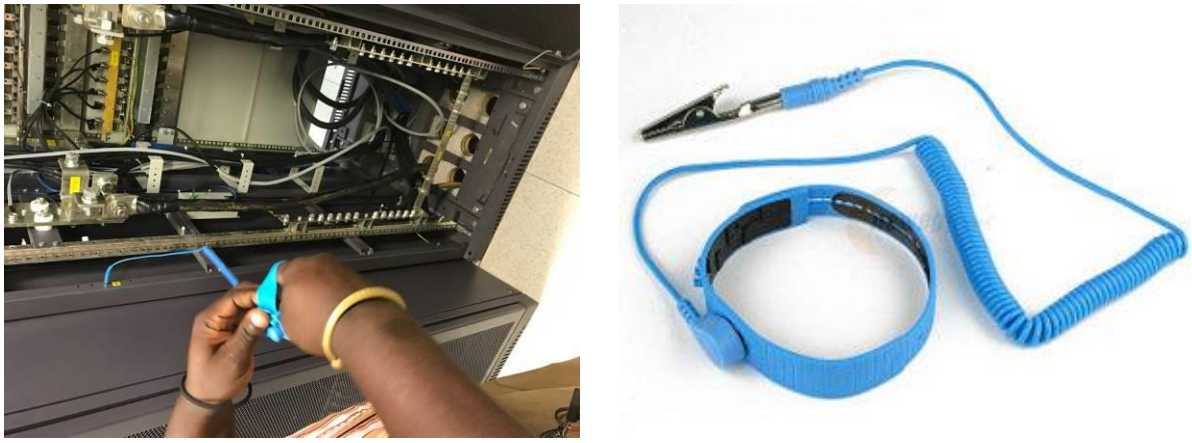


Figure 2.3-1: Technician putting on the Electrostatic Discharge Wrist-Strap

2.4 Ancillary Operations

In addition to the technical aspects of the operations, Orange SL Limited also engages in a range of support services to their customers including customer care, marketing (advertisements, promotions and campaigns) and sales (sim cards, phones, internet modems etc).

2.4.1 Utility Consumption

2.4.1.1 Water

In Freetown, water is provided by the Guma Valley Water Company which supplies water in bowsers to above ground storage tanks for cleaning and domestic (toilets) use.

In the provincial network sites visited, water is sourced from neighbouring community or private water sources (hand dug water well, hand pumps and streams). Water storage at the sites is limited with either no facilities for storage being available or storage tanks are dilapidated and no longer in service.

In the Company Shops at Kono, Makeni and Bo, water is stored in above ground storage tanks for cleaning and domestic (toilets) use. The water supply in these shops is from water wells which are connected with which submersible pumps are used to deliver water into the storage tanks. Water for consumption by staff is purchased by bottle/sachets. At the time of the study, the Kenema shop had installed an above ground storage tank (1500L) but which was not yet in service, whilst the Bumbuna shop had no water storage facility. Water for the Bumbuna shop was being sourced from a community hand pump borehole about 300m away from the shop.

Figure 2.4-1: Water Storage Tanks in Freetown

On average, weekly usage volumes are as follows:

Offices – 10,000L

Shops – 10,000L

Active Network Sites - 1,000L

2.4.1.2 Electricity and Energy

Electricity is obtained from 3 sources – the main electricity grid (EDSA), back up batteries and diesel generators. Back up battery banks (48 Volts DC) are being installed and are operational in most network sites. Grid power is the preferred option in all locations. At network sites, if the grid power fails, the battery bank automatically kicks in. Diesel back-up generators are used when grid power fails in offices and shops, and if neither grid power nor battery power is available at network sites. Where battery power has been depleted, the generator runs until the battery bank is fully charged at which point the generator is turned off and the battery bank takes over.

The Headquarter Office has 2 Diesel Generators – a 250KVA used during the day when required and a 100KVA generator used at night. The Data Centre also has 2 generators – 275KVA generator which is most often used and two 1,500KVA generator which are rarely used. Network sites have 12.5 to 60KVA generators.

Diesel consumption at network sites varies between 600 and 2000L monthly (2000L Capacity tanks are installed at all sites), with the average consumption figure being roughly 1,200L.

Figure 2.4-2: Back-up Generators at Headquarters

Figure 2.4-3: 48VDC Battery Bank at FBC Network Site

2.4.2 Waste Management

In Freetown, waste is managed by the Mr Klin waste management company which is responsible for cleaning, collecting and disposing of the company's facilities. Domestic waste is stored in sealed wheelie bins for disposal at the city landfills. Storage areas are clean and free of debris, and receptacles protecting wastes from dispersal.

Operational wastes such as waste/used oil are removed from the facility by the equipment suppliers' technicians who perform repairs/servicing. Obsolete equipment, computers, etc are safely stored at the headquarters until they can be sold off to interested buyers who recycle and repurpose the equipment parts. Orange is in the process of drawing up policies for re-use and disposal of these equipment for use in any 3rd party purchase agreements.

Waste/used oil from the repair of machinery and vehicles is collected and disposed of by the engineering contractors in charge of servicing and maintenance.

Sewage is directed into underground cesspits and emptied by the Freetown City Council as often as is required.

Waste management in the provincial sites is however less structured. Very few network sites were noted to have waste receptacles, with most opting to dispose of their wastes in nearby

waste heaps within the community. These public disposal areas are such that wastes are prone to dispersal by wind, water or animals; communities also resort to open burning of these wastes.

Shops utilise waste baskets which are collected and emptied regularly at the designated city/town landfill.

2.4.3 Fire Safety

Fire safety consciousness is evident throughout the facilities. With fire extinguishers strategically positioned at all the offices/shop/network sites visited. Data and server rooms are fitted with smoke detectors, fire alarms and sprinkler systems. The Data Centre is installed with a fire fighting (hydrant) system.

Figure 2.4-4: Fire Fighting Systems

Figure 2.4-5: Fire Alarm Systems

Fire drills are for staff are conducted with the National Fire Force bi-annually. Jonay Associates are contracted to manage the Company's fire security system.

2.4.4 Occupational Health and Safety

Occupational health and safety is employed in all the facilities through a variety of means including provision and use of Personal protective equipment, signage indicating prohibited areas, dangerous areas, reminders to use PPE etc.

Figure 2.4-6: Safety Sign at Network Site in Pujehun

Staff training is also employed to ensure that staff area aware of safe work practices and proper use of PPE. Risk assessments are carried out before risk prone activities such as working at heights, exposure to electricity or radiation, etc. In these situations, PPE specific to the required work is issued, such as safety harness for working at heights (e.g. on the towers), electrostatic discharge wrist-strap for working with electricity, etc. Only staff trained and qualified to handle these specialist areas are utilised.

3 ANALYSIS OF ALTERNATIVES

3.1 Introduction

In accordance with current ESIA good practice, it is appropriate for the ESIA to review alternatives considered during planning of the Company's operations, and to explain why the proposed methods were selected, including any environmental considerations. The aim is to establish whether there are reasonable alternatives which could be pursued which meet the Company'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 company's operations, within the context of an ESIA and in terms of various advantages of the alternatives compared to each other.

3.2 The "No Project Option"

Communication plays a very important role in the human life and telecommunications is an integrated part of society. In the earlier days communication was very difficult due to the lack of proper means of communication which were very costly, uncertain and time consuming (MITSOT, 2011). Because of all these reasons there was a great need of efficient means of communication to save time and money and hard work.

With efficient use of telecommunication various constraints in any economic sector can be removed resulting in increased productivity and better administration (MITSOT, 2011). Effective controlling mechanisms can be possible only through better communication and with better use of telecommunication equipment.

Telecommunication has made the world a global village, bringing 98% of the world under its network coverage (Jalal, 2016). It helps a nation to achieve its goal, by helping to integrate the government's various ministries, departments and agencies and the general public, and also achieve development goals through modernization, industrialization and automation. With the aid of the internet and telecommunication, data can be shared and information exchanged (Jalal, 2011).

In Sierra Leone, the overall telecom market is approximately $200 million per year, with data contributing to approximately 20% of the overall market. There are currently over 1 million data users engaging primarily in social networking in the country. Orange SL Ltd is the leading telecommunications company in Sierra Leone, providing extensive coverage in the Sierra Leonean capital and other major towns and is set to expand mobile connectivity and internet access to customers living outside major urban areas.

In the absence of the Company's operations in Sierra Leone, communications within the country would be severely limited, with far reaching impacts on various aspects of the Country's economy.

The "no project" option is therefore not a beneficial option, with the pros of the Company's operations outweighing the environmental, social and economic cons.

3.3 Network Site Selection

The work of network site location commences with the production of a site brief which specifies the preferred location requirements with acceptable tolerances and states the predicted antenna height above ground level (AGL), the area to be served and the estimated population coverage (Agubor, Ndinechi and Opara, 2013). Basic specification for site selection includes the following:

i. Virtually in line-of-sight at the proposed antenna height, with the desired service area.

ii. In line-of-sight with the main or relay station from which the signal feed is to be taken and have a sufficiently wide path between obstructions to avoid ghosting.

iii. So located as to be free from co-channel interference (CCI) and other radio interferences.

iv. Currently in the ownership of a party willing to sell or lease at an acceptable price.

v. Acceptable to Government Authorities.

vi. In such a position that the antenna structure will not interfere with human activities or aircrafts.

The above six requirements are essential. In addition however, the ideal site should preferably:

i. Be free from geological problems like erosion and the soil should be such that it has the capacity for supporting the antenna structure without need for sophisticated foundations. The soil should not be rocky but good enough to allow for the grounding of the radio antenna which is very necessary for the protection of the radio equipment against damage from lightening stroke. For an AM broadcasting antenna, ground screen is a requirement and is made up of several cables that are buried below the soil surface.

ii. Have existing vehicular access, or be positioned such that access can be provided at reasonable cost.

iii. Be surrounded by open land to facilitate the erection of mast or tower.

iv. Be within reasonable distance of an adequate and reliable means of electricity supply.

v. Be clear of existing and proposed overhead high tension (HT) cables.

vi. Be free from legal encumbrances.

The above items are important points that must be born in mind during site investigation activities. In practice the ideal site is rarely found, and the final choice is usually a matter of compromise.

3.4 Choice of Technology

The process of sending, transmitting and receiving information, rendering it possible to make phone calls across the country involves the use of various types of equipment, machinery and processes. The technology utilised in Orange's operations are selected based primarily on their technical effectiveness and efficiency. Other important considerations include health and safety benefits.

The Company is currently in the process of replacing technical features from inherited infrastructure (installed by previous operators) with more recent and advanced technology. These new technology come with improved health and safety benefits in relation to radiation levels, radiation protection/exposure risk minimisation.

4 POLICY, LEGAL, REGULATORY and INSTITUTONAL CONTEXT

4.1 Policies and Plans

4.1.1 National Environmental Policy, 1994

This 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 man and his environment. It also promotes efforts which will prevent or eliminate damage to the environment and biosphere and 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;
- Mining and Mineral Resources;
- Coastal and Marine Resources;
- Working Environment (Occupational Health and Safety);
- Energy Production and Use;
- Settlements, Recreational Space and Greenbelts;
- Public Participation;
- Quality of Life;
- Gender Issues and the Environment;
- Institutional and Government Arrangements;

- Legal Arrangement.

Subsequent to this policy is the Environmental Protection Act of 2008

4.1.2 Draft National Lands Policy, 2013

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;
- 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 the following 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;
- 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.

4.1.3 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;
- Catalyze 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;
- Facilitate information sharing and co-ordinated action among the various stakeholders at the national level and foster scientific and technical cooperation with other countries and international organisation.

4.1.4 Forestry and Wildlife Sector Policy for Sierra Leone (Draft), 2003

This draft policy document is still under review and awaiting parliament approval. The goal of the document is to support the development and reduce the exploitation of forests and wildlife of Sierra Leone in a sustainable manner for the material, cultural and aesthetic benefit of the people of Sierra Leone in particular and mankind in general.

The main general forestry policy objectives of Government are to:

- Promote best practices in forest management so as to develop an environmentally-friendly, self-sustaining forestry sector that is sensitive and responsive to the economic, social and cultural needs of those who live in the forest;
- Foster enabling environments for supervised production of sustainable volumes and quality of forest products that will create national wealth and contribute to food security;

4.1.5 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.

4.1.6 Disaster Management Preparedness Plan, 2006

As part of its post-war recovery effort, the Government of Sierra Leone 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;
- Improve effectiveness of response through stronger disaster preparedness.

4.2 Legal and Regulatory Framework

Legislations governing environment issues are found as Acts enacted in parliament. The legislations of the various government line ministries or institutions include the following.

4.2.1 Laws

4.2.1.1 The Telecommunications Act, 2006 (Amended in 2009 and 2015)

This Act serves to establish the National Telecommunications Commission and to provide for the licensing and regulation of telecommunications operators. It also serves to promote universal access to basic telecommunication services, fair competition for the benefit of investors in, and the users of telecommunication networks and services, to improve the national, regional and global integration of Sierra Leone in telecommunications and to provide for other related matters. The 2015 amendment terminated the monopoly of the Sierra Leone Telecommunications Company (SierraTel) in the operation of the international gateway and other related matters

4.2.1.2 Environmental Protection Agency Act, 2008

The EPAA 2008 is the government of Sierra Leone's overarching legislation that deals with the protection of the environment. The Environment Protection Agency 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 EPAA, 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;
- 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 EPAA, 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.

4.2.1.3 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.

4.2.1.4 Factories Act, 1974

This Act became effective on the 30th May, 1974. It basically deals with health and safety measures as they concern the factory worker. It protects the worker through demands for all aspects of cleanliness, reports of all injuries, accidents, diseases and death.

A Factories Appeal Board is in operation and has the duty of hearing and determining any appeal submitted by factory owners, thus giving right where it is due. Going by the interpretation of the word factory, as stipulated in this Act, industrial companies are factory based companies, and are therefore covered by any legislation pertaining to this aspect.

4.2.1.5 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 Forest Act e.g. Forest Guards

- 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.

4.2.1.6 Land Tenure and Ownership

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

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.

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.

4.2.1.7 Wildlife Conservation Amendment Act, 1990

The Wildlife Conservation Act, 1972 and the Forestry Act, 1988 are the main legislations 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;
- Introduction of species from outside of the boundaries of the reserve.

The Wildlife Conservation Act of 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. Despite the minor amendment the Wildlife Conservation Act of 1972 along with the Forestry Act of 1988 continue to be the main legislature for biodiversity conservation in Sierra Leone.

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.

4.2.1.8 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.

4.2.2 Regulations

4.2.2.1 Forestry Regulations, 1989

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.

4.2.2.2 Draft Wildlife Regulation, 1997

The Wildlife Regulation came in to force in 1997. It describes Wildlife Conservation Estate as areas described under the 1972 Wildlife Conservation Act 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 stipulates 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.

4.3 Institutional Context

4.3.1 The Ministry of Information and Communication

The Ministry of Information and Communications is responsible for ensuring that every citizen has access to timely, accurate, clear and objective information on national and international issues of relevance. The Ministry aims 'to develop all segments of the information and communications sector in order to keep all citizens well informed, educated and sensitized.

The mandate of the Ministry relevant to the telecommunications sector includes the following:

- Provide internal and external information services
- Develop communications strategy and introduce improved methods of communication

4.3.2 The National Telecommunications Commission (NATCOM)

The National Telecommunications Commission (NATCOM) was established by an Act of Parliament in 2006 to regulate the Sierra Leone telecoms sector, protect consumer interest and ensure fair competition among service providers.

The major policy direction of the Commission is:

- the establishment of an effective, sound and dynamic licensing regime that is responsive to industry demands;
- the regulation of the activities of telecoms operators aiming at promoting efficiency and fair competition;
- ensuring expansion in investment in the sector; and adopting rules and procedures that guarantee and protect the rights of users of telecoms services.

The Commission in essence started the process of restructuring by setting a sound legal and regulatory framework, reviewing the licence conditions of new and existing operators and service providers and providing an interactive forum (The Consumer Parliament) for the Consumers and Service Providers to meet with the Regulator and discuss issues pertinent to the industry.

4.3.3 Sierra Leone Cable Ltd (SALCAB)

Sierra Leone Cable Limited (SALCAB) was incorporated as a limited liability company with 100% shareholding from the Government of Sierra Leone in 2012. The company is being supervised by the Ministry of Information and Communication on behalf of the Government of Sierra Leone. The company was set up to manage the fiber optic backbone of Sierra Leone and to provide affordable fiber optic capacity to Telecommunication companies.

The company's mission is to provide ICT Service providers with equal access to service portfolios under an open and non-discriminatory access regime in order to promote broadband internet access at affordable prices nationwide (SALCAB, 2015).

4.3.4 Environment Protection Agency Sierra Leone

The Environment Protection Agency was set up to replace the National Commission for Environment and Forestry (NaCEF), which was mandated to oversee issues pertaining to the environment and forestry. The Environment Protection Agency was established with a Board of Directors set up as its governing body. This Board consists of a Chairman and representatives from the various line Ministries and a Unit as stated in section 3 of part II of the Environmental Protection Agency Act. Subject to this Act, the Board shall have the control and supervision of the Agency. The Agency shall act in liaison and co-operation with government agencies to control pollution and the general protection of the environment. The

Agency, subject to this Act, shall promote effective planning in the management of the environment and coordinate and monitor the implementation of national environmental policies, relating to Sierra Leone.

4.3.5 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
- Collaboration with relevant Government Ministries and with national and international organisations and Institutions

4.3.6 Ministry of Works, Housing and Technical Maintenance

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:-

Public Works Division

This division is responsible for:

- The Sierra Leone Road Authority (SLRA);
- Regulation of civil Building and Civil Engineering Standards;
- Registration of civil work contractors;
- Seaface Protection;

Housing Division

This division is responsible for:

- Approval of Building Plans and issuance of building permits;
- Enforcement of development control of building regulations.

Infrastructure Division

This division is responsible for:

- The development of a National Infrastructure Policy in collaboration with line ministries;
- To proffer 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 International Conventions Policies, Protocols and Guidelines

4.4.1 International Conventions

Sierra Leone is a party to many international agreements, conventions, and protocols that seek to protect the environment and ensure sustainable development.

The following sections briefly discuss the International conventions that have relevance to operations of this nature.

4.4.1.1 The Commonwealth Telecommunications Organization (CTO)

Sierra Leone is a 'Full Member Country' of the CTO which is the oldest and largest Commonwealth intergovernmental organisation in the field of Information and Communication Technologies (ICT). Being fully involved in the development and use of ICTs for social and economic development, the management of the organisation recognise that it must stay at the cutting edge of ICT developments in order to deliver significant benefits to its members.

The CTO's Strategic Plan 2016 – 2020 is structured around 6 strategic goals (CTO, 2017), as follows:

- Enhance the value of the CTO membership and expand the CTO's membership base, including through Member Action Plans which define clear programmes and activities for each member.
- Promote enabling regulatory environments in key areas such as licensing, spectrum management, quality of service and over-the-top operators.
- Promote affordable universal and high-quality broadband connectivity via enabling policies and regulatory measures that facilitate the rapid rollout of broadband infrastructure.
- Promote a culture of cybersecurity and effective cyber governance through the establishment of cybersecurity frameworks, standards and guidelines.

- Promote the development and use of ICT applications for socio-economic development e.g. e-governance, e-health, e-education and e-agriculture, among others.
- Ensure effective coordination of Commonwealth countries at international ICT conferences and meetings.

4.4.1.2 The International Telecommunications Union

ITU is the United Nations specialized agency for information and communication technologies. The organisation allocates global radio spectrum and satellite orbits, develops the technical standards that ensure networks and technologies seamlessly interconnect, and strives to improve access to ICTs to underserved communities worldwide.

The ITU is unique among UN agencies in that they have both public and private sector membership including 193 Member States (including Sierra Leone), ICT regulators, many leading academic institutions and some 700 tech companies (ITU, 2017).

4.4.1.3 The Africa Telecommunications Union (ATU)

Established on December 7th, 1999, the African Telecommunications Union, of which Sierra Leone is a member, is the leading continental organisation fostering the development of information and communication technologies infrastructure and services.

The mission of the Union is to promote the rapid development of info-communications in Africa in order to achieve universal access, and full inter-country connectivity.

ATU provides a forum for stakeholders involved in ICT to formulate effective policies and strategies aimed at improving access to information infrastructure and services. In addition, the Union represents the interests of its members at global decision-making conferences and promotes initiatives aimed at integrating regional markets, attracting investment into ICT infrastructure, and building institutional and human capacity (ATU, 2017).

4.4.1.4 United Nations Convention on Biological Diversity (UNCBD)

This convention, whose main objectives are to preserve biological diversity and rehabilitate all degraded areas, was ratified by Sierra Leone on 12th December, 1994. All signatory States are obliged to effect 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;
- Provision of educational facilities.

4.4.1.5 Convention of the International Trade of Endangered Species - (CITES)

The requirements of this convention 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 International Union for Conservation of Nature and Natural Resources (IUCN), as endangered or threatened. CITES also takes cognizance of species not necessarily threatened, but which require trade control to protect them from being threatened or endangered.

4.4.1.6 United Nations Framework Convention on Climate Change

Sierra Leone ratified this convention on 22nd 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.

4.4.1.7 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.

4.4.1.8 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.

4.4.1.9 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;
- 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.

5 BASELINE SURVEY AND CONDITION

5.1 General Overview of Physical and Biological Environment

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

The data presented in this section are those reviewed from previous studies in the different operational areas.

5.1.1 Western Area

5.1.1.1 Climate

Rainfall

The average annual rainfall is about 3060mm. Rainfall along the coast can reach 4950mm per annum. This heavy rain period is the time when rivers, streams and run-off attain maximum discharge influencing the sea in different ways: reduced surface water salinities, lowered solar radiation and dips in mixed layer temperatures, increased turbidity and change in waves and current situations.

Temperature

The normal temperature range is 22.1^{o}C to 32^{o}C although it can drop during the Harmattan season to as low as 10^{o}C.

Relative Humidity

Relative humidity level (at 09.00 hrs) is between 78.1- 91.1% and (at 1500 hrs) between 62.4-82.8%, with low values occurring between January and March.

A summary of some climatic data for the Freetown area is presented in the following table.

Table 5.1-1: Historical Climatic Data for Freetown

Climatic Variable		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Mean Temp (^{o}C) (1976-2005)	Max	30.8	31.2	31.7	31.8	31.3	29.3	28.6	28.5	29.5	29.4	30.6	29.3
	Min	22.7	23.4	32.0	24.1	23.9	23.3	22.9	22.1	23.0	23.2	23.6	23.4
Average	9 a.m.	78.7	79.1	78.1	78.9	81.4	86.0	89.4	91.1	88.7	86.3	83.6	79.8

Climatic Variable		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Relative Humidity (%) (1976 – 2005)	3 p.m.	62.4	63.4	64.0	65.9	70.5	75.5	81.0	82.8	78.8	76.0	74.1	67.9
Monthly Means of Rainfall (mm) (1976 – 2006)		37.2	7.3	26.6	58.8	235.0	352.1	778.0	515.6	605.4	435.3	96.2	13.4

5.1.1.2 Geology

The Freetown Complex is a major intrusion characterized by prominent layering of repeated sequences of troctolitic, gabbroic and anorthositic rocks. Differential resistance of these rocks to weathering and erosion has given rise to the parallel range of mountains from which Sierra Leone derived its name "Sierra Leona", - the Lion Mountain.

The Freetown Complex forms a crescent shaped Peninsula intruding into the Atlantic Ocean from the West Coast of Serra Leone. The Complex is approximately 60km from the most northerly exposure to the southern tip of Banana Islands with a maximum width of 12km. The Complex is essentially a Lopolith based on inwardly dipping layering that steepens towards the ocean.

Intensive mapping, geophysical prospecting and drilling by the Department of Geological Survey revealed that the intrusion is part a funnel-shaped body with the centre of the "funnel" situated in the Atlantic, west of the Peninsula. The layered structures are concordant with the floor of the intrusion.

The funnel-shaped intrusive sequence consists of Olivine gabbro, layered troctolite, gabbronorite and anorthosite with a composite thickness of approximately 7000 metres.

The layered series of the complex has been divided into four major zones, in each of which is a generalised upward sequence from olivine-rich to plagioclase-rich rocks and within which prominent rhythmic layering occurs with strong differentiation in terms of mineral proportions. Also these four zones are delineated by two characteristics; topographically expressed, whereby the base of each zone forms a scarp and the top of each slope and strike valleys and by the repetition of rock types. A fifth zone, described as a marginal Facies, is unexposed and was revealed by the limited drilling on the eastern side of the complex.

5.1.1.3 Hydrology

The oceanic tidal movement on the West African coast is driven by an amphidromic system centred in the West Indies. The resulting tidal wave is propagated in a northerly direction along the West African coast, such that the coastal tidal streams off Sierra Leone flow southward on the ebb and northwards on the flood. Additionally, Cape Sierra Leone is close to the null point between the Canary current which flows south westwards down the North

African coast and out into the Atlantic at Cape Verde, and the Equatorial Current which approaches the African coast from the west in the region of Cape Sierra Leone. Although there is some seasonal movement of these currents, and being near the null point the coastal current is not strong, there would appear to be a general southward drift at all times off Cape Sierra Leone. The tide sets across the estuary mouth in a NW-SE direction, which is indicative of an oceanic current influence.

The result of these water movements is a potential for a net southerly movement of the water mass across the mouth of the Sierra Leone estuary. The strong slick lines that were observed during the ebb tide to the south of Cape Sierra Leone reinforce this argument. Consideration of the oceanic currents and the probable mass movement between the ocean and the estuary thus suggests that the estuary will have a strong flushing component to the south at each tide.

The hydrographic regime of Sierra Leone waters is characterized by a relatively stable, shallow thermocline lying at 'mid-shelf" depth and affecting the distribution of fish. Seasonal changes are due to the following effects of the monsoonal wet season extending from May to October: high river discharges, reduced surface water salinities, lowered solar radiation and a dip in mixed layer temperatures.

5.1.2 Southern Province

The description of the southern province's physical and biological environment is based on Bo District using information/data collected during previous studies there.

5.1.2.1 Climate

There is limited recorded material on climatic conditions within this region. However, climatic and other data from the Sierra Leone Meterological Services stationed in Bo have been used to represent conditions within the Southern Province. A summary of some climatic data for Bo is presented in tables 5.1-1.

Generally, the climate is described as wet tropical monsoon with a single wet season each year. The average annual rainfall is about 2738 mm overall. The greater part of this rain falls between mid-May and mid-November and the wettest month is usually August, even though rivers attain maximum discharge in mid-September. There is very little or no rain in December, January and February

According to 1986 - 1988 rainfall summary reports for Bo the daily and monthly minimum rainfall is zero whilst the daily and monthly maximum rainfall figures are 92.6mm (September) and 573.7mm (August) respectively.

The maximum shade temperatures in the study area are consistent throughout the year, being around 31^{o}C – 35^{o}C, generally lower in the wet season at 26^{o}C – 31^{o}C whilst the minimum only falls below 18^{o}C on odd days in January and December, when the influence of the cold, dry wind from the north of the desert are felt.

River discharge is at its lowest in March and April, and begins to gradually increase in May. Groundwater levels remain relatively stable until late July.

Table 5.1-2: Summary of Some Climatic Data for Bo 1990 – 2007

Climatic Variable		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Mean Temperature (ºC) (1990-2007)	**Max**	32.3	33.9	34.3	33.9	32.6	30.8	29.2	28.5	30.0	31.2	31.7	32.1
	Min	19.5	20.7	21.7	21.7	21.8	21.6	21.2	21.2	21.6	21.6	21.6	20.6
Average Relative Humidity (%)	**9 a.m.**	86.1	84.4	82.3	84.5	87.4	88.3	92.3	93.7	92.6	89.8	89.0	88.3
	3 p.m.	52.2	48.3	50.9	63.0	63.0	71.4	77.0	81.8	75.8	69.2	65.8	59.3
Monthly Means of Rainfall (mm)		11.3	17.0	63.4	101.5	236.9	340.7	412.0	607.3	470.0	326.7	120.2	15.1
Monthly Means of Evapotranspiration (mm)		129	130	141	141	136	124	114	111	113	121	121	125

Wind Speed

The following table shows the wind speeds recorded in some communities in Bo. The figures indicate that winds at this time of the year (October) are generally calm.

Table 5.1-3: Wind speed measurements in Bo

Location	Average wind speed (m/s)
Yamandu	0.03
Singimi	0.4
Kualelima	0.9
Yamandu (Bo- Kenema highway)	1.6
Gbandi	0.1
Ndogboguma 1	0.3
Ndogboguma 2	0.7

Source: CEMMATS October 2016 (AGES Draft ESIA,)

5.1.2.2 Geology

Most of Sierra Leone is underlain by a series of ancient, folded, crystalline rocks of varying lithology, belonging to the Archean subdivision of the Precambrian period.

These rocks are over 2100 ma old and are unconformably overlain by the Rokel River and Saionia scrap Groups of late Precambrian to the late Ordovician age, and the much longer Bullom Group sediments of Tertiary to Recent age.

The regional geology of Bo is referred to as the granit-greenstone terraine. The granite/greenstone complex comprises a series of iron and magnesium-rich rocks metamorphosed to the amphibolites facies (Sula Group) over a quartz-rich basement of granitic composition. The grade of metamorphisms in the basement tends to increase towards the Sula Group boundary giving rise to local occurrences of granulite (Mano-Moa formation). So-called Younger granite was intruded after the most intense period of deformation at about 2.7ma ago and occurs around the margins of the Sula Group.

5.1.2.3 Landform

This region has gently undulating plains with isolated hill remnants, dissected by well-defined valley swamps. The hills are usually pointed and rise with an extremely low relief from fairly broad interfluves. The gently to moderately sloping interfluves side slopes have commonly been dissected by broad gullies giving rise to narrow crests.

5.1.2.4 Land Use

The major land use activities in this region are mining (gold and diamond) and agriculture (coffee, cacao and oil palm). Agriculture is carried out mainly in the upland and valley swamps where small to large scale plantations can be found. Other land use activities include fishing and trading.

5.1.2.5 Ecology

The biogeographic characteristic of this area is that it falls within the western extent of the Guinea-Congo forest biome and the western edge of the Upper Guinea forest. Therefore, the vegetation is historically closed canopy forest, which is thought to have been 60% of the cover of Sierra Leone. However, in recent times, farmbush ecology is the dominant cover, with few isolated and small patches of secondary forest confined to the vicinity of villages and along streams and tributaries.

5.1.3 Eastern Province

The description of the eastern province's physical and biological environment is based information collected during previous studies in the Kono and Kailahun Districts.

5.1.3.1 Climate

This is the Rain Forest Agro-climatic Region of Sierra Leone, characterized by a high mean annual rainfall of 2500 -3000 mm and moderately low (290+/-30mm) water deficit spread over some 100 - 200 days (Kowal, et. al. 1980).

Average annual rainfall is about 2540 mm overall, with about half of the annual precipitation (1460 mm) finding its way to groundwater or runoff resulting in stream and river flows (Dijkerman et al, 1964). River discharge is at its lowest in March and April, and begins to gradually increase in May. Groundwater levels do not rise significantly until late July.

The following table presents data collected on winsdpeed, rainfall and relative humidity in Kono over a period of 6 months in 2016:

Table 5.1-4: Meteorological Data for Jan - June 2016

	Relative Humidity (%)	Windspeed (m/s)	Rainfall (mm)
January	76.628	1.199	-
February	37.803	0.837	-
March	79.097	0.948	-
April	88.450	1.390	0.177
May	70.407	0.849	1.203
June	-	-	10

Source: Koidu Ltd Weather Station (Kono)

Historical Climatic data for Yengema, Kono District

Climatic Variable		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Mean Temperature (°F) (27)	Max	33.4	34.9	35.4	34.5	33.3	32.0	30.2	29.7	31	32.3	32.4	32.7
	Min	15.4	18.1	19.8	20.3	20.2	20.1	19.8	19.8	19.4	19.1	19.2	16.6
Average Relative Humidity (%)	9 a.m.	81.3	77.8	74.3	79.7	84.2	89.0	89.5	89.8	88.7	87.8	88.8	85.3
	3 p.m.	41.1	35.5	39.5	51.3	61.0	68.3	73.7	72.9	68.1	66.6	63.3	49.2
Monthly Mean Rainfall (mm)		3.03	14.8	29.33	53.20	86.5	102.9	121.2	123.7	149.9	110.7	58.6	13.7
Monthly Mean Evapotranspiration (mm)		43	43	47	47	45	41	38	37	38	40	40	42

Source: UNDP/FAO-TR5, 1980

5.1.3.2 Geology

This area is part of the Archaean age West African Craton comprising an infracructal basement of migmatitic gneisses and granitoids overlain by supracrustal rocks of the Kambui Supergroup. These rocks were subject to two major orogenic episodes/thermotectonic events during the Leonean (>2700 million years) and Liberian (~2700 million years) events.

During the Liberian episode, the Kambui Supergroup of lavas and sediments was metamorphosed to the tightly folded high amphibolite greenstone belt Facies seen in the N-S trending Nimini Hills, a duricrusted plateau, rising 350 m above the basement rocks of the Koidu Basin. This dominant directional trend typical of the West African craton comprises faults and fractures extending for hundreds of kilometers and is followed by planes of schistosity and foliation in rocks.

The Nimini Hills lie to the east of River Sewa and are made up of amphibolites, schists and banded ironstones with intrusions of late kinematic granites (granitoids). The Liberian thermotectonic event (2700 m yr) imposed a dominant N-S lineament trend seen in the Kambui Hills.

Other main fracture systems seen in the area are the dominant radial system exhibiting long straight lineaments with directional trends from NW through to a NE direction, and the annular system with NE to WNW trending fractures (Morel 1979).

Emplacement of kimberlite dykes took place in the Cretaceous period along existing ENE-WSW fractures. The kimberlites are porphyritic containing xenoliths of granitic rock, amphibolite and amphibole schist. The bedrock at the proposed dam site on the Sewa comprises biotite and hornblende gneisses of the infracrustal basement (Lahmeyer 1995). The

Yengema-Koidu kimberlite dyke zone complex lies to the east of the Sewa River (Hubbard 1986). Alluvial diamond deposits occur along the entire Bafi-Sewa drainage channel derived from weathered and eroded diamondiferous kimberlite dykes (Hall 1965).

5.1.3.3 Landform

This region consists of a variable dissected complex of plains and rocky hills of low to moderate relief and also irregularly dissected high-lying plains of low relief and isolated rocky hills and narrow valleys.

Features typically found in this region and their characteristics are described in the following table:

Table 5.1-5: Landform Characteristics

Feature	Characteristics
Hill crest	The hill crests are generally broad; crestal slope; gentle to very gentle
Hillslope	Generally medium to long; straight; steep to very steep and moderately dissected by gullies
Footslope	Short to medium length; straight; gentle to very gentle
Interfluves	The interfluves are dissected by valley swamps, medium to long; irregular; very gentle to moderate slope
Minor floodplains	Level to nearly level; 50 – 200m wide; channeled, sometimes terraced. Adjacent to major rivers and streams there are discontinuous floodplains of variable width
Valley Swamps	Level to nearly level; straight with varying width; commonly channeled

5.1.3.4 Land Use

Agriculture and Mining are the main land use activities carried out in this region. The seasonality and distribution of rainfall is critical to land use patterns. Whilst rainfall is appreciated in the wet season for certain land use activities, it is unwelcome in the dries for others. For example, the rainy season is the period during which rain-fed crops are cultivated. These include the staple food, rice, and other annuals. They are cultivated on both uplands and wetland ecologies.

During the dries, farming activities are confined to wetlands; particularly inland valley swamps (IVS). Irrigation is done, and crops grown are mainly garden crops such as leafy vegetables (example, potato), garden eggs, groundnut etc. The limited number of swamps however restricts the number of households involved in such farming during the dry season. Other livelihood activities are therefore ventured into, particularly off-farm (example, mining). At the same time, swamps are reported losing their waters faster than before due to climate change. This places much pressure on households to do more irrigation during the day, if crops are to do well.

The dry season is also the period during which households take part in mining activities. This is because of two main reasons. The first is because the rainy period is reserved for farming, which is the main stay of survival. Secondly, most households are poor and cannot afford the capital needed to undertake mining activities during the rains which would require machines to bail out rain water and/or water that bursts from underground aquifers.

Other land use practices common during the dries include charcoal burning, timber production, palm oil production etc.

5.1.3.5 Ecology

Sierra Leone's vegetation is divided into two major biomes – the Sudan-Guinea savannah biome which occurs mainly in the north and Guinea-Congo forest biome in the southern sector of the country. Much of the central zone is covered in a transition type vegetation which comprises a mixture of components of the two major biomes. The Eastern Province falls within the Guinea-Congo forest biome which can generally be described as a mosaic of closed forest, degraded forest, farmbush, farmlands and open areas. The Upper-Guinea forest, is known to have two key biogeographic importance to global biodiversity conservation: an Endemic Bird Area (EBA) and an Eco-region (ER). An EBA is an area that supports birds whose global range do not exceed 50,000 sq. km, whilst an Eco-region is one that is defined by a unique community of flora and fauna, as a significant component of global conservation. Much of the original vegetation has been modified primarily by the age-old slash and burn agriculture, with various age of bush regrowth, which characterises the landscape. This has also broadly determined the diversity and distribution of plant communities and fauna. Remnants closed primary forest still remain in this region of the country as exemplified by the Gola Forest National Park to the south and a number of fragmented forests, some of which are used by the communities as sacred groves. The Kambui Hills Forest Reserve,

located in the Kenema District is a designated Important Bird Area (IBA) (Okoni-Williams et al., 2005).

5.1.4 Northern Province

The description of the Northern Province's physical and biological environment is based information collected during previous studies in the Tonkolili District.

5.1.4.1 Climate

This area is classified as being in the transitional rainforest savannah woodland agro climatic region of Sierra Leone (UNDP/FAO, 1980). The following tables show climatic data for the Northern Province, taken in Bombali (Makeni) and Tokolili. In terms of water regime, the characteristics of the region are shown in the annual water budget table for Makeni area in the following table (CEMMATS 2014).

Table 5.1-6: Annual Water Budget for Makeni (mm)

Budget Component	Value (mm)
Precipitation	3158
Evapotranspiration	1441
Water Surplus	2193
Water Deficit	476
Effective Precipitation	1065
Growing Period Duration (days)	287

Source: (UNDP/FAO- TR5, 1980)

Table 5.1-7: Summary of Some Climatic Data for Makeni Area

Climatic Variable		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Mean Temperature (°C) (27)	Max	32.8	34.4	34.7	34.4	32.6	31.5	30.1	29.4	30.0	31.3	31.7	31.8
	Min	19.6	20.7	21.3	21.8	22.6	22.4	21.8	22.0	21.8	22.2	22.0	20.9
Average Relative Humidity (%)	9 a.m.	79.1	91.8	80.4	82.0	85.5	88.1	90.4	91.8	90.1	88.0	87.8	78.9
	3 p.m.	43.6	43.7	44.8	48.9	59.1	66.2	72.3	75.2	70.5	66.8	61.9	49.5
Monthly Mean Rainfall (mm)		2.3	3.1	11.3	37.3	73.8	132.4	161.6	221.5	188.8	139.2	68.6	21.2

Climatic Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Mean Evapotranspiration (mm)	42	42	44	46	43	39	37	35	34	38	39	41

Source: UNDP/FAO-TR5, 1980 & Meteorological Dept.

Table 5.1-8: Wind Speed Measurements in Tonkolili

LOCATION	AVERAGE WIND SPEED(m/s)
Maborbor	0.00
Petifu	1.40
Magbuna	0.00
Ropiti	0.65
Magbogba	0.30
Mayinda	0.13
Mayeriba	0.18
Matamba	0.53
Petifu-Kafe	0.55

Source: CEMMATS field measurements September 2013

5.1.4.2 Geology

This region contains the Sula Mountains greenstone belt which is divided in a western and western-eastern branch. The central part is governed by the older granitiods. Former researchers considered the greenstone belt as a geosynclinals sequence deformed and metamorphosed during subsequent Liberian Episode.

The Sula Group consists of two formations, the older Sonfon Formation has a largely metavocanic character and the Tonkolili Formation comprises both metatuffeaceous and metasedimentary members.

The Sonfon Formation is composed mainly of amphibolites and banded, massive,and pillow-bearing types are represented and are thought to be former lavas extruded in a marine environment. Their compositional variation from monomeralic amphibolites suggests a considerable rande in original igneous composition.

The massive amphibolites are mesocratic, fine to coarse grained, generally schistose rocks with a well-developed fabric.

Pillow-bearing type has a similar mineralogy to the massive amphibolites. The matrix between pillows is usually amphibole schist in which fine-grained amphibole prisms envelop small plagioclases and plagioclase clase- quartz aggregates. The relics igneous minerals such as sericitised plagioclase, hypersthenes and diopside are preserve. These relics minerals are enveloped by fine to medium grained amphibole.

The Tonkolili Formation, which stratigraphically overlies the Sonfon Formation, is composed mainly of politic, semipelitic and tuffaceous metasediments. The last are predominant at the base of the formation and the tuffaceous component decreases upwards. In addition, concentrations of iron oxides at certain levels forms ironstones of considerable extent.

Semipelitic tuffaceous metasediments or metatuffs in the Tonkolili River section show bedding and sedimentary structure which are sometimes very dark owing to the concentration of femic minerals into laminae.the groundmass usually contains quartz in excess of plagioclase and may either be free of femic minerals or contain minor hypersthenes and diopside. Typical metamorphic minerals in these metatuffs include biotite and amphibolites usually as cummingtonite-grunerite and more rarely as hastindsite or pargasite. Pelitic metasediments vary from politic schists, with a strong s-fabric defined by orientated muscovite, sericite, chlorite, and biotite flakes in a quartzose groundmass to semipelitic schists with a similar fabric but coarser quartzose groundmass (CEMMATS, 2014)

5.1.4.3 Landform

The Eastern Region falls in a dissected escarpment. Hills range from moderate to high relief, and there are dissected plains of extremely low relief. There are also small hills and common terraces with valleys swamps.

5.1.4.4 Landuse

Populations within this region depend on the natural resources available to them for both their livelihood and income. Specifically, agriculture (rice farming and mix cropping) and mining (artisanal gold mining) are the fundamental land use activities defining the livelihood of this population.

Other types of land uses include settlements, forests reserved for sacred/society purposes, burial places and social venues like football fields.

The types of land cover, which are typically secondary forest and forest re-growth combined with the local economic situation of the population, encourage the popularity of agriculture and mining activities.

5.1.4.5 Ecology

The vegetation of this region comprises of elements of forest and savanna conditions at various locations, which has naturally resulted from the occurrence of the mosaic of Guinea-Congo forest and the Sudan-Guinea savanna biomes. The forest ecology is assumed to be influenced by a number of forest reserves within the vicinity of the site, such as the Tama-Tonkoli to the east and Loma Mountain forest reserves to the northeast. However, the ecology has been greatly modified by slash and burn agriculture, which is the main livelihood mechanism in the area.

5.2 Primary Data Collected from Operational Areas

The following operational areas were visited during the main ESIA field study covering the provincial facilities:

	Sites visited	UTM Coordinates			Sites visited	UTM Coordinates	
		X	Y			X	Y
1	Magburaka	175237	965446	15	Tongor Site	280771	909167
2	Levuma	193365	848290	16	Yengema Site	275074	953971
3	Koribondo Highway	199874	875670	17	Magbenteh	821356	983149
4	Kimbadu Site	285317	955529	18	Kambia 2	728203	1007666
5	Kabala Radio	220316	1059680	19	Feredugu Site	775159	968396
6	Daru	297061	883382	20	Mattru Jong	811896	841359
7	Gormbu	260919	872383	21	Moyamba	784456	903981
8	Fadugu New Site	195770	1039579	22	Panlap	826374	987519
9	Bumpeh	179427	873372	23	Port Loko	744212	969140
10	Blama Site	243063	871258	24	Makeni Shop	825194	983886
11	Binkolo	172000	990687	25	Kono Shop	282901	956120
12	Nimikoro Site	269997	945324	26	Kenema Shop	258461	871507
13	Pujehun	199425	814233	27	Bunbuna Shop	198207	1000885
14	Senehun Ngobeh	174953	904183	28	Bo Shop	198008	881499

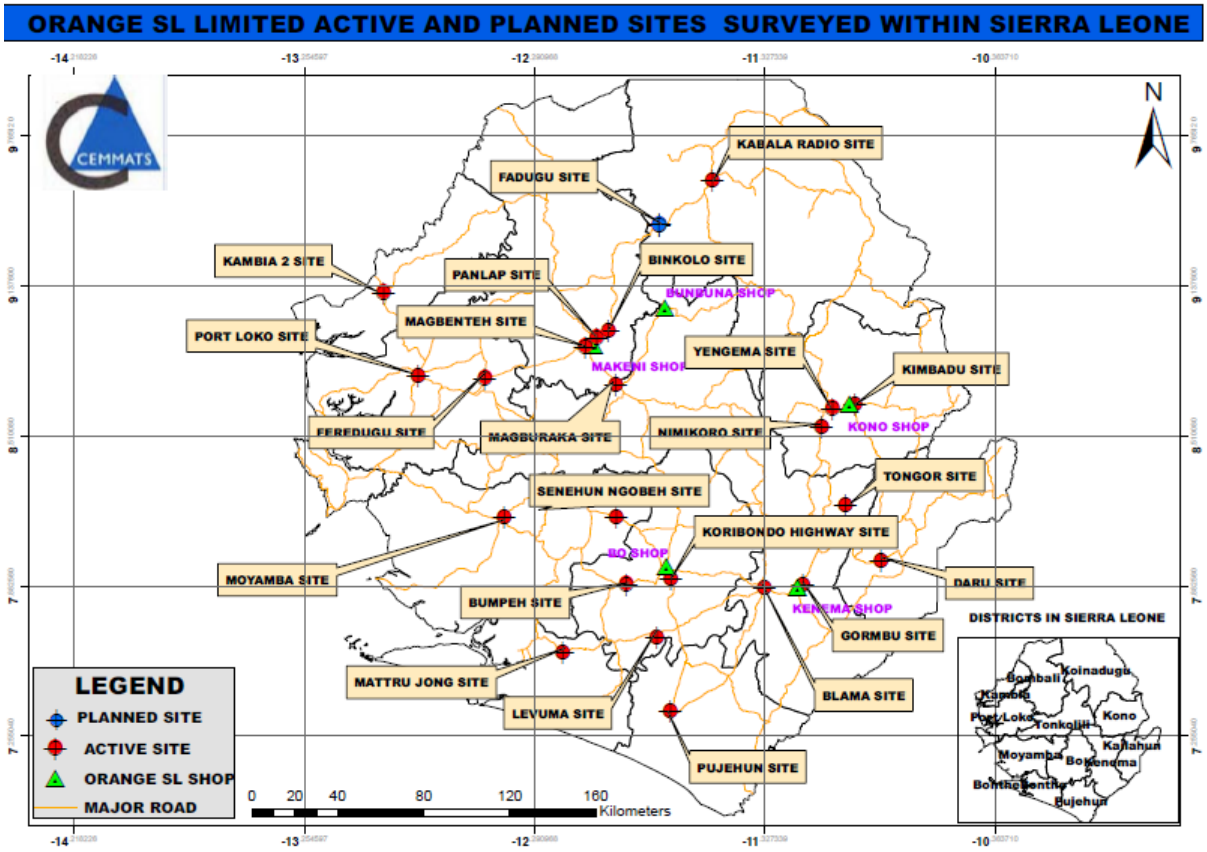


Figure 5.2-1: Environmental Measurement Points

5.2.1 Wind Speed

5.2.1.1 Methodology

Wind speed measurements were recorded at twenty five (25) active and plan sites. The measurements were recorded at different site and times of the day using the portable anemometer vane probe.

Measurements taken were compared to the Beaufort Scale which categorises wind speeds.

Table 5.2-1: Beaufort Scale

Wind Speed (m/s)	Category
<0.3	Calm
0.3 – 1.5	Light Air
1.6 – 3.3	Light Breeze
3.4 – 5.5	Gentle Breeze
5.5 – 7.9	Moderate Breeze

5.2.1.2 Results

The following table shows the wind speeds recorded during the study period. The figures indicate that wind speeds for this time of the year are generally ranging from calm air to light breeze (according to the beaufort scale) and are moving in various directions depending on the elevation and the open spaces. Higher wind speeds were recorded in elevated areas and open spaces.

Location	Date	Time	Average wind speed (m/s)
Foredugu	8/2/18	1.50 pm	0.8
Kambia Town	8/2/18	3.50 pm	0.4
Port Loko Town	8/2/18	5.45 pm	0.1
Moyamba	9/2/18	2.20 pm	0.1
Mattru Jong	10/2/18	12.10 pm	0.2
Bumpeh	10/2/18	4.50 pm	0.0
Levuma	11.2/18	10.30 am	0.2
Koribondu Highway	11.2/18	12.05pm	1.2
Pujehun	11/2/18	2.05 pm	0.1
Senehun Ngobeh	12/2/18	9.20 am	0.0
Bo shop site	12/2/18	11.05 am	0.2
Blama	12/2/18	3.00 pm	0.4
Daru	13/2/18	3.35 pm	0.0
Gormbu	14/2/18	12.00 pm	0.4
Kenema shop site	14/2/18	2.40 pm	0.1
Lowuma - Tongo	15/2/18	12.15pm	0.9
Njiama Nimikoro	15/2/18	3.45 pm	0.0
Kimbadu	16/2/18	10.30 am	0.0
Yengema	16/2/18	1.05 pm	3.1
Mabguruka	17/2/18	11.35 am	0.0

Location	Date	Time	Average wind speed (m/s)
Binkolo	17/2/18	4.10 pm	0.0
Panlap	17/2/18	5.00 pm	0.1
Kakendema - Fadugu	19/2/18	10.45 am	0.5
Kabala radio	19/2/18	12.30 pm	0.6
Magbenteh	19/2/18	3.50 pm	1.4

5.2.2 Noise Levels

5.2.2.1 Methodology

The noise levels were recorded at potential noise/vibration sources at the selected site. A total of twenty seven (27) measurements were recorded at these sites at different times of the day using a sound level meter.

5.2.2.2 Results

Most of the sites are located within communities and as such, noise threshold considered are those prescribed for residential areas, which prescribe 55dB during the day and 45dB at night. Noise measurements were taken between 9:00am and 6:00pm daily. Values above 55dB are highlighted in red.

Location	Date	Time	Average peak noise level range (dB)
Foredugu	8/2/18	2.00 pm	39 - 47
Kambia Town	8/2/18	3.55 pm	40 - 47
Port Loko Town	8/2/18	5.50 pm	57 - 59
Moyamba	9/2/18	2.25 pm	57 - 58
Mattru Jong	10/2/18	12.15 pm	73 - 74
Bumpeh	10/2/18	4.55 pm	59 - 61
Levuma	11.2/18	10.35 am	59 - 67
Koribondu Highway	11.2/18	12.10 pm	55 - 75

Location	Date	Time	Average peak noise level range (dB)
Pujehun	11/2/18	2.10 pm	55 - 64
Senehun Ngobeh	12/2/18	9.25 am	40 - 49
Bo shop site	12/2/18	11.10 am	68 - 70
Blama	12/2/18	3.05 pm	45 - 54
Daru	13/2/18	3.40 pm	44 - 49
Gormbu	14/2/18	12.05 pm	44 - 53
Kenema shop site	14/2/18	2.45 pm	51 - 56
Lowuma - Tongo	15/2/18	12.20 pm	40 - 49
Njiama Nimikoro	15/2/18	3.50 pm	45 - 50
Kono shop (generator)	16/2/18	10.00 am	72 - 73
Kimbadu	16/2/18	10.30 am	40 - 51
Yengema	16/2/18	1.15 pm	41 - 47
Magburuka	17/2/18	11.40 am	47 - 57
Binkolo	17/2/18	4.20 pm	41 - 48
Panlap	17/2/18	5.05 pm	42 - 49
Kakendema - Fadugu	19/2/18	10.50 pm	40 - 53
Kabala radio	19/2/18	12.35 pm	54 - 57
Magbenteh	19/2/18	3.55 pm	43 - 48
Makeni shop (generator)	20/2/18	10.40 am	72 - 73

Elevated noise levels exceeding prescribed thresholds cannot however be attributed solely to Orange's operations and result from a number of external factors including nearby highways/roads and community activities at the time of measurement.

Almost all the network sites visited back up battery banks as alternative power sources to generators; this greatly helps limit the noise impact from generators which are the primary noise sources at the operational areas.

5.2.3 Air Quality

5.2.3.1 Methodology

The volume of dust particulate matter found in the air (PM10) was recorded at twenty five (25) different sites, at different times. Readings were taken using a portable micro-dust pro aerosol monitoring system.

5.2.3.2 Results

The following table shows the recorded values in each location. Maximum and average values were recorded, with average values ranging between 0.001 mg/m^3 and 0.018 mg/m^3 and maximum values also ranging from 0.009 mg/m^3 to 0.353 mg/m^3.

Recorded values exceeding the recommended threshold of 0.05mg/m^3 are highlighted in red.

Exceedances were determined to be due to external factors as no dust generating activities or were being conducted or point sources identified at Orange's facilities at the time of measurements. Likely causes include to the movement of vehicles as some of the sites are close to unpaved roads, and other community activities.

Location	Date	Starting Time	Duration	Average Values (mg/m^3)	Maximum Values (mg/m^3)
Foredugu	8/2/18	14:24:37	26: 07	0.009	0.288
Kambia Town	8/2/18	16:16:02	30:31	0.011	0.140
Port Loko Town	8/2/18	18:15:44	33:08	0.007	0.141
Moyamba	9/2/18	15:26:48	26:33	0.015	0.033
Mattru Jong	10/2/18	12:27:54	38:56	0.002	0.057
Bumpeh	10/2/18	17:05:01	54:20	0.004	0.073
Levuma	11.2/18	10:59:35	30:49	0.005	0.328
Koribondu Highway	11.2/18	12:40:17	25:15	0.009	0.071
Pujehun	11/2/18	14:37:36	25:50	0.014	0.149

Location	Date	Starting Time	Duration	Average Values (mg/m^3)	Maximum Values (mg/m^3)
Senehun Ngobeh	12/2/18	09:52:12	34:09	0.001	0.096
Bo shop site	12/2/18	11:35:43	24:01	0.015	0.355
Blama	12/2/18	15:21:49	30:40	0.016	0.407
Daru	13/2/18	16:09:13	30:54	0.008	0.083
Gormbu	14/2/18	12:16:11	39:30	0.005	0.009
Kenema shop site	14/2/18	15:11:18	32:43	0.018	0.235
Lowuma - Tongo	15/2/18	12:43:08	30:06	0.009	0.353
Njiama Nimikoro	15/2/18	16:06:31	35:12	0.009	0.086
Kimbadu	16/2/18	11:00:22	36:15	0.011	0.052
Yengema	16/2/18	13:11:55	24:33	0.009	0.015
Mabguruka	17/2/18	12:04:53	40:30	0.006	0.027
Binkolo	17/2/18	16:27:29	43:52	0.009	0.011
Panlap	17/2/18	17:30:18	30:12	0.015	0.127
Kakendema - Fadugu	19/2/18	11:26:30	30:39	0.008	0.208
Kabala radio	19/2/18	12:58:25	31:29	0.010	0.281
Magbenteh	19/2/18	16:21:29	30:12	0.012	0.084

5.2.4 Ecology

5.2.4.1 Methodology

The assessment involved the following aspects: (i) Observational assessment of all the sites visited (ii) pictorial representation of vegetation at sites visited (iii) general overview of the ecology of the various regions where Orange has facilities, (iv) impact identification and mitigation of project related effects on ecology.

Information used in this section was obtained through desk studies and observational assessments on the field.

5.2.4.2 Results

General Ecology of Sierra Leone

It has been estimated that seventy percent of Sierra Leone was at one time forested. The current distribution of forests hardly conveys that, with just under five percent of the country under mature forests. Human impact on the vegetation has been the most severe, largely due to logging and slash-and-burn agriculture. Broadly classified, there are 7 vegetation types and these include moist rain forest, semi-deciduous, montane, mangrove, savannah, farm bush and swamp forests. Farm bush arises from slash-and-burn agriculture and is becoming the dominant vegetation type in Sierra Leone. The savannah is limited to the northern parts of the country and is increasingly being subjected to frequent fires. Most of the moist and semi-deciduous forests are located within protected areas, often on mountain tops and slopes.

With its high rainfall, Sierra Leone has an extensive system of rivers and swamps. A variety of mammals, birds and reptiles are found in the water, on the rocks and sandy beaches or on the trees along the riverbanks. Rivers that periodically flood and dry in the rains and dries respectively have a variety of migratory bird species that nest on the exposed rocks and sandbanks. The palm nut vulture and the West African fish eagles are birds commonly seen perched on tree sandbars. Hippopotamus, Otters (river dogs) Crocodiles, Nile monitor Lizards are common riverine species in Sierra Leone.

Description of Vegetation at Sites Visited

Vegetation in the immediate surroundings of the operational areas visited during the study is relatively limited, with typically a few trees outside the facility boundary.

Figure 5.2-2: Typical Vegetation Seen around Network Sites

Within the larger vicinity of the various facilities, vegetation could generally be described as a variety of different landscape features, dominated by farmbush (agricultural fallow land) community farmlands.

Figure 5.2-3: Farmbush Ecology

5.2.5 Hydrology

Five main rivers (Little Scarcies, Rokel, Jong, Sewa and Moa) flow from north-east to southwest, draining most of Sierra Leone's land surface. In addition six smaller basins and drainage areas (Great Scarcies, Lokko, Rokel Estuary, Western, Robbi/Thauka and Sherbro Water Resources Areas) complete the picture. FAO (Aquastat) estimate Sierra Leone's total renewable water resources as 160km^3 /year (out of 182.6km^3/year which is estimated as rain. This estimate of the nation's water resources – at 88% of mean annual rainfall - is certainly a gross over-estimate, as it fails to account adequately for evapotranspiration (Lapworth et al., 2015). Runoff is highly seasonal, reflecting the seasonal distribution of rainfall. Discharge increases from May, peaking in September and decreasing to near-zero by March.

5.2.5.1 Methodology

First hand field observations and key informant interviews with Orange security personnel and local residents were the methods employed to acquire hydrology information for the various project site.

Observations in and around the operational facility was conducted in order to identify surface/ground water resources that could be possibly impacted by the stations.

Surface water bodies were found to be a distance away from all the operational areas visited, but boreholes equipped with hand pumps existed in the majority of host communities.

5.2.5.2 Results

Boreholes are categorized into perennial and seasonal. Seasonal boreholes usually yield water for a shorter period during the crucial months of December to March. The water quality in these water wells and boreholes is good, and water uses according to community residents are generally for drinking and domestic purposes.

Transmission of electromagnetic waves from facilities will not result in any negative impact on community water sources. Possible risks from operations of this nature are related to pollution of water sources from spill and leaks on site which can seep into the soil and find its way into ground water sources, or be carried away by surface runoff into nearby surface water sources.

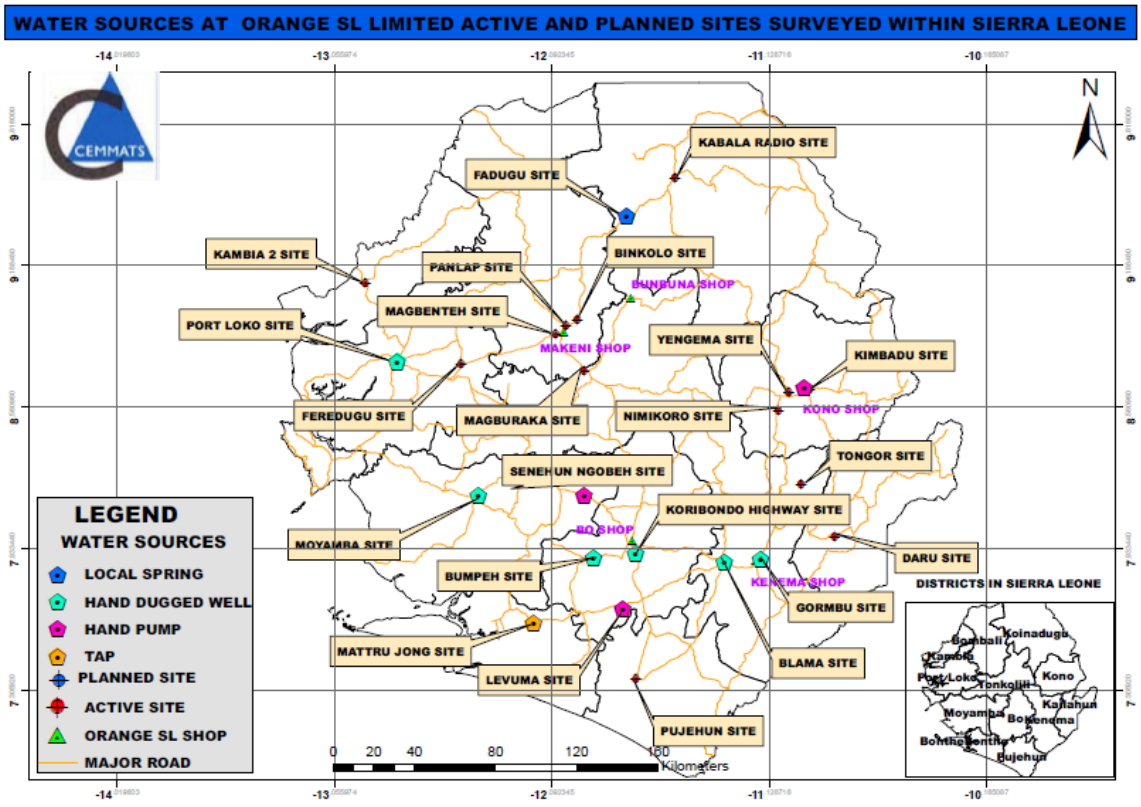


Figure 5.2-4: Water Resources within Operational Areas

6 SOCIO-ECONOMIC BASELINE DATA

This section focuses on the socio-economic characteristics of inhabitants living in the various operational areas. It gives background national information on Sierra Leone and the study area at regional levels.

6.1 National Socio-Political Context

Sierra Leone covers a total area of 71,740 km^2 and had an estimated population of 4.9 million in 2004 (Sierra Leone Population and Housing Census, 2004) but according to the 2015 Housing and Population Census result, the population has increased to 7,092,113. 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 with an HDI value of 0.413, but 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. This means that Sierra Leone has overtaken its bigger neighbour Guinea for the first time while Liberia continues to lead its two bigger Mano River neighbours on the Human Development Index.

The report further shows that 77.5% of the population of Sierra Leone (about 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 have 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). This implies that there is 65.0% loss in human development as a result of gender inequalities in reproductive health, empowerment and economic activity.

Table 6.1-1: Information on National Social Indicators

Key Social Indicators	Rate	Source
National Population	7,092,113	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

Key Social Indicators	Rate	Source
		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

Key Social Indicators	Rate	Source
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 as well as the increase in population in Freetown and provincial cities over the past decade as a result of the civil conflict (PSRP II, 2008).

From surveys done from the PRSP II document prepared by the Government of Sierra Leone, about 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 consumption 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. 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. 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 the 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. 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 11,300km 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).

6.2 Local Governance Structure

Administratively, Sierra Leone is divided into four distinct areas: the Northern Province with its headquarters in Makeni, the Southern Province with Bo as its headquarters, the Eastern Province with Kenema as its headquarters and the Western Area comprising the Freetown Peninsular with Freetown as its headquarters.

The Local Government Act 2004 is the legal framework for the effective running and administration of local councils. It makes provision for the re-establishment of local councils as they existed before 1972, when they were suspended (five town councils, 12 district councils and Freetown City Council). Through statutory instruments introduced in 2006, city status was granted to the former towns of Bo, Kenema, Koidu-New Sembehun and Makeni, and municipal status to Bonthe Town Council.

Local government operates in a single tier with 13 district councils and six city councils. All 19 local councils are governed by the Local Government Act 2004, which gives councils legislative, financial and administrative powers.

6.3 Socio-Economic Context of Operational Areas

The following information is sourced from the UN Office for the Coordination of Human Affairs, 2015 District Profiles Report.

6.3.1 Western Area

Education

Education in Sierra Leone is legally required for all children for six years at primary school level and three years in junior secondary school. A shortage of schools and teachers has made implementation impossible, although the number of children in primary education has greatly increased since the end of the civil war. Recently, the outbreak of Ebola led to the closure of schools for a prolonged time period from July 14 to April 2015. In Western Urban after the Ebola outbreak 1,120 schools were operational. As of October, 2015, 540 schools were open in Western Rural district.

Sierra Leone has a low level of literacy among adults with only 37.1% of adults literate in 2006.

Food Security

As a result of poor yields, even in rural areas, three quarters of the population rely on markets for access to food. Poverty and the exposure to international food price volatility are the underlying causes of vulnerability in Sierra Leone. The EVD outbreak has further eroded the livelihoods of both affected and non-affected communities. The total number of people food insecure in Western Urban Area is 203,659 and the percentage of household food insecure (severe and moderate) is 23.0%. While in the Western Slum Area the total population food insecure is 24,142 and the percentage of household food insecure (severe and moderate)is 40.3%. Freetown peri-urban which corresponds to the whole of the Western Area has the lowest proportion of food insecurity in the country. The total number of people who are food insecure in Western Rural Area is estimated at 53,116 and the percentage of households who are food insecure (severe and moderate) is 22.0%.

Although most food is imported via Freetown and as a consequence, the Western Area is the most import-dependent in the country, this makes it the most exposed to global market shocks and hikes in food grain prices, particularly rice. The population is involved in agriculture and urban activities such as petty trade and non-agricultural labour. The small amount of suitable agricultural land available has high value as urban demand for fruit and vegetables is high.

Health

District Health Management Team (DHMT) has registered a total of 538 staff medical and non-medical staff working in health facilities in Western Urban Area. In addition, the facilities available in Western Rural Area are 20 Community Health Center (CHC), 20 Community Health Post (CHP), 13 Maternal Child Health Post (MCHP) and 9 hospitals. Traditional medicine forms part of the primary health care system in Sierra Leone.

Water and Sanitation

Water is rationed in many areas in Freetown with almost no customers receiving a 24-hour supply and as a consequence there is limited access to safe drinking water. The rapid urbanisation that occurred mostly during the 11 year conflict made 70% of Freetown an unplanned urban slum. Linked to this is the fact that 40% of water produced by the Guma Valley Water Company utility does not generate an income, either through wastage (leakages) or illegal access through pipe breakages. Urban access to improved sanitation facilities was at 23% in 2010 (up from 22% in 1990).

Access to safe drinking water in the rural areas has remained considerably low over the last two decades, fluctuating between 26% and 35% during 1990-2008, before rising to 48% over the next two years to 2010. The sanitation situation remains poor, with rural access to improved sanitation at 9% over the last two decades. The depletion of economic and social infrastructure, combined with the deterioration in levels, access, and quality of social services during this time placed Sierra Leone in a very fragile position. In 2010, almost a fifth of rural

water points were reported as broken. The Water Point Mapping in 2012 reported that 18% of existing water points across the country was broken, while another 14% are partly damaged and currently dysfunctional. Many communities, especially the rural poor, depend on streams and swamps to gather their water; many of these dry up during periods of severe drought. During the rainy season, floods can overwhelm existing systems, contaminating drinking water, and creating sewerage overflows.

6.3.2 Southern Province

6.3.2.1 Bo District

Bo district is in the Southern Province, and borders with Kenema district to the east, Tonkolili district to the north, Moyamba district to the west, Bonthe district to the southwest and Pujehun district to the south. It is the second most populous district in Sierra Leone (after the Western Area Urban district). Bo City is the second largest city in the country and the district capital. Other major towns in the district are Baoma, Bumpeh, Serabu, Sumbuya, Baiima and Yele. The fifteen chiefdoms of the district are Badjia, Bagbwe, Baoma, Bumpe Ngao, Jaiama, Kakua, Komboya, Lugbu, Niawa, Bo, Selenga, Tikonko, Valunia, Wonde and Gbo. The district population is ethnically and culturally diverse, particularly in the city of Bo, however, over 60% of the population belongs to the Mende ethnic group. During the May-October rainy season, the district receives an average of 292cm rainfall annually.

Livelihood and Economy

The major economic activities of the district population are gold and diamond mining, other activities include trading, agricultural production of rice and root crops, cash crops such coffee, cacao and oil palm plantation. Trading is also a livelihood means for many residents as the district serves the important trade route and business hub for the south west of the country. Traditional farming is a common livelihood and family income source for the majority of the population in the country, however, less than half (49%) of Bo residents are engaged in farming activities. The Wealth Index shows only 9% of residents fall under the poorest quintile and 22% are in the medium poor category. Outside the capital Freetown, poverty was relatively consistent across the country, however Bo district with a 50.7% poverty level remained one of the lowest levels in the country. Despite a low level of poverty, the income inequality (Gini coefficient)** stands at 0.33 (on a scale 0 to 1) which is moderately high compared to the national range between the highest level 0.42 in Bombali and the lowest level 0.21 in Tonkolili.

Education

There are over 700 schools in the district, of which roughly 74% are primary schools. According to a Ministry of Education census conducted in 2013, only 17% of these schools are government owned, while the rest are run by missions and private entities.

Bo has the second highest school enrolment (78%) after the Western Area (83%), and district has one of the highest literacy rates in the country.

The Njala University is the second largest university in Sierra Leone located in Bo city. Bo Government Secondary School (commonly known as Bo School) is one of the biggest and most prominent secondary schools in West Africa.

Food Security

According to the Emergency Food Security Assessment in Sierra Leone 2015, over 57% of the district population experienc severe (10%) to moderate (47%) food insecurity.

The prevalence of chronic malnutrition among children 6-59 months is 38.5% while for the same age group the rate is 22.9%. Though malnutrition rates are relatively moderate compared to other districts, the rate remains high for the region. Food purchase accounts for 62% of household e of the district residents, which undermine the capacity to allocate other essential expenditures such as health, education and family welfare.

Health

Bo district has 117 health facilities including one Government and two Mission hospitals, 27 Community Health Centers (CHC), 21 Community Health Posts, 62 Maternal and Child Health Posts (MCHP) and 4 private clinics. According to the Ministry of Health and Sanitation (2013), on average a health facility serves 5,462 persons and has one bed for 2,061 people. The vaccination coverage is 82% among the children aged between 12-23 months old, 1.5% children of the same age group have never been vaccinated. The overall HIV prevalence rate is 1.4%, while the prevalence rate among women (1.8%) is higher compared to men (1%).

6.3.2.2 Bonthe

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 and with mainland being next to the Atlantic Ocean. The capital is Mattru Jong town. The largest city Bonthe is on Sherbro Island. The district is divided into eleven chiefdoms Bendu-Cha, Bum, Dema, Imperri, Jong, Kpanda Kemo, Kwamebai Krim, Nongoba Bullom, Sittia, Sogbeni, Yawbeko. Bonthe district is the least populous in Sierra Leone where the inhabitants mainly belong to the Mende ethnic group and the Sherbro people (native residents of the district). During the rainy season (May-November) an average 168 days have rain with annual rainfall of 366cm.

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. Sierra Rutile Limited, owned by a consortium of foreign investors, began commercial mining operations in early 1980's. The district suffered the mass exodus of IDPs when Sierra Rutile, 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).

Education

The district has over 280 schools of which 77% are primary schools. The district has a relatively high net primary enrollment (70%) compared to other districts. According to the Ministry of Education (2013), 76% of the schools in the district are community, missions 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.

Food Security

According to the Emergency Food Security Assessment 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 labor hire and labor exchange. The prevalence of chronic malnutrition among children age 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%).

Health

The government general hospital is 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 rate5 among the women (1.3%) is higher compared to men (0.5%).

6.3.2.3 Moyamba

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 namely Lower Banta, Upper Banta, Timdale, Bagruwa, Kagboro, Dasse, Kowa, Kaiyamba, Kongbora, Kori, Kamajei, Fakunya, Ribbi and Bumpe. The ethnicity of the district is largely homogeneous with the Mende forming 60% of the population, the other ethnic groups comprise Sherbro, Temne and Loko.

Livelihood and economy

Agriculture remains the mainstay of the District residents and the largest sector of economy in the 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 Gbangbatok 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).

Education

The district has over 560 schools in the district, 86% of which are primary. 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 enrollment rate (in 2013) wa 64%.

The district is the home of Hatford Secondary School for girls - one of the elite secondary schools in Sierra Leone.

Food Security

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

On an average 62% of household expenditure is accounted 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.

Health

The district has two Government and two Mission hospitals; in addition to this other healthcare support systems including 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 diarrhea 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 an average each family has 1.5 nets, not sufficient to cover the entire family needs. The overall HIV prevalence rate is 1%, the rate among women is higher (1.3%) compared to men (0.6%).

6.3.2.4 Pujehun

Pujehun district is in the Southern Province and third largest district in the country. It borders the Atlantic Ocean in the southwest, the Republic of Liberia to the southeast, Kenema district to the northeast, Bo district to the north and Bonthe district to the west. The town of Pujehun is the capital of the district. The other major towns are Gandorhun, Zimmi, Gendema, Masam, Bomi and Potoru. Twelve chiefdoms of the district are Mano Sakrim, Soro Gbema, Kpaka, Makpele, Yakemu Kpukumu Krim, Gallines Perri, Malen, Barri, Sowa, Pejeh and Kpanga Kagonde. The population is predominantly Muslim mainly belonging to the Mende ethnic group. Pujehun was destroyed during the country's civil war, and still visibly carries the marks of war.

Livelihood and Economy

Diamond mining is a major economic activity; a number of internationally owned mining corporations are operating in the district. These companies are the major employers in the district for both skilled and unskilled labour in the mining industry.

In recent years, the government has been leasing large land areas to foreign investors for the development of commercial plantations of palm oil. The agricultural production of root crops

is cassava and sweet potato, with cash crops being coffee and cacao. Pujehun is one the country's poorest and least developed districts.

Education

The district has over 300 schools in the district, 90% of which are primary schools.

Only 17% of these schools are owned by the Government while the rest are mission, community, or privately owned.

The net primary enrolment rate is 60.7% According to the student enrolment at different education levels (MoE, 2013) there has been a very drastic downtrend in the number of students (both boys and girls) between primary and the junior level of education and this trend persists into the senior secondary schools enrolment compared to the other two levels.

Food Security

30% of the district population are food insecure of which 2% are severe and 28% are moderately food insecure. According to the Emergency Food Security Assessment 2015, Pujehun is the third lowest food insecure district in the country. Food, credit and seeds are three key priority needs identified during the assessment. Food purchases accounted for the 54% of household expenditure of district residents, which is the least among all the districts.

Health

The district has 74 health facilities, only one of which is a government hospital.

Like many other districts in the country, the only hospital in Pujehun has provision of one bed per approximately 4,433 persons. Nearly 73% of children aged between 12-23 months have completed a full course of vaccinations against the most common diseases (BCG, DPT, Polio and Measles). The overall HIV prevalence rate is 0.8%, the rate is higher (1.5%) among women compared to a negligible rate .01% among men.

6.3.3 Eastern Province

6.3.3.1 Kenema

Kenema district is in the Eastern Province of Sierra Leone, the capital and the largest city is Kenema, which is the third largest city in Sierra Leone. The city is located on the railway line, in a valley of the Kambui Hills. The district is ethnically diverse, and the Mende people make up the largest ethnic group.

Politically, Kenema is a stronghold of the Sierra Leone People's Party (SLPP), the main opposition party in Sierra Leone.

Rainfall is 2,001 to 3,000 mm per year.

Livelihood

Kenema city is the centre of the Alluvial Diamond Mining Scheme Area and the site of the Government Diamond Office. Kenema is an important agricultural market town and the centre of the timber industry in Sierra Leone. The area's production of cocoa, coffee, palm oil and kernels, furniture, and wood carvings is transported mainly by road to Freetown for sale and export.

Education

In Sierra Leone, it is legally required for all children from six years to attend primary school and three years in junior secondary school. A shortage of schools and teachers has made implementation of this policy impossible. The number of children in primary education has however greatly increased since the end of the civil war in 2002. Currently, Kenema has over 739 schools 82% of which are primary schools.

Food Security

Kenema is one of the most food insecure districts in the country. The State of Food Security and Nutrition in Sierra Leone (2010) report confirmed the percentage of household as food insecure was 33.8%, exceeding the 40% critical threshold of chronic malnutrition set by WHO. By 2014 following the Ebola Outbreak, the district recorded alarming levels of food insecurity, with more than 50% of households being food insecure.

Health

Healthcare is provided by Government, private and non-governmental organizations (NGOs). The Ministry of Health and Sanitation (MoHS) is responsible for health care. Following the civil in war in 2002, the Ministry moved to a decentralised structure of health provision to increase coverage. The District has 1 Government Hospital and various other medical facilities including community health centers (CHC), community health posts (CHP), maternal child health posts (MCHP) and clinics owned by missions, NGOs and private entities. Endemic diseases include Yellow Fever and Malaria.

6.3.3.2 Kono

Kono district is in the Eastern Province, and borders with Kenema district to the southwest, the Republic of Guinea to the east, Koinadugu district to the northeast and Kailahun district to the southeast. Its capital and the largest city is Koidu town. The other major towns in the district are Motema, Yengema, Tombodu, Jaiama Nimikoro and Sewafe. This district is divided into fourteen chiefdoms namely Fiama, Gbane, Gbane Kandor, Gbense, Gorama Kono, Kamara, Lei, Mafindor, Nimikoro, Nimiyama, Sandor, Soa, Tankoro, and Toli. The

population is religiously mixed between Muslim and Christians and home to many ethnic groups. During the decade long civil war (1991-2002), heavy fighting caused many people to flee their homes and there was widespread looting. The rich reserves of diamonds in the area were one of the main reasons for the fighting.

Livelihood and Economy

Kono district is the largest diamond producer in Sierra Leone, gold and alluvial diamond mining are important economic activities of the residents. Although agriculture has not been the main source of livelihood of the majority (less than 30% rely on farming), in some areas rice, cassava, corn, and beans are grown and small groups of residents grow coffee, cacao and palm oil. The diamond mining industry has attracted many people from other parts of the country to settle down in Kono, making the district a cosmopolitan one. Diamonds were first discovered in the area during the 1930s. 12% of the population are in the poorest category and 30% fall into the medium poor category. Gini coefficient is 0.27 which is on the lower side (scale from 0-1).

Education

There are over 480 schools in the district 73% of which are primary schools. Only 12% of these schools are government owned. The number of students enrolled in higher level of education is considerably low at only 12 % compared to enrolment rates in primary schools (57%).

Food Security

According to the Emergency Food Security Assessment 2015 report, 44% of the district population falls under severe (10%) and moderate (34%) food insecurity. Food purchases accounted for 63% of household expenditure. The survey also revealed that 28% of household main priority need is food support followed by credit (financial support) and seeds. Chronic malnutrition prevalence rate was 31.5% (measured by stunting) among the children between aged between 6-59 months while the malnutrition rate measured by being underweight for the same age group was 14.5%, both the rates were moderately high.

Health

The district has one Government General Hospital, and several other health facilities including Community Health Centers (CHC), Community Health Posts, Maternal and Child Health Posts and Health Clinics. There are an average of 3,185 residents per health facility, and one bed per 2,389 residents. Vaccination coverage is 73.82% among children aged between 12-23 months old, 0.6% children of the same age group have never been vaccinated.

The overall HIV prevalence rate is relatively high 2.5%, among women the prevalence rate is 3.6% and among men 1.2%.

6.3.3.3 Kailahun

Kailahun is a district in the Eastern Province of Sierra Leone. Its capital and largest city is Kailahun town. Other major towns in the district include Segbwema, Koindu, Pendembu and Daru. Kailahun district is subdivided into fourteen chiefdoms. The border of the district with Guinea is formed by a section of the Moa River. The population in the district is predominantly Muslim. Rainfall in this area is 2,001 to 3,000 mm per year and vegetation is a mix of savanna, forest and secondary growth.

Livelihood

Kailahun has a mixed economy with small-scale mining and agricultural production of coffee, cacao and rice. After years of civil war (1991-2002), with a slow recovery, this district remains one of the poorest in the country.

Education

Kailahun has over 400 schools 84% of which are primary schools . The outbreak of Ebola led to the closure of schools for a prolonged period from July 2014 to April 2015. Many of the schools are in dire need of repair and do not have adequate access to water and toilet facilities.

Food Security

In June 2015, an emergency food security assessment identified Kailahun as a district with one of the highest prevalence rates of both moderate and severe food insecurity in the country (59% and 16% respectively). They reported a surge since 2011, when only 13 percent of the households were food insecure. In 2014 the Ebola outbreak coincided with the planting season and lasted throughout the crop maintenance period and critical harvesting period for staple crops (rice, maize and cassava). In the communities directly affected by the Ebola outbreak, livelihoods were impacted as a result, with irregular incomes, lower food consumption. Farmers reported decreased rice production due to a reduced farming workforce, caused by containment measures

6.3.4 Northern Province

6.3.4.1 Bombali

Bombali district is located in the northern province of Sierra Leone. Bombali is the second largest district in Sierra Leone and its capital and largest city is Makeni, which is the largest

city in the north. It compromises thirteen chiefdoms. The population of Bombali district is ethnically diverse, although the Temne and Limba form the largest ethnic groups.

Bombali is a political stronghold of the All Peoples' Congress (APC), the current ruling party in Sierra Leone; and one of the two major political parties in the country. During the war (1991-2002), Bombali was a principal former rebel stronghold and experienced considerable displacement, destruction, and trauma as a result of the conflict. While progress has been made since the conflict, particularly in restoration of state authority, the level of social services and economic recovery remains unsatisfactory throughout the district.

The provincial importance of Makeni is in contrast with its lack of basic services, such as water and power supply. The poor road network and large distances in the district have meant that limited intervention has been made in chiefdoms outside of the Makeni area, particularly in the far north. Savannah woodland is mostly found in Bombali. Approximately 90% of the cattle in the country are found in the Northern Province, predominantly in Koinadugu and Bombali districts. Range or pasture management is limited; bush fires continue to affect about 200 000 hectares of savannah woodlands annually.

Education

Bombali has 679 schools 75% of which are primary schools. Many are in need of repair and lack basic water and sanitation facilities.

Food Security

This zone is characterized by open-bush and grasslands. Rice, cassava and sweet potatoes are the staple food crops while groundnuts, peppers and tobacco comprise the main cash/non-staple crops. The percentage of people subject to food insecurity in Bombali is 25.5%.

Health

Medical services are provided by a mix of government, private and non-governmental organizations (NGOs) including 1 Government and 1 military hospital. Traditional medicine forms part of the primary health care system.

6.3.4.2 Port Loko

Port Loko district is in the Northern Province, and is the fourth most populous district in the country. Port Loko borders the Western Area to the west, Kambia district to the North, Bombali district to the East and Tonkolili district to the South. The 11 chiefdoms of the district are Bureh Kasseh Makonteh (BKM), Buya Romende, Dibia, Kaffu Bullom, Koya, Lokomasama, Maforki, Marampa, Masimera, Sanda Magbolontor, and Tinkatupa Makonteh Safroko (TMS). Lunsar is the district's largest Town, and other major towns are Masiaka,

Rokupr, Lungi, Gbinti and Port Loko town. The population is predominantly Muslim (80%) and the largest ethnic group is Temne.

Livelihood and Economy

Production of food crops, such as rice, cassava and sweet potato, are the main livelihood sources for over 80% of the population. Small scale mining also takes place. The city of Port Loko is a major trade center in the Northern Province. The areas around Port Loko are known for bauxite mining. The London Mining Company, which operates iron-ore mining in Lunsar and Marampa, is a major employer in the area. The global demand for bauxite and iron-ore slowed down recently, and this coupled with falling prices in the international market, has negatively impacted the employment sector in the mining industry. To a lesser extent, some people are engaged in cash crop production, such as coffee and cocoa. During 2013-14, the London Mining Company, jointly with the Cotton Tree Foundation, Sierra Leone, implemented a USD 115,000 agricultural project supporting the youth groups of Marampa and Mafroki chiefdoms. Hiring labor and exchange workers are seasonal activities during the plantation and harvesting season from which the farming communities generate income. Due to EVD outbreak, in 2014 that income was lost as the number of hired labor and exchange workers during the season was reduced by 29% compared to 2013. The Wealth Index (WI)4 indicates that 26% of the district population falls into the poorest quintile, while 33% fall under a medium poor rating. Port Loko has the second highest portion of households (59%) in the two poorest quintiles.

Education

Port Loko has over 680 schools, 75% of which are primary schools. Port Loko has the second highest number of schools in the country after Freetown. The majority (63%) of schools are missionary, community or private schools, with the remaining 27% government schools. The net primary enrollment rate is 57.5%. Educational attainment is higher among boys compared to girls in all three school levels. The average teacher-student ratio for the district is 1:47. The overall literacy rate is 32%. The Port Loko Teacher's College is one of the oldest and best known colleges in Sierra Leone.

Food Security

The Emergency Food Security Assessment 2015 report shows that over 52% of the District's residents are moderate to severely food insecure, while 40% are marginally food insecure. 92% of the District's residents are facing some form of food insecurity.

Crop production is the most vital livelihood source for the majority of the population, but this source of livelihood was the most adversely affected during the EVD outbreak. The Coping Strategy Index (CSI) has significantly increased from 6% in 2010 to 13% in 2015, which implies that people have reduced meal portions and/or eat less of their preferred foods. The

CSI trend is alarming and is an indication of increased vulnerability in the district. Food purchase accounts for 61% of household expenditure, which reduces the purchasing power of people. This compromises both the quality and quantity of other essential necessities, such as Health, Education, and Family Welfare.

Health

The Port Loko Government Hospital and Lungi Government Hospital are the two main heath facilities in the district. On average, one health facility serves 477,611 people, and the population per hospital is 151,249. 65%5 of children aged between 12-23 months have completed a full course of vaccination against the most common diseases (BCG, DPT, Polio and Measles), while 5% of children of the same age group did not have any vaccinations at all. During the Ebola response, a number of organizations, such as CDC, IMC, IRC, GOAL, Marie Stopes, Plan International, Partners in Health, OXFAM, UNFPA, WHO, UNICEF, WFP, IFRC, Christian Aid, Restless Development and the District Health Management Team (DHMT) were actively involved in the response, surveillance, contract tracing, quarantine, managing the treatment centers (Ebola Treatment Centers) etc.

6.3.4.3 Kambia

Kambia District is in the Northern Province, and borders with the Republic of Guinea to the North, Port Loko district to the South and Bombali district to the East. Kambia town is the largest town, and the district capital. The district population is ethnically diverse; the largest and most prominent ethnic groups are Temne, Susu, Limba, Fula, and Mandingo. The district provides a vital trade route between Sierra Leone and the neighboring Republic of Guinea. The average household size is 7 people per family. There is a wide variation in different indicators between urban and rural populations, such as the number of livelihood activities, access to education and health facilities, mortality and morbidity rates, etc.

Livelihood and Economy

The livelihood activities of the district residents are mainly farming (rice and roots crops - cassava and yam), followed by cross-border trade with neighboring Guinea. A revival of the cross-border trade in the traditional markets known as *'Loumah'* increased, from 5 in the pre-war period to 15 currently, in the towns and villages on both sides of the border. These markets attract thousands of traders and other visitors from far-off areas, including from Freetown and Conakry. People also engage in fishing and very small scale animal rearing. Men engage in fishing activities, while fish trading in the market is carried out by women. Exchange and hiring of labor is a common practice in the district particularly during the planting and harvest seasons. However, in 2014 this activity drastically dropped compared to pre-Ebola in 2013 and had a significant impact on the seasonal household income. The Wealth Index (WI)3 indicates that 43% of the district households are in the two poorest quintiles.

Education

Educational achievement is higher among boys compared to girls. The literacy rates among men and women for the district vary widely and are respectively 43% and 20%. There is a large percentage of people with no education (52% male and 64% female) while 0.9% male and 0.02% female have attained post-secondary education. There are 133 secondary schools in the district. According to the Back to School – Prepared Rapid pro Survey by UNICEF in August, 2015, (prior to the new school year) there are 424 schools in the district.

Food Security

Emergency Food Security Assessment 2015 findings indicated that the Ebola outbreak has negatively impacted the district population, affecting the vital livelihood activities of crop production (mainly rice). 71% of the district residents are moderate to severely food insecure. The report anticipated that 2015 rice production would reduce to 85 compared to 129 in 2014. The Coping Strategy Index (CSI) for the district is 7.9% compared to the national average CSI 8.9%, Ebola Virus Disease had impacted the CSI index increasing it from 7% to 12%. Food purchases accounted for the 60% of household expenditure of District residents, which undermines the capacity to allocate other essential expenditure, such as health, education, and family welfare.

Health

The main hospital is in the district capital of Kambia town; each of the 7 chiefdoms has a Health Center or Health Post. In Kambia district, the inability to pay for treatment, distance to health facilities and unwillingness to visit health facilities alone are three major barriers for women aged 15-49 years old seeking health services when they are sick. 52% of children aged between 12-23 months have completed a full course of vaccinations against the most common diseases, while 7% of children of the same age group have not received any vaccination. Acute respiratory infection (ARI), fever and diarrhea are the most common diseases among children under 5 in the district. Since the outbreak of Ebola in mid-2014, the entire health system and services provision has primarily focusing on Ebola, specifically surveillance, control, and treating the infected. New health facilities were established within hospitals and health centers (Ebola Treatment Centers) to provide treatment of Ebola patients.

6.3.4.4 Koinadugu

Koinadugu district is in the Northern Province, and borders Bombali district to the west, Tonkolili district to the south-west, Kono district to the south and the Republic of Guinea to the North East. This is the largest district in terms of geographical area, with the least population density in the country. The district capital is Kabala, which is among one of the major cities in Northern Sierra Leone. The other major towns are Sinkunia, Falaba, Fadugu

and Kurubonla. The district is divided into eleven chiefdoms, namely Nieni, Neya, Diang, Kasunko, Mongo, Wara Wara Bafodia, Wara Wara Yagala, Senqbe, Sulima, Folosaba Dembelia and Dembelia Sinkunia. The population is ethnically diverse and the major ethnic groups are the Fula (mainly in the district capital Kabala), Kuranko, Mandingo, Limba and Yalunka. May to October marks the rainy season with an average of 147 rainy days where an average of 208 cm of rainfall is recorded.

Livelihood and Economy

Agriculture is the main livelihood of more than 84% of the district population. A high proportion of households in the district are involved in cash crop production such as coco and coffee. Growing rice and vegetables are among the agricultural activities8, while a handful of families are engaged in cattle rearing. During the 2014 harvest season, hiring and exchange of labour, an important source of household income was reduced by 28% compared to 2013 season. The Wealth Index (WI) indicates that 49% of the population falls in the poorest (25%) and medium poor (24%) categories. According to the Poverty Profile of Sierra Leone5, the World Bank study findings, the district has a medium level of income inequality (0.28 Gini coefficient).

Education

The district has over 440 schools, 85% of which are primary schools. The district does not have any vocational or home economics institute. Government owned schools account for 19% while the remaining are owned by mission, community and private owners. The district has the second lowest 55% net primary enrolment4 (52% is the lowest in Kambia). There is a drastic declining trend of the number of students attending the higher level of education (from primary to junior and junior to senior secondary), in this district.

Food Security

The Emergency Food Security Assessment 2015, reported some 48% of the district residents are moderate (38%) to severely (10%) food insecure. The farmers experienced lower rice production in 2014 compared to previous years due to a reduction in the farm workforce caused by the Ebola outbreak. Irrespective of the means of livelihood, food purchases accounted for the 69% of household expenditure of district residents, which is among the highest in the country. The prevalence of chronic malnutrition among children 6-59 months is 34.4 (Stunting) for the same age group the rate is 11.7% measured by being underweight.

Health

According to the Ministry of Health and Sanitation (MoHS), there are 71 health facilities in the district including one government hospital, while the rest are Community Health Centres

(CHC), Community Health Posts (CHP), Maternal and Child Health Post (MCHP) and clinics. The data indicate that on an average one health facility caters for 4,606 people and one bed per 2,181 persons. 63.6% 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 3.9% of children of the same age group did not have any vaccinations. The overall HIV prevalence rate is 1% while the rate is 1.2% and 0.7% among women and men respectively.

6.3.4.5 Tonkolili

The district comprises eleven chiefdoms, with Magburaka as the capital, and Mile 91, the commercial center. The population of the district are predominantly Muslim, with a Christian minority. Tonkolili is strategically located in the center of Sierra Leone, and is crossed by many rivers including the Pampana River and Sierra Leone's longest river, the Rokel.

The district has both highlands and lowlands. The highlands rise up to 700 feet, and are the highest in Sambaia Bendugu chiefdom. It is from these hills that the major rivers in the district have their sources. The rest of the district is lowland which occupies a greater part of the district and is appropriate for rice production.

Roads in this region are particularly poor, as is access to markets.

Livelihood and Economy

In the past, the district was covered with thick forests, but due to increased farming activities, and the use of slash and burn methods of cultivation, the forests have gradually given way to grass lands. Tonkolili has two major industries: The Magbass sugar complex, which produces sugar and ethanol, and the Gari factory at Robinke, which processes cassava. There are other small-scale industries such as tailoring, carpentry, weaving, blacksmithing, gara tie-dye and soap making.

Education

Tonkolili has over 630 schools, 83% of which primary schools. The district suffered significant losses during the civil war in terms of educational facilities, with 66% of schools in the district completely destroyed during this period. The outbreak of Ebola further exacerbated the situation with the closure of schools for a prolonged time period from July 2014 to April 2015. Many of the schools are in need of repair and access to water and sanitation facilities.

Food Security

Tonkolili is significantly affected by food insecurity. The percentage of people who are subject to food insecurity (severe and moderate) is 74.1%. Tonkolili has a high prevalence of

acute malnutrition in women (4.6%). The EVD outbreak further eroded livelihoods of communities. Farmers in Tonkolili experienced a drop in rice production, due to a reduction in the farming workforce caused by the Ebola containment measures. As a result of unmet food needs, and a high economic vulnerability, the food security situation remains very poor.

Health

All medical care is generally provided by a mixture of government, private and non-governmental organizations (NGOs). The Ministry of Health and Sanitation (MOHS) is responsible for health care. Medical facilities include 1 Government hospital, community health centers (CHC), community health posts (CHP), maternal child health posts (MCHP) and clinics.

6.4 Results of Socio-Economic Consultations during Study

6.4.1 Methodology

The social baseline study, involving a review of available data and appropriate literature materials on the various operational areas was conducted, followed by a reconnaissance visit selected operational areas (shops, offices and network sites). Field investigations by various social experts were carried out in February 2018 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.

Consultative meetings were held with Paramount Chiefs, Section Chiefs, Town Chiefs and other host community stakeholders to get their perceptions and/or concerns of Orange's operations in their locality. These meeting were held in all the operational areas visited as shown in Figure 6.4-1.

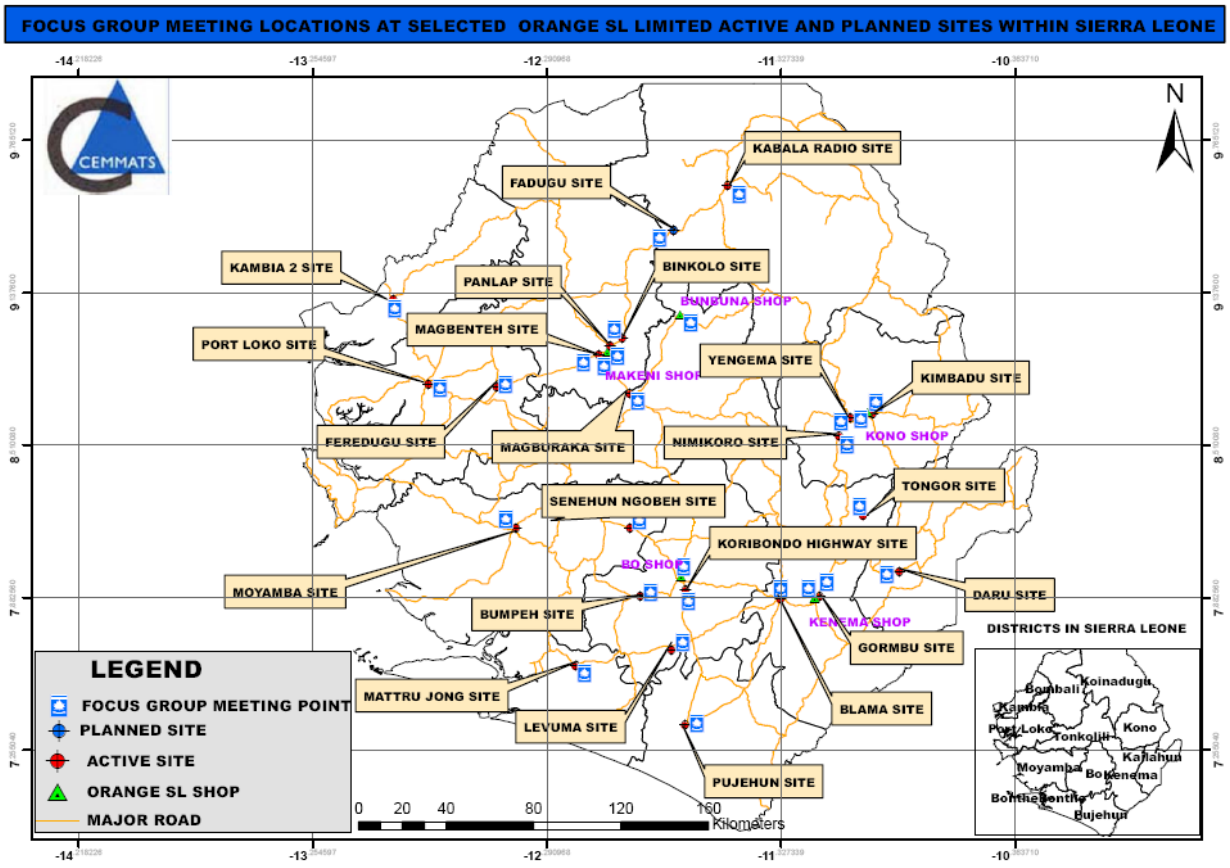


Figure 6.4-1: Locations of Focus Group Discussions

6.4.2 Results

At the start of each meeting, the CEMMATS team was introduced and an overview given of Orange's operations and the importance of the ESIA study being conducted.

The following tables provide a summary of the questions and answers fielded during the discussions in all the operational areas visited.

Table 6.4-1: Responses to CEMMATS Checklist Questions

Checklist Issue	Summary of Response
What is the main livelihood activity	Farming was the main livelihood activity, reportedly practised in every community visited. According to focus group participants, farming is done 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. Mining was reported as the primary livelihood activity in Kono and Kenema districts (particularly Koidu, Yegema, Tongo, Njaima

Checklist Issue	Summary of Response
	Nimikoro) and some parts of Bo district.
What are the secondary livelihood activities?	Secondary livelihood activities reported by participants, to support their primary livelihoods included fishing, hunting and petty trading.
Community awareness of Orange Operations.	All participants in the focus group meetings held in the selected operational areas confirmed awareness of Orange's operations in their vicinities. Participants reported the visual presence of the company's facilities and the availability of communication network in their communities as the reasons for their awareness.
Community perceptions regarding the project	All participants responded positively regarding Orange's operations and were happy to have them in their communities.
Reasons for positive outlook on Orange's operations	Some of the reasons given as to why participants viewed Orange's operations in their communities as positive include: • Availability of communications network • Employment opportunities • Reduction in transport fares as family member or business partners can be easily reached by a phone call. • Potential for increase in business activities within the communities • Increased likelihood of NGOs and other developmental organisations setting up in their communities due to the availability of mobile network. • Security lights from the facilities (network sites) brightening the environs and driving away thieves. • Provision of electricity for neighbouring houses and businesses (planned sites)
Perceived noise impacts from the Company's operations.	Most of the communities responded that noise during construction was very minimal and that no construction work was done at night. One complaint was received from the host community of the active network site in Daru (Jawie Chiefdom, Kailahun District), regarding the Company's generator which they reported needed to be serviced or replaced as the noise and smoke generated by it was becoming unbearable. They complained that they have made several complaints but to no avail.
Perceived dust impacts	None of the communities reported being affected by dust/ air pollution

Checklist Issue	Summary of Response
from the Company's operations.	from Orange's operations.
Perceived visual impacts from the Company's operations (e.g. blocking view, casting shadows, contrasting with surroundings, etc)	With the exception of focus group participants around the active site in Port Loko (Water Works Road), respondents assured that they were not affected visually by the presence of the company's facilities in their communities.
Other perceived negative impacts	Potential negative impacts resulting from Orange's operations, listed by participants when asked include: • Fear of lightning strikes when there is thunder and lightning; • Fear of towers falling on houses when there is heavy wind • Inadequate toilet facility for Orange security personnel; toilet facilities provided for security personnel at the active sites have been damaged, and security personnel rely on the toilet facilities of neighbouring houses or within host community.
Community suggestions for mitigation of perceived negative impacts	Participants proposed the following mitigation measures for the perceived negative impacts: • Orange should pay adequate compensation for loss of lives and/or property in the event of an accident resulting from their operations. • Provision of toilet facilities for workers at their network sites. • Take precautionary measures to prevent accidents during stormy weather (wind and lightning). • Orange to fix faulty security light as a few were reportedly not functioning
Development needs of Communities	Participants were asked what issues within their communities they most required external assistance with. The responses were similar in most cases and included the following: • Provision of potable drinking water sources; • Assistance in agricultural activities including provision of improved planting materials, fertilisers and tools; • Construction of community centres

Once the Focus Group Discussion checklist issues had been discussed, participants were given the opportunity to ask the CEMMATS team questions. This is a means of ensuring that any areas of concerns not captured by the checklist are covered and also assessing the participants understanding about the nature of the ESIA study.

The following questions were raised by participants from various communities.

Table 6.4-2: Responses to Questions from Meeting Participants

Community Questions	Community	CEMMATS Responses
How much does Orange pay for a piece of land to erect a pole?	Fadugu (Planned site)	Participants were reminded that CEMMATS was a consultant for Orange, dealing only with environmental and social issues relating to their facilities and operations. The question would be better addressed by Orange.
Why is it that Orange does not give light to the neighboring houses or businesses around the pole?	All sites	Provision of electricity is not within Orange's scope of operations, or part of their Corporate Social Responsibility. The Company also does not have the legal mandate to provide electricity to communities in their operational areas.
Will orange extend light/electricity to neighboring houses or villages		
Why is it that Orange network is unstable?	All active site communities	Participants were reminded about the role of CEMMATS in the ESIA study, but however assured that Orange was in the process of upgrading inherited facilities from previous operators which would eventually impact on the overall quality of service.
What will Orange do about our economic trees that are likely to be destroyed during construction of new facilities?	Fadugu (planned site)	Orange will ensure that due process in followed in land lease and compensation issues where necessary, as required by law before embarking on any development activities.
What are the chances for employment of youths in	Several sites	Telecommunication is a highly technical job that requires highly skilled labour.

Community Questions	Community	CEMMATS Responses
the host communities?		Orange will advertise job openings which will be open to qualified applicants. An employment scheme will be developed to allow for priority to be given to host community applicants who apply.
What is the life span of the pole?	Gumbu Section, Kenema	Telecommunications infrastructure are designed to last a long time and may last for 25 years or more with the correct type and frequency of maintenance.
Why does Orange deduct from our airtime even when we do not make calls?	All active and planned sites	Participants were reminded about the role of CEMMATS in the ESIA study, and advised that this was a question best directed to Orange.
What should we do in the event of fire accident from the tower and antennae equipment?	Daru (Jawei Chiefdom, Kailahun district)	The likelihood of fire occurring at the facility is very low as the facility has fire extinguishers and the security are trained in using them. In the event of a major incident, the Company's Emergency Response Plan will be effected including collaborations/communication with local authorities.

6.4.3 Picture Gallery of Community Consultations

Figure 6.4-2: Meeting with the Paramount Chief and chiefdom elders of Jawie Chiefdom, Kailahun District

Figure 6.4-3: Initial Meeting with Paramount Chief Jawie Chiefdom, Kailahun District

Figure 6.4-4: Consultative meeting with the Paramount Chief and chiefdom elders of Lower Bambara Chiefdom, Kenema District

Figure 6.4-5: Consultative meeting with the Paramount Chief of Bumpe Ngao Chiefdom, Bo District

Figure 6.4-6: Consultative meeting with the Paramount Chief of Nimikoro Chiefdom, Kono District

Figure 6.4-7: Consultative meeting with the Paramount Chief of Kolifa Rowalla Chiefdom, Tonkolili District

Figure 6.4-8: Focus Group Discussion meeting in Senehun (Bo District)

Figure 6.4-9: Focus Group Discussion meeting in Magboroka (Kolifa Rowalla Chiefdom, Tonkolili District)

Figure 6.4-10: Focus Group Discussion meeting in Binkolo (Safroko Limba Chiefdom, Bombali District)

Figure 6.4-11: Focus Group Discussion meeting in Levuma (Baogbo Chiefdom, Bo District)

Figure 6.4-12: Focus Group Discussion meeting in Fadugu (Koinadugu District)

Figure 6.4-13: Focus Group Discussion meeting in Gumbu section, Kenema

7 IDENTIFICATION OF POTENTIAL IMPACTS

7.1 Introduction

This chapter identifies and describes the potential environmental and social impacts of the operations on the biophysical and socioeconomic 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 operations, with mitigation measures recommended accordingly.

7.2 Environmental and Social Impact Assessment

7.2.1 Background

An ESIA (a combination of desk studies and on-site observations by the project team) was carried out on 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 carrying out the impact assessment:

- 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;
- 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.
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 measures.
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

Mitigation Potential	Impact Significance				Certainty of Impact
	Low	Moderate	High	Very High	
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 abandonment altogether of 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 potential environmental impacts identified for carrying out operations of this nature, and their mitigation measures are presented in the following tables.

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 construction and designs requirements are met and done in such a way as to limit the negative environmental and social impacts that could occur during operations.

During the construction stage, 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 of New Sites

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Air Quality	Dust generated from construction machinery can cause considerable nuisance to communities close to construction sites, and could cause health problems including respiratory complaints / diseases.	Likely	Moderate	Medium	- Dust minimization measures shall be implemented including watering of the construction areas. - Vehicles transporting construction aggregate will be enclosed or sheeted. - Loading, unloading and handling of dusty materials will as best as possible be done furthest away from the most immediate neighbours.	Achievable	Low	Minor
	Emissions from construction activities like fuel combustion from generators and vehicles could cause adverse impacts on air quality worker/ community health and air quality	Likely	Low	Minor	- 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.	Achievable	Low	Minor
Noise	Noise generated from construction activities include the operation of machinery, stone crushing, hammering and other, etc. This will be a source of disturbance to communities close to the construction site.	Certain	Moderate	Medium	- Construction activities producing excessive noise levels will be restricted to the day-time. - Locating and orientating equipment to maximise the distance, and to direct noise emissions away from the closest neighbours where possible; - Turning off equipment when not in use. - Maintenance of equipment and vehicles to prevent emission of excessive noise or vibration - Workers will be provided with noise protection PPE when operating noise generating machinery	Achievable	Moderate	Medium
Vegetation	Loss of vegetation	Certain	Moderate	Medium	- In general, the contractor will ensure that clearing of vegetation will be restricted to work areas only, to prevent excessive loss of	Achievable	Moderate	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	which in some cases will be permanent is unavoidable.				vegetation. - Vegetation clearance is to be undertaken using mechanical (not chemical) means.			
Soil Erosion	Soil erosion is likely to occur as a result of site preparation and vegetation clearing in new construction areas, resulting in the exposure of loose soil. Eroded soil can block drains and also end up in watercourses, affecting water quality.	Likely	Moderate	Medium	- Area to be cleared will be kept to the minimum necessary to prevent disturbance of soils outside the facility boundary. - Vegetation along drainage lines and gullies will be protected where practicable to provide natural attenuation of flows. -	Achievable	Low	Minor
Hydrogeology	Excavation, land clearance and development of construction sites could give rise to interruption of hydrogeological conditions.	Unikely	High	Medium	- Avoid, as far as possible locations where springs occur, or the water table is close to the surface.	Achievable	Low	Minor
Water Quality	Pollution of water resources may arise at construction sites due to accidental spillage or leakage of polluting materials (fuel, paints, chemicals, etc). Pollution may also occur as a result of poor waste management with	Likely	High	Major	- The construction contractor will be contractually required to take all reasonable precautions to prevent and clean up all spills / leaks. - The Waste Management Plans will be implemented including effective housekeeping and waste storage measures.	Easily Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
	waste being carried off into nearby water sources by surface water, wind, etc. Such pollution adversely affects those who depend on local water resources.							
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.	Likely	High	Major	- The construction contractor will implement waste management and environmental health and safety plans to limit water pollution. - 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. The construction of communication towers may result in increased bird collisions.	Certain	Moderate	Major	- Vegetation clearing will be strictly confined to the areas where their presence would otherwise affect the construction work. - Construction workers will be strictly forbidden from killing animals or engaging in hunting, selling or purchasing of bushmeat during work hours around the project area.	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 all construction sites 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. - Where possible, wastes will be re-used. - Burning of waste will not be permitted	Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
					- Construction personnel will be trained in the appropriate management of waste. - Waste materials that can be safely reused or recycled may be donated to local communities following an appropriate risk assessment.			
Visual Impacts	Changes in landscape due to construction and installation of facilities could be a cause for concern or dissatisfaction in surrounding communities.	Likely	Moderate	Medium	- Community consultations will be carried out so that they understand what the development will involve to prepare them for the visual impact.	Difficult	Low	Moderate
Occupational Health and Safety	Injuries at construction work-sites include falling from heights, getting hit by 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 installation of communication towers and electrical components include exposure to live current and electromagnetic waves.	Likely	High	Medium	- An appropriate OHS management system will be implemented. - 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 and communications infrastructure installations.	Achievable	Moderate	Minor

Environmental / Social 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 new operational areas, resulting in a permanent loss of access to these areas.	Certain	High	Major	- Land lease arrangements will be made for any community land to be utilised during this phase. - Crop compensation will be undertaken where required in advance of the construction process. - Once the construction phase is concluded, the contractor will be required to ensure that the project area around the new facility is made safe, including the removal of all wastes, demolition and removal of unwanted structures, clearing away of any contaminated soils, etc	Achievable	Moderate	Minor
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)	Likely	Moderate	Minor	- 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. - Unskilled labour will be preferentially hired from the local communities. - Opportunities for sustainable local procurement of goods and services to support construction will be identified wherever possible and measures will be devised to maximize the potential for these opportunities.	Easily achievable	High	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 modifications and inclusions will be made to better address issues based on experience. This section describes the impacts likely to occur during operations.

Table 7.2-7: Environmental and Social Impacts and Mitigation Measures during Operations Phase

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Air Quality	Emissions from generators and vehicles could cause adverse impacts on air quality worker/ community health and air quality	Likely	Low	Minor	- 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.	Achievable	Low	Minor
Noise	Noise generated from operations will mostly emanate from generators which may be a source of annoyance to immediate neighbours.	Likely	Moderate	Medium	- Turning off generators when not in use. - Maintenance of Generators to prevent emission of excessive noise or vibration	Achievable	Moderate	Medium
Water Quality	Pollution of water resources may arise during operations from accidental spillage or leakage fuel/oil. Pollution may also occur as a result of poor waste management with waste being carried off into nearby water sources by surface water, wind, etc. Such pollution adversely affects those who depend on local water resources.	Likely	High	Major	- Workers in operational areas (office/ shop/ network site) will be required to take all reasonable precautions to prevent and clean up all spills / leaks. - The Waste Management Plans will be implemented including effective housekeeping and waste storage measures.	Easily Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
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 in all operational areas for the disposal of the various types of wastes. These bins will be clearly marked to facilitate segregation at source. - Separation of domestic and hazardous waste at the source shall be strictly enforced. - Arrangements will be made with a local waste management company for collection and disposal of domestic wastes. Hazardous wastes e.g. waste/ used oil, used batteries, electrical and electronic wastes will be safely stored in designated storage areas until a suitable disposal option becomes available. - Burning of waste will not be permitted - Company personnel will be trained in the appropriate management of waste. - Waste materials that can be safely reused or recycled may be donated to local communities following an appropriate risk assessment.	Achievable	Low	Minor
Occupational Health and Safety	Occupational health and safety issues during operations include exposure to electric current, electromagnetic fields, trips, falls, and other activities related to operation and maintenance of facilities.	Likely	High	Medium	- An appropriate OHS management system will be implemented. - Company personnel involved in technical operations 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 maintenance of equipment and machinery.	Achievable	Moderate	Minor
Community Health and Safety (Exposure to EMF - Microwave and Radio Frequency	Health risks associated with the exposure of humans to EMF from telecommunications equipment.	Unlikely	Low	Minor	- The consensus of the scientific community is that the power from these mobile base stations antennas is far too low to produce health hazards as long as the general public are kept away from direct access to the antennas (Dawoud, 2003). - Orange equipment are sourced from reputable telecommunications manufacturers and are designed to emit EMF within prescribed	Easily Achievable	Low	Minor

Environmental / Social Aspect	Impact Description	Certainty of Impact	Significance	Pre-Mitigation Impact Category	Mitigation / Enhancement Measure	Mitigation Potential	Significance	Post-Mitigation Impact Category
Radiation)					industry standards. - Network sites will be restricted to communities; related signage and security is in place to prevent unauthorised access.			
Community Grievances	Grievances may be generated in host or neighbouring companies as a result of company activities, unrealistic expectations about the company's presence in communities, etc. If allowed to continue, these grievances could escalate and into physical/ legal action which could interrupt or affect operations.	Likely	Moderate	Medium	- Regular community consultation to ensure that communication lines are open between communities and the company - Creation of a grievance mechanism which will serve as a means through which complaints can be relayed and handled by Orange. - Implementation of Community Development Action Plan activities will help mitigate	Achievable	Low	Minor
Community Benefits from Project	Job Opportunities for skilled and unskilled members of the community Business opportunities to provide goods and services to employees (e.g. food and drink) Benefits from community development activities	Likely	Moderate	Medium	- Management will seek to hire locally wherever possible, in order to maximise the benefit distribution and social acceptability of the project. Unskilled labour will be preferentially hired from the local communities. - Opportunities for sustainable local procurement of goods and services to support operations will be identified wherever possible and measures will be devised to maximize the potential for these opportunities. - Implementation of the CDAP	Easily Achievable	High	Positive

8 SUMMARY AND CONCLUSION

8.1 Summary

8.1.1 Components of the ESIA

The principal objective of the ESIA is to satisfy the requirements of the local environmental regulatory body, EPA-SL for the issuance of the EIA license for the Company's operations to continue. The study involved predicting the environmental impacts of the Company's operations as described, and suggesting mitigation measures where impacts are adverse and enhancement measures where impacts are positive.

The investigations of impacts on the social environment were a crucial part of the study, since Orange's operations may impact on host communities. The investigation of social impacts has involved the following:

- A baseline socio-economic study of districts and communities hosting Orange's facilities through desk studies and literature review.
- Undertaking stakeholders' focus group discussions to sensitise community stakeholders about the company's operations.

The study reports are presented in two volumes comprising:

- Results of the Environmental and Social Impact Assessment (ESIA) of the company's facilities, methodologies and activities;
- An Environmental Management Plan based on mitigation measures proposed in the ESIA entailing the following:
  - Formulation of a Community Development Action Plan (CDAP) from socioeconomic analysis and stakeholder discussions;
  - Description of the stakeholder, interested and affected parties engagement process in a Public Consultation and Disclosure Plan.

8.1.2 Key Assessment Findings

8.1.2.1 Physical Environment

There are potential impacts during daily operations relating primarily to air quality and noise. During the construction of new facilities, other construction-related impacts are likely to occur including impacts on soil and water quality. 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 loss of flora and fauna species during land clearing and preparation of sites for new facilities. However, the scale of these impacts in any one location is quite small, and it is not expected that any species will be permanently eliminated in any area as a result. During daily operations, impacts on ecology is negligible. Mitigation measures have been presented to ensure that minimal clearing is carried out to during any construction activities, to limit the extent of biodiversity loss.

8.1.2.3 Socio-Economic Environment

Perhaps the most critical aspect of the operations on communities is the visual impact, loss of land (construction of any new facility), potential conflict from issues related to job opportunities, and unrealistic expectations held by residents of host communities with regards to benefits created by the company's operations in their communities. Potential impacts on communities from exposure to electromagnetic fields is extremely unlikely, with the Company's use of equipment designed and maintained to emit radiation within industry prescribed radiation thresholds. Additional measures to keep communities away from Company facilities, through signage and security further limits the potential for community exposure.

The implementation of the Community Development Action Plan and Public Consultation and Disclosure Plan will ensure limit the likelihood of grievances developing and keep communities informed about any new operational developments.

8.1.2.4 Occupational Health and Safety

Inimical hazards exist mainly in relation to exposure to electric current and radiation. These risks are however minimised through various mitigation measures including the use of advance technology with lower radiation emissions, regular training of engineers and technicians, provision of required personal protective equipment and job safety analyses.

8.2 Conclusion

During the study, no adverse impacts were identified which would render it unadvisable for the Company's operations to continue. Impacts observed and predicted can be contained or minimised through the implementation of mitigation measures outlined in these reports.

A monitoring system must however be put in place to ensure that management practices for mitigating negative impacts and enhancing those that are positive be effected. It must however be ensured that recommendations made in the Environmental Management Plans are followed through

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