CEC Africa (SL) Western Area Power Generation Project

CEC AFRICA (SIERRA LEONE)

Volume I: Environmental, Social and Health Impact Assessment Review and Update:

Project Report

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CECASL Western Area Power Generation Project (WAPGP) – Volume I: Environmental, Social and Health Impact Assessment Review and Update: Project Report

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Distribution List

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1 Introduction and Overview

1.1 Introduction

The CECA SL Generation Limited (CECASL) is a Special Purpose Vehicle established in 2014 to develop an electricity-generating, Heavy Fuel Oil (HFO) fired power generation plant on a Build Own Operate and Transfer (BOOT) basis on a parcel of land located 4km east from the center of Freetown. This project has been given the name "Western Area Power Generation Project" (hereinafter, the project). An Environmental, Social and Health Impact Assessment (ESHIA) was undertaken for the project in 2015. In 2019, the project has been restructured from an HFO-fired power generation plant to a Liquefied Petroleum Gas (LPG) / combined cycle plant.

CECASL has retained Princeton Energy Resources International (PERI) to perform the Environmental, Social and Health Impact Assessment (ESHIA) of the project under a United States Trade and Development Agency (USTDA) Grant. This study is being done in order to comply with the environmental regulations of Sierra Leone under the Environmental Protection Agency of Sierra Leone (EPA-SL) The ESHIA will also meet the requirements of International Financing Institutions (IFIs) as generally defined in the International Financing Corporation (IFC) Performance Standards for Environmental and Social Sustainability ('IFC Standards' or 'the Performance Standards') and the Environmental, Health and Safety (EHS) Guidelines of the World Bank Group (WBG).

This ESHIA presents a statement of the likely social, environmental and health effects of the project and includes a description of the measures that are required to be implemented in order to avoid, reduce and where possible, remedy any identified significant adverse effects.

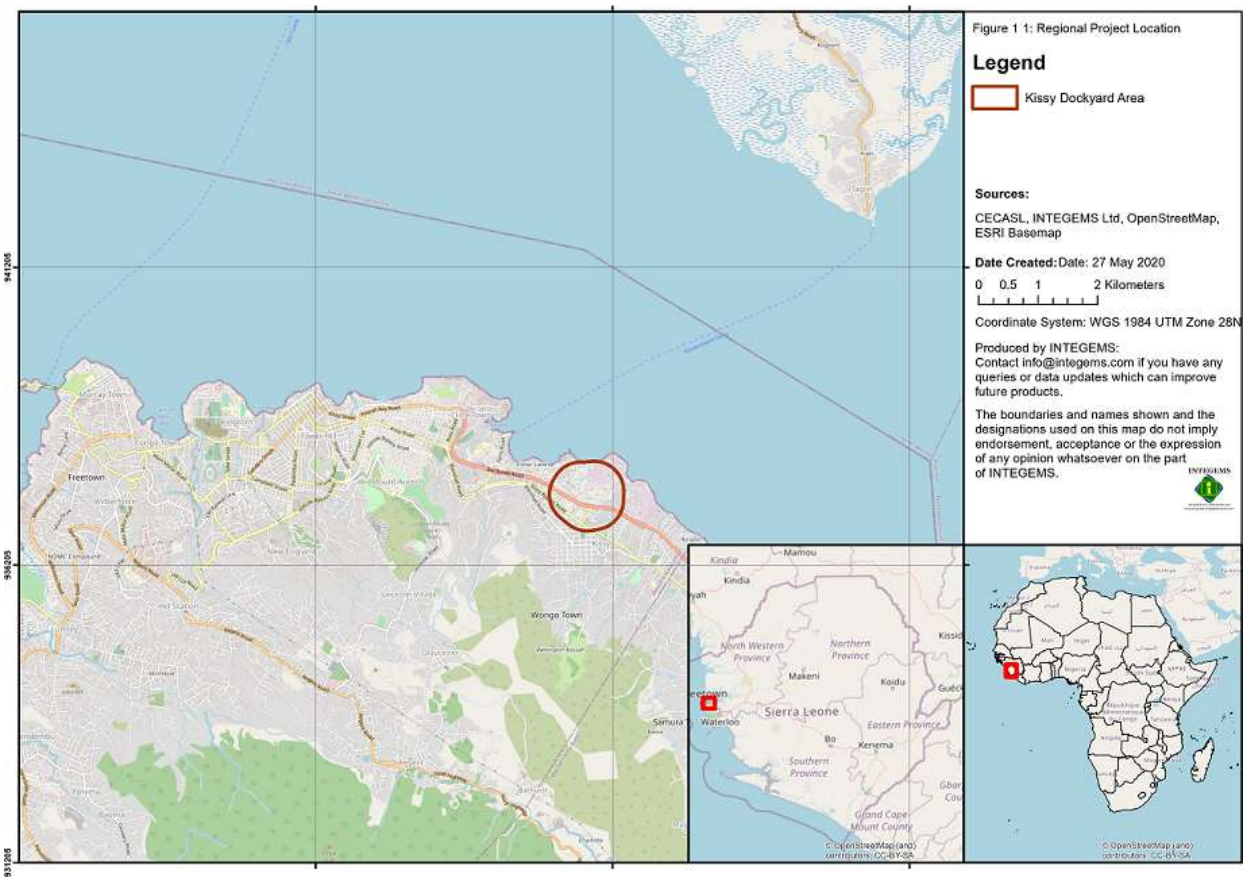
This submission comprises two parts, as follows:

- Volume I – Non-technical summary (NTS) and ESHIA main report text (this document)
- Volume II – Appendices

1.2 Project Overview

The project is located on a site in the Kissy Dock area, approximately 4km east of the center of Freetown, Sierra Leone. In the first phase of the project an 89-MW CCGT power block will be fueled by Liquified Petroleum Gas (LPG) delivered to the site via a new interconnecting pipeline and will be stored in horizontal tanks that are mounded in earthen berms for enhanced fire protection. To meet emissions requirements, the project will draw seawater from a beach well near Cline Bay and discharge brine east of the Jetty. Currently, power is to be evacuated at 33-kV to the Blackhall Road and Ropoti substations via existing overhead transmission lines that pass over the Site. A final determination will be made after the Grid Impact Assessment has been completed. The location of the site is shown in Figure 1.1.

Figure 1.1 Regional Location



The LPG is planned to be imported via the PetroJetty, which was constructed in 2015, north of the site via an approximately 1300 meter pipeline. The pipeline will be constructed on an elevated base or pipe rack within the existing right of way (RoW) and within the secured areas of the NP compound and former disused refinery

Figure 1.2 Project Site Location

The power will be exported to the national transmission and distribution network, which is owned and operated by the Electricity Distribution and Services Agency (EDSA). It is intended that building the power plant capacity in stages will allow for the concurrent development of evacuation capacity within the grid through projects such as the World Bank-funded, Energy Sector Utility Reform Project (ESURP), which aims to rehabilitate the grid.

The EDSA and GoSL will jointly purchase the power produced by the plant on the basis of a PPA that is currently being renegotiated.

1.3 The Project Sponsors

The Project is sponsored by a consortium of two firms, each with a 50% shareholding: Milele Energy and TCQ Power Ltd.

Milele Energy is an independent power-generation company head quartered in Nairobi with offices in the US and South Africa. Milele's vision is to provide clean, cost-effective electricity to Sub-Saharan Africa through investments in new sources of reliable energy. Milele — meaning "forever" in Swahili — invests in developing, owning, and operating solar, wind, geothermal, hydroelectric as well as conventional power-generation facilities. The company is an initiative of Everstrong Capital, a U.S.-based asset manager.

TCQ Power (TCQ) was established in January 2012 to acquire, build, develop, and operate power projects in Africa. It was set up by the Nasser family, who have experience in construction through their firm Target

Engineering Construction Co., which is based in the United Arab Emirates. In December 2008 Target Engineering was sold to Arabtec Holding PJSC for more than US$ 200M to form TCQ Power.

In anticipation of future international funding, the project will be designed to meet the requirements of the IFC Standards and WBG EHS Guidelines.

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1.4 Project Context

In September 2017, The Government of Sierra Leone Minister of Energy released an Electricity Sector Reform Roadmap (2017-2030). This roadmap cites the evacuation capacity to Freetown was assessed at 42MW, with distribution losses assessed at 35% in 2016. In 2015 the estimated demand for electricity was 256MW with a national generation capacity of 78.5MW leaving a large deficit.

The Electricity Sector Reform Roadmap provided key actions to be taken in short-term (2017-mid 2020), mid-term (2020-2025), and long-term (after 2025). A draft roadmap for reform for each term is shown in Appendix U. The CECASL Western Area Power Generation Plant represents a priority development that is urgently needed to support Sierra Leone's continued economic development.

In addition to the need for new generation, significant replacement / rehabilitation work to Sierra Leone's high voltage electrical distribution system is needed. The presentation "CEC Africa SL Emergency Scope Overview" (dated May, 302013) indicated that the Sierra Leone distribution system consists of a limited 161kV system, a 33kV system (much of which does not function) and an 11kV system. The consequence of this is that the 11kV system is utilized to transmit power over significantly longer distances than is desirable, resulting in increased transmission losses.

The project has been in development since early 2013 and the ESIA was initially commenced in December 2013. From June 2014 the Ebola crisis in West Africa significantly impacted Sierra Leone and prevented continued survey work. That ESHIA was completed in 2015 and approved by EPA SL. In 2018 the WB exited the transaction (after being its guarantor) given that it no longer wants to fund HFO projects. The project has since then been restructured as an LPG Combined Cycle Plant. Given this change in the design of the project the ESHIA had to be redone. CECASL has thus proceeded with this ESHIA in order to support ongoing project financing and technical design discussions.

The approach under the COVID-19 conditions during this period has been to focus the preliminary ESHIA on the key project issues required in order to progress the design. An assessment of issues of lower sensitivity / risk is included where information allows, but some are addressed as actions within the Environmental and Social Management Plan (ESMP). The ESMP is presented within Volume II of this submission.

Detailed mitigation will be developed and included as part of the detailed design phase, and the ESMP will be reviewed and updated accordingly at that stage. This approach has been agreed to by the project lender DFC.

1.5 Project Objectives

According to a 2006 report by the European Commission, Sierra Leone's energy production, supply and current utilization have serious implications for Sierra Leone's economy and environment. Bio-energy is the

main source of fuel for approximately 75% to 80% of the country's population (both rural and urban). Petroleum, hydropower, and coal are the major source of commercial energy in the country. The electricity sub sector contributes about 0.6 per cent of total energy consumption. Blackouts and power rationing, as a result of low water levels in the hydro dams are currently common. Power supply is restricted to mines or the major towns, where it is irregular and does not provide for minimum requirements. Aside from the project, hopes for improvement focus on the rehabilitation and expansion of the Bumbuna Hydro Power Plant.

According to the Sierra Leone Ministry of Energy, the following key goals have been identified for attainment by the year 2030:

- 99% of the population should have access to individual electricity supplies (in 2017 access was around 30%);
- 85% access to electricity in rural areas by 2030 (in 2017 this was 13%);
- Integration of the electricity grid with neighboring countries; and
- Establishment of a framework for development and growth in the sector.

The primary objective of the project is to provide additional reliable and efficient electricity-generating capacity in Sierra Leone.

1.6 Project Scoping

The findings of the ESHIA scoping phase identified the following potential impacts associated with the construction and operation of the project.

- Socio Economics
- Preliminary Health and Safety Risk Assessment
- Noise
- Air Quality
- Desalination Plant
- Soils, Geology, Hydrogeology and Hydrology
- Ecology
- Wastes
- Traffic and Transport
- Climate
- Hazardous Materials

1.7 Report Structure

The structure of Volume I: ESHIA main report, is as follows:

Non-Technical Summary: This provides an overview of the project, potential environmental impacts and proposed mitigation and monitoring strategies.

Section 1, Introduction and Overview: This section provides an introduction to the project, the findings of the screening and scoping assessment and an overview of the project objectives.

Section 2, Project Description: This section provides a description of the new development (including construction and operation) and an overview of the project location and its surroundings.

Section 3, Policy, Legal and Administrative Framework: This section summarizes the key elements of national, local and international legislation and standards that apply to the project.

Section 4, Socio-Economic Baseline: This section presents the socio-economic baseline conditions of the project area as identified by desk-based studies and supplemented by site visits.

Section 5, Physical Environmental Baseline: This section presents the baseline environmental conditions of the project area as identified by desk-based studies and supplemented by site visits.

Section 6, Environmental, Social and Health Impact Assessment Methodology: This section details the criteria applied to the assessment of potential impacts arising from the project elements described in the Section 2. It provides definitions of impact magnitude and significance as they apply to the potential effects on environmental aspects.

Sections 7 through 16, Impact Assessments and Mitigation: These sections present the likely impacts of the project elements on the identified social and environmental aspects:

- Section 7 – Socio Economic;
- Section 8 – Preliminary Health and Safety Risk Assessment;
- Section 9 – Noise;
- Section 10 – Air Quality;
- Section 11 – Desalination Plant;
- Section 12 – Soils, Geology, Hydrogeology and Hydrology;
- Section 13 – Ecology
- Section 14 – Waste
- Section 15 – Traffic and Transport
- Section 16 - Climate

Section 17, Hazardous Materials (Hazmat Management): This section presents hazardous materials that may be encountered and the preventative measures and mitigation plans that will be used.

Section 18, Environmental and Social Management Plan: The ESMP presents the social and environmental management, mitigation and monitoring measures, including roles and responsibilities, identified in Volume I by the ESHIA process as required to be undertaken during project implementation and operation to implement the mitigation actions and reduce adverse environmental and social effects to acceptable levels and to enhance potential benefits.

Section 19, Stakeholder Consultation: This section presents the consultation that has been conducted for the project and includes a proposed plan for consultation moving forward.

Volume II: Volume II: Appendices contains further information which supports Volume 1 of the ESHIA.

Cumulative impacts may potentially result from implementation of the project at the same time as other identified proposed developments in the area. At this time there are no known proposed developments near the project area.

1.8 Trans-boundary Impacts

The project is not located near the national borders and is not of a scale that is likely to result in trans-boundary impacts.

1.9 ESHIA Updates

Due to the recent COVID-19 pandemic in 2020, the survey and monitoring for the ESHIA have been limited. In particular, the conditions captured during noise monitoring at certain locations may reflect potential reductions in ambient noise levels as a result of nightly curfews, reduced working activities, and reduced travel within the local area during COVID-19 conditions.

As the project progresses and detailed design is concluded, a greater level of certainty will be available regarding the project's impacts and the environmental and social aspects that will require management during construction and operation. The assessment will be revisited as COVID-19 restrictions continue to be lightened.

2 Project Description

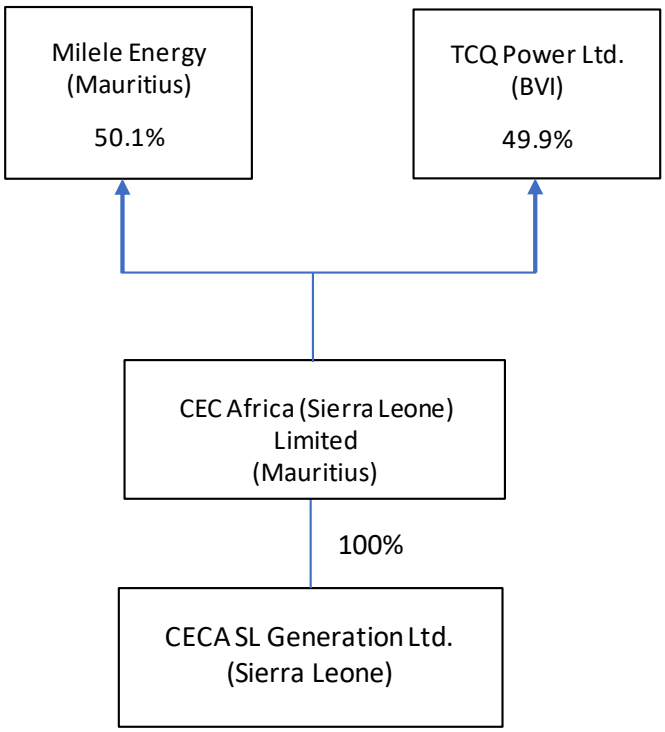
2.1 Project Ownership History

Blue Flare Power SL (BVI) Ltd. (Blue Flare) was founded to pursue opportunities for private sector investment in Freetown's electricity distribution network and power generation facilities. In July 2011, Blue Flare signed two foundational agreements with the Government of Sierra Leone (GoSL): the Grid Development and Management Agreement (GDMA) and the Power Purchase Agreement (PPA).

In 2012 TCQ Power Ltd. (TCQ) entered into agreements with the founders of Blue Flare and a Joint Development Agreement with CEC Africa Investments Ltd (CECA) was subsequently signed in April 2013. CECA has incorporated a Sierra Leonean entity named CECA SL Generation Ltd. and has re-branded the project under this name.

In 2016 the commonwealth Development Corporation acquired the shares from CECA and replaced them as the majority sponsor. In 2018, after the withdrawal of the World Bank from the project and the restructuring of the same to a Gas Powered CCGT plant, Milele Energy acquired the shares from CDC. Below in Figure 2.1 shows the current shareholding for the transaction.

Figure 2.1 Project Ownership



2.2 Project Development History

In late 2010, GoSL requested and reviewed three proposals to provide 120 MW of generating capacity for the town of Freetown. The founders of Blue Flare were amongst those invited to submit proposals for review. The technical proposal was prepared and supported by a San Francisco-based firm, Suntrough.

During initial negotiations, it was suggested that rehabilitation of the 33 kV grid was added to the scope, as a prerequisite to the generation project, due to the poor state of the distribution grid which would limit the ability of generated electricity to be delivered to customers, and therefore NPA's ability to collect payments. This proposal was set out in a power purchase agreement (PPA), grid development and management agreement (GDMA) and a Project Framework Agreement. These agreements were given GoSL Cabinet approval in July 2011.

During technical development of the arrangement, it was agreed that a staged approach to development of the generation capacity would be built up along with the increased evacuation capacity to the grid. In October 2013, meetings were held in Freetown between the Project Sponsors, The World Bank and GoSL and it was later then agreed that the WB and other donors will concentrate on increasing the distribution capacity of the grid and that the Sponsors need to concentrate on the Generation aspect. The GDMA was terminated and the PPA for the generation component was signed in May 2014 and ratified by Parliament in May 2014. In July 2014, the IFC, was appointed as the mandated lead. The financing documents were subsequently signed with the Lenders in October 2016. The sponsors went on to sign the amended PPA and Direct agreements with GoSL in January 2017 and ratified all the project agreements in December 2017. The sponsors went on closing the required conditions precedent for the project.

In December 2018, The World Bank Group having decided to stop HFO Fueled power plant developments decided to exit the project.

In conjunction with the World Bank leaving the project in 2018, CDC desired to sell their stake.

Shortly after Milele Energy executed the Sale and Purchase Agreement to take out CDC's stake in CECA Africa (Sierra Leone) Limited, a mandate letter with US DFC was signed. Since 2018 the project has been restructured from an HFO-fired power generation plant to a Liquefied Petroleum Gas (LPG) / combined cycle plant.

This ESHIA is for the generation project, though the generation project now includes an estimated 5000m transmission upgrade element.

CECA's experienced project team, including Milele and TCQ personnel, has been active in pursuing the various project workstreams necessary to reach financial close and commence construction. This ESHIA process is one of the key elements required prior to financial close.

2.3 Project Alternatives

2.3.1 'Do Nothing' Scenario

As outlined in Section 1.4:

The limitations to power supply development could adversely affect the economic development of Sierra Leone.

2.3.2 Alternative Sites

The project site was selected by the GoSL for the first development and forms the basis for the generation PPA. At this stage no further information has been identified regarding the basis of the GoSL decision on site selection. The ESHIA team will endeavor to obtain further information from GoSL on the basis for site selection as part of the baseline studies work phase.

Additionally, the government has indicated that the proposed site is the only government-owned land available in the area

2.3.3 Alternative Technologies

The original project's scope included reciprocating engines firing HFO as the most appropriate technology for the project primarily due to the absence of existing gas supply infrastructure.

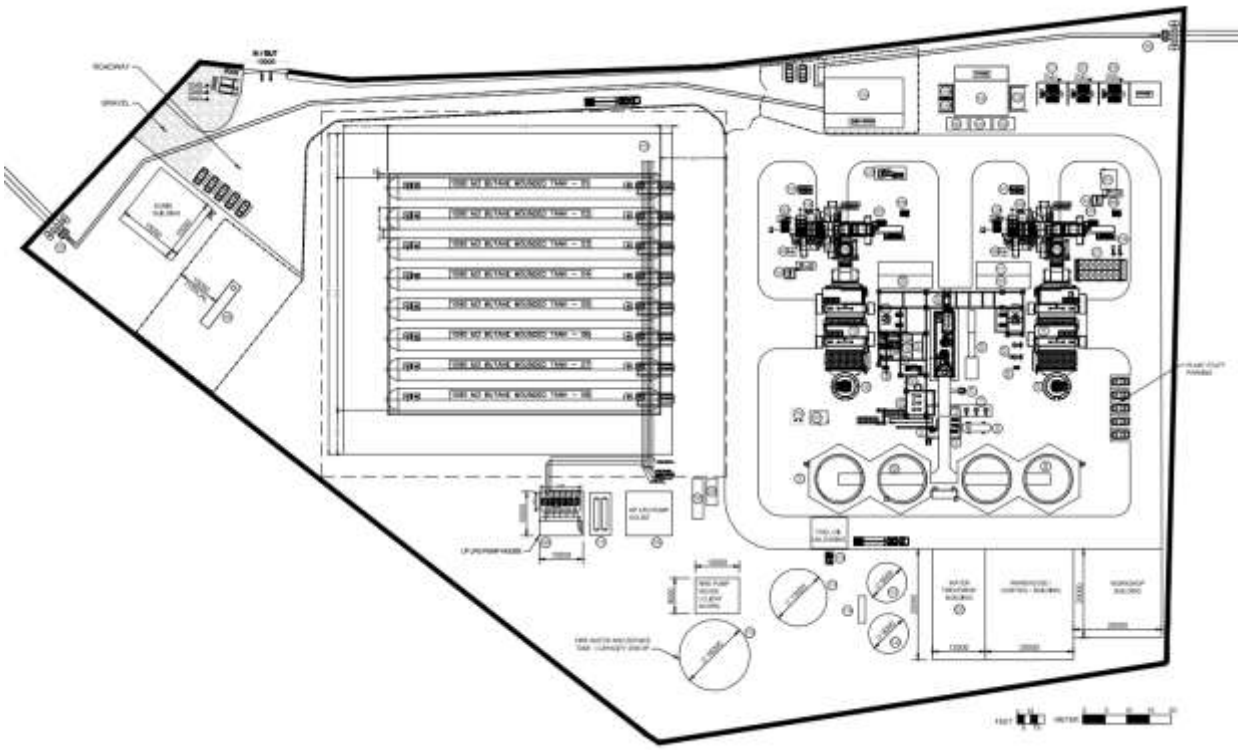
With the increase in world fuel supplies due to the shale gas boom, prices of gas have decreased to a point that they have become more cost competitive than HFO plants, in addition to the environmental benefits from the use of gas. With these improvements the sponsors opted to restructure the project to a gas-fired plant.

2.4 Key Elements of Project

The Western Area Power Generation Project will consist of two (2) combined cycle gas turbine (CCGT) power blocks with an 89.2-megawatt (MW) nominal output. The first 89.2MW CCGT power block will be fueled by LPG until LNG infrastructure is available in Sierra Leone. The LPG will be delivered by barge from the New Kissy PetroJetty. LPG will be transferred to the site via a new interconnecting pipeline and will be stored in horizontal tanks that are mounded in earthen berms for enhanced fire protection. To meet emissions requirements, the project will draw seawater from a beach well near Cline Bay and discharge brine east of the PetroJetty. Currently, power is to be evacuated at 33kV to the Blackhall RoadRopoti, and Wellington substations via existing overhead transmission lines that pass over the Site and a new transmission line that will need to built. A final determination will be made after the Grid Impact Assessment has been completed.

The plant configuration and layout shown on Figure 2.2. A higher resolution layout can be found in Appendix C.

Figure 2.2 Plant Arrangement



2.4.1 Power Station

The Project will be configured as a 2x1 combined cycle power plant (CCGT), consisting of two (2) Combustion Turbine Generators (CTGs) exhausting into two (2) Heat Recovery Steam Generators (HRSGs). The HRSG will be a two-pressure design (HP and LP) without duct firing. Steam from the HRSG will be admitted to one (1) condensing Steam Turbine Generator (STG). The steam cycle will be dry cooled using an air-cooled condenser.

The project will include a standby generator for black start capability and emergency shutdown.

The CTG exhaust gases will be used to generate steam in the HRSG.

LPG is the primary fuel for the Project, until LNG infrastructure is available in Sierra Leone, which will be delivered by ship to the New Kissy PetroJetty, located to the north of the plant. The Project includes a new pipeline that will connect the jetty LPG unloading line with the on-site storage system. LPG will be pumped to site and stored in horizontal bullet tanks, which are mounded beneath earth for improved fire protection.

Diesel fuel oil will be a backup fuel for the facility, should LPG not be available due to a delivery delay or LPG system outage. Diesel fuel oil will be brought to site by truck and unloaded into an on-site storage tank sized for one day of baseload fuel consumption.

Associated equipment will include emission control systems necessary to meet the proposed emission limits. The combustion turbines will require water injection to meet NO_X emission limits. NO_X emissions may be additionally controlled by a selective catalytic reduction (SCR) system in the HRSG. An oxidation (CO) catalyst may be installed in the HRSG to control CO emissions.

To meet needs for water injection, cycle make-up, and service / fire protection water requirements, the Project will use a desalination system. The desalination system will intake seawater near the New Kissy PetroJetty and will discharge treated wastewater to the northeast of the site at a point just offshore. Both the seawater intake and discharge pipelines will follow a common right-of-way with the LPG pipeline.

Potable water for drinking, safety showers, and sanitary uses will be served from the Project's water treatment system.

The electrical transmission interconnection will link the Project into the Sierra Leone National Grid through a 33kV Indoor Metal Clad Switchboard located at the CC Plant and two 33kV transmission lines between the CC Plant's Switchyard and three nearby substations: Ropoti to the southeast, Black Hall Road to the west and Wellington Road to the east.

Additional 33 / 11kV distribution substation upgrades will be included in the Project, as determined by the Grid Impact Assessment.

The equipment and layout of the plant is shown in Figure 2.2 and Table 2.1

Table 2.1 Project Equipment List

Equipment List	
Description (Simple Cycle)	**Description (Combined Cycle)**
GE LM2500 Combustion Turbine	Heat Recovery Steam Generator (HRSG)
Generator Circuit Breaker (GCB)	HRSG / Steam Turbine Generator (STG) Power Control Module (PCM)
Fuel Gas Filter Skid	ST Generator
Waste Drains Tank	High Pressure / Low Pressure Steam Turbine
Water Wash Cart	Feed Water Pumps
CO2 Skid	Recirculation Pump
Generator Lube Oil (GLO) Skid	HRSG Stack
Auxiliary Skid	Bypass Stack
Turbine Lube Oil/Hydraulic & Generator Lube Oil Fin Fan Cooler	Air Cooled Condenser (ACC)
Air Filter	Condensate Tank
Balance of Plant (BOP) PCM	Condensate Pumps
Raw and Fire Water Tank	Blowdown Tank with Transfer Pump
LPG Buffer Tanks	ADV
Drain Pit with Transfer Pump	ADV Pumps
Diesel Forwarding Pumps	Drain Pot Pumps
Pretreatment Tank	Closed Cooling Water (CCW) Pump Skid

Equipment List	
Description (Simple Cycle)	**Description (Combined Cycle)**
Diesel Fuel Storage Tank	CCW Fin Fan Coolers
Mounded LPG Storage Tank	Generator Step Up Transformer (GSUT) 33/11.5kV
Unit Auxiliary Transformer (UAT) 11.5kV/400V	Sampling Skid
Incinerator / Flare	Dosing Skid
Generator Step Up Transformer (GSUT) 33/11.5kV	Compressed Air Skid
Riser Tower	Start-Up Ejector
Combined GT PCM	Service Ejector
Control Module (LPG Vaporizer)	GSC
LPG Heat Exchanger	CCW Tank
Low Pressure LPG pumps	HP / LP Bypass Station
Black Start Diesel Generator	Flash Tank
Water Injection Boost Skid	STG Laydown Area
High Pressure LPG Pumps	-
11kV & 33kV Switchgear Building	Main Pipe Rack
Demineralized Water Tank	Blowdown Tank Fin Fan Cooler
Filtered Water Tank	Water Treatment Plant
Station Service Transformer (SST) 33kV/400V	
33-KV Switchgear Building (EDSA)	

A contract for operations and maintenance services for the debt repayment period of 15 years is expected to be in place from the date of commercial operation. During operations, the power plant is expected to employ approximately 60 permanent employees.

2.4.2 Plant Cooling System

The Project will require cooling systems for the steam cycle and smaller component heat exchangers.

Combined cycle and steam power plants have a heat sink in order to cool and condense steam back to liquid water as a part of the Rankine cycle. To avoid the use of cooling towers and reduce water consumption to the maximum extent practical, the Project will use an air-cooled condenser (ACC). The ACC will reject heat from the steam cycle to the atmosphere using four large fan units located near the steam turbine.

The Project will also require cooling for the combustion turbines, steam turbine, generators, pump bearings, and other miscellaneous equipment. The closed cooling water system circulates water through these component heat exchangers and rejects heat to the atmosphere using a fin-fan cooler. The fin-fan cooler is significantly smaller than the ACC but has a similar operation and was selected to reduce the water consumption of the Project.

2.4.3 Fuel

LPG will be used as the primary fuel until LNG infrastructure is available in Sierra Leone. Diesel fuel oil will be used as an emergency backup fuel.

2.4.4 Tank and Fuel Storage Area

LPG Mounded tanks will be located West of the power station. A diesel tank will be located south of the power station for emergency backup fuel.

2.4.5 Water Systems

There will be a water treatment plant in a building in the southeast area of the site. The field erected tanks will be as listed:

- Combined Service and Fire Water Tank
- Demineralized Water Tank
- Filtered Water Tank

2.4.6 Emissions to Air

The power plant will comply with the requirements for emissions to air set out in the WBG EHS Guidelines for Thermal Power Plants (WBG 2008) (see Section 3.4).

Emissions will primarily be sourced from four stacks on the Project:

1. Bypass Stack #1 – used by CTG-1 in simple cycle operation only
2. Bypass Stack #2 – used by CTG-2 in simple cycle operation only
3. HRSG Stack #1 – used by CTG-1 in combined cycle operation only
4. HRSG Stack #2 – used by CTG-2 in combined cycle operation only

The Project is primarily fueled by LPG, with diesel fuel oil as an emergency backup fuel. Demineralized water is injected into the combustion turbines to reduce NO_X emissions from the exhaust. This is the primary user of water on site and drives the design of the seawater intake, desalination, and discharge system.

At this stage of the project design, information from the potential turbine provider (GE) was used to determine the emissions to air, allowing an appropriate assessment to be carried out. During the operation of the plant, KEPCO will be responsible for guaranteeing emission levels do not exceed the maximum values. Additionally, GE will provide the exhaust characterizations for air emissions modeling. The stack height that will be used for emissions modeling will be the Good Engineering Practice (GEP) height established by USEPA (65m).

Table 2.2 Turbine Emissions to Air

Engine Type	Emission concentration (mg/Nm³)				Emission rate (g/s)			
	NOx	SO_2	PM	CO	NO_x	SO_2	PM	CO
GE LM2500 Bypass Stack	151.9	44.32	44.0 lb/hr	48.1	12.5	0.328	0.5	3.9

*Fuel Specification used from fuel sample "Site Gas Fuel#801-2994, 19634 Btu/lb, LHV"

The plant will also include an incinerator. Emissions from the incinerator will be quantified at detailed design stage and incorporated into the assessment, which would be required to confirm the detailed design and will meet WBG.

2.4.7 Noise Emissions

Noise impacts, control measures, and recommended ambient noise levels for thermal power plants are presented in Section 1.7 of the General EHS Guidelines. The WBG noise level guidelines are presented in Table 2.3. It is required that noise abatement measures should achieve either the following levels or a maximum increase in background levels of 3 dB(A). The city of Freetown does not utilize residential and industrial zoning which has resulted the area surrounding the project site to be a heavily industrialized area with fuel terminals and factories interspersed with residents that have built shanties up against facility boundary walls. The Project site was originally categorized by the original lender (IFC) as being in an industrial zone back in 2016 and an exemption was made to usual guidelines by the Lender that allowed noise levels as high as 70 dB at the Project boundary and 55 dB, daytime or nighttime, at the receptors themselves. The Project hopes to receive a similar exemption from the current proposed Lender. Regardless of which standard the Lender chooses the Project will take appropriate measures to ensure the standard designated by the Lender is met.

Table 2.3 WBG / IFC General EHS Guidelines: Noise Level Guidelines (dB)

Receptor	Daytime 07:00-22:00 hrs ($L_{Aeq\ 1hr}$)	Night-time 22:00-07:00 hrs ($L_{Aeq\ 1hr}$)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

2.4.7.1 Sound Power Levels with Standard Mitigation

Sound power data included in the modeling for this project was provided by the prospective turbine supplier (GE). As it is standard to supply power projects in urban environments with noise attenuation (such as engine halls, air intake attenuators, exhaust silencers, low-noise fans), the measures outlined in Table.2.4 have been included in the modeling labeled 'standard mitigation' scenario.

The major equipment supplier (GE) provided the sound pressure level estimates presented in Table 2.4 below. Equipment locations are provided in the Project General Arrangement Drawing.

Table.2.4 Weighted Sound Power Levels with Standard Mitigation

Equipment	Source	Total SPL, dB(A)	Mitigation Measures in Sound Model
	GT Enclosure	103	Gas turbines in standard enclosure for weather protection.
	Exhaust GT Fan	105	Standard equipment.
	Generator Package	106	Standard equipment.
Steam Turbine	Enclosure	102	Full enclosure for steam turbine generator, lube oil skid, and other auxiliaries for sound attenuation.
Heat Recovery Steam Generator	HRSG Inlet and Body	99	Standard equipment.
	HRSG Stack	90	Equipped with a silencer.
Air Cooled Condenser	ACC	106	Maximum SPL with all four fans running. Low-noise fans are specified.
Balance of Plant	Fin Fan Cooler	102	Low-noise fans are specified.
	Transformers	93	No directivity.

2.4.8 Construction Phase and Schedule

The proposed construction schedule is anticipated to be completed 24 months from financial close. At the peak of construction, the project is anticipated to employ up to 300 construction workers from the surrounding communities including Shell, Hotel 5-10, Kissy Thunderhill and Kissy Brook communities, where unemployment levels are currently high. There are currently no plans for a workers' camp.

It is currently anticipated that the site is large enough to provide required construction laydown areas for Phase 1. It is anticipated that plots of land will be available locally to be rented for use as laydown areas during construction for subsequent phases. Should offsite laydown areas be required, the EPC contract includes relevant provisions to ensure that the EPC Contractor employs standard and site-specific environmental mitigation controls in line with WBG / IFC standards for pollution prevention and control, community health and safety and potential land acquisition.

2.4.9 Pipeline and Project Infrastructure

Development for the project consists of a fuel pipeline from the Addax Jetty, where LPG will be obtained as shown on Figure 2.3. The pipeline will follow the leased plots secured by the project company and most of the route will be above ground. Sections that must cross public roadways will be buried below grade.

The pipeline will be approximately 1300m long. As shown on the General Arrangement Drawing – Figure 2.2, a pump station and buffer tank will also be constructed along the pipeline route at the coast as part of this project.

The power will be exported to the national transmission and distribution network, which is owned and operated by EDSA.

2.4.10 Site Access and Roads

Access to the site will be via South Road (See Section 15). The roads that will be used for the transport of goods will require partial regrading, and maintenance during construction. As described in Section 8.3.2 and Section 15, a Transport Management Plan will be developed which will address risks associated with

community safety. This will include measures such as raising awareness of general road safety, and in relation to the likely changes in traffic due to project construction. Appropriate checks in relation to this aspect of community safety will be included in the project audit by the contractor and the owner's engineer.

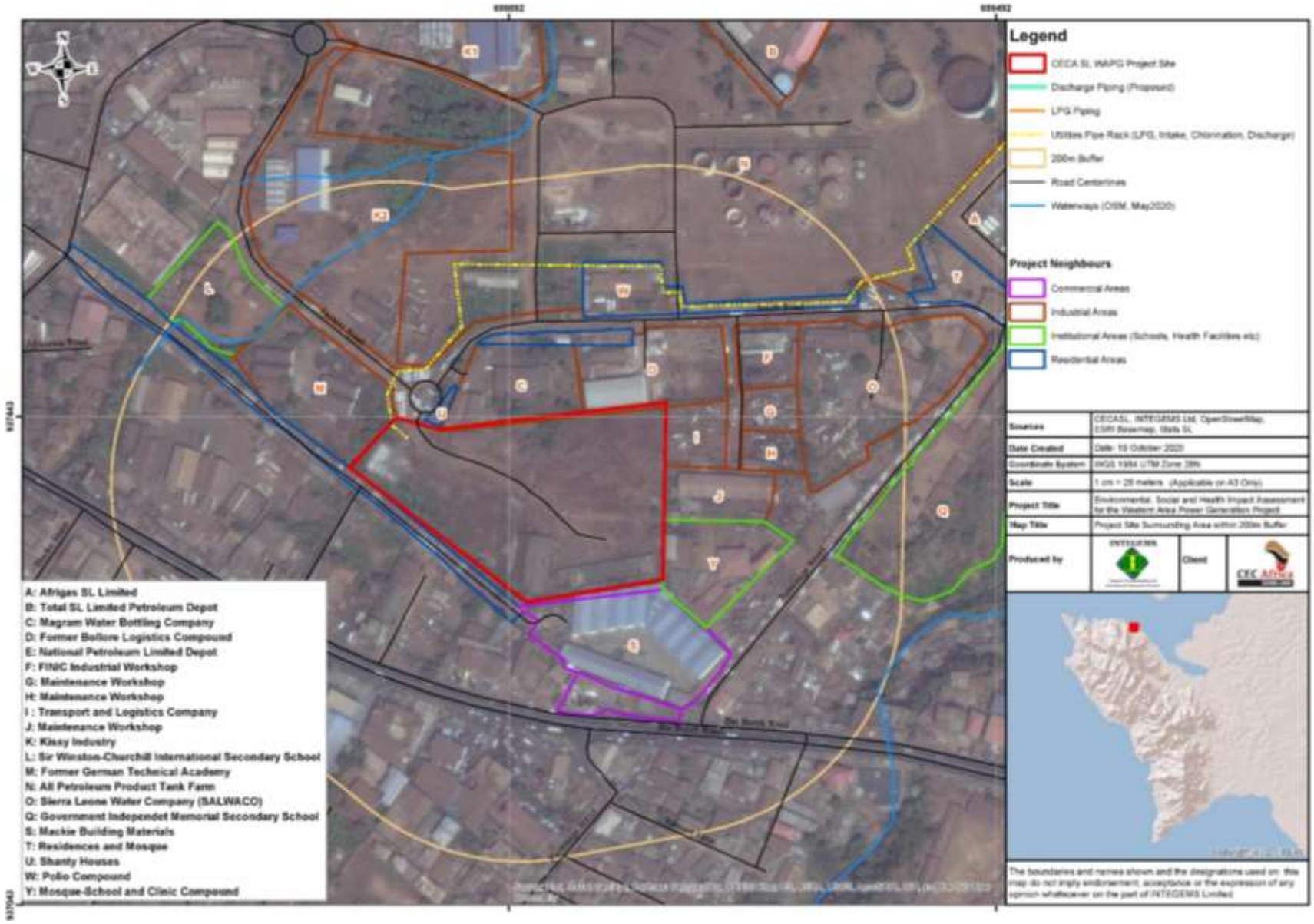
2.4.11 Project Site Surrounding Area

Land uses surrounding the site include the following:

- **North:** The All Petroleum Product Tank Farm ('N'), the Magram Water Production and Packing Factory ('C') and the former Bolloré Logistical Company ('D'). and other primarily commercial and industrial properties, reflecting the industrial zoning of the project site and local area. There is a polio treatment compound ('W') on the northern side of South Road and some residential dwellings on the southern side of South Road. There are also some shanty housing and stores located directly adjacent to the site entrance.
- **East:** North of the Mosque-School and Clinic compound, there are maintenance workshops ('G', 'H','J') and a transport and logistics company ('I').
- **West:** The former German Academy ('M') and the Winston Churchill Secondary School are located along Factory Road. There are some artisanal farming areas within the storm drain overflows along South Road.
- **South:** Mackie Building Material is directly south of the project. Additionally, there are residential buildings along the length of the western portion of the southern boundary, with a Mosque-School and Clinic compound to southeast ('Y').

In general, the area is characterized by industrial and commercial uses with some formal and informal shanty dwellings and schools dispersed between. Key features of the surrounding area are shown on Figure 2.3.

Figure 2.3 Project Site Surroundings



2.5 Associated Facilities

Associated facilities are defined in IFC PS1 as “facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable”.

PS1 states that environmental and social risks and impacts should be identified in relation to the context of the project’s area of influence including any such associated facilities, however there are no associated facilities consistent with this definition to be developed for this project.

- The pipeline is a project facility and, as such, is covered by this ESHIA
- The Addax jetty to be used is not an associated facility because it is a separate government / private sector project that is open to use by others and was not designed with the plant in mind.
- The transmission line and substations are not associated facilities as both are already existing and are being upgraded as part of a long-standing project by World Bank.
- The access road is not an associated facility as it is already in existence, but the road is covered by this ESHIA in the context of transport community risk.

3 Policy, Legal, and Administrative Framework

3.1 Introduction

Relevant identified legislation, regulations, policies, guidelines and standards from Sierra Leone and International treaties, conventions, protocols and guidance will be considered in the development of the ESHIA.

3.2 Sierra Leonean Legislation

The applicable legislation and standards from Sierra Leonean legislation are provided in Table.3.1

Table.3.1 Relevant Sierra Leonean Legislation

Legislation/ Policy	Summary	Project Relevance
National Environmental Policy 1994	The National Environmental Policy seeks to achieve sustainable development in Sierra Leone through the implementation of sound environmental management systems which will encourage productivity and harmony between man and his environment. 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 indicates inter-sectoral synergies in major areas for policy formulation. It takes into consideration major sector goals and policies for enhancing sustainability in environmental management systems.	Given that the Project is generally sensitive and covers key environmental components, this Policy will thus, promote efforts which will prevent / eliminate damage to the environment and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation.
National Energy Policy 2010	The objective of the National Energy Policy is to ensure the provision of modern energy services for increased productivity, wealth creation and improved quality of life for all Sierra Leoneans. The energy supply sub-sectors covered by this policy are electricity, petroleum, and renewable energy, with a focus on increasing modern energy supplies for Sierra Leone. The policy is geared towards increasing supplies, through a comprehensive reform of the power sector, including liberalization of the sub-sector, attracting private investments and involvement and putting in place more effective mechanisms for monitoring and control. For the petroleum sub-sector, the upstream focuses on oil exploration, while the downstream addresses measures to reduce costs, without compromising the security of supply.	The Project aims at complementing Government's efforts in the energy sector development in by increasing access to increased electricity supply in Western Area. Thus, the project is required to be developed in line with the policy commitments in Chapter 3 of the National Energy Policy of Sierra Leone.
National Land Policy 2015	The National Land Policy promotes the objectives of equal opportunity and sustainable social and economic development. The principles guiding the Land Policy include: (1) protecting the common national or communal property held in trust for the people; (2) preserving existing rights of private ownership; and (3) recognizing the private sector as the engine of growth and	CECA SL Generation has acquired a lease over the land on which the WAPG Project will be developed. The acquisition of the lease was undertaken in accordance with the National Lands Policy's provisions for Access to Land for Responsible Investment (Section 6.4).

Legislation/ Policy	Summary	Project Relevance
	development, subject to national land-use guidelines and rights of landowners and their descendants.	
Environment Protection Agency Act 2008 (No. 11 of 2008) as amended in 2010	This Act establishes the Environment Protection Agency—Sierra Leone (EPA-SL), defines its functions and powers, provides for its organization and administration, and provides rules for various matters regarding the environment in Sierra Leone. The Agency is established as a corporate body managed by the Board of Directors and an Executive Chairperson to provide for the effective protection of the environment and other related matters. It mandates the EPA among others to: • Advise the Minister of Environment on the formulation of policies on all aspects of the environment; • Issue environmental permits and pollution abatement notices for controlling the volume, types, constituents and effects of waste discharges, emissions, deposits or other sources of pollutants of substances which are hazardous and dangerous to the quality of the environment; • Prescribe standards and guidelines relating to ambient air, water and soil quality, air pollution, water, land and other forms of environmental pollution including the discharge of waste and the control of toxic substances; • Ensure compliance with any environmental impact assessment procedures laid down in the planning and execution of development projects; and • Impose and collect environmental protection levies. Part IV of the Act exclusively deals with the activities requiring Environmental and Social Impact Assessment and describes the permitting processes leading to the acquisition of an environmental license.	Given that the Project's activities would impact various Environmental and Social components within and around the Project area, CECA-SL is required to acquire an EIA License as stipulated in Part IV, Sections 23 and 24 of the EPA-SL Act of 2008 (as amended in 2010).

Legislation/ Policy	Summary	Project Relevance
National Electricity Act 2011	This Electricity Act is established as an Act to incorporate the Electricity Generation and Transmission Company (EGTC) and to establish the Electricity Distribution and Supply Authority (EDSA) to provide for other related matters. EGTC is responsible for the generation and transmission of electricity and the sale of electricity to the Authority subject to a power agreement approved by the commission. EDSA is responsible for the supply, distribution, and retail sale of electricity for the entire country exception areas in which the Commission has issued a distribution License to another appropriately qualified person.	The Project will be operating a power plant that will generate electricity with EDSA as the single off-taker through a 20-year Power Purchase Agreement (PPA). Therefore, CECA SL Generation Ltd is required to comply with the provision of Section 52 (which dictates the conduct of Independent Power Producers), Sections 55-61 (which dictates the conduct of IPPs with regards land acquisition and use) and Section 62 of the National Electricity Act of 2011 which stipulates that that environmental, social, health and safety legislation should be complied with in constructing and operating an electricity generation and supply project.
National Water Resources Management Agency Act 2017	This Act provides for the equitable, beneficial, efficient, and sustainable use and management of the country's water resources; to establish a National Water Resources Management Agency; to provide a Water Basin Management Board and Water Catchment Area Management Committees for the management of the water resources and other related matters. The Act makes provisions for how the Project is required to abstract water from the water resource points. Specifically, Part II, Section 2 prohibits the unlicensed use of raw water, while Part VII, Sections 28 and 29 outlines the procedure for a water use permit acquisition.	The Project will mechanically abstract water from boreholes or the sea for cooling of power plant engines and other ancillary operations. Therefore, CECA SL Generation Ltd is required to acquire a Water Use Permit as stipulated in Sections 28 and 29 of the National Water Resource Management Agency (NWRMA) Act of 2017, which repeals the Water (Control and Supply) Act, (Act No. 16 of 1963).
Factories Act 1974	This Act 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. It makes provision for inspection of facilities, prescribes the powers of an inspector, and sets penalties for defaulting parties.	Although the interpretation of "Factory" presented in Section 3 of the Act does not specifically include power plant construction and operation, the provisions of the Factories Act are important in the management of occupational health and safety at the WAPG Project.

Legislation/ Policy	Summary	Project Relevance
Petroleum Regulatory Agency Act 2014	This Act establishes the Petroleum Regulatory Agency, to Register, License and Regulate the efficient Importation, Storage, Transportation, and Distribution of Petroleum, to ensure its regular availability to consumers at reasonable prices and to provide for other related matters. The Petroleum Regulatory Agency is therefore responsible for issuing license and regulates the importation, refining, storage, transportation and distribution of petroleum products in a bid to ensure their regular supply to consumers at reasonable standard prices, and for the efficient administration and enforcement of the enactments relating to downstream petroleum activities. The PRA also regulates monitors and overseas petroleum and petroleum products in the downstream industry in Sierra Leone, for growth, efficiency, and stakeholder satisfaction, efficiently connecting global energy supplies, as a catalyst for economic transformation and growth in Sierra Leone.	The Project will be importing Liquefied Petroleum Gas (LGP) or Liquefied Natural Gas as the fuel in the power plant. Section 12(1) of the PRA Act of 2014 mandates the Agency to license and regulate the importation, refining, storage, transportation and distribution of petroleum and petroleum products in Sierra Leone. This implicitly implies that the Project would require a License from the Agency for the importation and storage of LPG / LNG for its operation.
Sierra Leone Local Content Policy, 2016 and the Sierra Leone Local Content Agency Act 2016	The National Local Content Policy creates an opportunity for local / indigenous businesses and individuals to maximize benefits from the increasing private investments in the country. This policy was issued to boost the economy by leveraging the power of the local industries and Sierra Leone citizens through their participation in the economy. For example, it indicates that: • In all enterprises operating in any sector of the economy; at least 20 % of the managerial and 50% of intermediate positions shall be held by Sierra Leonean citizens. The respective ratio will be increased over time and after 5 years of the establishment will stand at 60% for managerial positions and 80% for intermediate positions. • A foreign company that partners with Sierra Leonean firms will be granted preferential treatment when competing against companies with no percentage of equity share ownership by Sierra Leonean firms or citizens. That 20% of the equity shares of every registered foreign entity in Sierra Leone should belong to Sierra Leoneans. The Project should have a preference for local competence in the provision of goods and services.	The Project will be creating employment and training opportunities for people at each of its phases. To ensure maximum benefits to the local businesses and population, it is Policy of the Government of Sierra Leone to ensure that priority is given to Sierra Leonean citizens and businesses. This policy is promulgated on the in Part VIII, Sections 54 and 55 of the Sierra Leone Local Content Agency Act of 2016.

Legislation/ Policy	Summary	Project Relevance
National Protected Area Authority and Conservation Trust Fund Act 2012	This Act provides for the establishment of the National Protected Area Authority (NPAA) and Conservation Trust Fund. The purpose of the Act is to promote biodiversity conservation, wildlife management, research and to provide for the sale of ecosystems services in national protected areas. Part III of the Act states the role of the NPAA, which is to exercise oversight and authority over National Parks and Protected Areas designated for conservation purposes and to promote sustainable land-use practices and sustainable environmental management. Furthermore, section III (f) states that another function of the NPAA is to collaborate with other stakeholders in developing a national REDD+ Strategy and to promote REDD+ projects in Sierra Leone as a sustainable source of financing for protected area management. Section III (xi) promotes co-management of natural resources for the NPAA within and outside national protected areas with local forest edge communities.	The Jetty is located within the Sierra Leone River Estuary (SLRE), which is the main marine habitat within the Project Area. The SLRE is located on the Atlantic Ocean and is formed by the Bankasoka and Rokel Rivers. The estuary is the only site in Sierra Leone designated as Wetlands of International Importance (Ramsar Site)[1] and is one of four Marine Protected Areas in Sierra Leone. Therefore, considerations from NPPA would be required for the WAPG Project.
National Biodiversity Strategic Action Plan 2017	The Sierra Leone Biodiversity Strategic 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 actions proposed to cover 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; facilitate information sharing and coordinated action among the various stakeholders at the national level and foster scientific and technical cooperation with other countries and international organization.	The Project site is not located at any major area of concern for National Protected Area Network. However, there is potential that, the Project will be posing threats such as habitat loss and fragmentation of natural habitats of certain dominant terrestrial species such as lizards, green mantis, ants, earthworms, birds etc., due to the project's operations as stipulated in the NBSAP.
Local Government Act 2004 (as Amended in 2017)	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 organizations, and the private sector. The	The local authorities within and around the Project area will act as a direct representation of the central government in the locality and they will be the primary point of contact in terms of community engagement, community development and the welfare of the people in the community as stipulated in Part V, Section 20 (1 & 2) of the Local Government Act, 2004 (as Amended in 2017).

[1] The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar, 1971) is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Legislation/ Policy	Summary	Project Relevance
	local council should initiate and maintain programs 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 projects 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 project operates. Therefore, every project is required 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.	

The work of several Ministries, Departments and Agencies (MDAs) also impacts on the work of the EPA to varying degrees. These include the Ministry of Finance (fiscal and tax matters), the Ministry of Lands, Country Planning and the Environment (MLCPE), the Ministry of Local Government and Community Development (communal lands) and the Ministry of Works, Housing and Technical Maintenance (MWHTM). These ministries will be engaged with as part of the ESHIA consultation and disclosure process to ensure any relevant requirements or concerns regarding the project are considered as appropriate.

Administratively, Sierra Leone is divided into various administrative areas / units: Country, Province, District, Chiefdom, Section and Village.

3.3 International Treaties, Conventions, and Protocols

The applicable legislation and standards from international treaties, standards and regulations are provided in Table 3.2.

Table 3.2 Relevant International Treaties, Conventions, and Protocols

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
Vienna Convention on Protecting the Ozone Layer	The Vienna Convention for the Protection of the Ozone Layer was adopted in 1985 and entered into force on 22 Sep 1988. In 2009, the Vienna Convention became the first Convention of any kind to achieve universal ratification. The Vienna Convention is often called a framework convention because it served as a framework for efforts to protect the globe's ozone layer. The objectives of the Convention were for Parties to promote cooperation through systematic observations, research, and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer.	21 August 2001	29 August 2001

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	The Convention did not require countries to take concrete actions to control ozone-depleting substances. Instead, following the provisions of the Convention, the countries of the world agreed on the Montreal Protocol on Substances that Deplete the Ozone Layer under the Convention to advance that goal. The Parties to the Vienna Convention meet once every three years, back-to-back with the Parties to the Montreal Protocol, to make decisions designed to administer the Convention.		
United Nations Framework Convention on Climate Change (UNFCCC)	The UNFCCC entered into force on 21 March 1994. Today, it has near-universal membership. The 197 countries that have ratified the Convention are called Parties to the Convention. Preventing "dangerous" human interference with the climate system is the ultimate aim of the UNFCCC. The Convention recognized that there was a problem and bound member state to act in the interests of human safety even in the face of scientific uncertainty. The ultimate objective of the Convention is to stabilize greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system." It states that "such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed sustainably."	11 February 1993	22 June 1995
Kyoto Protocol to the United Nations Framework Convention on Climate Change	The Kyoto Protocol was adopted on 11 December 1997. Owing to a complex ratification process, it entered into force on 16 February 2005. Currently, there are 192 Parties to the Kyoto Protocol. The Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries to limit and reduce greenhouse gases (GHG) emissions following agreed individual targets. The Convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically. The Protocol is based on the principles and provisions of the Convention and follows its annex-based structure. It only binds developed countries and places a heavier burden on them under the principle of "common but differentiated responsibility and respective capabilities", because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere.	Acceded	10 November 2006

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	In its Annex B, the Kyoto Protocol sets binding emission reduction targets for 36 industrialized countries and the European Union. Overall, these targets add up to an average 5 percent emission reduction compared to 1990 levels over the five years 2008–2012 (the first commitment period). The Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries to limit and reduce greenhouse gases (GHG) emissions following agreed individual targets. The Convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically. The Protocol is based on the principles and provisions of the Convention and follows its annex-based structure. It only binds developed countries and places a heavier burden on them under the principle of "common but differentiated responsibility and respective capabilities", because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere.		
The Paris Agreement	The Paris Agreement builds upon the UNFCC and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort. The Paris Agreement central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity-building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework. Further information on key aspects of the Agreement can be found here.	26 September 2016	1 November 2016
Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment	The Montreal Protocol, 1987, is a global agreement to protect the stratospheric ozone layer by phasing out the production and consumption of ozone-depleting substances (ODS). The stratospheric ozone layer filters out harmful ultraviolet radiation, which is associated with an increased prevalence of skin cancer and cataracts, reduced	Acceded	29 August 2011

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	agricultural productivity, and disruption of marine ecosystems. The Montreal Protocol has proven to be innovative and successful and is the first treaty to achieve universal ratification by all countries in the world. Leveraging worldwide participation, the Montreal Protocol has sent clear signals to the global market and placed the ozone layer, which was in peril, on a path to repair. The Montreal Protocol's Scientific Assessment Panel estimates that with the implementation of the Montreal Protocol a near-complete recovery of the ozone layer can be expected by the middle of the 21st century. On October 15, 2016, Parties to the Montreal Protocol adopted the Kigali Amendment to phase down production and consumption of hydrofluorocarbons (HFCs) worldwide. HFCs are widely used alternatives to ozone-depleting substances such as hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs), already controlled under the Protocol. This amendment creates market certainty and opens international markets to new technology that is better for the environment, without compromising performance. It calls on all countries to gradually phase down their production and consumption of HFCs in the coming decades using the flexible, innovative, and effective approaches the Montreal Protocol has used for three decades. Global stakeholders endorsed the adoption of the Kigali amendment, including most of the major U.S. companies working in related sectors.		
United Nations Convention on Biodiversity (UNCBD)	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. The objectives of the Convention, to be pursued following its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding. Each Contracting Party shall, in accordance with its particular conditions and capabilities: a) Develop national strategies, plans or programs for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programs which shall reflect, inter alia, the	12 December 1994	12 March 1995

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	measures set out in this Convention relevant to the Contracting Party concerned; and b) Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programs, and policies.		
African Convention on the Conservation of Nature and Natural Resources	The African Convention on the Conservation of Nature and Natural Resources was adopted in 1968 in Algiers. Considered the most forward-looking regional agreement of the time, it significantly influenced the development of environmental law in Africa. The Convention supersedes the Convention Relative to the Preservation of Fauna and Flora in their Natural State of 1933 and has been superseded by the African Convention on Conservation of Nature and Natural Resources (revised) signed in Maputo in 2003. The objective of the Convention is to encourage conservation, utilization and development of soil, water, flora and fauna for the present and future welfare of mankind, from an economic, nutritional, scientific, educational, cultural and aesthetic point of view.	15 November 1968	Acceded
Convention on Migratory Species (The Bonn Convention)	The Convention on Migratory Species (CMS) is an intergovernmental treaty, concluded under the aegis of the United Nations Environmental Program (UNEP), concerned with the conservation of wildlife and habitats on a global scale and in particular terrestrial, aquatic and avian migratory species throughout their range. Marine debris is a significant concern for species and populations of animals that spend all or part of their life cycles in or near the marine environment. The key threats are through entanglement and ingestion, as well as from the pollutants transferred into the food chain through microplastics	23 June 1979	1 June 1983
International Convention for the Prevention of Pollution from Ships (MARPOL)	The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The MARPOL Convention was adopted on 2 November 1973 at IMO. The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered	2 November 1973	2 October 1983

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	into force on 19 May 2005. MARPOL has been updated by amendments through the years. The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes.		
Ramsar Convention on the Conservation of Wetlands	The Convention on Wetlands is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". Under the "three pillars" of the Convention, the Contracting Parties commit to work towards the wise use of all their wetlands; designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management; cooperate internationally on transboundary wetlands, shared wetland systems and shared species. The Secretariat, which carries out the day-to-day coordination of the Convention's activities is based at the headquarters of the International Union for the Conservation of Nature (IUCN) in Gland, Switzerland.	15 January 2000	13 December 1999
United Nations Convention on the Law of the Sea (UNCLOS)	The United Nations Convention on the Law of the Sea lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole. The Convention was opened for signature on 10 December 1982 in Montego Bay, Jamaica. This marked the culmination of more than 14 years of work involving participation by more than 150 countries representing all regions of the world, all legal and political systems, and the spectrum of socio / economic development. At the time of its adoption, the Convention embodied in one instrument traditional rules for the uses of the oceans and at the same time introduced new legal concepts and regimes and addressed	20 January 1914	25 May 25 1980

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	new concerns. The Convention also provided the framework for further development of specific areas of the law of the sea.		
International Convention for the Safety of Life at Sea (SOLAS), 1974	The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960. The 1974 version includes the tacit acceptance procedure - which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of Parties. As a result, the 1974 Convention has been updated and amended on numerous occasions. The Convention in force today is sometimes referred to as SOLAS, 1974, as amended.	20 January 1914	25 May 1980
Convention on the International Regulations for Preventing Collisions at Sea (COLREG), 1972	The 1972 Convention was designed to update and replace the Collision Regulations of 1960 which were adopted at the same time as the 1960 SOLAS Convention. One of the most important innovations in the 1972 COLREGs was the recognition given to traffic separation schemes - Rule 10 gives guidance in determining safe speed, the risk of collision and the conduct of vessels operating in or near traffic separation schemes. The first such traffic separation scheme was established in the Dover Strait in 1967. It was operated voluntarily at first but in 1971 the IMO Assembly adopted a resolution stating that that observance of all traffic separation schemes be made mandatory - and the COLREGs make this obligation clear.	20 October 1972	15 November 1977
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)	The OPRC was adopted in 1990 after the 1989 conference of leading industrial nations in Paris called upon IMO to develop further measures to prevent pollution from ships. Parties to OPRC are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries. Ships are required to carry a shipboard oil pollution emergency plan. Operators of offshore units under the jurisdiction of Parties are also required to have oil pollution emergency plans or similar arrangements which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents. Ships are required to report incidents of pollution to coastal authorities and the convention details the actions that are	30 October 1990	1995

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	then to be taken. The Convention calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill combating exercises and the development of detailed plans for dealing with pollution incidents. Parties to the convention are required to assist others in the event of a pollution emergency and provision is made for the reimbursement of any assistance provided. The Convention provides for IMO to play an important coordinating role.		
International Convention on Civil Liability for Oil Pollution Damage	International Convention on Civil Liability for Oil Pollution Damage, 1969 (and renewed in 1992) applies exclusively to pollution damage caused on the territory including the territorial sea of a Contracting State and to preventive measures taken to prevent or minimize such damage[2]. The Civil Liability Convention was adopted to ensure that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. The Convention places the liability for such damage on the owner of the ship from which the polluting oil escaped or was discharged. Subject to a number of specific exceptions, this liability is strict; it is the duty of the owner to prove in each case that any of the exceptions should operate. However, except where the owner has been guilty of an actual fault, they may limit liability in respect of any one incident.	1973	13 August 1993
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	The text of the Rotterdam Convention was adopted on 10 September 1998 by a Conference of Plenipotentiaries in Rotterdam, the Netherlands. The Convention entered into force on 24 February 2004 with the objectives to: • promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals to protect human health and the environment from potential harm. • contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.	Acceded	1 November 2016

[2] International Convention on Civil Liability for Oil Pollution Damage (accessed via: http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-on-Civil-Liability-for-Oil-Pollution-Damage-(CLC).aspx, 24 august 2020)

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	• The Convention creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure. It built on the voluntary PIC procedure, initiated by UNEP and FAO in 1989 and ceased on 24 February 2006. • The Convention covers pesticides and industrial chemicals that have been banned or severely restricted for health or environmental reasons by Parties and which have been notified by Parties for inclusion in the PIC procedure. The Convention promotes the exchange of information on a very broad range of chemicals through: • the requirement for a Party to inform other Parties of each national ban or severe restriction of a chemical; • the possibility for Party which is a developing country or a country in transition to inform other Parties that it is experiencing problems caused by a severely hazardous pesticide formulation under conditions of use in its territory; • the requirement for a Party that plans to export a chemical that is banned or severely restricted for use within its territory, to inform the importing Party that such export will take place, before the first shipment and annually thereafter; • the requirement for an exporting Party, when exporting chemicals that are to be used for occupational purposes, to ensure that an up-to-date safety data sheet is sent to the importer; and • labelling requirements for exports of chemicals included in the PIC procedure, as well as for other chemicals that are banned or severely restricted in the exporting country.		
Stockholm Convention on Persistent Organic Pollutants	The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or the environment. Exposure to Persistent Organic Pollutants (POPs) can lead to serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and damages to the central and peripheral nervous systems. Given their long-range	26 September 2003	1 November 2016

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	transport, no one government acting alone can protect its citizens or its environment from POPs. In response to this global problem, the Stockholm Convention, which was adopted in 2001 and entered into force in 2004, requires its parties to take measures to eliminate or reduce the release of POPs into the environment. As set out in Article 1, the objective of the Stockholm Convention is to protect human health and the environment from persistent organic pollutants with a requirement of each party to[3]: • Prohibit and/or eliminate the production and use, as well as the import and export, of the intentionally produced POPs that are listed in Annex A to the Convention (Article 3). • Restrict the production and use, as well as the import and export, of the intentionally, produced POPs that are listed in Annex B to the Convention (Article 3). • Reduce or eliminate releases from unintentionally produced POPs that are listed in Annex C to the Convention (Article 5). The Convention promotes the use of best available techniques and best environmental practices for preventing releases of POPs into the environment. • Ensure that stockpiles and wastes consisting of, containing, or contaminated with POPs are managed safely and in an environmentally sound manner (Article 6). The Convention requires that such stockpiles and wastes be identified and managed to reduce or eliminate POPs releases from these sources. The Convention also requires that wastes containing POPs are transported across international boundaries taking into account relevant international rules, standards and guidelines.		
African Convention on the Conservation of Nature and Natural Resources	The African Convention on the Conservation of Nature and Natural Resources was adopted in 1968 in Algiers. Considered the most forward-looking regional agreement of the time, it significantly influenced the development of environmental law in Africa. The Convention supersedes the Convention Relative to the Preservation of Fauna and Flora in their Natural State of 1933 and has been superseded by the African Convention	Acceded	15 November 1968

[3] UNEP – Stockholm Convention (accessed via: http://www.pops.int/TheConvention/Overview/tabid/3351/Default.aspx, 30 March 2020)

Treaty / Convention / Protocol	Summary	Year Signed	Year Ratified
	on Conservation of Nature and Natural Resources (revised) signed in Maputo in 2003. The objective of the Convention is to encourage conservation, utilization and development of soil, water, flora and fauna for the present and future welfare of mankind, from an economic, nutritional, scientific, educational, cultural and aesthetic point of view.		

3.4 International Standards

This ESHIA also considers the policies, guidelines, and standards of the World Bank Group's International Finance Corporation (IFC). The requirements of the World Bank Multilateral Investment Guarantee Agency (MIGA) essentially reflect those of the IFC Performance Standards for private sector projects.

3.4.1 IFC Performance Standards (IFC PS) (2012)

Table 3.3 International Standards Considered for the ESHIA

IFC PS	Summary
Performance Standard 1: Social and Environmental Assessment and Management Systems	Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders. Drawing on the elements of the established business management process of "plan, do, check, and act," the ESMS entails a methodological approach to managing environmental and social risks and impacts in a structured way on an ongoing basis.
Performance Standard 2: Labor and Working Conditions	Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by the protection of the fundamental rights of workers. For any business, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient in the sustainability of a company. Failure to establish and foster a sound worker-management relationship can undermine worker commitment and retention and can jeopardize a project. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.
Performance Standard 3: Resource Efficiency and Pollution Prevention	Performance Standard 3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use

IFC PS	Summary
	and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world. These are often implemented through continuous improvement methodologies similar to those used to enhance quality.
Performance Standard 4: Community Health, Safety and Security	Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Also, communities that are already subjected to impacts from climate change may experience acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project-related activities, with particular attention to vulnerable groups.
Performance Standard 5: Land Acquisition and Involuntary Resettlement	Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. Resettlement is considered involuntary when affected persons or communities do not have the right to refuse land acquisition or restrictions on land use that result in physical or economic displacement. This occurs in cases of (i) lawful expropriation or temporary or permanent restrictions on land use and (ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.
Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management	Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.
Performance Standard 8: Cultural Heritage	Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. Also, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

3.4.2 IFC / WB Environmental Health and Safety (EHS) General Guidelines (2007)

The Environmental, Health, and Safety (EHS) Guidelines, shown in Table 3.4, are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). These General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary.

Table 3.4 Relevant WB / IFC EHS Guidelines

WB / IFC EHS General Guidelines	Summary
Environmental	This guideline applies to facilities or projects that: • generate emissions to air at any stage of the project life-cycle (Air Emissions and Ambient Air Quality); • consume energy in process heating and cooling; process and auxiliary systems, such as motors, pumps and fans, compressed air systems and heating, ventilation and air conditioning systems (HVAC) and lighting systems (Energy Conservation); • discharge of process wastewater, wastewater from utility operations or stormwater to the environment (Wastewater and Ambient Water Quality); • promote the continuous reduction in water consumption and achieve savings in the water use (Water Conservation); • store or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics (Hazardous Materials Management); • that generate, store, or handle any quantity of waste across a range of industry sectors (Waste Management); • addresses impacts of noise beyond the property boundary of the facilities (Noise); and • management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil, including naturally occurring substances (Contaminated Land). This sector complements the industry-specific environmental guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for emissions management that may be applied to a range of industry sectors.
Occupational Health and Safety	Employers and supervisors are obliged to implement all reasonable precautions to protect the health and safety of workers. This Guideline provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Although the focus is placed on the operational phase of projects, much of the guidance also applies to construction activities. Companies should hire contractors that have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements.

WB / IFC EHS General Guidelines	Summary
	The Occupational Health and Safety issues focus on the following: • General Facility Design and Operation • Communication and Training • Physical Hazards • Chemical Hazards • Biological Hazards • Radiological Hazards • Personal Protective Equipment (PPE) • Special Hazard Environments • Monitoring
Community Health and Safety	This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but related to the project operations, as may be applicable on a project basis. These issues may arise at any stage of a project life cycle and can have an impact beyond the life of the project. These issues include: • Water Quality and Availability • Structural Safety of Project Infrastructure • Life and Fire Safety (L&FS) • Traffic Safety • Transport of Hazardous Materials • Disease Prevention • Emergency Preparedness and Response
Construction and Decommissioning	This section provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life cycle, or due to expansion or modification of existing project facilities. Cross-referencing is made to various other sections of the General EHS Guidelines.

This ESHIA has also been undertaken with consideration of the African Development Bank's (AfDB) 'Environmental and Social Assessment Procedures' (AfDB, 2001), and the associated 'Integrated Environmental and Social Impact Assessment Guidelines' (AfDB, 2003).

4 Socio-Economic Baseline

4.1 Objective

The main objective of the study is to update the socio-economic and health baseline data to be incorporated in the updated ESHIA Report that will provide an analysis of the Project's potential social socio-economic and health impacts. The specific objectives of the study are to:

- Describe the basic social and health characteristics, of the study area;
- Identify the main economic activities undertaken in the area;
- Describe the baseline conditions focusing on:
    - Demographic indicators;
    - Vulnerable groups;
    - Community and social organization.
    - Housing;
    - Education;
    - Employment, income and livelihoods;
    - Land ownership and use;
    - Energy and water supply;
    - Waste management;
    - Archaeological and cultural heritage; and
    - Community health

4.2 Project Area of Influence

To determine the study limit and inform the analysis of the baseline data collection, it is important to determine the Project Area of Influence (AoI). The AoI is the broader area where risk and potential impact to receptors are defined. The area of socio-economic influence for the Project is considered to be 5km around the site based on a review of the population and economic assets likely to be influenced by the project. This area of influence was selected because it covers all of the adjacent communities where the project is expected to create direct economic or social impact. This includes the Fisher Lane to the north, beyond which is the Sierra Leone River Estuary. To the southeast is Wellington, and to the west and northwest are Allen Town, Moeba Town, Kortright, Foulah Town, Mount Aureol, Tower Hill, Magazine, Jinger Hall, Cline Town Upgun Area and Kissy Dockyard. To the south and southwest are vegetated areas with a lower population density.

For the purpose of the household survey (HHS), an area of up to 500m radius from the Project Site boundary was demarcated as the study area for the Project by considering the extent of direct project impact in terms of human settlement and location of the access roads. The communities within the study area include Pipeline, Upper Parsonage Street, Shell, Temne Town, Africanus Road and Kissy Dockyard.

4.3 Methodology

The socio-economic and health baseline has been compiled to understand the Project within the context of human environment and to provide an overview of economic activities and health conditions within the Project Area. Primary and secondary data sources were consulted to achieve the objectives of the study. Secondary data sources included available socio-economic and health information reported in the 2015 ESHIA as well as general public information such as the 2015 Population and Housing census data.

Additional information was collected from primary data sources via Household Surveys (HHS), Focus Group Discussions (FGDs), and Interviews.

A team of enumerators were recruited and trained to conduct HHS whilst INTEGEMS Consultants facilitated the FGDs and KIIs to acquire primary quantitative and qualitative data. The HHS enumerators were managed and supervised by INTEGEMS' Consultants.

4.3.1 Household Survey

Household surveys were conducted to provide supplemental data on the baseline conditions in the local community. The Household surveys were completed on 16 August 2020. From the 2015 census data, it was estimated that a total of 2,690 households were found largely or wholly within the study area, from which a total of 538 (20%) were interviewed. Surveys were conducted using a structured questionnaire comprising both closed and open-ended questions. The survey was piloted to test the questionnaire for appropriateness. The household survey (HHS) questionnaire covered the following sections:

- Respondent Details;
- Household Demography;
- Housing;
- Water and Sanitation;
- Energy / Electricity
- Education;
- Health;
- Cultural Values;
- Vulnerable Communities;
- Income, Expenditure and Savings; and
- Perceptions and Expectations.

Those surveyed include the residents neighboring the project site and residents and community members belonging to the "Polio Compound''. Adjacent project sites with residents which include the Polio Compound and residences physically adjacent to the projects site are all included in the household survey. The Islamic Compound adjacent to the site is comprised of a mosque and a school attended by the local community which is accounted for in the household surveys. Only the Heads of households were interviewed for the HHS, except in instances of their unavailability, other knowledgeable members were selected.

This survey work was conducted using proper personal protective equipment (PPE) appropriate under COVID-19 conditions at the time. However, it is recognized that conditions under COVID-19 may not accurately represent business-as-usual baseline socio-economic conditions in the project area, and further survey work (supplemented by project consultation) should be conducted to confirm any conclusions of this survey. The results from the household surveys are presented herein.

The survey noted the following existing socio-economic challenges in the community:

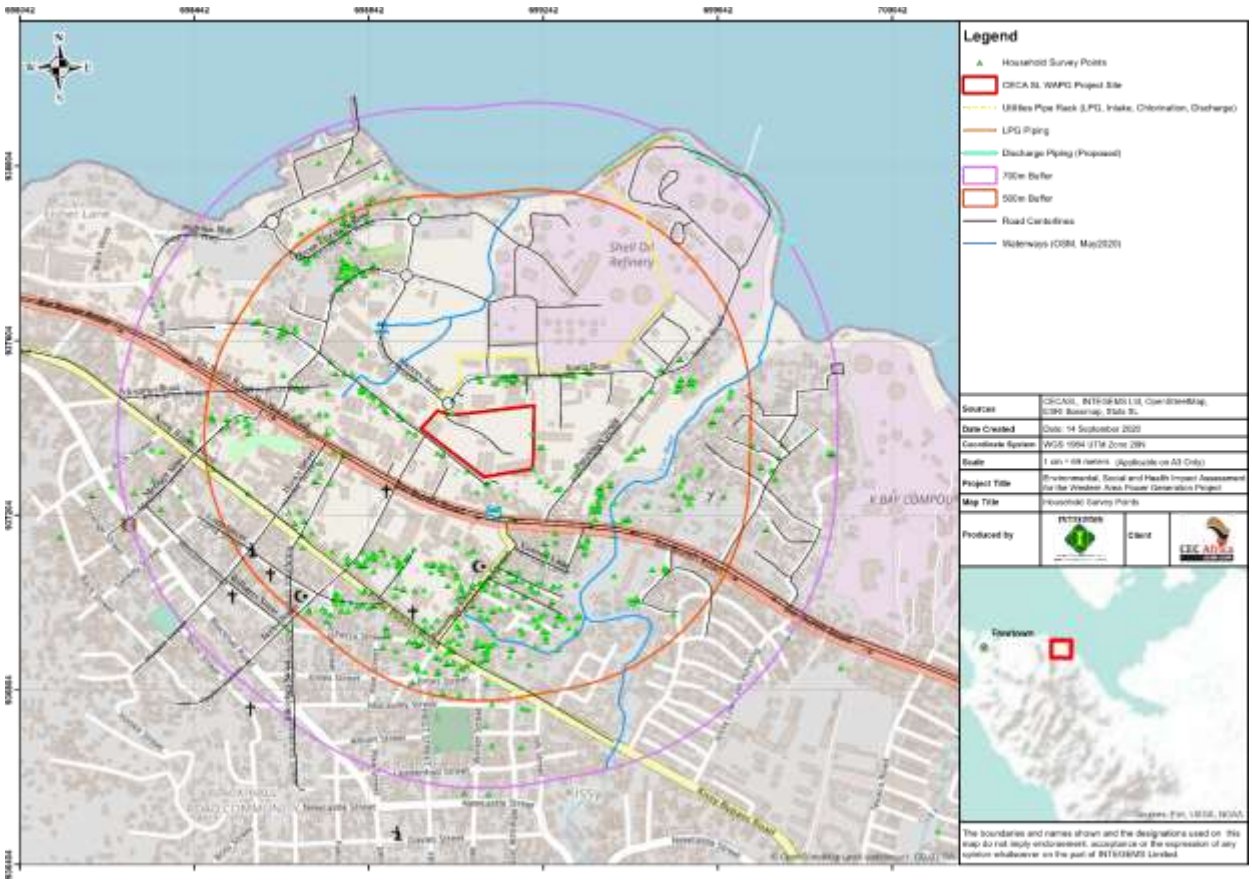
- Inadequate solid waste management and disposal, water and sanitation issues;
- Lack of access to potable water;
- Lack of access to basic social services (i.e., health); and
- Limited income-generating activities, especially among the youth.

The household survey also identified the following key concerns and perceived benefits from the community for the project:

Table 4.1 Household Survey Project Concerns and Benefits

Concerns	Perceived benefits
Increase noise, pollution, and vibration	Access to reliable electricity
Potential physical displacement	Potential employment opportunities, but concerned that people do not have the needed skills for those potential jobs
Increased demand for social services and rental accommodations that are currently lacking / limited	Access to potable water
CECA vessels may scare the fishes away from the specific areas	Access to solid waste management
Increase traffic and safety issues, especially to children	Potential for improved roads
Increase crime rates and implications for overall social safety	Potential business opportunities
Increased exposure to diseases	

Figure 4.1 Socio Economic Survey Area



4.3.2 Focus Group Discussions (FGD)

Three FGDs were conducted at different locations within the Study area, constituting key community stakeholders, youth group and a mix of residents. The FGDs also included representatives from the Islamic Mission School and squatters adjacent to the project site. A question guide was developed to facilitate the discussion which generally focused on the following areas:

- Demography/General Profile;
- Local Economy/Livelihoods and Standard of Living;
- Community Leadership;
- Vulnerable Groups;
- Transport and Communication;
- Socio-economic Infrastructure;
- Archaeological and Cultural Heritage;
- Project Knowledge and Perception;
- Key Social Problems; and
- Key social problems and considerations for community development action plan.

The following table summarizes the results of the Focus Group Discussions.

Table 4.2: Focus Group Discussion Observations

Category	Date and Venue	Purpose of Engagement	Key Observations/Outcomes
Focus Group Discussion			
Key community stakeholders **Participants:** Councillors Area chiefs Religious leaders Youth leaders Disable community Women's leaders Political party representatives.	**August 17, 2020** Kissy Dockyard Community (Councillor Bintu's house)	To notify them about the Project and the ESHIA update. To acquire in-depth information on community issues that should be considered by the project and the ESHIA process. To provide guidance on how to conduct the ESHIA especially with regards to cultural and other sensitive issues.	There were thirteen participants (9 male and 4 female). **Comments and concerns are as follows:** Majority of those present confirmed that they are aware of the project and pledge to provide support where needed. They believe that the operations of the project will contribute to boost local business in terms of electricity supply They expressed dissatisfaction over the compensation package that wasn't paid for the remaining year(s) for the Project Affected People (PAPs). They expressed concern about noise and air pollution that will be generated from the operations of the company especially those in close proximity to the project site. They requested CECA should consider locals within the community for employment particular for unskilled labour. They stated that the movement of CECA vehicles will likely contribute to further degradation of the roads in the area and therefore requested that CECA provide

Category	Date and Venue	Purpose of Engagement	Key Observations/Outcomes
			support to rehabilitate the roads in the community. **Activities suggested for the CDAP:** Support to health (Construction of a health centre) Support to road rehabilitation Support to education and skill training
Youth Group **Participants:** Youth men and women	**August 17, 2020** In front of CECA compound	To notify them about the Project and the ESHIA update. To get their own perspective as youths about the project and to understand their major concerns in the community.	There were sixteen participants in total (14 male and 2 female). **Comments and concerns are as follows:** Majority of those present confirmed that they are aware of the project and expressed their commitment to provide support where needed. They are concern about impacts of noise and air pollution that will be generated form the operations of the company especially for those living closer to the project site. They are expected to benefit from the project in the area of employment opportunities and particularly requested CECA to prioritise the youths. They are also keen to know when the project implementation will commence. They requested CECA to support in rehabilitating the roads within the community. **Activities suggested for the CDAP:** Support to health (Construction of a health centre) Support to road rehabilitation Support to education and skill training
Mix Group **Participants:** Community authorities Young and old people Disable community	**August 18, 2020** South road (Kissy Dock Yard)	To notify them about the Project and the ESHIA update. To acquire in-depth information on community issues that should be considered by the project and the ESHIA process. To have a further understanding of the socio-economic settings and issues within the community.	There were twenty-three participants (7 male and 16 female). **Comments and concerns are as follows:** Majority of those present confirmed that they are aware of the project since 2015. Impacts of noise and air pollution that will be generated from the operation of the company was a general concern. Community members complained that they haven't been given job opportunities by other existing companies and requested CECA should consider locals within the community for employment particularly for unskilled labour. Some of the community members also suggested that CECA should directly engage the local community members to

Category	Date and Venue	Purpose of Engagement	Key Observations/Outcomes
			give them an opportunity expressed their genuine concerns/constrain. Community members are keen to know when the project implementation will commence. Movement of CECA vehicles will possibly add to further degradation of the roads in the community and therefore requested the support of CECA in the rehabilitation of the roads. **Activities suggested for the CDAP:** Support to road rehabilitation. Support to education (Construct primary school). Micro-finance support to business people.

Discussions during the FGDs showed support for the Project and a keen interest from the local community as to when the Project would commence. However, some issues were repeatedly brought up in the three FGDs. These issues are:

- Concern about noise and air pollution that will be generated from the operations of the Project especially those in close proximity to the project site; and
- Continued degradation of the roads in the area due to the increased traffic from the Project.

All three focus group discussions expressed a hope the Project would be able to provide:

- A contribution from the Project to rehabilitate the roads
- Increased employment opportunities for the locals within the community, particularly for unskilled labor; and
- The construction of a health center.

The first focus group also reported a dissatisfaction with the fact that the remaining payments for the project affected people has not yet been paid.

The discussions were facilitated by an INTEGEMS moderator and note taker and all of the discussion points were thoroughly addressed. Participants spoke voluntarily about concerns and knowledge about the Project. The discussions were recorded and transcribed. Once the inputs had been transcribed, the recordings were deleted to ensure confidentiality was maintained.

4.3.3 Key Informant Interviews (KIIs)

Interviews were held with key local stakeholders to gather additional primary data and to validate existing secondary information. These included local authorities, health officials, security personnel and school authorities amongst others. The KIIs provided an avenue to explore new ideas and issues related to the Project that had not been anticipated but that are relevant to the purpose of the study. The list of stakeholders who have been identified and notified are listed below:

Table 4.3: Identified and Notified Stakeholders

No	Institution/Organization	No	Institution/Organization
1	Ministry of Environment	17	Sierra Leone Maritime Administration
2	Ministry of Health and Sanitation	18	Sierra Leone Police (SLP)
3	Ministry of Energy	19	National Fire Force (NFF)
4	Ministry of Trade and Industry	20	West Africa Regional Fisheries Programme
5	Ministry of Fisheries and Marine Resources	21	Sierra Leone Standards Bureau
6	Ministry of Lands, Housing and Country Planning	22	Climate Change Secretariat
7	Ministry of Water Resources	23	Statistics Sierra Leone
8	Environment Protection Agency, Sierra Leone (EPA-SL)	24	Institute of Marine Biology and Oceanography, Fourah Bay College, University of Sierra Leone
9	Electricity Distribution and Supply Authority (EDSA)	25	Freetown City Council (FCC)
10	Electricity Generation and Transmission Authority (EGTC)	26	Councillor - Ward 415
11	Guma Valley Water Company (GVWC)	27	Parliamentarian - Constituency 119
12	Sierra Leone Water Company (SALWACO)	28	Sierra Leone Association of Non-Governmental Organisations
13	Electricity and Water Regulator Commission (EWRC)	29	Native Consortium and Research Centre (NCRC)
14	National Water Resources Management Agency (NWRMA)	30	Conservation Society Sierra Leone (CSSL)
15	Sierra Leone Ports Authority (SLPA)	31	Friends of the Earth Sierra Leone (FESL)
16	Sierra Leone Meteorological Agency	32	Environmental Foundation for Africa - Sierra Leone (EFA-SL)
No.	**Project Neighbours**	**No.**	**Project Neighbours**
33	National Petroleum (SL) Limited	41	Government Independent Memorial Secondary School
34	Total (SL) Limited	42	German Technical Academy
35	PetroJetty	43	Sir Winston-Churchill International Secondary School
36	AfriGas (SL) Limited		
37	Magram Water Company	44	Occupant of former Bollore Compound - adjacent Project Site
38	Sierra Fishing Company	45	Residences adjacent Project Site
39	All Petroleum Product Limited	46	Fomel Industries and National Industrialisation Centre (FINIC) Kissy Industries
40	Islamic Mission School and Clinic Facility adjacent Project		

A full copy of the KIIs can be found in Appendix J.

The non-governmental stakeholders that responded to the notice are provided below.

Table 4.4 Non-Governmental Stakeholders Responding to Notice

KEY INFORMANT INTERVIEWS/MEETINGS			
Organization	**Date and Venue**	**Participants**	**Key Observations/Outcomes**
Abdala Abdelgani Medical Centre	**August 15, 2020** Clinic facility	Mariatu Moseray **In-charge**	The purpose is to notify health centre authorities about the project and to obtain information on the health status of the community and also understand the potential health impacts of the project from a health expert perspective. **Comments and concerns:** There is no public health centre in the community and the only one present is a mission owned which constrained with insufficient water supply and lack of building infrastructures. The common sicknesses prevalent in the community are Malaria, Typhoid and high blood pressure. Malaria and Typhoid are mainly caused by mosquito bite and consumption of contaminated water or food. While high blood pressure is mostly associated with aging. The major health related concern for the project would be air and noise pollution which can cause respiratory diseases and hearing deformities with prolong exposure to pollutant sources.
Sir Winston Churchill Secondary School	**August 19, 2020** School Compound	Abdul Frederick Sesay Principal and Proprietor	Sir Winston Churchill Secondary School is approximately less than 100m from the Project Site and the only private secondary school within the delineated 500m study area. It is therefore important to engage the school authorities to inform them about the project; understand the general status of the educational facilities within the community and to obtain concerns they might have relating to the project. **Comments and concerns:** Most schools in the project area are government and government assisted schools. Some of the challenges in the schools are lack of electricity, unequipped libraries, water shortage and computer labs etc. Electrical fault, noise and air pollution are major concerns about the project that will potentially affect schools. Expected benefits are access to electricity, support to education and road rehabilitation.
Artisanal Fishing Group	**September 9, 2020** Crab Town, Pipeline Community, Kissy Dockyard, Freetown	Madam Yamborah Kamara (Chief), Sallu Conteh (fisherman), Mohamed Conteh (fisherman-Habourmaster), Idrissa Conteh (fisherman).	The purpose of the engagement was to notify the fishing group in the community about the Project and enquire to understand how the project might affect their fishing activities or how their activities might impact the project. The Crab Town and Pipeline communities falls within 600m away from the project site. The following issues were highlighted from the engagement: Fishing is one of the livelihood activities in Crab Town and Pipeline communities. However, only six people are engaged in the activity which each of them having one canoe. The group is headed by the Harbourmaster. The group noted that they fish in the estuary using hook and line with small dug-out canoes. Fishing is mostly done during periods of low tides and on daily basis with weather being an important factor. *Spanish, Mackerel, Kuta, Corel, catfish, Whittie, Lady, Shine nose and Cocos* are among the fishes mostly caught. Other boats from Tasso Island, Pepel, Samgblema and Kakum anchors boats docks at the wharf on a weekly basis.

KEY INFORMANT INTERVIEWS/MEETINGS			
Organization	**Date and Venue**	**Participants**	**Key Observations/Outcomes**
			The LPG product that CECA-SL intends to use was perceived as a poisonous gas associated with breathing discomfort to humans. This claim was supported by perception and experience from the current operations of AfriGas in the area. Concerns were raised about the engagement strategy that will be put in place to prevent interruption of fishing activities by CECA's fuel vessel. The fishermen recommended that CECA provide them with improved engine boats so they can fish far away from the jetty. Another concern was that CECA vessels will scare the fishes away from the specific areas where they fish. This was considered as a potential negative effect on their livelihood. The fishermen also raised concerns about the potential for noise pollution from the project. The fishermen claimed to have a skilled driver, fitter, electrician and bricklayer amongst them and appealed for CECA-SL to provide employment for them. When asked to identify the general needs of the community for CDAP consideration, the participants highlighted the construction of a small crossing bridge, provision of safe drinking water and construction of a health facility and school.
Sand Ground – Ground Committee	**September 10, 2020** Sand Ground – Kissy Dockyard	Gibril Fofanah Secretary-General Kelfala Ansumana Kamara Financial Secretary	The purpose of the meeting was to notify the sand miners about the project and enquire to understand how the project might affect their sand mining activities or how their activities could affect the project. The sand Ground is about 600m away from the project site. Comments and concerns from the engagement are summarised below: Mr Fofanah noted that he was engaged during the 2015 ESHIA study on community-related issues and highlighted that sand mining started as far back as 1990 with just 3 boats. The business became highly attractive over time and is a major source of livelihood for many young men living in the community. The sand ground is managed by different groups including the Ground committee (the highest body that provides supervision to the other sub groups), Sierra Leone United Boats Owners Organisation – Kissy Dockyard Branch, Drivers Union - Kissy Dockyard Branch, and Labour Committee. Sand is mainly mined across the estuary in Kaffu Bullum Chiefdom and its surroundings. The Miners noted that they work daily except on Fridays and/or during unfavourable weather conditions. Some of their major challenges are insufficient life jackets and bad weather conditions. They recommended that CECA SL should establish a channel of communication in order to avoid boat collision, adding that, if their operation need to be halted during CCECA vessel reception, they should be adequately compensated. Expectations from the projects include provision of scholarship for deserving students, employment of locals, provision of access to pipe-borne drinking water, and provision of motorboats for sand mining.

4.4 Socio-Economic Baseline Data

4.4.1 Demographic Indicators

4.4.1.1 Population - Number, Density and Distribution

The Population and Housing Census (PHC) 2015 reported that the total population of Sierra Leone was 7,092,113 in 2015, with about 51% (3,601,135) being female and 49% (3,490,978) males. Of this population, 20% (1,439, 308) were based in the Southern Province, 35% (2,508,201) in the Northern Province, 23% (1,642,370) in the Eastern Province, and 21% (1,500,234) in the Western Area. 59% of population lived in rural areas (4,187,016), and 41% (2,905,097) lived in urban areas. The national population density in 2015 was 79 persons per km^2 and 73 persons per km^2 in the Southern Province. The Northern Province had 70 persons per km^2 and the Eastern Province 110 persons per km^2. The population density in the Western Area was high, with 2,693.4 people per km^2 (SSL, 2015). The Project falls within Western Area Urban, which is home to a population of 1,055,964 inhabitants in 2015, distributed across eight administrative zones, with a population density of 130 persons per Km^2 (See Table 4.5).

The surveys recorded a total of 2,296 people from 538 households, with an average household size of 4.3 persons per household. This is lower than the average household size as reported in the PHC (2015) for Freetown (4.6 persons per household). Majority of the households surveyed are extended families (53%), while 47% are nuclear families.

Table 4.5 Population of Western Area Urban

Chiefdom	Total	Male	Female
Western Area	**1,493,252**	**741,566**	**751,686**
Central I	61,777	31,040	30,737
Central II	19,552	9,767	9,785
East I	60,930	30,218	30,712
East II	89,179	44,993	44,186
East III	447,708	221,344	226,364
West I	53,793	26,289	27,504
West II	129,559	64,133	65,426
West III	187,803	94,240	93,563
Western Area Urban	**1,050,301**	**522,024**	**528,277**

Household Characteristics

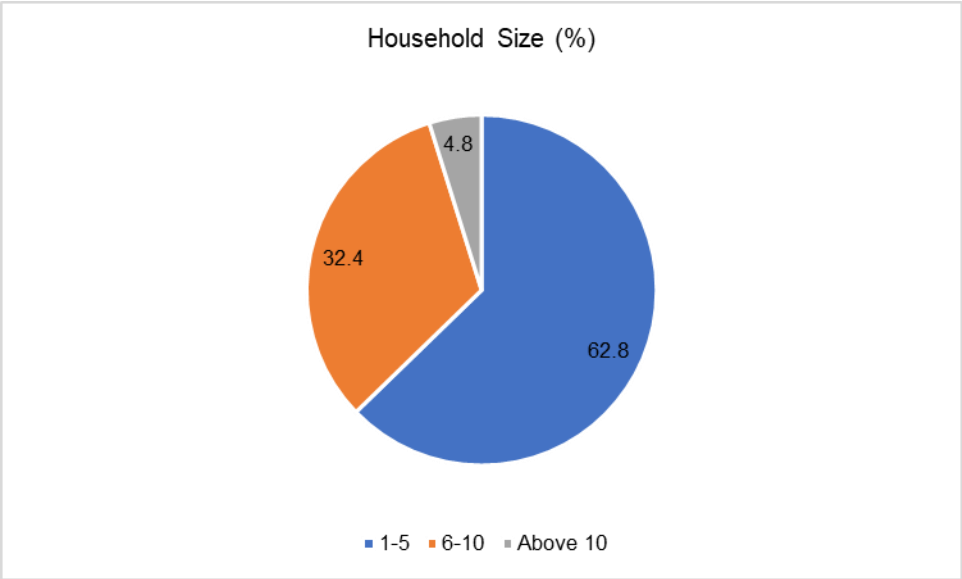
The surveys recorded a total of 2,296 people from 538 households, with an average household size of 4.3 persons per household. This is lower than the average household size as reported in the PHC (2015) for Freetown (4.6 persons per household). The majority of the households surveyed are extended families (53%), while 47% are nuclear families.

From the HHS, children under age 15 comprise 34% of the total population recorded. Age 15-35 accounted for 50 %, while aged 36-59 years accounted for 13%, and 3% were those aged 60 and older. Working-class

population (age 15-59 years) accounted for about 63% of the total population sampled, while 37% are within the non-working class.

Households surveyed were generally divided into those supporting between one to five members (62.8%) and those with six to 10 members (32.4%). Only 4.8% of households have more than 10 household members, as illustrated on Figure 4.2.

Figure 4.2 Household Size



The housing infrastructure in the Study Area consist of a mixture of makeshift zinc structures and modern (concrete) buildings. Majority of the houses surveyed are semi-detached (47%), single unit (28.6%) and story building accounting for 61.8%. Others include improvised home (kiosk, disused shipping container, panbody – homes made from corrugated zinc sheet) and uncompleted buildings.

The walls are made of cement blocks (81%), mud brick (4%) and zinc (13%), most of which are squatters attached to fences of companies and industries in the Study Area. Floor covering with cement accounted for 65.8% of the houses surveyed in the study area. Other materials used for floor comprise tile (32.3%) and mud (1.7%). Similarly, about 96.8% of the houses are covered with zinc roof while 3.0% constitutes houses covered with concrete.

From the HHS, 61% of the households' surveyed secured ownership of their house through rent, 25% owned their house and the rest acquired theirs via family / friends, lease or other means.

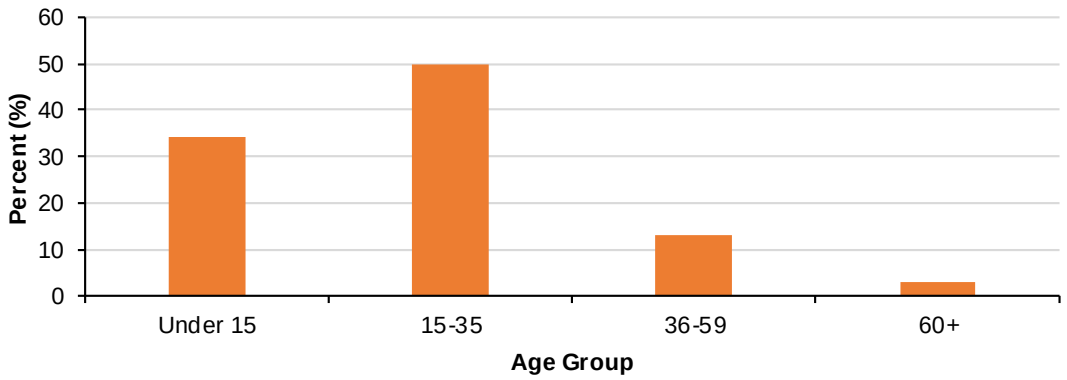
The previous study performed in 2015 indicated a large number of households moved into the area without prior family ties in the community (59%) and had no difficulty settling into the community (78%). For the households that had difficulty with settling, the reasons provided relate to poor road networks, water supply and difficulties with settling in a new community. It is assumed these percentages are similar in 2020 with many of the same difficulties present.

4.4.1.2 Population Age Profile

According to the PHC (2015), 41% of the national population comprised of children under 15 years, while people aged between 15-64[4] accounted for 56%, and 4% were aged 65 and older. It is, therefore, reasonable to conclude that about half of the national population comprised of people aged 20 or younger.

From the HHS, children under age 15 comprise 34% of the total population recorded. Age 15-35 accounted for 50 %, while aged 36-59 years accounted for 13%, and 3% were those aged 60 and older. Working-class population (age 15-59 years) accounted for about 63% of the total population sampled, while 37% are within the non-working class.

Figure 4.3 Age Distribution of the Sample Population (from HHS)



4.4.1.3 Population Growth

Freetown's population has shown a greater increase (27.5%) between 2004 and 2015. Migration is likely to be a significant factor, as urbanisation and economic activities have highly expanded in the capital city. From the FGDs and KIIs, it was noted that there has been an increase in population within the Project Area in the last 4 years. This is mainly due to job opportunities, expansion of business activities and increase in birth rate.

4.4.1.4 Gender Distribution and Relations

The PHC (2015) indicates that women constitute 50% of Freetown's population while the men also represent 50%. The HHS recorded 50.3% male and 49.7% females from the sampled population with male-headed households accounting for about 69%, while female household heads accounts for 31%.

The war in Sierra Leone was associated with high levels of extreme sexual and gender violence towards women and children. Levels of Gender Based Violence (GBV) are difficult to ascertain, but the UNICEF Gender analysis of the situation of women and children in Sierra Leone (2011) report estimates them to be very high.

The Rainbo Centres provide services to victims of rape and sexual assault. In 2019 they provided support to 3,897 clients, compared with 754 fewer in the previous year, indicating an increase in service access.

[4] Note that this age bracket has been adapted to meet the needs of this study. However, the official Population and Housing Census recognises the ages 15-64 as working-class population.

In the same year, only 216 cases out of approximately 4000 filed were successfully prosecuted in court. The years of civil war have normalized violent behaviour, although this acceptance is beginning to change.

While equally likely to attend primary school, girls are less likely to complete their education. Reasons cited include sexual exploitation by teachers and the low number of female teachers and other role models, as well as demands from families or themselves to marry and start a family. Another difficulty faced by women is the customary inability for women outside the Western Area to own property or land. A livelihood closely tied to land access and food security can therefore be severely compromised in the event of marital breakdown.

Women are under-represented in almost all non-agricultural employment fields. Gender parity in senior positions is particularly low, and despite a recommendation of the Truth and Reconciliation Commission that political parties ensure at least 30% of their candidates for public elections were women, this has not been achieved. Reasons for this may include barriers to women entering politics (for example low literacy), bullying behavior in a male-dominated environment, difficulties in financing election campaigns, and in commanding respect.

4.4.1.5 Community Safety and Security

Issues of community safety and security is one of the key responsibilities of the police and therefore, they were consulted to understand security status and concerns within the community. During key informant interviews the Sierra Leone Police were consulted due to the Shell police posts location within the project area of influence. The Shell police post indicated assault, larceny, and pickpockets are the common crimes prevalent within the community.

4.4.1.6 Cultural Diversity, Ethnicity and Religion

A total of sixteen languages are spoken nationally in Sierra Leone with English being the official language. However, Krio is the most widely spoken language, followed by Temne and Mende.

The Creoles are the indigenes of Freetown but Temne and Mende have the highest population in the city. The Study Area is ethnically diverse with Krio being the widely spoken language. The HHS recorded Temne as the main ethnic group with 39%, followed by Mende with 15% (See Figure 4.4)

The HHS recorded that about 70% of participants in the study area are Muslims, while 30% are Christians.

IFC PS8 recognizes the value of preserving community cultural heritage, which can include properties and sites of archaeological, historical, cultural, artistic, and religious significance. It also refers to unique environmental features and cultural knowledge, as well as intangible forms of culture embodying traditional lifestyles that should be preserved for current and future generations (IFC, 2012).

No sites of cultural importance, historical monuments or buildings exist within the Project AOI that meets the cultural heritage definition in IFC Performance Standard 8. However, from the consultations with community stakeholders, it was stated that there are a number of secret societies (Hunting, Ojeh etc.) existing within the Project Area and they often display their arts through masquerade dance especially during festive seasons. However, all activities have been halted with respect to government injunction on such activities. Also, Queen Elizabeth road was named after Queen Elizabeth II of Great Britain believing that was the first road, she walked on during her visit to Sierra Leone just after the World War II. There are considerably a number of places of worship mainly for both Muslims and Christians. However, as the project area is generally industrialized, the influence of the proposed power station on intangible aspects of culture is unlikely to change as result of the project. Therefore, issues associated with impacts to cultural resources from the project are not considered further in this assessment.

Figure 4.4 Ethnic Makeup of the Study Area (from HSS)

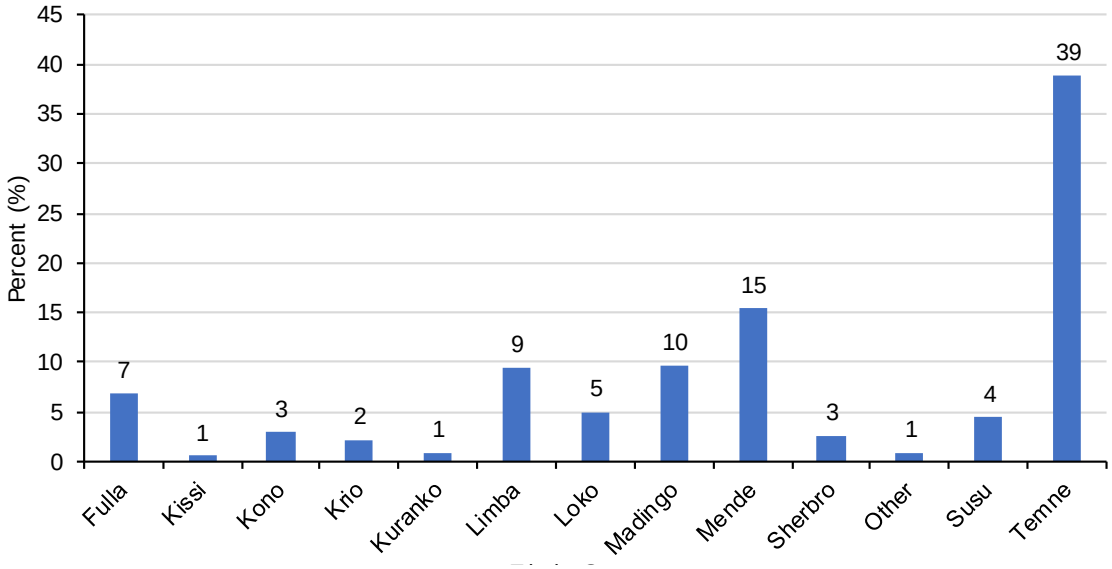


Figure 4.5 Places of Worship

Masjid Abdala Abdelgani

United Methodist Church - Kissy

4.4.2 Vulnerable Groups

Vulnerable people in Sierra Leone include children, women, the elderly, sick, persons with disabilities, and those who are part of any ostracized or disempowered minority. It was observed that a renowned compound called ''Polio Compound'' exists in the Project Area approximately 50m from the site and it's accommodating a number of disabled people who are mostly skilled workers and some are street beggars. While employment opportunities will be made equal between racial and religious groups, vulnerable groups, the construction and operation of the project could affect vulnerable people differently to others.

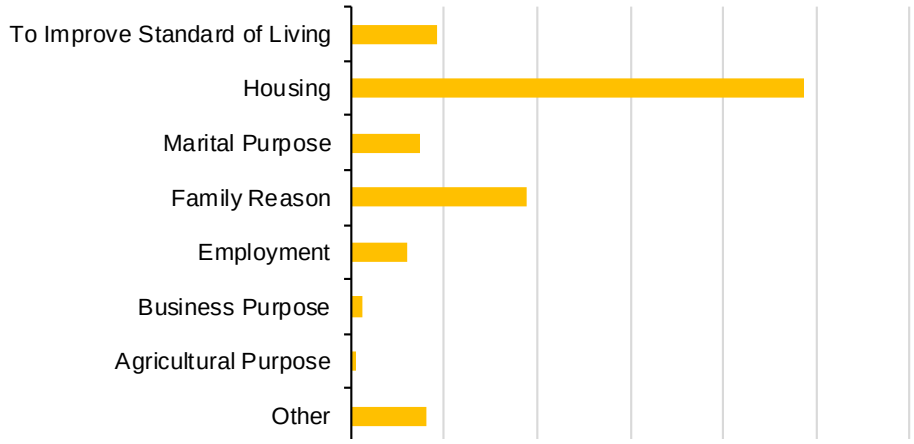
Some of the pressures the project may exert on local services and infrastructure as a result of worker influx, may have a proportionally larger impact on vulnerable groups. For example, medical services that could be further stretched by increasing population may have more significant consequences for those who are sick, elderly, disabled and children.

4.4.3 Migration

Following the civil war in Sierra Leone (1991 – 2001), many people have migrated to urban areas (especially Freetown) where an urban lifestyle and perceived employment opportunities, better service delivery and social infrastructure are the drivers leading to migration (SSL, 2015)

32.2% of the respondents reported to have migrated to the Study Area for different purposes such as employment, marriage, better standards of living etc. (See Figure 4.6).

Figure 4.6 Reason for Migration



4.4.4 Community Governance and Social Organization

4.4.4.1 Leadership and Governance Structure

The Project is located in the Eastern part of Freetown. Politically, the city is divided into three regions: East, Central and Western Freetown, each subdivided into wards. Freetown is the capital city where most of the government ministries are located. Freetown is governed by a Mayor, who is elected every four years. Each ward in Freetown is governed by their respective elected councilors. Western Area Urban, which comprises Freetown, is by far the most populous district in the country, with 20 Parliamentary Constituencies and 68 Wards. Freetown City Council is responsible for the overall management of the city including the provision of critical social services to the population.

The Project's AoI entirely falls within Western Area Urban District (Freetown), precisely Ward-415. Each Ward has an administrative leader called Councillor; whose tenure of office lasts for a period of four years but with a mandate of a re-election. The Councillor is responsible for the general administration, maintenance of law and order and the development of his/her Ward. The Councillors works closely with ward committee members who are appointed by the Councillor in agreement with community members. Each Ward is sub-divided into zones who are represented by their zone committee members. There are also heads of different social strata's (women, youth, religious groups etc.) who assists in the administration, maintenance of law and order in their different communities.

4.4.4.2 Community-Based Organizations and Social Infrastructure

Community-Based Organization include groups set up to provide mutual support for community development and this include women's associations, youth organizations and religious organizations with strong political and social structures.

These organizations organize activities such as football competitions and festival events to generate funds that is used to help support community development. However, these organizations are also constrained by the lack of adequate logistical support and capacity to effect the desired change in the communities.

From the HHS, 29% of the respondents belong to an organization or association operating within or outside the study area. These organizations are CBOs, religious groups, social clubs, political groups and trade unions.

4.4.5 Employment, Income and Livelihoods

According to the International Labor Organization (ILO), the labor force participation rate in Sierra Leone was 57% in terms of national employment and the unemployment rate was 4.7% in 2014. Youth unemployment is estimated at 9.5% (ILO, 2017). About 55% of the households that were surveyed generate primary income from employment in the informal sector, notably petty trading, commercial bike riding, carpentry, tailoring, masonry, artisanal sand mining, etc. A small percentage (11.2%) are engaged in the formal sector such as health worker, teaching, general labor, security guards, etc. (see Figure 4.7).

Most household's income is highly driven by parents and remittances from relatives and other business ventures. Figure 4.8 illustrates the average total monthly income generated by households per month including cash and other goods that households receive was generally between Le 500,000 to Le 1,000,000, which is equivalent to approximately 50 to 100 US dollars (income of 32% of households) and Le 1,000,000 to Le 2,500,000, which is equivalent to approximately 100 to 250 US dollars (income of 32.4% of households). Majority of the sampled households use their income to pay for food and education.

Figure 4.7 Employment Status

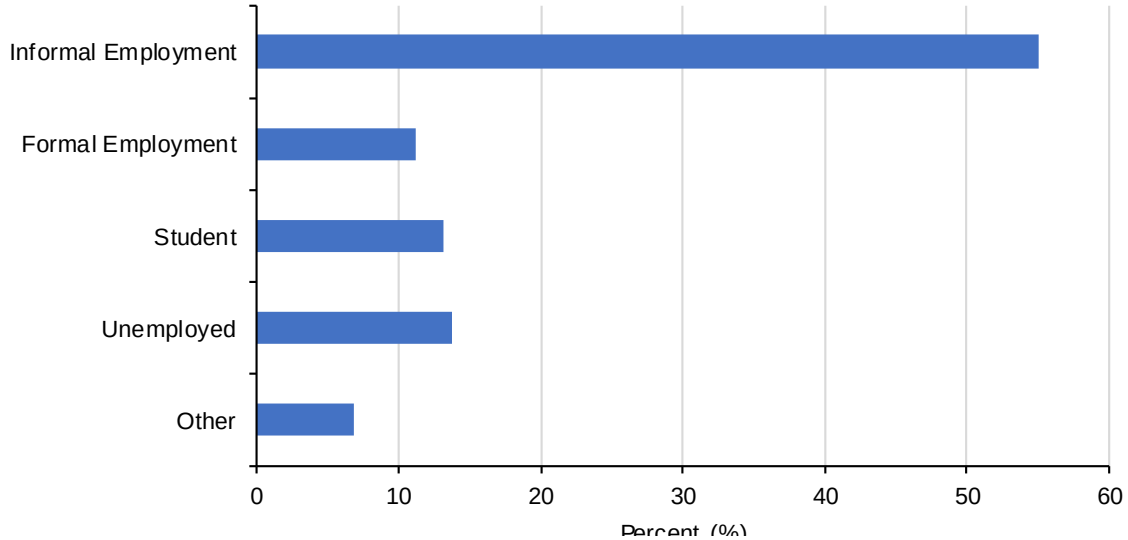


Figure 4.8: Monthly Household Income Level

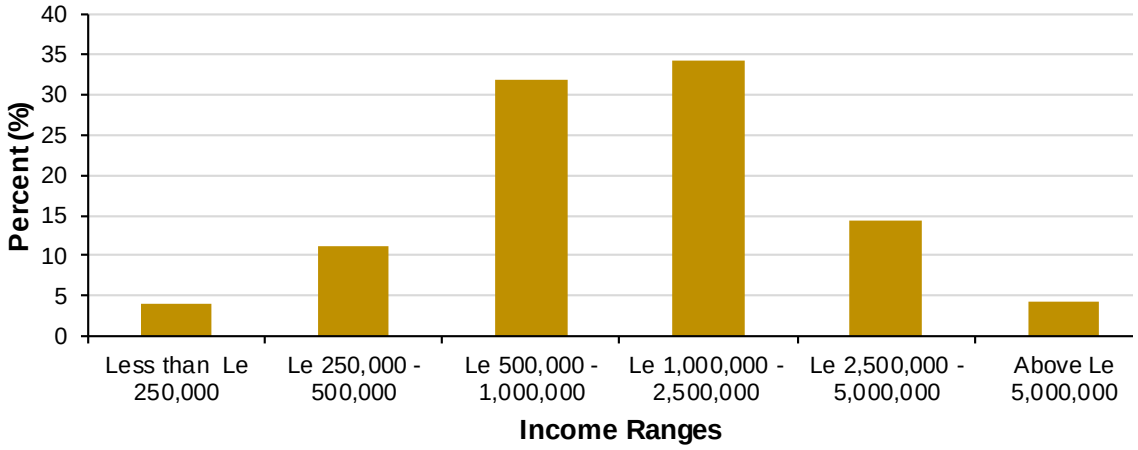


Figure 4.9: Employment Activities in the Study Area

Motorbike (Okada) Riding

Sand Transporting

Street Vendor

Petty Trading

4.4.6 Education

Quality Education is a country's positive social investment for human and economic development and a key determinant of its national development. As a strong pillar for key industries in a country, education provides the foundations for moral regeneration and revival of all citizens. In 2018, the government of

Sierra Leone launched the Free Quality School Education Program (FQSEP) and committed 21 percent of the national budget to improving education.

Basic education is regarded as a right in Sierra Leone, but school attendance is generally low. The Sierra Leone Population and Housing Census (2015) showed that among the 6,589,838 people aged 3 years and above, 55.5% had attended school and 44.5% had never attended school. Some 37% were in school at that time of the survey. The percentage of the national population that had never attended school was shown to be higher in rural areas (33%) than in urban areas (12%). These figures demonstrate a significant disparity, the roots of which may lie in issues of access to education, poverty and gender roles, among others (SSL, 2015).

The PHC (2015) also showed that 88% of household heads had not completed tertiary education. An estimated 50% had completed secondary school, while 26% had completed senior secondary school (SSS) and 24% had only completed junior secondary school (JSS). The quality level of schooling is generally poor as many teachers are ill equipped with resources and they often do not possess appropriate teaching skills. As a result, the education level of students is far below the level of their western peers.

Currently there are 10,747 schools (pre-primary, primary, junior secondary and senior secondary) in the country. Freetown has the highest number of schools and the largest number of school-going pupils in Sierra Leone with 1,666 schools. Basic and senior secondary education in Sierra Leone is now mandatory for all children and officially "free of charge". However, a shortage of schools and teachers, and a general lack of resources have made this implementation extremely hard. Like in any other parts in the province, schools in Freetown are also challenged with the lack of adequate infrastructure and overcrowding despite government recent effort to cut down a number of students per class.

The HHS revealed that 22.62% of the sampled population has no formal education while 77.38% can read and write (had either attained primary, junior or senior secondary school, or tertiary level). The survey also recorded that 19.4% had attained primary level, 16.3% had reached a junior secondary level and 28.8% claimed to attain senior secondary school level (See Figure 4.10)

The major educational challenge highlighted during the community consultations is the lack of public primary schools in the Study Area. Children have to board public transports or trek long distances to go to school which they described to be more financially burdensome and high risk in the case of road accidents. Government Independent Secondary School is the only public secondary school within the Project AoI (See Figure 4.11).

Figure 4.10 Respondent's Education Level

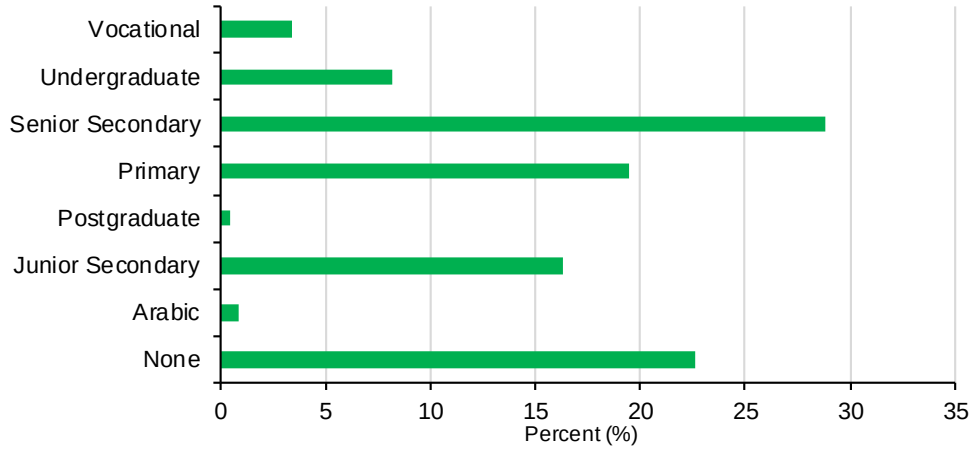


Figure 4.11: Academic Institutions

Sir Winston Churchill International Secondary School (SWISS)

Government Independent Memorial Secondary School (GIMSS)

4.4.7 Infrastructure

Water Supply and Access

Sierra Leone is endowed with considerable water resources, both surface water and groundwater. These resources are unevenly distributed in space and in time. In the dry season, there is an acute shortage of water to meet drinking water supply needs in urban and rural settlements. The demands on the resources are increasing due to rapid population growth and shift, increased industrial activities, environmental degradation causing soil erosion and pollution of wetlands.

Access to safe drinking water is important to help prevent waterborne diseases such as cholera, typhoid and schistosomiasis, and to reduce the adverse health consequences associated with other contaminants. The Guma Valley Water Company (GVWC) is the major water source via piped water to parts of Freetown though access is limited especially with the growing population in the Project Area. The piped water supplies that do exist can be intermittent particularly during the dry season. The GVWC dam has a reliable yield of approximately 80,000m^3 per day, as against a daily estimated demand of 130,000m^3 per day.

Therefore, water is rationed to many areas in the City with almost no zone getting 24-hour supply. This inadequate water supply is forcing parts of the population to seek informal sources, seriously increasing the hazards to health and the risk of disease.

The HHS reveals that that 64.5% of households interviewed sourced their domestic water from a public tap, 7.8% from a protected well, 7.8% from a hand pump and 4.6% sourced theirs from an unprotected well (see Figure 4.12). Most of these sources are either found within the compound or less than 50 meters away from home (see Figure 4.13).

Figure 4.12 Main Source of Domestic Water

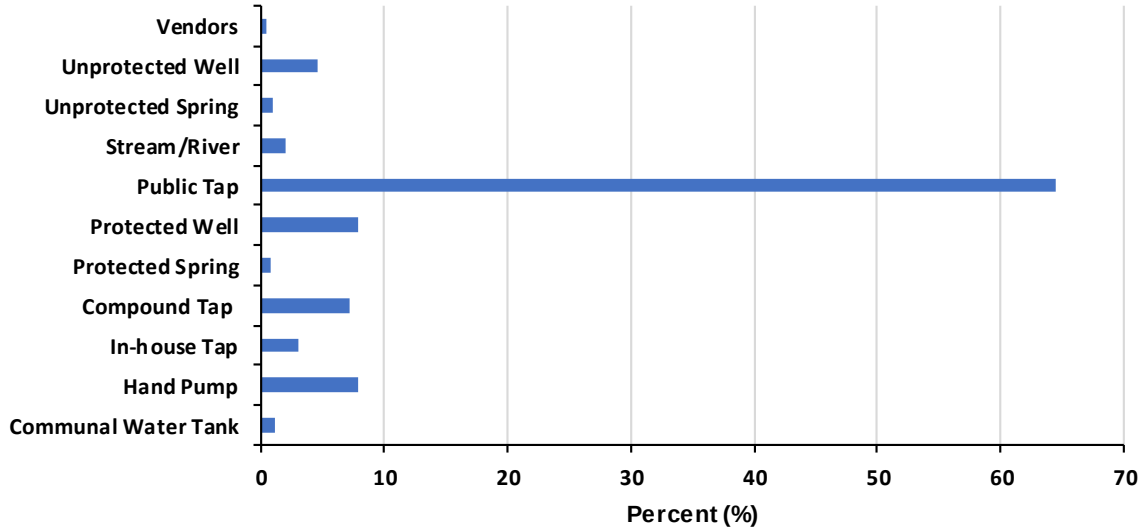


Figure 4.13: Distance to Domestic Water

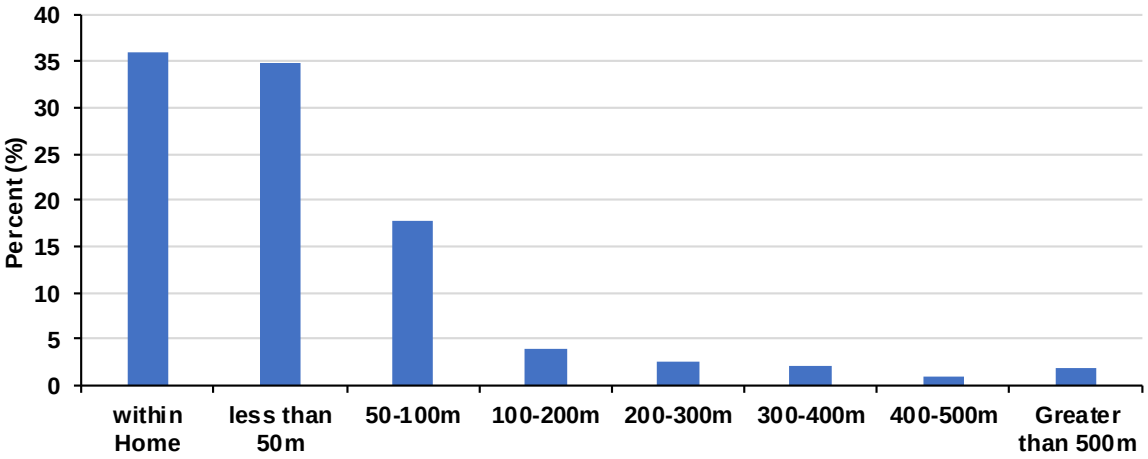


Figure 4.14: Water sources within and around the study area

Hand Pump in Pipeline Community

Protected Well in Pipeline Community

Guma Valley Water Utility Pipe Connection

Water Tank donated by AfriGas to the Community

Waste Management

As is the case in many parts of West Africa, there is no adequate means of refuse disposal in Freetown. The dumping of refuse on undesignated sites is associated with breeding grounds for disease-causing organisms, vermin, bad odors and other health and safety issues. Burning of refuse is also practiced but can also create problems through the production of noxious fumes, the potential for fires becoming out of control, and explosions associated with the burning of highly combustible materials. Further information on waste management is shown in Section 5.6.

Power Infrastructure

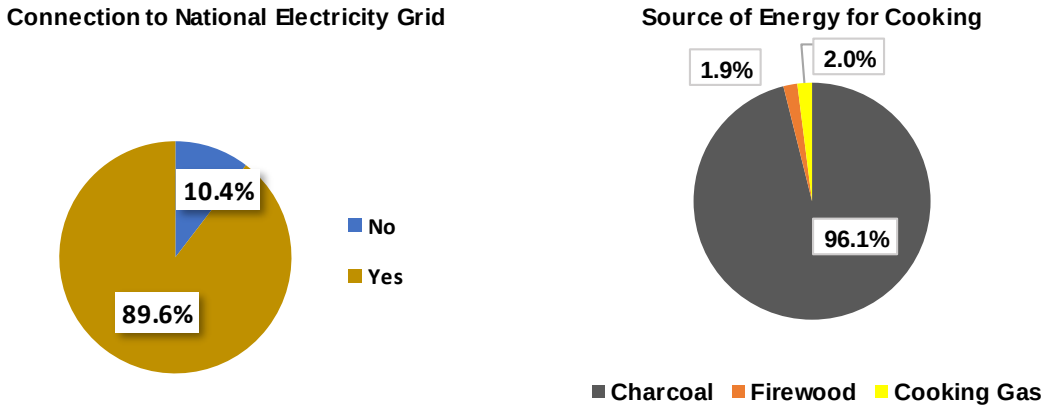
The majority of households surveyed are connected to the national power grid (81%), but the majority (78%) also feel that lack of electricity supply affects their domestic needs. Alternative sources of energy for lighting include Chinese-made battery powered lanterns (32%) or generators (19%). A significant number of households do not have any alternative lighting source. Only 40% of the schools surveyed are connected to electricity supply. Most businesses (89%) are connected to the national grid and are reliant on it for their power / electricity needs. However, businesses typically own generators to supplement power needs when there are outages. The majority of businesses (67%) have both national grid power and generators to meet their electricity needs, while only 22% of businesses are fully reliant on their generators.

4.4.8 Energy

Energy Distribution and Supply Authority (EDSA) is the sole distributor of electricity in the entire Freetown. However, industries and residents within the Study Area also utilise alternative sources of electrical power (e.g., portable and fixed generators and solar panels). There are some inhabitants in the Study Area without electricity in their homes – their main source of lighting includes solar lamps/panels and battery/rechargeable lights.

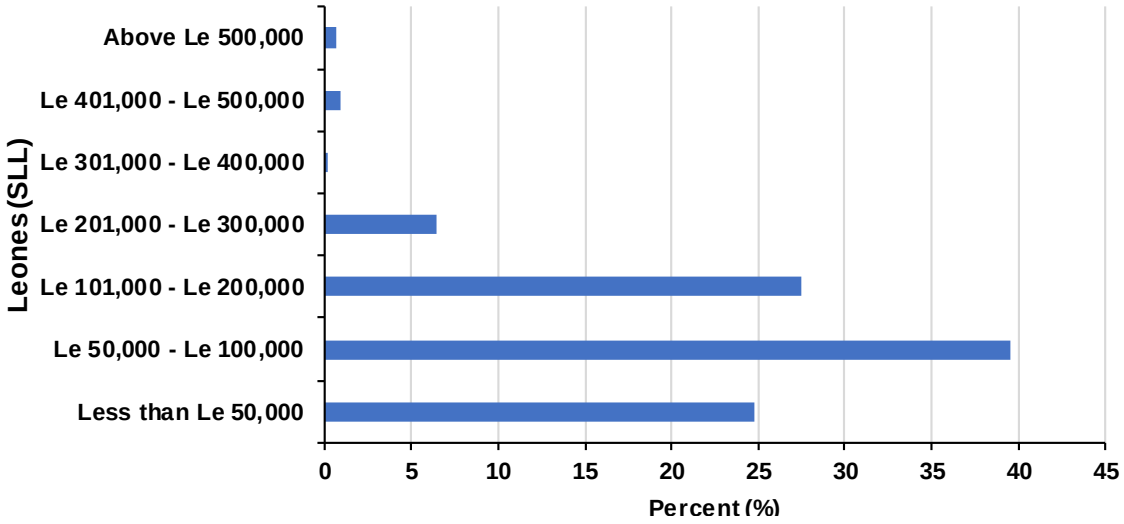
Majority of households in the Project area surveyed during the HHS (see Figure 4.15) are connected to the national power grid (89.6%), although most of these respondents (43%) complained that access is coupled with challenges such as erratic supply and fluctuating voltage which often affects their domestic and industrial appliances. Few households (10.4%) use alternative sources of energy for lighting, including Chinese-made battery powered lanterns, private solar and generators. While most businesses are connected to the national grid and are reliant on it for their power/electricity needs, few typically own generators to supplement power needs when there are power outages. Majority of households (39.6%) spend between Le 50,000 – Le 100,000 on payment of electricity bills monthly to EDSA.

Figure 4.15: Connection to National Electricity Grid and Source of Energy for Cooking



Generally, wood fuel is the largest source of biomass energy in Sierra Leone followed by charcoal. The traditional source of energy used almost exclusively by households within the study area for cooking and crafting activities is charcoal. This accounts for about 96.1% of respondents, while 2% use gas only about 1.9% of households use firewood for cooking and smoking of fish (see Figure 4.15).

Figure 4.16: Household Monthly Cost of Electricity



4.4.9 Road Network, Accessibility and Telecommunication

Global System of Mobile Communications (GSM) networks operators within the Project Area are Orange, Africell, QCell and Sierratel. Network coverage and connection within the AOI is relatively good compared to other parts of Freetown. The coverage is stronger in communities that are in proximity to the nearest signal towers.

Much of Freetown's road network has been neglected and is in a poor state of repair. With heavy congestion and severe weather conditions (intense heat and humidity in the dry season and heavy rainfall in the wet season), the roads have suffered badly, such that potholes and broken surfaces are the norm. The Project site can be accessed through established roads via the main Bai Bureh highway and passes through Africanus Road to the east and Parsonage Street to the west. The road network within the Project Area community requires proper reconstruction, rehabilitation, re-gravelling and the restoration of proper drainage systems. The site layout makes provision for the adequate movement of vehicles except in the case of traffic as many other industry and company vehicles plies that same roads. Additional mitigation measures proposing minor improvements if required are proposed in the instance that roads would be unsafe or unsuitable for use.

Figure 4.17 Road Condition in the Project Area

Personage Street Branching to the Project Site

South Road Leading to the Project Site

Main Bai Bureh Road

Kissy By-Pass Road

4.4.10 Agriculture and Land Tenure

By virtue of its colonial legacy, Sierra Leone has two broad categories of tenure: freehold in the Western Area (the former British Crown Colony) and Sherbro Urban, and leasehold in the provinces (the former British Protectorate). While private ownership exists in the Western Area, land in the provinces is communally owned by the indigenes with title vested in the Paramount Chiefs. It is understood that the land for the project development is owned by the GoSL and land permitting documentations for the project site are completed.

Land use within the Project area is mainly for residential and industrial. Other land uses include recreational and agricultural.

In 2015 most households surveyed in the project area were occupied by renters (51%), while 41% of households were identified as owning the house they live in. Of that group, the majority of homeowners had owned their property for 11 years or more.

4.4.11 Land Use

4.4.11.1 Current Site Layout

There are no current occupants on the site. CECA SL Generation Ltd. signed a land lease with GoSL on January 17, 2017 and has occupied the site since then.

The areas described below are descriptions of how the land was used before signing the lease. These organizations do not currently occupy the site.

The Former Area Held by Sierra Leone Roads Authority-Western Region (SLRA-WR): The remit of the SLRA-WR was to maintain the roads in Sierra Leone's Western Region. The SLRA-WR area was primarily used to store equipment and machinery.

Ancillary features of the administration building include:

The office potable water tank (between the building and the boundary);

- A borehole ('M') to the east of the building (believed to be 3 to 4m deep);
- A temporary structure used as a carpentry / upholstery workshop ('R'); and,
- A shed housing the generator for the administration building ('P').

Former Area held by China Republic Construction Company (CRCC) Compound: The southeast quarter of the SLRA-WR site contained the CRCC compound. It was fenced off from the WR site by chain fencing topped by razor wire.

Formerly artisanal farming was being conducted on part of the site. The farmers have been relocated and as of February 2018, the farmers entered into a resettlement and compensation plan in which they received cash and in-kind compensation.

Former Area held by The Mechanical Service Unit (MSU) Compound: The MSU was a commercial department of the SLRA responsible for repair, maintenance and hire of all SLRA vehicles, plant, and machinery.

4.4.11.2 Surrounding Land Use

As stated above, the areas surrounding the project site are zoned industrial. Residential uses in the area are either mostly shanty buildings constructed by the individuals dwelling or are generally occupied by renters. Other facilities, such as the Islamic Compound and the Polio Compound, described in Vulnerable Groups, have also been informally established in the area. Additional information regarding the Project Site Surroundings are detailed in *Section 2.4.11* Project Site Surrounding Area and shown in Figure 2.3 Project Site Surroundings.

Major projects in operation within the Project's AOI include NP & Total (petroleum product storage and distribution); Afrigas (LNG storage and distribution in canisters for use as cooking fuel); Kissy Industries (edible oil processing); Oryx Petro Jetty (Petroleum Vessel Reception). The only major project under development within the AOI, is the APP Petroleum Tank Farm (at the Disused Refinery), and the proposed refurbishment of the Old Kissy Jetty.

4.4.11.3 Disused Refinery and National Petroleum / Kissy Jetty

Currently the crude oil and refined petroleum storage tanks in the Disused Refinery are being rehabilitated by a new private company (All Petroleum Product Limited) for the storage and distribution of imported refined petroleum products. The same company has acquired a lease from the Government of Sierra Leone for the refurbishment of the Old Kissy Jetty. Some studies on the structural integrity of the Jetty has been conducted by the new developer. However, at the time of INTEGEMS visit, no construction activities were ongoing at the site. Additionally, a Floating Power Plant (Kapowership) was berthed adjacent the Old Jetty from which its supply vessel also docked. The Power ship has moved from the location as per the terms of the contract with the Government.

The Old Kissy Jetty is no longer operational. However, a new Jetty (Oryx Petro Jetty) was constructed adjacent (west of) to it. The Oryx Petro Jetty is currently used by National Petroleum, Total, Afrigas (for LNG), Leonoil (LEONCO) and other importers and distributors of petroleum products.

There are existing pipelines for fuel supply and fire water with a large cage house that housed pumps that supplied fire water for the Jetty, NP and the disused refinery. However, these are no longer functional and NP officials noted that in addition to water supplied by Guma (the national utility for Freetown), the Company extracts water from a couple of boreholes to fill up their reservoirs used for domestic purposes and fire-fighting water supply. Oryx Petro Jetty officials noted that water used at the new Jetty is supplied by Guma with a storage tank within the Jetty's control room compound.

As was previously reported in 2014, tankers are usually parked along the roads in the vicinity along Personage Street and South Road as well as the entrance to the proposed WAPG project site.

4.4.12 Agriculture and Land Tenure

By virtue of its colonial legacy, Sierra Leone has two broad categories of tenure: freehold in the Western Area (the former British Crown Colony) and Sherbro Urban, and leasehold in the provinces (the former British Protectorate). While private ownership exists in the Western Area, land in the provinces is communally owned by the indigenes with title vested in the Paramount Chiefs. It is understood that the land for the project development is owned by the GoSL and land permitting documentations for the project site are completed.

Land use within the Project area is mainly for residential and industrial. Other land uses include recreational and agricultural.

In 2015 most households surveyed in the project area were occupied by renters (51%), while 41% of households were identified as owning the house they live in. Of that group, the majority of homeowners had owned their property for 11 years or more. Project Knowledge, Perceptions and Expectations

4.4.13 Project Knowledge, Perceptions and Expectations

The HHS was also structured to gain insight on the respondents' knowledge perception and expectations of the Project. Only 16% of the HHS respondents are aware of the Project, mostly through neighbors / friends / family members, while 84% are not aware of the project. However, respondents' express concerns regarding Project's benefits especially with opportunities for employment and associated environmental risks. Some 98.5% of the respondents gave satisfactory feedback regarding the establishment of the Project.

4.5 Health Baseline Data

4.5.1 National Context

Sierra Leone has one of the poorest health indicators in the world, with a life expectancy of 50 years at birth and under-five mortality and maternal mortality ratio that are among the highest in the world (WHO, 2016). Women in Sierra Leone have a 1 in 7 life-time risk of dying due to pregnancy or childbirth, and maternal deaths account for 36% of all deaths among women aged 15-49 years. Likewise, Sierra Leone has one of the highest rates of under 5 child mortality in the world, estimated (UN IGME 2018) at 111 per 1,000 live births, with a neonatal mortality rate of 34 per 1,000 live births and an infant mortality rate of 82 per 1,000 live births. It is estimated that 32,000 children die each year, with the leading causes being neonatal conditions, malaria, pneumonia and diarrhea. This needs to be addressed both by community

approaches to ensure children are treated early in their illness, and by improving the quality of care for sick children, particularly in hospitals.

In 2010, the government of Sierra Leone launched the Free Health Care Initiative (FHCI) to increase access to health services and provide free maternal and child health services to pregnant women, lactating mothers and children under five years. The FHCI also provides malaria testing and treatment services free to the entire population. Despite significant investment in the training of staff and improvements in the availability of free health care medicines and equipment, this has not translated enough into the expected reductions in maternal, child or neonatal mortality.

At the district level, a District Health Management Team (DHMT) is responsible for the overall health planning, implementation, coordination, monitoring and evaluation of health services. The DHMTs are an extension of the Ministry of Health and Sanitation (MoHS), but as established by the Local Government Act of 2004, work under the local council. Primary and secondary care falls under the jurisdiction of the local councils, while tertiary hospitals still remain under the jurisdiction of central level MoHS.

4.5.2 General Health and Sanitation

Available evidence shows that Freetown faces myriad health risks and vulnerabilities mostly identified relating to poor waste collection and disposal systems, poor sanitation, water contamination, air pollution and flooding related health problems. Hazardous wastes, which can be in the form of solid, liquid, sludge or even gas, contain highly persistent inorganic or organic chemicals and compounds with acute and chronic (immediate, short-term, as well as long-term) impacts on human/public health and on environment.

The minimum package of activities found in health centers and clinics in Freetown are those of the first line health care delivery, which typically include curative consultations; minor surgery; antenatal care; delivery; immunization; pharmacy; and management of first line emergencies (first aid and short stay). Also, in almost all clinics, outreach activities are carried out to address both health education and promotion, but also to improve immunization coverage.

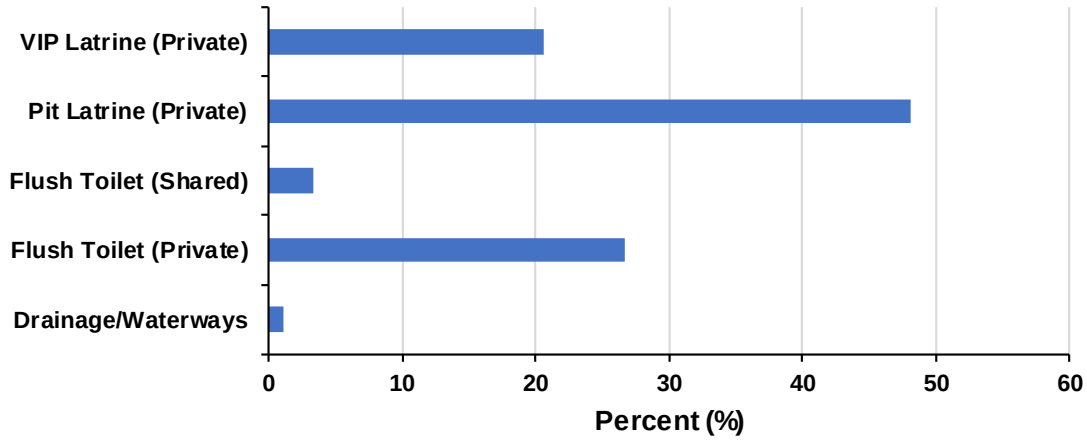
4.5.3 Community Health and Sanitation

Sanitation and community health are interrelated with sanitation being a basic human need in the terms of cleanliness and remains one of the factors for disease prevention effort. Availability of clean drinking water, sewage disposal, and household waste disposal are of importance when considering environmental health. Access to safe drinking water is important to help prevent waterborne diseases such as cholera, typhoid and schistosomiasis, and to reduce the adverse health consequences associated with other contaminants. Majority of inhabitants in the Project area rely on standpipes.

The Guma Valley Water Company (GVWC) mainly supplies piped water to parts of Freetown but access is limited. The piped water supplies that do exist in the Project area can be intermittent, particularly during the dry season. The access to clean/potable water supply services has serious implications on community health and water borne diseases. The HSS results reveals most households rely on public tap as a source of drinking water. Given that the most used source of water supply is via public tap, most people in the Project area already have access to clean water. However, it is important to note that limited hygiene of drinking water exist in the study area, highly dominated by the diversity of sources, the conditions of transportation and storage and the relatively low level of knowledge on water-related diseases.

The HHS revealed that majority of the residents in these communities use private pit latrines (48.1%) and private flush toilets (26.8%) as toilet/sanitary facilities. Other means include private VIP latrines (20.6%) and 3.3% use shared flush toilets (See Figure 4.18).

Figure 4.18 Access to Toilet Facility



4.5.4 Healthcare Facilities and Services

Maintaining good health is a major problem facing many inhabitants in the Project area. Primary healthcare is the initial point of contact for patients, delivered at Peripheral Health Units (PHUs) which comprise Community Health Centers (CHC), Community Health Posts (CHP) and Maternal and Child Health Posts (MCHP).

The Abdalla Abdelganni Arab clinic is the only medical facility in close proximity to the Project site providing only first-level care package including maternal and child health, immunization (routine and outreach), preventive and curative consultations. The clinic does not have capacity to admit patients and hospitalization services are offered only at the nearest Government Hospitals (Ola During Cottage Hospital and Rokupa Government Hospital, which are located approximately 4km and 3km from the project site respectively) as the referral centers. However, other private health facilities are located within the study area or within a 2km away.

Major programs against life-threatening diseases like malaria (MCP – Malaria Control Program), tuberculosis and HIV/AIDS are being implemented with support from NGOs and donors. The UMC Mission Hospital, commonly known as Sarola Hospital also plays a key role in the Project area and beyond, especially in offering specialized eye care services.

Health treatment facilities typically visited by the local community are generally located within a 1-2km radius (see Figure 4.20) of people's homes and include government hospitals, clinics, or pharmacies. General waiting periods for medical treatment were relatively short, ranging from less than 30 minutes to up to an hour.

Figure 4.19 Type of Health Facilities Visited

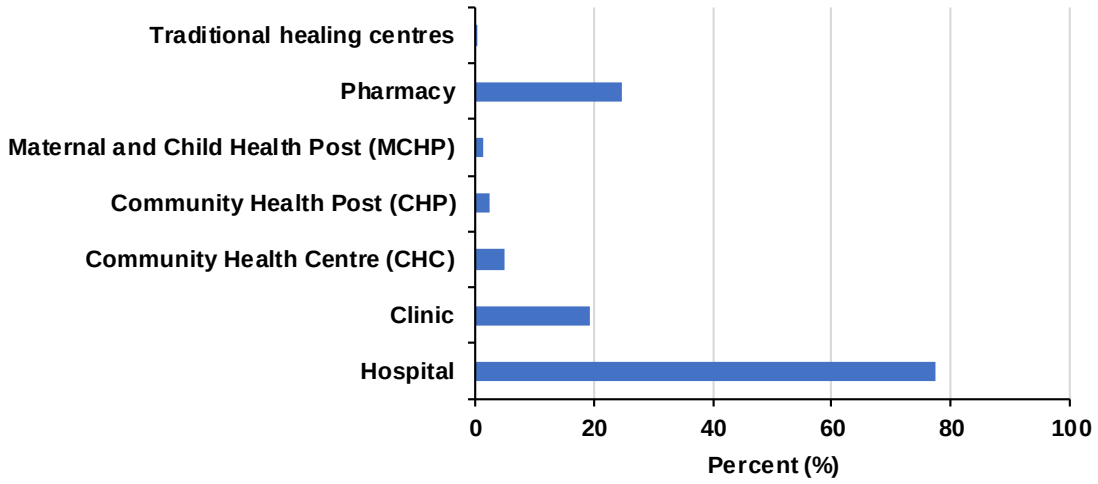
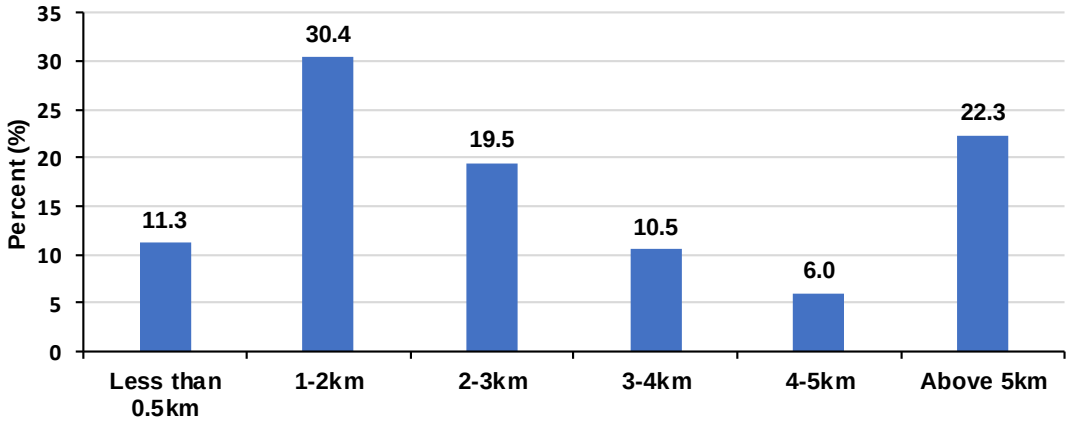


Figure 4.20 Distance from Health Facility



4.5.5 Disease Prevalence

Sierra Leone is one of the most severely malaria-burdened nations in Africa, with its entire population of over 7 million people at risk of the disease. In addition to its increasing risks of complications during pregnancy, WHO estimates that the disease contributes to 20% of all under-5 deaths in the country. For these reasons, efforts to reduce mortality rates in Sierra Leone will depend to a large extent on effective malaria prevention and control.

The HHS results revealed that Malaria and Common Cold accounts for the highest prevalent illnesses reported in the last 3 months. Other illnesses recorded include Typhoid, Body Pain and High/Low Blood Pressure (see Figure 4.22).

Sierra Leone is currently implementing the HIV/AIDS National Strategic Plan 2016-2020 aimed to help end HIV/AIDS as a public health and development problem in the country. In 2017, national prevalence of

generalized HIV/AIDS epidemic stood at 1.5% with an estimated 2,812 new HIV infections and 2,390 AIDS-related deaths (WHO, 2017).

In addition, the Project will ensure that the EPC contractor will hold training sessions for workers and establish policies to minimize the spread of any diseases, such as HIV/AIDS brought in by workers outside of the community, and to prevent its introduction to the local community.

Figure 4.21: Households Reported Illnesses in Last 3 Months

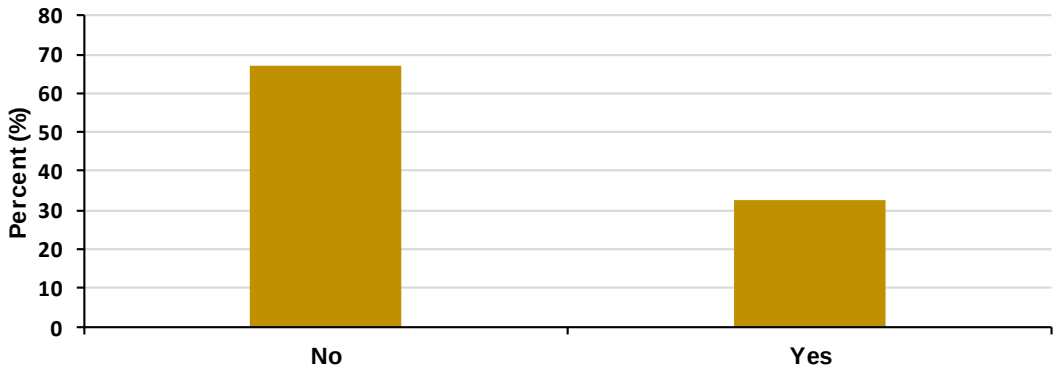


Figure 4.22: Household Common Illnesses Reported within Last 3 Months

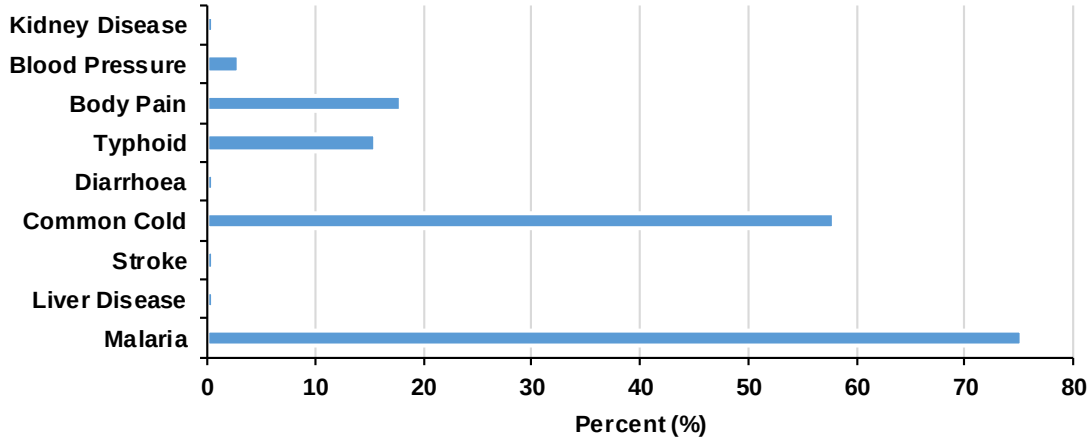


Figure 4.23: Households Recorded HIV/AIDS Positive Cases

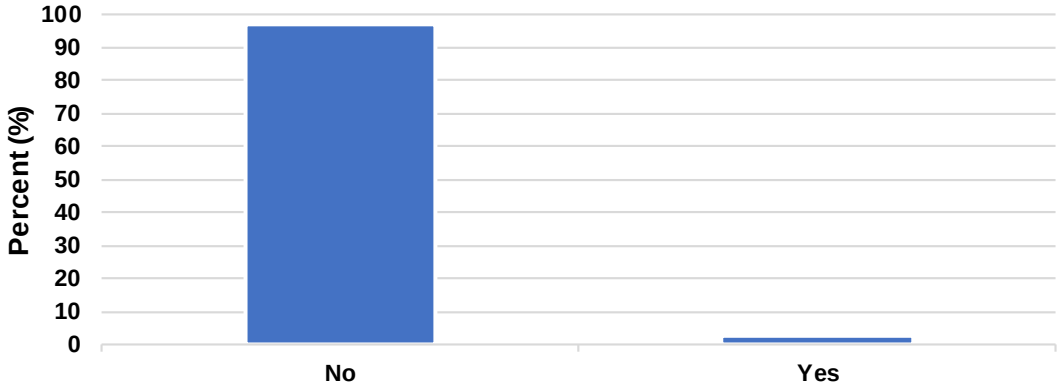
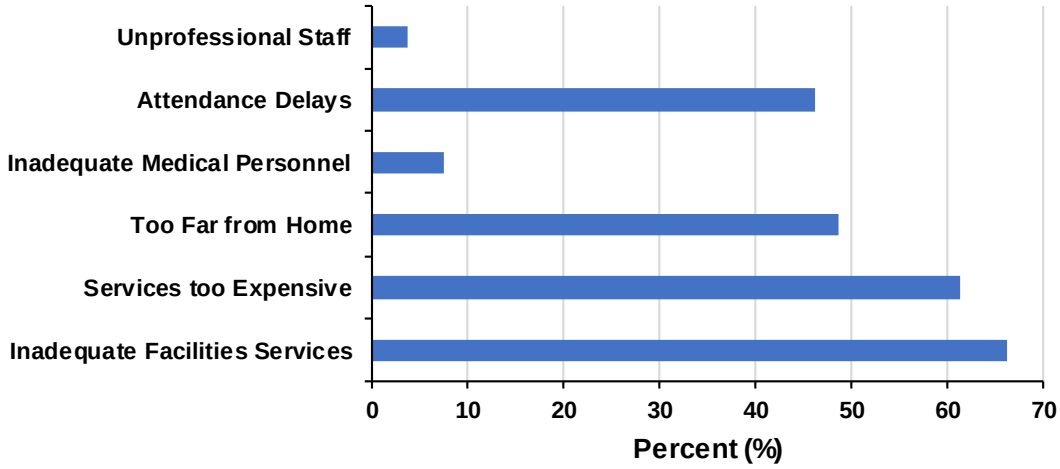


Figure 4.24: Concerns with Health Services



4.5.6 Health Seeking Behavior and Cultural Health Practices

When it comes to seeking treatment for ill health, there are a range of physical and material barriers, especially for those in informal settlements in Freetown. These include long distances, poor roads, long wait times, and high costs for services. There are also social barriers, for example the role of religious and cultural beliefs, in preventing some of the people from accessing formal health care. Men belonging to secret societies can be put off seeking treatment if staff are female. Health workers' breaching confidentiality and poor attitudes are also barriers to accessing care. Health workers on the other hand, are experiencing high workloads, a lack of formal enrolment and low motivation. All of these factors contribute to limiting access to formal healthcare in Freetown and contribute to the growing burden of ill health in communities.

Therefore, common practices of dealing with ill health in Freetown is through self-administered treatments. Illnesses are reported to the healthcare centres mostly when conditions get worse; or when

self-treatment fails. These decisions are sometimes largely based on the high cost of travel to the facilities and to obtain healthcare services.

Additionally, others will buy drugs for minor illnesses (e.g., cold, headache, fever and malaria) or seek treatment from informal health providers (traditional healers) and will only visit health facilities when they realise that it is not working. In all such cases, people will visit health centres only for more serious health conditions or when their condition has worsened.

From the HHS, it was revealed that 87.4% of respondents do not visit formal medical facilities for check-up, while 10.2% seeks medical check-up at least every 3 months. About 1.7% undergo medical check-up on an annual basis. Only a small number (0.7%) of the respondents goes for medical check-up at least every 6 months (see Figure 4.25).

The 2015 PHC report shows that out of the 5,030,016 population 10 years and above in Sierra Leone, 9.1 percent took tobacco only, 3.5% took alcohol only, while 2.6% took both tobacco and alcohol. The HHS results shows that 13.4% and 12.3% of households have members who smoke and drink alcohol respectively, which are comparatively higher than the national figures (see Figure 4.26).

Figure 4.25 Frequency of Medical Check-up

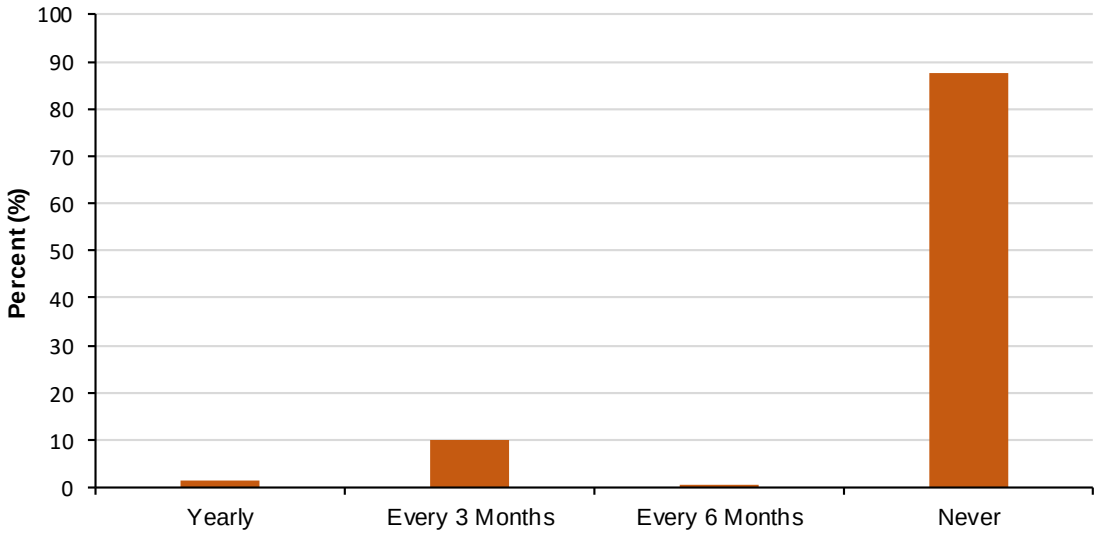
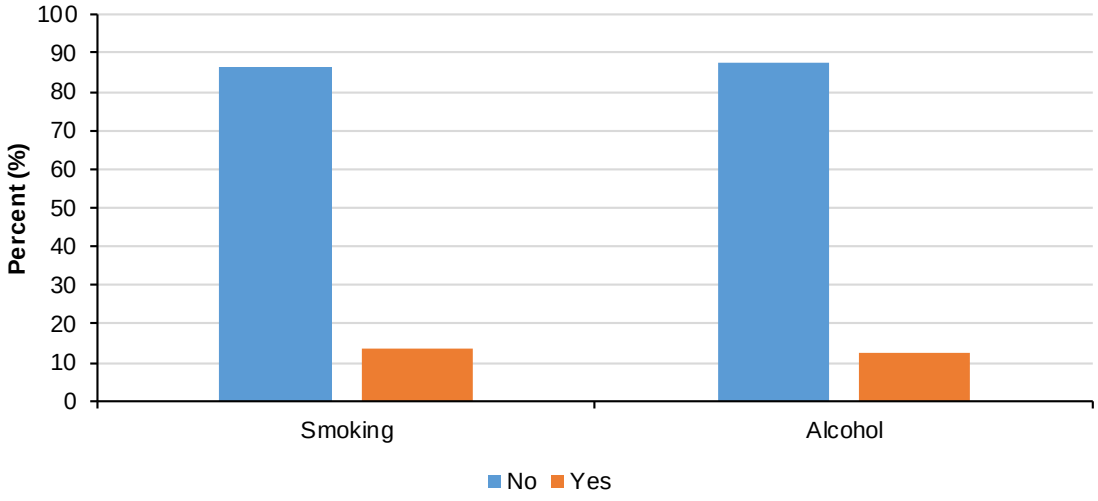


Figure 4.26 Respondents' Alcohol and Smoking Habit



4.5.7 COVID-19 Outbreak

Since its initial outbreak, COVID-19 disease has spread all over the world and has been declared by the World Health Organization as a pandemic. The disease has caused millions of infections and thousands of deaths, causing significant challenges to every health systems (Bressan, Buonsenso , Farrugia, Parri, & Oostenbrin, 2020). The Government of Sierra Leone (GoSL) activated the Emergency Operations Centre (EOC) and Public Health Emergency Reponses Pillars including Surveillance, Case Management, Laboratory, Drugs and Medical Supplies and Risk Communication as early as January. In mid-March, a State of Emergency was declared that will remain in effect for 12 months. The airport and points of entry with Guinea and Liberia were closed.

The first case of COVID-19 was confirmed in Sierra Leone on 30 March 2020. Learning institutions were closed; travel and trade restrictions between districts were placed in effect; handwashing stations are required at all businesses; social distancing, partial lockdown and curfews remained in place. As of 21 September 2020, there were 2,168 confirmed COVID-19 cases, 72 deaths and 1,650 recoveries in Sierra Leone. Overall Case Fatality Rate (CFR) is 3.3% (MOHS, 2020)

Since the month of July, the number of confirmed COVID-19 cases reported has considerably declined, with an average of 9.5 new cases per day and a decline in fatality rate from 4.1 per cent at the end of June to 3.7 per cent. The highest number of positive cases remains to be in Western Area Urban and Rural districts accounting for 57.8 per cent of all cases. Kenema, Bo and Port Loko districts have reported the next highest cases at 6.2%, 5.6%and 4.8% respectively. Partial re-opening of schools has occurred for exam students only with strict infection prevention and control (IPC) measures in place, including handwashing stations at all entry points to the schools, use of face masks and social distancing is in practice. Commercial flights resumed operations on 22 July with few airlines serving Sierra Leone. The inter-district travel ban has also been lifted and the curfew reduced to 11pm-5am daily. Restrictions on market operations and prayer services have also been eased.

The level of awareness of COVID-19 from households interviewed was high. The study revealed that 4.1% of households had tested positive of COVID-19. Social distancing, frequent handwashing, the use of hand sanitiser facemask were the common practices in the community during the time of the HHS.

4.6 Project Social Risks, Impacts and Mitigations

4.6.1 Project Security Forces

Interviews with local police have indicated theft and trespassing crimes are not commonplace in the area, there is still the potential for negative interactions between security at the project and the local community. Although the nature and deployment of the project security force has yet to be determined, the Project will take appropriate measures to ensure that the operator creates a plan that minimizes negative interactions with the local community and provides training for the security force that reflects this. This plan will comply with Security Performance Standards (PS4) and the UN Voluntary Principle on Security and Human Rights.

4.6.2 Worker Rights Protection

It is understood those belonging to vulnerable groups, indicated in Section 4.4.2, will be employed at the jobsite. The Project will take appropriate measures to ensure that the operator develops a plan that will include anti-discrimination and harassment policies. This plan should include at a minimum a definition of harassment, ongoing training for employees, an established reporting mechanism, and a clearly spelled out discipline policy for violations. The goal of this established plan is to provide protection not only for all workers at the site, but especially for those from vulnerable groups who are likely to be the result of discrimination and harassment.

4.6.3 Population Displacement Due to Project Activities

At this time, the project has accounted for all displaced community members, however as the project progresses, the government of Sierra Leone may request addition substations and / or transmission lines to be built that result in the temporary or permanent relocation of members of the local community. Should this happen, the Project will take appropriate measures to ensure that a relocation plan for those who are temporarily or permanently displaced by future project activities will be compensated.

4.7 Human Rights Impact Assessment

Although a full Human Rights Impact Assessment has not be conducted, the majority of the issues that would come up in it have been addressed in the ESHIA through the reinforcement of human rights in a variety of areas. These areas are:

- Use of force in Section 4.6.1.
- Discrimination in Section 4.6.2.
- Population Displacement in Section 4.6.3.
- Worker and Occupational Safety in Section 8.2.

4.8 Conclusion

The following general conclusions can be made in accordance with the findings regarding the individual baseline aspects studied

- **Demography:** The Study Area has a demographic structure, with young and youthful population. The population is ethnically and culturally diverse and social cohesion is good. There is good social integration of some vulnerable groups, such as the polio minority.
- **Infrastructure and Services (Road, Energy, Water Supply):** Water supply is relatively good in the area but the rapid urbanization and over population is part of the reasons for the water crisis in

the city and the kissy community as the estimated beneficiaries far outweigh the capacity of the national Guma valley water company that is responsible for water supply in the city. Electricity is mainly supplied by EDSA. The road network is good but as general the condition of the roads is poor and needs maintenance and/or rehabilitation.

- **Education:** the educational opportunities offered within the AoI settlements are mostly limited to the private school system, with only one government public school in the area. The quality level of schooling is generally poor as many teachers are ill equipped with resources and they often do not possess appropriate teaching skills. As a result, the education level of students is far below the level of their western peers.
- **Economic Context & Livelihoods:** The local economic context is dominated by small scale commercial business and trading and mix of light and heavy industry. Other forms for generating income include employment in the informal sector, petty trading, commercial bike riding, carpentry, tailoring, masonry, artisanal sand mining, etc. Local incomes are modest, with low levels of savings and spending. Households supplement their financial incomes with remittances from friends and relatives and other business.
- **Health and Sanitation**: The biggest local health problem currently is the COVID-19 outbreak. The issue of affordable and adequate health facilities; understaffing; lack of appropriate amenities and equipment; poor waste collection and disposal systems, poor sanitation is a challenge. In cases where some people cannot afford to pay for health care services, traditional healers, home remedies and self-administered treatments are substituted where the services are less expensive of more or less free. The most common illness in the Study Area is Malaria and Common Cold.

  Waste management has been a challenge in the Freetown and in the community also. These challenges come with a huge cost to human health. The lack of a well-planned and regulated waste management system is a key driver of indiscriminate waste dumping in the Project Area, which is invariably linked to health challenges for the communities.

5 Physical Environmental Baseline

5.1 Introduction

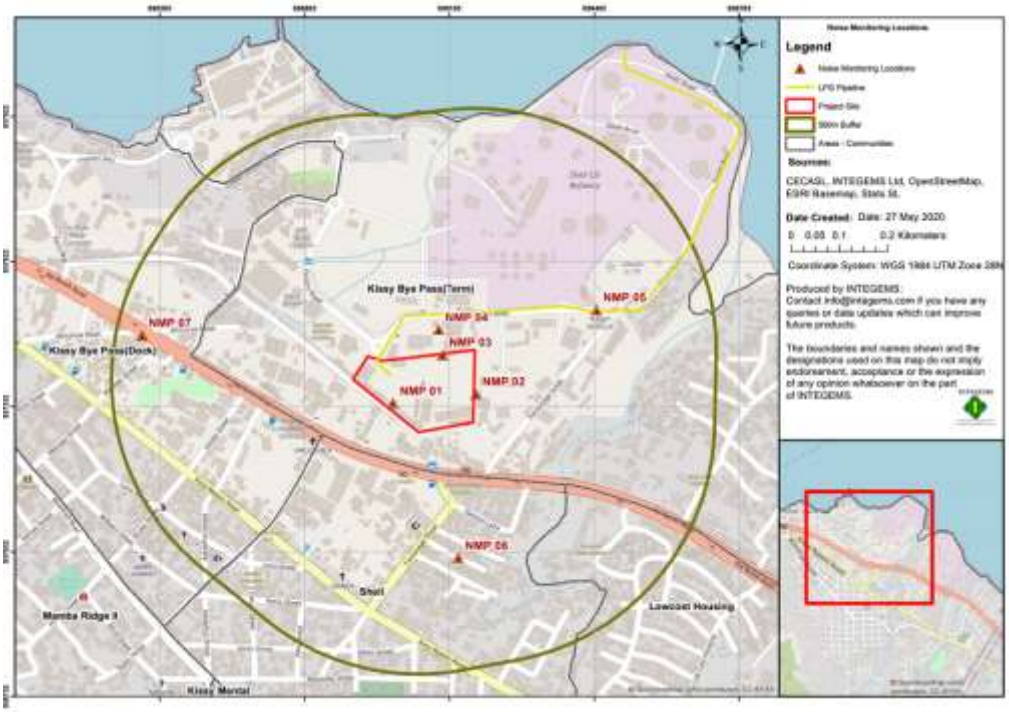
The environmental baseline of the project and its surrounding areas has been established for each environmental aspect under consideration. Most of this data was originally established from the HFO project study in 2015 and was achieved largely through consultations with relevant stakeholders, a desktop review of available data, a literature review and site walkthroughs. Due to the new scope of the project new environmental aspects will be considered and have been added to the study.

The detailed assessment process has included both an additional desk study and data review combined with independent field surveys and computer modelling where appropriate. The detailed assessments have included ambient noise and air quality monitoring.

5.2 Noise

To establish the existing ambient noise environment, noise surveys have been conducted by INTEGEMS. The first noise surveys were conducted during February and September of 2015 during the original study. A second noise survey was done in 2020 to compare the ambient noise environment. Due to the COVID-19 Pandemic the noise survey that was conducted did not include data from the night time period due to a curfew that was put in effect by the GoSL. The curfew was lifted at the end of November of 2020 and plans are in effect to conduct a new noise survey that includes data during the nighttime as soon as the local economic activity returns to normal so that accurate readings from the industrial facilities can be captured.

Figure 5.1 Noise Monitoring Locations



The equipment used to measure sound pressure levels complies with the requirements of Class 1 of British Standard EN 61672-1:2003: "Electroacoustics – Sound level meters – Part 1: Specifications". The

measurement equipment was calibrated in the preceding two years by a competent calibration laboratory that can demonstrate that its measurements are traceable to national standards.

Ambient environmental noise monitoring was undertaken at seven (7) locations within and around (i.e., 500m buffer) the project site (see Figure 5.1) in April and May 2020. The monitoring locations were selected based on existing noise sources and potential receptors. At each of the locations, a Casella CEL 633A – a Class 1 noise meter was set to log 5-minute averages of the following A-weighted broadband statistical noise descriptors for a monitoring duration of 1 hour per log.

Table 5.1 Noise Monitoring Locations

ID	Name	Latitude	Longitude	Approx. Distance from Project Site (m)
NMP 01	Project Site	8.475598	-13.191870	0
NMP 02	Project Site	8.475754	-13.190315	0
NMP 03	Project Site	8.476494	-13.190938	0
NMP 04	Magram Water Bottling Company Compound	8.476960	-13.191005	40
NMP 05	Government Independent Memorial Secondary School	8.477320	-13.188037	278
NMP 06	Shell Lane	8.472696	-13.190654	295
NMP 07	Bai Bureh Road	8.470800	-13.190910	466

The mean LA_{eq} values for each location during the day and night are presented in Table 5.2.

Table 5.2 Logarithmic Average Noise Results for Each Location

Location ID	Location Description	LA_{eq}, dB(A)
NMP 01	Project Site – Southern Boundary	59.8
NMP 02	Project Site – Eastern Boundary	48.2
NMP 03	Project Site – Northern Boundary	49.5
NMP 04	Magram Water Bottling Company	64.4
NMP 05	Government Independent Memorial Secondary School (GIMSS)	63.1
NMP 06	Shell Lane – Off Parsonage Street	69.0
NMP 07	Bai Bureh Road / Africanus Road	75.1

Noise measurements at all locations were undertaken on publicly accessible land near properties, rather than close to the façades of the dwellings. Measurements were taken at 1.2 – 1.5m above the ground, in free-field conditions (more than 3.5m from any reflecting surface). The same equipment was used for the September survey as for the February survey.

Table 5.3 Mean Daily Continuous Sound Pressure Level

Location ID	Location Name	Day		Date	Total Monitoring Duration, hrs	Average LA_{eq} dB(A)
NMP 01	Project Site – Southern Boundary	Day 1		15 April 2020	7	62.9
		Day 2		18 April 2020	9	52.7
NMP 02	Project Site – Eastern Boundary	Day 1		16 April 2020	8	49.0
		Day 2		19 April 2020	8	47.2
NMP 03	Project Site – Northern Boundary	Day 1		17 April 2020	8	50.6
		Day 2		24 April 2020	8	47.9
NMP 04	Magram Water Bottling Company	Day 1		22 April 2020	7	51.2
		Day 2		23 April 2020	5	68.1
NMP 05	Government Independent Memorial Secondary School (GIMSS)	Day 1		20 April 2020	7	63.5
		Day 2		21 April 2020	8	62.6
NMP 06	Shell Lane – Off Parsonage Street	Day 1		25 April 2020	8	68.6
		Day 2		28 April 2020	7	68.9
NMP 07	Bai Bureh Road / Africanus	Day 1		30 April 2020	8	75.2
		Day 2		01 May 2020	7	74.9

5.2.1 Comparison with the 2015 Ambient Noise Levels

To establish the existing ambient noise environment, noise monitoring was conducted by INTEGEMS during February 2015 at the locations outlined in Table 5.4 Noise Monitoring Locations in 2015**Error! Reference source not found.**. The locations were selected with due consideration of risks around Ebola and were collected for a limited duration. While these locations were considered representative of conditions adjacent to the development site, they may not be representative of all the receptor locations in the project area.

As was the case for the April / May 2020 during COVID-19 outbreak, the conditions captured during monitoring at certain locations / days in 2015 may reflect potential reductions in ambient noise levels as a result of reduced working activities and travel within the local area under Ebola conditions. Therefore, a brief comparison of the result is presented here for measurement locations NMP 01 to NMP 04. A summary of noise data recorded at the four locations at which measurements were undertaken in 2015 is presented in Table 5.4 and graphically displayed in Figure 5.1.

Table 5.4 Noise Monitoring Locations in 2015

Measurement Location	Location Description
Point 1/ NMP 01	CRCC Compound
Point 2/ NMP 02	SLRA/MSU Compound
Point 3/ NMP 03	SLRA/MSU Compound
Point 4/ NMP 04	Magram Water Bottling Company Compound

Table 5.5 Day-time Ambient Noise Recorded in February 2015 and in April / May 2020

Location ID	Location Description	LA_{eq}, dB(A)		WBG EHS Limit LA_{eq}, dB(A)	
		2020	2015	Residential	Industrial
Point 1/ NMP 01	Project Site – Southern Boundary	59.8	49.8	55.0	70.0
Point 2/ NMP 02	Project Site – Eastern Boundary	48.2	48.0	55.0	70.0
Point 3/ NMP 03	Project Site - Northern Boundary	49.5	49.8	55.0	70.0
Point 4/ NMP 04	Magram Compound	64.4	50.6	55.0	70.0
NMP 05	GIMSS Compound	63.1	-	55.0	70.0
NMP 06	Shell Lane – Off Parsonage Street	69.0	-	55.0	70.0
NMP 07	Bai Bureh Road / Africanus Road	75.1	-	55.0	70.0

Table 5.6 Average Night-time Noise Results for Each Location

Location	2015 LA_{eq}, 1h, dB(A)
Point 1/ NMP 01	48.6
Point 2/ NMP 02	43.8
Point 3/ NMP 03	45.3
Point 4/ NMP 04	38.9

The average noise levels measured in 2015 were below the WBG EHS Guideline limit during daytime for both industrial and residential settings. The average measured night-time noise levels around the site were well below the WBG EHS Guideline noise level for industrial areas (70 dB) but marginally exceeded the IFC night-time guideline level (45 dB) for residential areas at points 1 and 3 (see Table 5.6). Comparable daytime noise levels were recorded at points 2 and 3 in April / May 2020, while the mean LA_{eq} recorded at points 1 and 4 were significantly higher in 2020 than in 2015 (see Table 5.5). The deviations in the data from points 1 and 4 could be attributed to noise from an industrial power generator from a nearby metal works center, which was in operation throughout the day 1 of monitoring at point 1 and from Magram's

generator, which was in operation for a significant part of the day 2 of monitoring at point 4 (see Table 5.5).

5.3 Air Quality

Urban air pollution has the potential to cause significant environmental problems. The pollutants from combustion activities have the potential to cause detrimental effects to human health or sensitive vegetation and ecosystems.

There is no regulatory local monitoring undertaken within Sierra Leone, although some work carried out by the Njala University, Sierra Leone, indicates that air quality at certain locations in Freetown is considered poor for some substances (Taylor & Nakai, 2012), and these locations could potentially be classified as degraded airsheds.

The key sources of air pollution which influence air quality in the vicinity of the project site are likely to be domestic or commercial-scale power generators, burning of household or commercial wastes, residential wood and charcoal ovens, road traffic emissions, industrial emissions and re-suspended dust / particulate matter from poorly surfaced or unsurfaced roads. Due to unreliable power sources, domestic and commercial power generators, commonly running on diesel are prevalent in most parts of Freetown, including around the site. This will lead to increased emissions of substances associated with combustion in addition to those emitted by road traffic, for example, nitrogen dioxide, sulfur dioxide, particulates and carbon monoxide. The amount of poorly surfaced roads is likely to lead to significant dust generation during the dry season. During the rainy season, the potential for significant dust generation is less likely.

5.3.1 Monitoring Survey to Determine Background Concentrations

Air quality monitoring was undertaken to update the data acquired in 2015 for the previous ESHIA. The monitoring was undertaken at five locations between April and May 2020. As best as possible, these locations were the same locations as those in the 2015 baseline study. However, the sites were subjected to accessibility and security constraints. Therefore, only five sites were monitored, and with marginal deviations from the original positions. Generally, the selection of the locations is based on various factors such as site topography, prevailing wind direction, the layout of the proposed project components, the location of the nearest sensitive receptors and good international industry practices and guidelines.

The following are the air pollutants parameters measured during the monitoring: Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Sulphur Dioxide (SO_2), Ozone (O_3), Volatile Organic Compounds (VOCs), Particulate Matter aerodynamic diameter 10 µm (PM_{10}) and Particulate Matter of aerodynamic diameter 2.5 µm ($PM_{2.5}$). The monitoring was designed to record the average concentrations of each pollutant in the air at the specified locations over a three (3) days period.

Air pollutants are emitted into the atmosphere from a variety of sources and the concentration of these pollutants in the ambient air depends not only on the quantities that are emitted but also the conditions and ability of the atmosphere, to either absorb or disperse these pollutants. Understanding the behavior of meteorological parameters is important because the atmosphere is the medium in which air pollutants are transported away from the source, which is determined by the meteorological parameters. Therefore, at each monitoring location data was additionally acquired for temperature and relative humidity.

The air quality monitoring was undertaken using a portable air quality monitor Aeroqual Series 500 sensor, which enables accurate short-term fixed real-time surveying of common outdoor air pollutants. The sensors are housed within an interchangeable cartridge ("head") that attaches to the monitor base which can be removed and replaced in seconds, allowing users to measure as many gases as desired.

The measurements were carried out by placing the equipment at a height of about 1.5 -1.7 meters from the ground level and sufficiently away from any disturbance or direct obstacle from the source(s) under consideration to ensure that the air that is monitored is representative of the air that most residents / visitors were breathing. During the monitoring, the field staff were stationed on the sites on a daily basis to perform routine data checks, performance audits, and scheduled maintenance. The field technicians carried out QA / QC duties, including change of filters (where necessary), and retrieval / download of raw data.

Table 5.7 Air Quality Monitoring Locations

Site ID	Site Name	Description	Latitude	Longitude
AQMP 01	Shell Police Station	Location AQMP 01 is approximately 74m south of the project site along Bai Bureh Road, a highway with frequent vehicular movement, petty trading and numerous small and large-scale commercial activities. Within the vicinity of the point is a Bus Park for passengers travelling out of Freetown to the Province with a gas station located at a distance of 40m south of the monitoring point.	8.474425	-13.191168
AQMP 02	Sierra Leone Housing Cooperation (SALHOC) Gate	Monitoring point AQMP 02 is located southwest of the project site at a distance of about 132m. The point is similarly located along Bai Bureh Road. Within the immediate vicinity of AQMP 02 are SALHOC Compound, National Petroleum (NP) gas station, Commodity Trading Company (CTC), Tahweb Primary School and a tire servicing center about 10 meters away.	8.475105	-13.193238
AQMP 03	Sir Winston Churchill International Secondary School (SWISS)	AQMP 03 is located at the SWISS compound at approximately 137m northwest of the project site. The monitoring point is about 30m south of Factory Road, an unpaved road within the Kissy Dockyard industrial zone. A metal welding shop is located within the SWISS compound, although this facility was not operational during the monitoring period.	8.477215	-13.193336
AQMP 04	Masjid IHASAN Mosque	Location AQMP 04 is 266m east of the project site at the Masjid (Mosque) IHASAN compound along South Road, which is frequently plied by fuel bowsers en route to NP's Fuel Depot, which is about 200m northeast. The critical receptors within the vicinity of this point include squatters along South Road and the Government Independent Memorial Secondary School along Parsonage Street.	8.477328	-13.188037
AQMP 05	Fomel Industries and National Industrialization Centre (FINIC) Fence	AQMP 05 is located adjacent FINIC at about 67m east of the project site and about 30m off South Road. Within the most immediate vicinity of AQMP 05 is Bollore Logistics Compound and with squatters along the fences of the industrial compounds.	8.476635	-13.189709

Figure 5.2 Air Quality Monitoring Locations

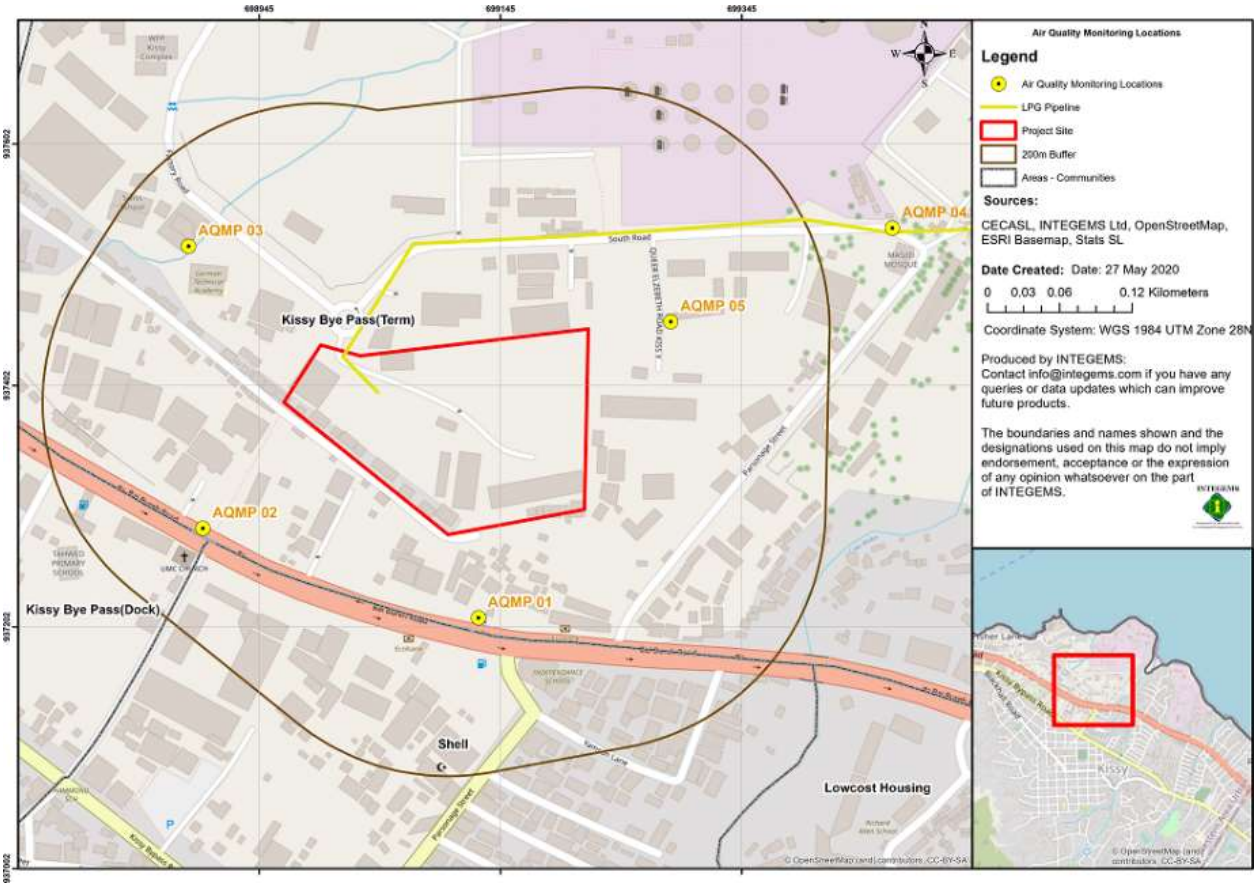


Table 5.8 Mean Air Pollutant Concentrations

Parameter	Units	WHO Daily Standard Values	AQMP 01	AQMP 02	AQMP 03	AQMP 04	AQMP 05
$PM_{2.5}$	$\mu g/m^3$	25	24.11	38.05	34.77	16.23	68.32
PM_{10}	$\mu g/m^3$	50	63.53	82.99	93.49	48.81	71.48
NO_2	$\mu g/m^3$	200	18.48	9.73	14.06	23.7	15.27
CO	$\mu g/m^3$	3000	57.44	75.76	28.85	0	0
O_3	$\mu g/m^3$	100	21.88	24.12	23.28	26.17	27.95
SO_2	$\mu g/m^3$	20	0	0	0	0	0
VOCs	mg/m^3	NA	624	391	307	617	635
Temperature	^oC	NA	34.8	33.6	34	35.9	35
Relative Humidity	%	NA	56.3	59.6	60.9	50.9	55.8

Table 5.9 Daily Air Mean Pollutant Concentrations

Locations	Day	Date dd/mm/yyyy	$PM_{2.5}$, µg/m^3	PM_{10}, µg/ m^3	NO_2, µg/ m^3	CO, µg/ m^3	O_3, µg/ m^3	SO_2, µg/ m^3	VOC, mg/ m^3	Temperature, OC	Relative Humidity, %
Standard Values			25	50	200	3,000	100	20	NA	NA	NA
AQMP 01	1	15/04/2020	21.29	63.15	9.177	0.00	10.62	0.00	977	34.1	57.5
	2	16/04/2020	33.56	68.72	34.810	172.31	34.67	0.00	478	35.1	55.1
	3	17/04/2020	17.47	58.72	11.460	0.00	20.35	0.00	417	35.2	56.4
AQMP 02	1	18/04/2020	19.77	63.12	6.308	0.00	26.42	0.00	385	32.3	61.5
	2	19/04/2020	59.23	108.31	13.538	0.00	24.64	0.00	411	35.6	53.9
	3	20/04/2020	35.15	77.54	9.346	227.28	21.29	0.00	378	33.0	63.3
AQMP 03	1	21/04/2020	35.77	83.03	23.154	0.00	24.03	0.00	322	34.7	57.3
	2	22/04/2020	31.12	87.04	7.615	86.54	15.46	0.00	312	35.1	58.4
	3	23/04/2020	37.42	110.39	11.423	0.00	30.35	0.00	286	32.3	66.9
AQMP 04	1	24/04/2020	20.62	47.95	31.690	0.00	34.13	0.00	405	35.3	57.3
	2	25/04/2020	8.58	18.46	23.920	0.00	22.42	0.00	467	35.9	49.5
	3	28/04/2020	19.49	80.03	15.490	0.00	21.95	0.00	979	36.6	45.9
AQMP 05	1	29/04/2020	48.19	70.50	15.850	0.00	23.54	0.00	752	35.9	54.5
	2	30/04/2020	142.47	114.36	25.420	0.00	37.42	0.00	498	32.6	58.8
	3	01/05/2020	14.31	29.59	4.540	0.00	22.89	0.00	656	36.5	54.2

5.3.2 Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2) Monitoring

Nitrogen dioxide is a naturally forming gas, characterized as having an irritating odor. Small quantities can be produced by plants, soil and water, but anthropogenic activities, such as the combustion of fossil fuels and biomass, are the sources of most NO_2. Nitrogen dioxide is one of a group of gases called nitrogen oxides (NO_x). While all of these gases are harmful to human health and the environment, NO_2 is of greater concern. It primarily gets in the air from the burning of fuel in vehicles, power plants, and off-road equipment. Human respiratory tract irritation represents a direct effect of NO_2 exposures. Due to it being relatively insoluble (relative to SO_2), NO_2 can penetrate deep into the lungs, causing potential tissue damage. Effects of NO_2 exposure include alveolar tissue disruption and obstruction of the respiratory bronchioles. Long term effects of exposure include increased potential for lung infections.

The NO_2 concentrations recorded for all the locations are within the 24-hourly mean according to the WHO ambient air quality guideline of 200 µg/m^3. However, AQMP 01 and AQMP 02 positioned adjacent the busy Bai Bureh Road recorded roadside measurement which is not generally representative of ambient concentrations in the areas at proximity to the proposed project site.

Sulphur dioxide is a colorless gas and is characterized as having a sharp, irritant odor. It is a primary pollutant, which can react easily with other substances and form secondary pollutants such as sulfur trioxide and sulfuric acid, amongst others. SO_2 is formed by human activities through mainly industrial processes that contain sulfur, such as the combustion of coal, oil or gas. Sulphur dioxide is damaging to the human respiratory function when inhaled, causing coughing and shortness of breath. Either long term exposure or exposure to a large dose can result in chronic respiratory disease and the risk of acute respiratory illness. With respect to the impacts on vegetation, SO_2 can inhibit the photosynthetic properties of plants and in some cases, eliminate more sensitive species on the ecosystem level with continuous exposure.

The monitoring data indicated zero background SO_2 concentration across all the monitoring locations. This could be attributed to the absence of significant SO_2 sources within the monitoring locations. However, it must be noted that long-term atmospheric monitoring within the area could record SO_2 concentrations as was the case in the 2015 ESHIA study.

5.3.3 Particulate Matter (PM_{10} and $PM_{2.5}$) Monitoring

Particulate Matter is airborne particles that include dust, smoke, soot, dirt and liquid droplets and can either be emitted naturally (e.g., windblown dust of roads) or by human activity (e.g., stack emissions). PM is defined by size, with coarse particles being between 2.5-10 microns (µm), fine particles less than 2.5 µm, and ultrafine particles less than 0.1 µm. PM has adverse effects on humans, such as respiratory illnesses (asthma, bronchitis) or cardiovascular diseases and is also considered as being carcinogenic.

Except for location AQMP 04, the average PM concentrations for all other locations exceeded the WHO guideline values. The elevated particulate concentration in the study area is due to exhaust emissions (Fuel and oil combustion from automobiles), non-exhaust emissions (particles released into the air from brake wear, tire wear, road surface wear and resuspension of road dust during on-road vehicle usage) and some fugitive emissions from other domestic and commercial activities such as biomass burning.

It must, however, be noted that monitoring was undertaken at the end of the dry season with sporadic rains, which would lead to lower ambient particulate as compared to the absolute dry season.

5.3.4 Carbon Monoxide

Carbon monoxide is a colorless, odorless, highly toxic gas that deoxygenates human blood, causing oxygen deprivation. The most common source of carbon monoxide is motor vehicle emissions, where it results from the combustion of petrol in the presence of insufficient oxygen. It is also a result of hydrocarbon fuel-consuming industries and domestic fires.

Recorded data for CO in all monitoring points within the study area are lower than the WHO 24-hourly guideline value of 3,000 µg/m^3. Locations AQMP 04 and 05 recorded zero CO background concentrations. This could be attributed to the absence of quantifiable CO emissions within the vicinities of the monitoring locations. Conversely, the CO concentrations recorded at the other locations could be attributed to exhaust emissions from frequent vehicular movement, emissions from generators and chimneys from nearby industrial activities.

5.3.5 Ozone

Ozone in the stratosphere absorbs most of the ultraviolet radiation from the Sun. Although ozone high up in the stratosphere provides a shield to protect life on Earth, direct contact with ozone is harmful to both plants and animals (including humans). Ground-level (or “bad”) ozone is formed in the atmosphere by photochemical reactions in the presence of sunlight and precursor pollutants, such as NO_x and VOCs.

Ozone is the major constituent of photochemical smog, which is a complex mixture and also contains oxidized organics. In the troposphere near the Earth's surface, the natural concentration of ozone is about 10 parts per billion. According to the US-EPA, exposure to ozone levels of greater than 70 parts per billion for 8 hours or longer is unhealthy. Such concentrations occur in or near cities during periods where the atmosphere is warm and stable. The harmful effects can include throat and lung irritation or aggravation of asthma or emphysema.

The monitoring results indicate that ozone concentration is relatively low compared to WHO guideline values. The concentration of natural tropospheric ozone is estimated at 10 ppb (about 21.1 µg/m^3). Therefore, it can be concluded that the recorded ozone levels are within the thresholds considered to be normal. Additionally, it is worthy to note that as a secondary pollutant, ozone's concentration in the troposphere is dependent on the interaction between NO_2 and VOCs and the relative abundance of sunlight.

5.3.6 Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are organic compounds that easily become vapors or gases. Along with carbon, they contain elements such as hydrogen, oxygen, fluorine, chlorine, bromine, Sulphur or nitrogen. Volatile organic compounds are released from burning fuel, such as gasoline, wood, coal, or natural gas. They are also emitted from diesel exhaust and released from solvents, paints, glues, etc. VOCs, when combined with nitrogen oxides, react to form ground-level ozone or photochemical smog.

VOCs concentration in all the monitoring sites ranges from 286 mg/m^3 to 979 mg/m^3. However, there is no known standard concentration value for the regulation of VOCs in the atmosphere. Potential sources of VOCs within the study area include vehicles (i.e., as evaporates and from exhaust emissions), manufacturing facilities, petroleum depots (i.e., storage tank farms), gas stations as well as from solvents, paints and glue within the surroundings.

5.3.7 Summary of Baseline Conditions

The airshed refers to the local area around the power plant where ambient air quality is directly affected by emissions from the power plant. The size of the airshed depends on plant characteristics, such as stack height, topography and meteorological conditions. The monitoring results are all within the WHO guideline values except for particulates. This would indicate that there is a degraded airshed for PM_{10} and $PM_{2.5}$. The background measurements obtained in the vicinity of the site are likely to be elevated by traffic flows and emissions from nearby industries, petroleum depot, business units and residents.

5.3.8 Ecological Site

The existing air quality, specifically NO_x and SO_2, at sensitive ecological sites also needs to be considered as part of the air quality assessment. The background measurements obtained in the vicinity of the site are likely to be elevated by anthropogenic sources such as road traffic, industrial and residential sources, and as such are unrepresentative of a rural background or the likely ambient concentrations at the selected ecological sites considered in this assessment (see Section 5.5, which specifies the ecological sites considered in the air quality assessment).

There is no known information on the existing air quality or existing nutrient nitrogen or acid deposition rates at the selected ecological sites to characterize the baseline conditions.

5.4 Geology, Hydrogeology and Hydrology (Including Contamination)

5.4.1 Introduction

Sierra Leone is not considered to be a water deficient country. However, both water access and water contamination are an issue for much of the population. The main water uses in Sierra Leone include domestic purposes, watering livestock, power generation, irrigation and industries, with agriculture being the largest water consumer. In some regions, water is relatively scarce. Even where the supply itself is adequate in quantitative terms, the quality of the water is in serious decline. Despite the efforts to improve the situation, water shortages and quality degradation are common problems in Sierra Leone (EU, 2009).

5.4.2 Soils and Geology

The coastal regions of much of Sierra Leone and adjacent countries are generally low-lying and flat. The Western Area of Sierra Leone is the only mountainous coastal region in West Africa comprising a range of thickly forested mountains rising from sea level to close to 1,000m and dominating the peninsula at the northern end where Freetown is situated. The regional geology here is known as the Freetown Complex, a major intrusion characterized by prominent layering of repeated sequences of troctolitic, gabbroic and anorthositic rocks, together with transitional rock types.

Apart from the areas of hard standing or cultivation, the surface of the site is primarily sand / gravel with patchy weed-type vegetation. There are areas of hard laterite pan outcropping across the ground surface within the MSU compound, which indicates that shallow hard rock is likely to be encountered across the site.

Local soils in the area are known to be well drained with dusky reddish gravelly sandy clay loam to clay loam with sand content increasing with depth with some laterite and quartz gravel materials.

A geotechnical and contamination site investigation was undertaken by contractors in November 2014 on behalf of CECASL. Results of this investigation are summarized in Appendix G.

Eleven boreholes were drilled in total, including three environmental boreholes with installations. The borehole logs from the site investigation show the geology beneath the site to be laterite, underlain by medium grained sand at approximately 5m. In some borehole logs, there is 1m of lateritic gravel with topsoil at the surface. A summary of a representative borehole log is shown in **Error! Reference source not found.**.

Table 5.10 Borehole Log Summary

Depth	Strata
0-1m	Reddish brown lateritic Gravel, topsoil with occasional organic materials and rootlets. Gravel is sub rounded of Laterite
1-6m	Reddish brown mottled yellow, moderately weak to weak, fine-coarse grained, Massive, Cemented, Concretionary, honeycombed filled with soil material hard pan Laterite
6-15m	Pinkish white mottled brown, medium dense Sand. Sand is medium grained

The ground conditions present are generally likely to be permeable and therefore soil and groundwater will be vulnerable to contamination from surface spills or from migration of offsite sources of contamination.

The key contamination sources on site and receptors are shallow groundwater and adjacent land receiving runoff from the site. Ultimately, the end receiving environment for groundwater and runoff is likely to be the Sierra Leone estuary which could result in cumulative impacts.

Twenty-five (25) soil samples were taken during the site investigation and analyzed for metals, asbestos, extractable petroleum hydrocarbons (EPH), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). These have been compared to commercial land use guideline assessment criteria (GACs as part of a human health and groundwater impact assessment.

Full results can be found in Appendix G. A summary of the results is presented in **Error! Reference source not found.**, no significant soil contamination was encountered by the site investigation. Bis(2-Ethyylhexyl) phthalate was detected in two samples at a maximum of 316ug/kg, this is a low level that could have potentially been due to a laboratory contamination. Recommended mitigation measures regarding the potential for encountering contamination during construction have been included within the ESMP (Volume II).

Table 5.11 Soils Results Summary

Analysis	Results
Metals	All samples were below the GACs for metals.
Asbestos	Asbestos was not detected in any of the samples. Non-asbestos fibers were detected in BH03 2.5m and BH05 2.5m.
PAHs	All samples were below the GACs for PAHs.
SVOCs	bis(2-Ethylhexyl) phthalate was detected in BH02 0-1m and BH4 0-1m with a maximum of 316ug/kg in BH04.
EPH	All samples were below the GACs for EPH.
VOCs	All samples were below the detection limits for VOCs.

5.4.3 Hydrogeology / Groundwater

Groundwater was encountered at depths between 7.5 and 16.0m below ground level during the site investigations undertaken in November 2014. The water strike levels are listed in **Error! Reference source not found.**.

Table . Groundwater Level Strikes During Site Investigations (November 2014)

Borehole ID	Groundwater Strike (m below Ground Level)	Ground Elevation (m above Datum)	Groundwater Strike Elevation (m above Datum)
BH01	8.9	35.36	26.46
BH02	15.6	34.13	18.53
BH03	-	34.62	-
BH04	7.08	32.89	25.81
BH05	7.8	35.36	27.56
BH06	7.9	32.17	24.27
BH07	7.6	34.06	26.46
BH08	-	32.91	-
BH1 ES	15.1	35.53	20.43
BH2 ES	8.2	37.18	28.98
BH3 ES	16.0	34.81	18.81

The groundwater strikes recorded during the site investigations indicate a varied water table across the site which might suggest shallower perched groundwater is present (between 7 and 9m below ground level) above the main water table at 15 to 16m below ground level. The elevation of deeper strikes (considered likely to be representative of true groundwater surface) indicates that groundwater flow is likely to be broadly in line with the local topographic gradient towards the north and the Sierra Leone River Estuary.

A later site visit by CEMMATS Group Ltd, in preparation for a pumping test in the existing abstraction borehole in the SLRA WR area, identified that all but three of the site investigation boreholes were found to be dry. Where groundwater was identified, the water level was measured at a depth between 8.3 and 15.2m below ground level.

Table 5.12 SLRA WR Abstraction Borehole Observations (March 2015)

Parameter	Measurement / Observation
Borehole depth	70m
Borehole diameter	125mm (5 inches)
Casing type / thickness	PVC / 2mm thickness
Static water level	17.2m
Size of existing pump	100mm (4 inches)
Current pump setting depth	45m

An existing abstraction borehole is located within the SLRA WR area of the site. This borehole was inspected in March 2014 as part of a pumping test exercise for the site investigations at the site. This identified that the abstraction borehole is approximately 70m deep, with the static (non-pumping) water levels at approximately 17m below Ground Level, which corresponds to the deeper groundwater strikes

recorded in site investigation boreholes. Details of the observations made by the contractor (CEMMATS Group Ltd) are provided in **Error! Reference source not found.**.

Pumping tests performed on this borehole showed that the borehole has a low efficiency to pumping, resulting in a high drawdown of water levels in the borehole during pumping. As a result, the pumping test results indicate that the likely maximum sustainable abstraction rate from the borehole would be between 1.2 and 1.3 liters/second (100 to 110m^3/day). However, the pumping test results indicate that the aquifer may be able to yield a greater volume of water in a more fit-for-purpose borehole.

Three groundwater samples were taken during the site investigation to assess the quality of the groundwater beneath the site. These samples were analyzed for metals, EPH, PAHs, VOCs and SVOCs. Additional samples were collected from the abstraction borehole during the pumping test program, although the results from this analysis had not been received at the time of writing.

The groundwater sample results were compared to the UK Environmental Quality Standards (EQS) and UK Drinking Water Standards (DWS) as part of the human health and groundwater quality assessment included in Appendix E. No significant contamination (e.g. free phase product or significant dissolved hydrocarbons) was encountered, though elevated EPH concentrations (two boreholes were significantly above the EQS and UK DWS) are such that potential hydrocarbon contamination sources may be present in the area potentially form a contaminant plume from the industrial site, and appropriate construction mitigation considerations should be employed (e.g. watching brief and control measures where required, installation of monitoring wells at the site to monitor these contaminants). Full results are presented in Appendix G, with a results summary provided in Table 5.13. Mitigation measures are outlined in Section 11.

Table 5.13 Hydrogeology Results Summary

Analysis	Results
Metals	Below EQS with the exception of copper and zinc. These samples were well below the UKDWS however.
PAHs	All below the limit of detection
SVOCs	All below the limit of detection
EPH	EPH in BH01ES and BH03ES were above the EQS and UK DWS of 10ug/l with a total of 702.1ug/l in BH03ES and 350ug/l in BH01ES.
VOCs	1,2-Dichloroethane was detected in BH01ES and BH03ES with a maximum of 3700ug/l in BH01ES.

In August and September of 2020 an investigation of the borehole capacity and water quality was done. Three boreholes were used for the production and monitoring cases dure the capacity test and water quality analysis shown in Figure 5.3.

Figure 5.3 Locations of Production and Monitoring Boreholes

Constant Discharge Test

Water levels in the Production Borehole are seen to respond immediately after pumping commenced, and water levels reached a maximum drawdown of 15.22m (31.66m bgl) by the end of the four-hour constant discharge test. Water levels then responded immediately following the cessation of pumping and by the end of the two-hour recovery test, levels had recovered to within 2.41m of the static water level.

Pumping rates were calculated based on the time to fill a container with a known volume (10 liters). The four rates presented in Table 5.14 were calculated for each hour of the test.

Two observation boreholes at the NP Terminal and the Holy Quran College located at distances of 582m and 227m, respectively from the production borehole were monitored during the test. However, no drawdown was observed in both boreholes. Field logs from the constant rate discharge and recovery tests are presented in Appendix G.

Table 5.14 Pumping Rates Measured during the Constant Discharge Test

Period (hour)	Pumping Rate		
	Litres per second (l/s)	Litres per minute (l/m)	Litres per hour (l/h)
1st	0.42	25.2	1,512
2nd	0.41	24.8	1,488
3rd	0.41	24.8	1,488
4th	0.41	24.8	1,488

Step-Rate Test

The step-rate test involved pumping water out of the production borehole at different discharge rate (steps) for an hour per step in order to determine the drawdown at each step of discharge. The pumping rates and drawdown down for each of the four steps are summarized in Table 5.15. During the step-rate test, the borehole at NP Terminal was also monitored for any potential drawdown.

Table 5.15 Summary of Step-rate Test Discharge Rates and Drawdown Response

Step	Average Pumping Rate		Water Level (End of Step)	Drawdown (End of Step)
	l/sec	m^3/hour	m below Ground Level	m
1	0.47	1.69	27.17	16.5
2	0.52	1.87	43.09	14.83
3	0.57	2.05	46.78	3.69
4	0.62	2.23	50.48	3.70

Groundwater Quality

To gain an understanding of the quality of the water from the borehole and to assess its appropriateness for use for the Project, samples were collected from the borehole at different times before and during the pre-test pumping and sent to the Sierra Leone Ministry of Water Resources' National Water Quality Laboratory for analysis. Furthermore, an in-situ analysis was undertaken using a multiparameter water quality meter. The results of the water quality analysis are presented in Table 5.16 and Table 5.17.

Table 5.16 Laboratory Water Quality Analysis Results

	Parameters	Laboratory Results	
Sample ID	CEC_BH01-1	CEC_BH01-2	CEC_BH01-3
Sampling Time	14:15	17:35	18:50
Sampling Date	22/08/2020	22/08/2020	22/08/2020
Approximate Sampling Depth, m bgl	20	29	31
Water Temperature (°C)	26.5	26.4	26.3
pH	7.5	7	6.9

	Parameters	Laboratory Results	
Turbidity (NTU)	26.5	0	26.3
Conductivity (µS/cm)	184	121	124
TDS (mg/l)	92	60.5	62
Salinity (ppt)	-	-	-
Residual Chlorine (mg/l)	0.01	0.01	0.01
D O	6.55	6.42	6.78
Aluminium (mg/l)	0.21	0.07	0.09
Ammonia (mg/l)	0.29	0.04	0.13
Bromine (mg/l)	-	-	-
Calcium Hardness (mg/l)	3	4	5
Total Hardness	20	20	20
Copper (mg/l)	2.12	0.4	0.39
Fluoride (mg/l)	0.39	0.46	0.21
Iron (mg/l)	1.44	0.05	0.06
Magnesium (mg/l)	0.3	0.1	0.1
Manganese (mg/l)	2.18	0.2	0.16
Molybdenum (mg/l)	2.29	0.17	0.11
Nitrite (mg/l)	0.15	0	0.02
Nitrate (mg/l)	3	6	6
Potassium (mg/l)	16	0.4	0.3
Phosphate (mg/l)	2.4	0.7	0.4
Silica (mg/l)	0.18	0	0.02
Sulphate (mg/l)	15	26	13
Sulphide (mg/l)	0.16	0	0
Sulphite (mg/l)	2.8	0.5	0.3
Chloride (mg/l)	2	4	4.9
Arsenic (mg/l)	0	0	0
Chromium	0.64	0.45	0.48
Bicarbonate (mg/l)	0	0	0
Zinc (mg/l)	0.96	0	0.15
E. Coli	Nil	Nil	Nil
Faecal Coliforms (Total)	101	Nil	20
Non-Faecal Coliforms	Nil	100	Nil
Vibro-parahaemolyticus	-	-	-
Salmonella sp.	-	-	-

Table 5.17 In-situ Water Quality Analysis Results

Parameters	In-situ Measurement Results		
Sample ID	CEC_BH01-1	CEC_BH01-2	CEC_BH01-3
Sampling Time	14:15	17:35	18:50
Sampling Date	22/08/2020	22/08/2020	22/08/2020
Approximate Sampling Depth, m bgl	20	29	31
Water Temperature (°C)	29.7	30.3	30.2
pH	6.7	6.0	5.9
ORP, mV	98.8	136.6	158.7
EC, µS/cm	207.7	133.5	129.0
Abs EC @ 25C, µS/cm	226.3	147.0	142.0
Resistivity, Ohm-cm	4815.7	7490.0	7750.0
TDS, ppm	103.8	67.0	64.5
Salinity, psu	0.1	0.1	0.1
Pressure, psi	14.6	14.6	14.6
D.O., %	38.4	21.0	21.2
D.O., ppm	2.9	1.6	1.6
Turbidity, FNU	200.8	35.8	62.7

5.4.4 Hydrology

The ESHIA will consider and assess the potential direct, indirect and cumulative impacts on hydrology resulting from the construction and operation of the project within its zone of influence. The zone of influence for hydrology extends 1km beyond the land-take boundary of the proposed project and where required extends beyond this to account for potential impacts outside this 1km extent.

5.4.4.1 Surface Water Features & Quality

The key hydrological features in proximity to the project site are indicated on Figure 2.2. The key sensitive hydrological feature is the SLRE. This is located some 400m to the north of the project site. The SLRE is a Ramsar site, and BirdLife International has designated it as an International Bird Area (IBA). The area supports mangrove forests and significant numbers of bird species, including 23 species of global conservation concern and of those, 12 are globally threatened. Principal threats to the Sierra Leone River Estuary have been identified during the site visits and desktop assessment undertaken as part of this ESHIA, as vegetation clearance and unsustainable fishing. There are no details of the current ambient water quality within the estuary. Consultation undertaken to date identified one of the main issues as being plastic waste.

Reference has been made to the ESIA for the PetroJetty New Oil Jetty Project: Main Report (2013). As noted in a site visit undertaken as part of that study, surface films of oil and grease on the water were observed and were linked to waste water discharge or leakage incidents from the transfer and storage facilities of the surrounding oil companies, or waste water from shipping vessels. The sewage system

within Freetown discharges to the SLRE and also a number of industries discharge into the drainage network and river which ultimately flow to the SLRE (Sankoh et al. 2009).

The second most significant surface water feature in proximity to the project site is the Wellington Creek. This stream is located some 200m to the east of the project site and this stream discharges to the SLRE. There is also a small stream located to the south of the project site that runs along the southern side of Old Railway Road and then turns north through the grounds of the Winston Churchill Secondary School and a disused refinery area before ultimately discharging to the SLRE. There are no details of the current ambient water quality within the Wellington or Old Railway Road streams.

There is currently no formal storm water drainage system on the site, apart from some small perimeter drains around the hardstand of the SLRA-WR administration building. Drainage across much of the site is, therefore, anticipated to be as surface runoff. Much of the site appears to drain towards the north in line with the prevailing topographic gradient and the western portion of the site by the site entrance slopes to the northwest. There are holes in the northern perimeter walls of the site to allow the runoff to pass through. Similar holes are present in the northern perimeter walls of the adjacent commercial premises to the north.

A site visit to the compound of one of the adjacent properties to the north identified that there is a concrete drain running along the northern side of the site boundary wall that transfers water away from an adjacent building. It was not possible to confirm the direction or receiving location of this drainage feature.

Beyond the properties to the north, it appears that the drainage route for overland flow is cut off by roadside storm drains along the south side of Factory Road. Tracts of land between the drains and the commercial premises, which may have previously received overflow from the drains during wet season, are now either cultivated by garden farmers or taken up by shanty dwellings. The direction of flow within the roadside storm drains was not confirmed, but in the vicinity of the site entrance, it appears to be to the west towards the small stream.

Existing drainage within and adjacent to the project site will need to be confirmed during the detailed design phase.

5.4.4.2 Water Services

Sewage effluent management on the site is currently through use of septic tanks with no municipal sewer connection identified.

The GVWC provides water supply services to Freetown, delivering water mainly from the Guma Dam (located in the Western Area Forest Reserve south of Freetown), supplemented by borehole groundwater. The water supply to eastern Freetown is currently activated by GVWC for 4 days each week, for 10 hours covering the working period. This is a set schedule and is a minimum supply target, which is expected to improve. There is maintenance of the service once / twice a month.

People were observed to be collecting water from the broken GVWC water pipe inside the northern boundary of the site. There is also a GVWC water pipe on Factory Road northwest of the site that is used by what may be a cooperative of local people.

A section of the site is used by artisanal farmers to grow cash crops, such as Cassava leaves, Potato Leaves, Corchorus (Krain Krain) and Soya. There are approximately 16 agricultural plots on the site, along the course of a drainage channel, which originates from the residential properties to the south of the site. Potential impacts to these farmers are dealt with in the socio-economic assessment (see Section 7).

5.4.4.3 Commercial Fisheries Resources

Consultation undertaken with the Conservation Society of Sierra Leone indicated that there were 28 fishing communities in the estuary area. However, consultation undertaken with the Sierra Fishing Company (SFC) indicated that no commercial fishing is done in the estuary, as there is a 5-mile exclusion zone. SFC indicated that artisanal fishermen do use the SLRE, and it was discovered that six (6) are located within the vicinity of the PetroJetty.

During key informant interviews the artisanal fishing group, headed by the Harbormaster, was consulted. The group consisted of only six fishermen with each of them having one canoe. During the interview, the following concerns were noted:

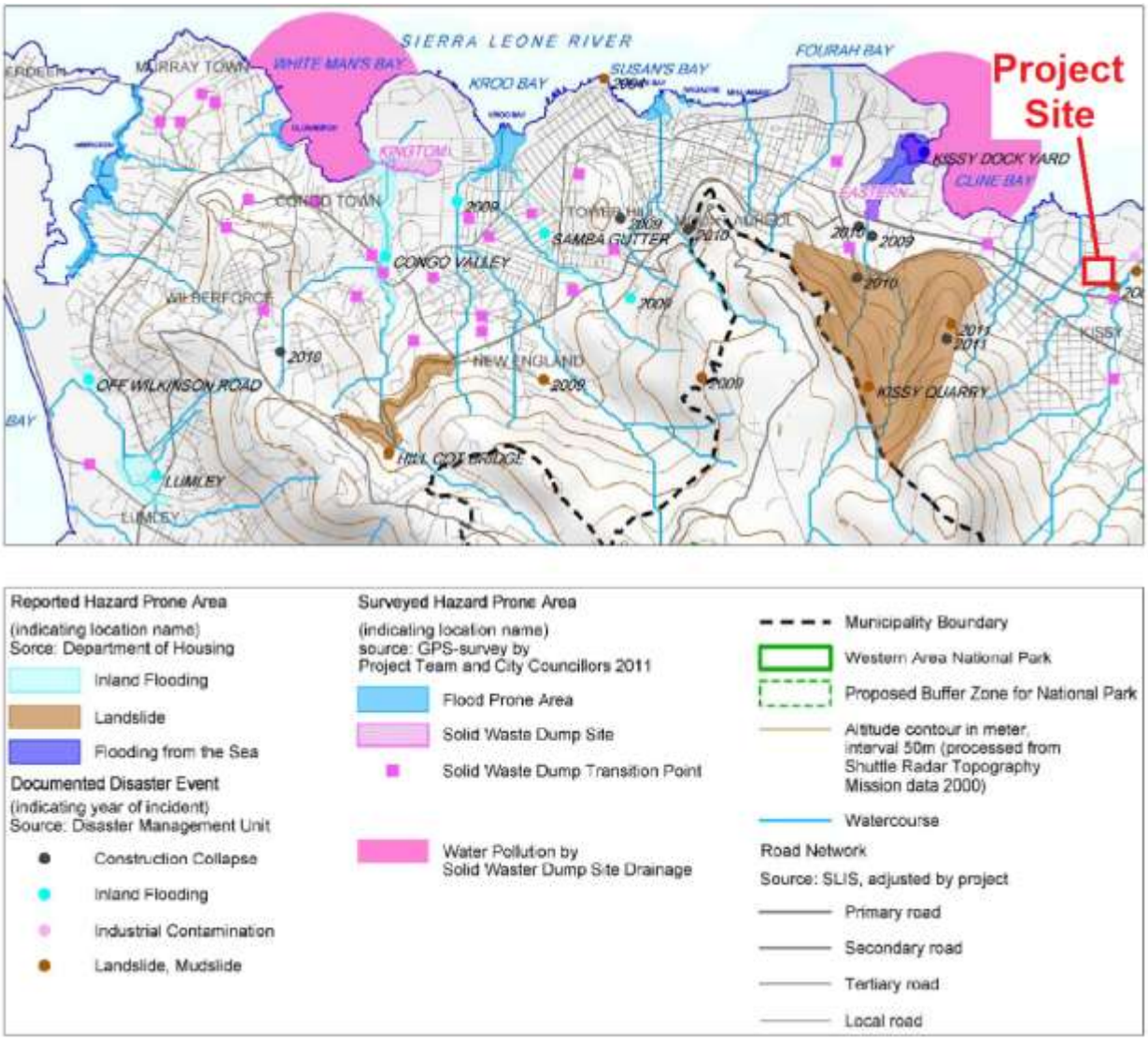
- Concerns were raised about the engagement strategy that will be put in place to prevent interruption of fishing activities by CECA's fuel vessel. The fishermen recommended that CECA provide them with improved engine boats so they can fish far away from the jetty.
- CECA vessels will scare the fishes away from the specific areas where they fish.
- The LPG product that CECA-SL intends to use was perceived as a poisonous gas associated with breathing discomfort to humans. This claim was supported by perception and experience from the current operations of AfriGas in the area.
- The potential for noise pollution from the project.

5.4.4.4 Flooding

Flooding is a significant issue in Sierra Leone and the Freetown area. Much of the problem has been attributed to changes in land cover on the hills outside Freetown, partly due to pressure on the land from migrants driven to the periphery of the city by the civil war. However, urbanization itself has exasperated the problem (Action Aid International, 2006). In relation to the project site, anecdotal information from site workers indicates the site suffers from significant surface water ponding / flooding during the wet season (June to November).

The immediate surrounding area to the site has been determined not to be a flood prone area by a report from the Freetown City Council. The map shown in Figure 5.4 shows the flood-prone areas in the region.

Figure 5.4 Map Showing Flood-Prone Areas



5.5 Ecology

This section presents detailed information on the baseline ecological resources in the vicinity of the project site. For this ESHIA, considerations will be taken for the activities of the Jetty where the project will be docking with their products. However, the Jetty is already in operation and used by other companies for the same purpose as the CEC-SL therefore, this study does not in any way include the activities of the Jetty beyond the docking of the CEC-SL ship. The study does not capture impacts caused by the docking of other ships even though they may be similar and does not also capture potential ecological disruptions created from the operation of the Jetty which may arise from their daily activities and routine maintenance.

5.5.1 Designated Sites

No designated areas overlap with the project site boundary. However, it is noted the Sierra Leone River Estuary Ramsar Wetland and International Bird Area (IBA), are designated areas within the vicinity of the site.

5.5.2 Habitats

Sierra Leone River Estuary Ramsar Wetland and IBA: Sierra Leone River Estuary Ramsar Wetland and International Bird Area (IBA) is located c.400m north of the project site, and immediately adjacent to the pipeline. It is the drowned estuary of the Rokel or Seli River. The site is bounded to the north by a coastal plain indented by creeks, and to the south by the mountainous Western Area peninsula. At the point of entry into the Atlantic Ocean, the estuary widens to about 11km and abruptly deepens along its southern shore to form a natural harbor (the third largest in the world). The estuary is lined by 110 ha of mud and sand foreshore, backed by mangrove, and 1,800 ha of intertidal mudflat and muddy sand flats. For the sake of this assessment in Section 12 of this ESHIA it is assumed that the mud and sand foreshore, mangrove and intertidal and muddy sand flats are all qualifying habitats in the Ramsar Wetland designation, although this is not explicitly stated in the Ramsar webpage for the site (Ramsar Convention, 2000).

The predominant mangrove tree species are Rhizophora racemosa, Avicennia germinans, Laguncularia racemosa and Conocarpus erectus, and these cover a total of 34,234 ha (19% of the total area of mangrove in Sierra Leone). The designated site's most important areas of mangrove and associated habitats are located along Bunce River approximately 3km east of the site, along the coast northeast and northwest of Tagrin Point, which itself is located in the northern part of the estuary and over 6km northeast of the project Site, and in Pepel and Tumbu more than 15km to the northeast. A small area of mangrove also occurs at Aberdeen Creek, which is located in western Freetown and more than 6km west of the site.

Table 5.18 lists the key qualifying bird interests in the Ramsar Wetland and IBA as of 2015. It will be updated to reflect the new population estimate once the information is made available.

Table 5.18: Qualifying Species Interests in Sierra Leone River Estuary Ramsar Wetland and IBA

Species	Season	2015 Population estimate5	2020 Population Estimate
Great white egret (*Ardea alba*)	Winter	500 individuals	
Kentish plover (Charadrius alexandrines)	Winter	2,100 individuals	
Grey plover (Pluvialis squatarola)	Winter	2,300 individuals	
Common ringed plover (*Charadrius hiaticula*)	Winter	8,600 individuals	
Common redshank (*Tringa tetanus*)	Winter	4,000 individuals	
Sanderling (*Calidris alba*)	Winter	2,900 individuals	
Curlew sandpiper (*Calidris ferruginea*)	Winter	9,500 individuals	
Waterbird assemblage	Winter	20,000 to 49,999 individuals	

As of 2015 a total of 36 wader species have been recorded in the estuary and numbers are stated by Birdlife International to exceed 20,000 regularly. The Sierra Leone River Estuary is one of the four major sites for wintering waders in the country. Concentrations are usually found along the banks of the Bunce River and Aberdeen Creek, where mangrove provides suitable roosting sites, as well as breeding habitat

[5] Source: Birdlife International (2015).

for such species as western reef heron (or striated heron) *Butorides striatus*. Less common migrant Palearctic waders (less than 500 individuals) include ruddy turnstone *Arenaria interpres*, Eurasian curlew *Numenius arquata*, marsh sandpiper *Tringa stagnatilis* and Temminck's stint *Calidris temminckii*.

Monitoring carried out by IBA in 2013 revealed that the site is being degraded by various agents, including rapid over-exploitation of fish and other aquatic resources across most (>50%) of the designated area, and residential and commercial development and pollution from domestic & urban wastewater across some (<50%) of the area.

Some limited conservation initiatives were reported to be in place. Although a management plan was known to exist it was out of date or not comprehensive, and less than 10% of the area was subject to conservation management at that time.

The Ramsar webpage for the Estuary (Ramsar Convention, 2000) states that it is threatened by vegetation clearance and unsustainable fishing, with efforts being made to conserve certain core areas within the site. It notes that vast areas of untouched mangrove forest still exist, and that traditional fishing and agro-forestry for fuelwood can be managed sustainably in collaboration with an existing EU-funded Artisanal Fishing Community Development Program. In addition, fine beaches in some areas provide hope for well-managed tourist development.

5.5.3 Flora

The study Area is deprived of stable plant habitat, as the region has been developed and regularly brushed to fit the convenience of the operations of the Jetties and nearby industries, which includes road paths to fare along the embankment. However, due to their aesthetics and ecological interactions, routine site observations were carried out along the ocean embankment to understand the flora component of the study area. During the study, it was found that there were no plant species of economic importance and the dominant plant species of the study area is that of the *poacea* (grass). The most significant plant species of the SLRE is the mangrove plant, which according to the 2015 ESHIA study could be found east of the project site along the Bunce river about 3km away from the Project site.

The 2013 Addax Jetty ESIA (CEMMATS Group Ltd, 2013) found out that there is a very little vegetation within this zone, with the exception of some urban gardens, vegetable plots and occasional trees, notably cotton tree (or kapok) *Ceiba pentandra*, mango *Mangifera indica* and oil palm *Elais guineensis*, as well as hedges, scrub, grasses and exotic herbaceous weeds, including elephant grass *Pennisetum purpureum*, Guinea grass *Panicum maxima* and butterfly pea *Centrosema pubescens.* In some places, trees form larger stands, notably groups of cotton trees up to 100 years old in age and stands of oil palm likely to have been planted by private house owners. Hedges are used in some places to demarcate boundaries. These mainly comprise exotic species such as *Bougainvillea* spp and tickberry *Lantana camara* and locally Manila tamarind *Pithecellobium dulce*. Additionally, during the expert site observation, the following species were found along the study area such as: *Panicum maximum* (Guinea grass)*, Dissotis sp* (Pink lady) *Rhynchospora corymbosa* (Matamat)*, Sporobolus urginicus* (Seashore dropseed)*, Ipomoea pes-caprae* (Goat foot vine)*, Ipomoea mauritiana* (morning glory)*, Canavalia rosea* (Bay Bean)*, Hymenocardia lyrata, Terminalia superb* (Frake).

All the species found around the study area are either of least ecological concern according to the IUCN or have not been assessed.

5.5.4 Fauna

The Project Site and Local Area: Due to the degraded and highly disturbed nature of the project site, the potential for faunal species of conservation interest to be present is low.

Walkover surveys carried out for the Addax Jetty ESIA recorded a range of species, most of which are common and widespread in Sierra Leone (CEMMATS Group Ltd, 2013). The potential for faunal species within the site was mainly associated with larger specimens of cotton tree which can act as roosting and breeding sites for large birds, such as the raptors black kite (*Milvus migrans)*, lizard buzzard (*Kaupifalco monogrammicus)* and hooded vulture (*Necrosyrtes monachus)* all of which are reported to be present in the local area in the Addax Jetty ESIA (CEMMATS Group Ltd, 2013). The tree can also host fruit bats and invertebrates.

5.5.4.1 Butterflies, Avifauna, and Herpeto-fauna

The 2013 Jetty ESIA surveys focused on butterflies, birds, and mammals in the local area. Apart from a range of common and widespread species, the following species of greater conservation interest were also recorded:

Butterflies:

- Euphaedra inanum – endemic to West Africa.
- Mylothris poppae – endemic to West Africa.

Avifauna:

According to Working Group International Water bird and Wetland Research (WIWO) there are 89 species of marine and coastal birds. Also, there are 23 species of seabirds of globally important conservation status which frequent Sierra Leone's coastal waters, including Lesser Flamingo, Damara Tern, Avocet, and Western reef heron. These birds congregate around the mouths of rivers and estuaries on mud and sand foreshores which provide good feeding and nesting area. Table 5.19 list some Seabird species along the coastline of Sierra Leone (Environment Protection Agency, 2015)

Table 5.19 Seabirds Along the Coastlines of Sierra Leone

Common Name	Family / Order	Number of Species	
		World	Sierra Leone
Ducks, geese, and swans	Anatidae / Anseriformes	14	
Storks	Ciconidae	19	7
Cormorants	Phalacrocoracidae	38	1
Boobies and gannets	Sulidae	9	2
Darters	Anhingidae	4	1
Bitterns, herons, and egrets	Ardeidae	61	16
Storm petrels	Hydrobatidae	21	5
Shearwaters and petrels	Procellariidae	75	4

The Sierra Leone River Estuary is one of the four major sites for wintering waders in the country. Concentrations are usually found along the banks of the Bunce River and Aberdeen Creek, where mangrove provides suitable roosting sites, as well as breeding habitat for such species as western reef heron (or striated heron) Butorides striatus. Less common migrant Palearctic waders (less than 500 individuals) include ruddy turnstone Arenaria interpres, Eurasian curlew Numenius arquata, marsh sandpiper Tringa stagnatilis and Temminck's stint Calidris temminckii. (2015 ESHIA).

Table 5.20 Species of interest in the SLRE Ramsar Wetland and IBA

Species
Great white egret (Ardea alba)
Kentish plover (Charadrius alexandrines)
Grey plover (Pluvialis squatarola)
Common ringed plover (Charadrius hiaticula)
Common redshank (Tringa Tetanus)
Sanderling (Calidris alba)
Curlew sandpiper (Calidris ferruginea)

Herpeto-fauna:

The herpeto-fauna (reptiles and amphibian) diversity indicates a total of 122 species: 67 species of reptiles and 55 species of amphibians. Sea turtles are highly migratory mega vertebrates that have extremely important roles in the functioning of the marine ecosystem since they first appeared in the oceans over 100 million years ago. They have been relentlessly exploited for centuries and are currently facing global changes that are gravely threatening their survival (Marco, 2015).

In Sierra Leone, five marine turtle species are known to occur in the country's Atlantic coast. The five species include the leatherback, (*Dermochelys coriacea*) olive ridley (*Lepidochelys olivecea*), green turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), and hawksbill (*Eretmochelys imbricate*). All five have been recorded to nest on beaches in Sierra Leone[6]. Turtles in Sierra Leone are reported to be vulnerable or endangered by the International Union for Conservation of Nature and Natural Resources (IUCN) 2020.

- Leatherback (Dermochelys coriacea) – vulnerable, listed on IUCN Red List of Threatened Species.
- Olive ridley (Lepidochelys olivacea) – vulnerable, listed on IUCN Red List of Threatened Species.
- Green sea turtle (Chelonia mydas) – endangered, listed on IUCN Red List of Threatened Species.
- Loggerhead (Caretta caretta) – vulnerable, listed on IUCN Red List of Threatened Species.
- Hawksbill (Eretmochelys imbricata) – critically endangered, listed on IUCN Red List of Threatened Species.

Although five species of marine turtle were reported in the Addax Jetty ESIA surveys as occurring on sandy beaches that line portions of the coastline, the ESIA states that there are no indications that their breeding range extends into the local coastline (CEMMATS Group Ltd, 2013).

No mammal species of note is reported to occur in the local area in the Addax Jetty ESIA (CEMMATS Group Ltd, 2013), and mammal presence is likely to be very low. An interview with a middle-aged respondent suggested that between 20 and 30 years ago a particular species of monkey, possibly the Campbell's monkey *Cercopithecus campbelli*, was present in mangrove and gallery forest along the coastal fringes in the vicinity of the study area, but this species has not been seen in a long time because of hunting and habitat destruction.

None of the species of conservation interest within the Western Area Peninsula National Park were recorded in the local area during the Addax Jetty ESIA surveys (CEMMATS Group Ltd, 2013).

[6] https://rapsl.org/marine-turtle-conservation-project/

Full detail of the assessment of potential impacts and details of mitigation measures regarding ecology are presented in Section 0 of this ESHIA.

5.6 Waste Management

Waste management planning in Sierra Leone falls under the remit of the Ministry of Health and Sanitation. An Integrated National Waste Management Strategy document was released by the ministry in 2012. The strategy includes a comprehensive framework for the management of healthcare, municipal and industrial waste along with recommendations for educational programs to raise awareness of domestic waste management and associated good practices.

Recent industrialization and associated urbanization have led to a significant population increase in Freetown, particularly within slum areas. This overwhelmed the limited waste handling capacity of the previously existing Freetown Waste Management Authority. Poor solid, liquid and healthcare waste management, combined with poor community and personal sanitation / hygiene practices has been closely related to high infant mortality due to spread of malaria, diarrhea, and cholera.

The strategy is in the early stages of implementation and significant new waste infrastructure is yet to be developed. Currently there are no engineered landfills in Sierra Leone. While community and formalized collections are taking place, it is believed that many households burn waste or dispose of it at the nearest ad-hoc dump site. Often this leads to waste clogging drainage systems leading to flooding and landslides during the wet season like those experienced in 2019.

From 2012-2017 the Masada Waste Management Company ('Masada') was the sole body responsible for all waste handling in Freetown. In 2017 a new initiative called Operation Clean Freetown (OCF) was created by the Freetown City Council as part of The President's Recovery Priorities, with the aim of reducing the risk and spread of epidemics.

The President's Recovery Priorities website describes Operation Clean Freetown as being comprised of the strategies below[7].

1. Flatten and compact the Kingtom and Granville Brook 'landfill' sites and temporarily increase transit / waste collection points and installing litter bins in the Central Business District.
2. Equipping and training youth groups as door-to-door waste collection micro-enterprises. The youth groups will receive 15 months of business development support to help them become sustainable businesses as well as capital investments including motorized tricycles, cleaning equipment and tools and customer registration aids.
3. All households are required to participate in an intensive ward-by-ward cleaning process and in the future, it will be compulsory for all households to subscribe to regular paid waste collection from either youth groups operating in their wards or from an alternative waste management provider.
4. Sustain the waste management efforts by enforcement of bye-laws; awareness raising, discussions with the manufacturers and distributors of plastic bags, sachets and bottles, to hear and secure their contributions to solutions to the problem of plastic waste; and an annual competition to reward the cleanest ward in Freetown.

[7] https://www.presidentsrecoverypriorities.gov.sl/operation-clean-freetown

5.7 Transport

The movement of people and goods in Sierra Leone is almost entirely dependent upon the road system. It is understood that some 97%[8] of all transport is by road. The provision of a basic and properly maintained highway system is therefore of critical importance to the country.

During site visits, the transport network in Freetown was observed to be poorly maintained and heavily congested, particularly during the morning and evening peaks.

Table 5.21 National Road Link Capacities provides details of the extents of the road network to be included in the scope of this assessment and also estimates the notional capacities of these links. These capacities have been derived from guidance taken from the UK Design Manual for Roads & Bridges (DMRB) Volume 5, Section 1, Part 3 TA 79/99 'Traffic Capacity of Urban Roads.'

Table 5.21 National Road Link Capacities

Road Link	Road Type*	Road Type Description	One-way hourly flow (vehs)**
Racecourse Road / Cline Street	UAP3	Variable standard road carrying mixed traffic with frontage access, side roads, bus stops and at-grade pedestrian crossings.	1,110-1,530
Bai Bureh Road	UAP2	Good standard single / dual carriageway road with frontage access and more than two side roads per km.	1,260-1,550
Africanus Road / Factory Road / Parsonage Street / South Road	UAP3	Variable standard road carrying mixed traffic with frontage access, side roads, bus stops and at-grade pedestrian crossings.	1,110-1,530

** UAP (Urban All-Purpose)*

*** Flow assumes a 60:40 directional split. Values given represent the busiest flow (60% figure).*

Since no traffic data is currently available for the road links around the proposed development, it is not possible to identify the levels of capacity at which the identified roads are operating. However, as outlined above, based on information from site visits, it would appear that these roads are heavily congested, particularly in the morning and evening peaks, and therefore the road links are operating at saturated traffic conditions (where the actual flow has exceeded the theoretical capacities outlined in Table 5.21 National Road Link Capacities).

5.8 Climate, Rainfall, and Climate Change

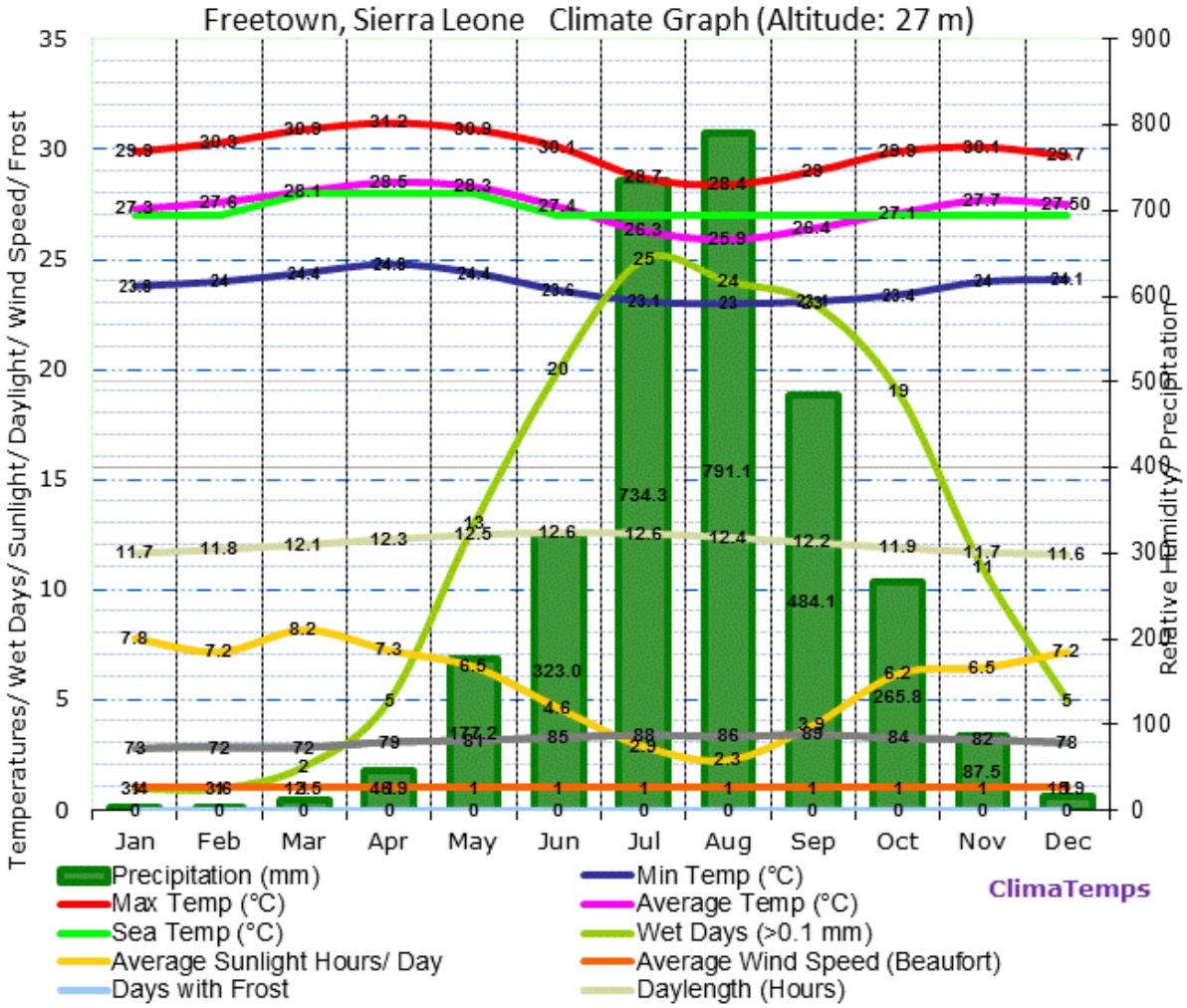
Figure 5.5 presents climate data for Freetown. Freetown, as with Sierra Leone and other West African countries has a tropical climate with two distinct seasons; the dry season which occurs between November and April and the wet season which occurs between May and October, with a peak of up to 800mm rain during August.

The temperatures are consistently high throughout the country, roughly averaging from 25–27 °C, with slightly lower temperatures (22–25 °C) during the wet season. Diurnal temperatures vary from 25 °C to 34 °C although, they could be as low as 16 °C at night during the Harmattan (dry season / winter winds).

[8] Delegation of the European Union to Sierra Leone

As the project site is located approximately 500m from the sea, it is likely to experience higher wind speeds than inshore locations.

Figure 5.5 Graph of Freetown Climate Data[9]



A detailed review of information sources regarding potential for climate change in the Sierra Leone Region is presented in the ESHIA Scoping Report Appendix H of this ESHIA. Risks to the project are generally considered low. The risk of flooding can be planned for by a consideration of predicted climate change in the drainage system design. Within the ESMP, a recommendation will therefore include that an appropriate increase in drainage capacity is to be incorporated into the design to account for potential increased rainfall relative to the historical and current norm.

The review of the ESHIA Scoping Report also considers climate change related temperature change impacts on engine efficiency and implications for greenhouse gas emissions. No specific mitigation can be implemented to prevent efficiency decrease due to temperature change and in any case, this is expected to be comparatively minor. However, data relating to engine efficiency should be considered in the selection of the engines to be used. Selecting an engine with a high threshold point over which efficiency decreases occur, and/or exhibits a slow rate of efficiency decline will ensure that output can be

[9] http://www.freetown.climatemps.com/graph.php [data source presumed to be Lunghi Airport, but not confirmed]

maintained as near as possible to the optimum, and thus minimize operation costs and emissions. This has been included as an action in the ESMP.

The ESMP also includes requirements regarding annual reporting of greenhouse gas emissions in line with the requirements of the IFC PS3.

5.9 Archaeology and Cultural Heritage

IFC PS8 defines cultural resources as "(i) tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; (ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles."

No sites of cultural importance, historical monuments or buildings exist within the Project AOI that meets the cultural heritage definition in IFC Performance Standard 8. However, from the consultations with community stakeholders, it was stated that there are a number of secret societies (Hunting, Ojeh etc.) existing within the Project Area and they often display their arts through masquerade dance especially during festive seasons. However, all activities have been halted with respect to government injunction on such activities. However, as the project area is generally industrialized, the influence of the proposed power station on intangible aspects of culture is unlikely to change as result of the project. The site is located within the heavily urbanized Kissy Docks area of Freetown. Those areas of the site that do not contain buildings are either hard rock outcrops or likely to be shallow sand / gravel (potentially made ground). Waste land within the site has been farmed at different times over the last 3 years. Therefore, issues associated with impacts to cultural resources from the project are not considered further in this assessment.

With no identified cultural resource features within the study area the topic has been scoped out of this ESHIA. In the event that evidence is identified during construction that indicates items of cultural significance may be present, a cultural resource expert should be appointed.

The Cultural Resource Expert would require:

- A proven background working on cultural resources reports;
- A thorough knowledge of applicable legislation, standards and guidelines;
- An understanding of the criteria for evaluation and classification of significance of impacts;
- An ability to understand and communicate to the EPC Contractor how cultural resource issues may affect the preconstruction and construction phases and program of the proposed development; and
- A capability to produce accurate, focused, and comprehensive research findings.
- To carry out a field inspection:
    - A detailed methodology should be produced;
    - Field work should be carried out in a systematic fashion;
    - All features should be recorded, described, and photographed; and
    - All limitations to the survey must be noted.

The field inspection and potential subsequent mitigation measure, including the potential requirement for a chance find procedure, would be completed in line with the requirements of the IFC PS8 Cultural Heritage.

If any artefacts or cultural heritage sites are discovered during the field inspection or construction phase, the EPC Contractor shall inform the Sierra Leone Ministry of Tourism and Cultural Affairs and proceed according to their recommendations.

5.10 Landscape and Visual

Given the size and scale of the development in the context of the heavily industrialized and urbanized Kissy Docks area, there will be no significant effects associated with Landscape and Visual amenity. In consultations with the EPA-SL, it was also confirmed that landscape and visual impacts are not considered to be a significant development constraint in Sierra Leone. Nevertheless, the following discussion of the current baseline is provided as a basis to scope out this assessment at this phase.

The site is currently operating as a commercial / industrial facility, and there are two significant industrial facilities within 400m to the north (the All Petroleum Product Tank Farm, former disused refinery, and Total SL Limited Petroleum Depot). There are already three significant structures located on the site (canopy in the SLRA-WR compound and the workshop and stores in the MSU compound). Some of these will be reused and are relatively similar in height to the main features of the proposed plant.

The area surrounding the site is predominantly flat coastal area (potentially a former wave cut platform) that stretches from the SLRE for 2 to 3km, before rising as the foothills of the Western Area National Park mountains. In the Kissy Dock / Eastern Freetown area, there are numerous buildings of similar or greater proportions to those already on the site and those proposed for the development, several telecommunications masts and emissions stacks (on the APP Tank Farm) and fuel tank farms (in both the refinery area and the NP facility). These are interspersed with significant numbers of large trees.

Essentially, the area's 'sense of place' is derived from this heavily urbanized and industrial setting, and the area is not considered to have significant amenity value from a landscape and visual perspective. Given the setting described above, the construction of a relatively low-rise power plant is therefore not anticipated to result in a significant change in the landscape character of the site. Views of the site will mainly be restricted to neighboring properties, and the nature of this view will not change significantly from the current baseline. The upgrade of nearby roads and clearing of debris on the project site is likely to represent an improvement to the appearance of the area.

On this basis, landscape and visual impacts associated with the project are not expected to be significant, and a detailed assessment will not be undertaken as part of the ESHIA. However, in the absence of a detailed assessment, it is highlighted that the visual implications of the development will still be considered appropriately within the project design. The ESMP (Volume II), therefore, includes relevant measures regarding the design of the buildings to reduce height / spread where possible and the use of complementary finishes to the significant components of site infrastructure.

6 Environmental, Social and Health Impact Assessment Methodology

6.1 Overview of the ESHIA Process

An ESHIA is a systematic, scientific, and participatory process to assess potential environmental, social and health impacts of a development, including consideration of project alternatives and cumulative impacts with other planned developments. The ESHIA process ensures that new developments, and extensions to existing developments, are located and designed in such a way as to minimize environmental and social impacts.

The objectives of an ESHIA are:

- To identify environmental constraints and opportunities within the study area, taking account of the characteristics of the development and the local environment;
- To identify potential impacts and interpret the nature of these impacts;
- To describe the mitigation measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment, including the appropriateness of avoidance and prevention measures;
- To determine the significance of any residual environmental effects following mitigation measures; and
- To underpin the ESMP for implementation, management, monitoring and reporting of mitigation measures.

6.2 The ESHIA Study Report

This document is the ESHIA study report and the following sections present an overview of the general impact assessment methodology applied to the assessment of potential impacts arising from the project elements. The findings of this assessment relevant to each of the environmental aspects listed in Section 1.6 are outlined in Sections 7 through 17, along with a description of any mitigation measures required. Impacts predicted as being of medium to high significance prior to the consideration of mitigation are assessed against appropriate mitigation measures to predict the residual impact significance.

This ESHIA Study Report is supplemented by the Environmental and Social Management Plan (ESMP) which is provided as Volume II of the ESHIA. The ESMP summarizes the mitigation action plan and shows how these will be implemented, managed, monitored, and reported.

This ESHIA Study Report enables the EPA, local community, and other key stakeholders to determine whether or not the proposals (including recommended mitigation) are acceptable. This report also informs the permitting process as the recommended mitigation measures and other actions included in the ESMP form conditions of the EIA Permit issued by the EPA.

In order to evaluate environmental impacts and determine their effects and significance, it is important that assessment criteria are identified. The various methodologies that have been used within each specialist area or discipline are made clear within the appropriate sections of this ESHIA Study Report.

Each specialist impact assessment section includes the following information:

- **Predicted effects**: An evaluation of the proposed project's impacts in quantitative and qualitative terms. In general, the effect of an impact is assessed by a combination of sensitivity of the environment and the degree of alteration from the baseline state (both positive and

negative) which can be predicted. Environmental sensitivity may be categorized by a multitude of factors such as the threat to a rare or endangered species, transformation of landscapes or changes to soil quality or land use. Impacts can have both direct and indirect effects, be cumulative, short-term, medium term or long term, permanent or temporary and have positive or negative effects. Impacts can be analyzed in terms of the source of pollution and the pathways by which they travel to arrive at a receptor.

- **Significance of effects**: Project impacts are determined to be 'significant' or 'not significant'. Significance is a combination of magnitude and sensitivity to change and is evaluated in terms of the geographic effect, duration and frequency, irreversibility, and any regulatory standards which may apply. For effects where an assessment of significance cannot be determined (e.g., for reasons of uncertainty), this issue will be highlighted, and an explanation given as to why significance could not be determined.
- **Mitigation measures**: A description of the measures proposed to minimize potential significant adverse effects.
- **Residual impacts**: A determination of the project's remaining level of effect after all the required and recommended mitigation measures are implemented.

6.3 Procedure for Assessment of Environmental Impacts and Their Significance

The methodology developed and adopted for the impact assessments provides a tool for assessing and evaluating the significance of effects and is based on the following criteria:

- The type of effect (i.e., whether it is positive / acceptable, negative / unacceptable, neutral or uncertain);
- Duration and/or frequency of occurrence (short-term / frequent, long term / long return period, intermittent);
- The policy importance or sensitivity of the resource under consideration in a geographical context (whether it is international, national, regional or local, as defined in Table 6.1); and
- The magnitude of the effect in relation to the resource that has been evaluated, quantified if possible, or rated qualitatively as high, medium or low, as defined in Table 6.2.

Both professional judgment and the results of modeling analysis are used to assess the findings in relation to each of these criteria to give an assessment of significance for each effect. Effects are considered to be major, minor or negligible and can be negative or positive. Where positive impacts are identified mitigation is not required.

Table 6.1: Geographical Context and Policy Importance

Geographical Context	Topic Definition
International	Important at global, African or trans-boundary levels
National	Important in the context of Sierra Leone
Regional	Important in the context of Freetown
District	Important in the context of the Eastern Freetown / Kissy Docks Area
Local	Important within the site and up to 1km from the site

Table 6.2: Magnitude Criteria

Magnitude of effect	Negative effects	Positive effects
High	• Widespread community concern • Failure to meet legal compliance requirements • Fatality or serious health disability • Severe or possibly irreversible damage to an important ecosystem or resource	• Widespread community benefit • High contribution to safety or prevention of fatalities • High level of technology transfer • Prevents serious damage to an important ecosystem or resource
Medium	• Local community opposition and levels of complaint • Regulatory concerns • Lost time injury or short-term health effects • Medium term damage to an ecosystem or resource	• Contributes to local development and economy • Provides confidence to regulators • Prevents medium term damage to an ecosystem or resource
Low	• Minor community opposition or complaints • Able to comply with legal requirements • Local / minor health effects requiring short-term treatment • Short-term, minor damage to an ecosystem or resource	• Low level of community support • Economic benefits not distributed locally

As a guide, Table 6.3 presents a significance evaluation tool which calculates the significance of the effect by a combination of importance / sensitivity and magnitude.

Table 6.3: Evaluation of Significance of Effect

Sensitivity of Impact	Magnitude of Impact		
	Low	Medium	High
International	Minor / Moderate	Major / Moderate	Major
National	Minor / Moderate	Moderate	Major
Regional	Minor	Moderate	Major
District	Minor / Negligible	Minor / Moderate	Minor / Moderate
Local	Minor / Negligible	Minor	Minor / Moderate

6.4 Mitigation Philosophy

Mitigation measures are measures proposed through the consideration of alternatives, physical design, project management or operation to avoid, reduce or remedy any significant adverse effects on people and the environment resulting from the proposed development.

The mitigation strategy employed is a hierarchical one which aims to primarily avoid potential impacts, to reduce those that remain, and lastly, where no other measures are possible, put forward compensatory measures. This approach is outlined as follows:

- Minimization of environmental effects through avoidance and therefore minimizing the number of reduction and remediation measures required to be 'built-in' to the project design;
- Minimization of any remaining potential effects (e.g., by the use of appropriate construction methods or timing); and
- Thirdly, where avoidance or reduction are not feasible, measures to remedy any remaining effects predominantly during the construction phase of the project have been promoted (e.g., habitat management and landscaping proposals).

6.5 Other Developments and Cumulative Effect Assessment

It is a key part of any ESHIA process that the additional or cumulative impacts associated with nearby existing or proposed developments, or where relevant any transboundary effects, be considered and the results reported. This cumulative effect assessment is concerned with identifying situations where a number of effects from separate projects combine to cause a significant effect on a particular resource.

Projects being developed by others can be considered if operational, under construction, holding permits or in the permitting process. The details of the existing and proposed surrounding developments are provided in Section 1.8. The cumulative impacts, taking into consideration these existing and potential developments, have been assessed for each environmental and aspect and findings are included in the detailed ESHIA assessments.

6.6 Environmental and Social Management Plan

An ESMP has been produced as part of the ESHIA and is presented in Volume II. The ESMP is sufficiently robust to support International Lending requirements as stipulated in IFC PS1 – Environmental and Social Assessment and meet the requirements of the EPA EIA requirements.

The ESMP ranks and prioritizes recommended environmental and social actions, describing time period for implementation. In addition, the ESMP indicates the roles and responsibilities of project personnel and third parties such as local and regional administrations and sub-contractors.

This ESMP will be used as a framework in the development of subsequent detailed management plans for detailed design, construction, operation phases. An Environmental Management Systems (EMS) team will be appointed for each project phase to review and further develop as required this framework ESMP. For the operational phase the ESMP will be developed into a full Environmental & Social Management System (ESMS) that will be aligned with ISO14001 that provides a formal and internationally acceptable structure that will be the central repository for all environmental and social plans and procedures.

7 Socio-Economic

This section will assess the potential socio-economic impacts of the proposed project during the construction and operation phases.

Table 7.1 Attributes of Socio-Economic Importance within the Study Area summarizes the important socio-economic resources within the study area based on the ESHIA methodology set out in Section 6.

Table 7.1 Attributes of Socio-Economic Importance within the Study Area

Attribute	Importance	Rationale
Ecosystem Services, Community Health and Safety	Regional and Local	IFC PS 4, 6, 7, 8
Commercial Fishery Resources	Regional	Value on a regional scale
Local Water Supply, Fish Stocks, Crops	District	Value on a district level to supply ecosystem services
Employment and Economic Development	Regional and Local	Value on a regional and local scale due to importance to eastern Freetown and Kissy Docks area for informal services such as food sales

7.1 Impact Assessment

7.1.1 Physical Displacement / Resettlement Economic Impacts

7.1.1.1 Construction and Operation

The project site itself has no current inhabitants (legal residents or squatters) at this time. No additional physical resettlement impacts are anticipated from the currently proposed project site. A follow up report on the status of 13 artisanal farmers that were originally relocated is shown in Appendix Q.

7.1.2 Economic Displacement and Livelihood Impacts

As discussed in the Ecology section of this document, ecosystem services relevant to local communities which occur within the project area of influence include:

- Estuary and Wetland related resources including any crop plantations in the wetland area.
- Wild foods and other non-timber forest products, including medicinal plants collected from the wetland habitats.

The project is most likely to have a negative impact on the wetland and estuary if any spillage of contaminants in the project area occurs.

Members of the workforce that are considered to be vulnerable (will include a grievance mechanism in place

We will address the outboard motors and the project will hold discussions with the 6 artisanal fishers to discuss each issue and response.

7.1.3 Employment

Employment impacts arising from the construction and operation phases of the project would include:

- Generation of direct employment by the project.

- Economic development created as a result of indirect employment by suppliers of goods and services to the project.

Direct employment created by the project would be considered a beneficial effect. Employment estimates provided by CECASL consist of the following:

- At the peak of construction, the project is anticipated to employ up to 300 construction workers.
- During operations, the plant is expected to employ approximately 60 permanent employees.

Potential employment impacts are discussed separately below under construction and operations.

7.1.3.1 Construction

At the height of construction, 300 employees, anticipated to be resourced from the surrounding community, would be employed on-site. This would result in beneficial employment and indirect employment impacts for suppliers, including goods and services providers for the project such as food vendors and petty traders and building materials companies. At this time, a worker's camp is not anticipated to be required for the project. However, if the selected EPC contractor elects to develop camp for employees, a plan for mitigation and monitoring associated with the camp would be required subject to the approval of CECASL and EPASL. The construction period will last approximately 24 months. The majority of employment during construction is likely to be relatively short-term and the extent of employment opportunities for local communities will depend upon skills levels and proximity. There is the potential for women to be disproportionately affected by this benefit as many of the construction jobs will be geared towards men. However, an influx of temporary employees to the site on a daily basis would increase the demand for services and expose the community to security risks.

Freetown under business-as-usual conditions is a robust community and is likely to be able to provide local labor for a construction project of this size. During the 2020 COVID-19 crisis daily business remains close to normal, however a partial lockdown and nightly curfews remain in place. As it is typical for workers to traverse Freetown, a worker's camp or an influx of workers and associated impacts is considered negligible for this project.

7.1.3.2 Operations

During project operations, employment impacts are considered to be positive. The project will offer an internship for one female engineering student per year. Permanent jobs associated with the project would include 60 positions. It is not clear whether or not these jobs will be able to be sourced from the local community as this would largely depend upon skill levels and training in the local and regional community. The level and range of skills and applicable working experience available in the community can be limited by education and relevant skill training. Without targeted training support from the project, the ability to acquire a position, and successful performance once hired, will favor experienced (skilled) personnel for professional roles, the majority of whom would likely come from abroad. This could create the potential for resentment from the local community towards outsiders.

The project will also provide a good source of potential indirect employment and economic growth for the area, although it will be relatively small.

7.1.3.3 Direct Employment

The project would have a moderate beneficial impact on employment during construction and potentially during operation in the project area of influence and in the wider geographical region. Considerable construction opportunities and a few potential operational employment opportunities could be

generated by the project. Local recruitment requirements regarding employment should be followed and training of the workforce carried out to maximize the overall benefits of direct employment.

7.1.3.4 Indirect Employment

The indirect employment effects of the plant will not change from those cited in the 2015 HFO ESIA. Plant staff and contractors will require vendors, suppliers, and service providers to meet the daily operating needs of the project together with the domestic needs of its employees. This could include goods and services including food vendors, laundry, supply of vehicles and transportation services, security patrols, as well as some construction equipment. There will be opportunities for utilizing local goods and services for the project and related activities.

Typically, 2.7 jobs in service and supply sectors are created for each direct job generated by oil and gas projects.[10] At the local and regional levels, this is likely to stimulate work for agricultural producers, as well as induce growth in other industries such as retail, hospitality, transportation, etc. This would be considered a minor beneficial impact.

A summary of the aforementioned socio-economic impacts prior to mitigation are presented in Table 7.2 Summary of Socio-economic Impacts During Each Phase (Prior to Mitigating Measures).

Table 7.2 Summary of Socio-economic Impacts During Each Phase (Prior to Mitigating Measures)

Topic	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Ecosystem Services	Regional	Water impacts, ecology impacts	Construction and Operations Impacts from the project on the Estuary or the marine environment or other water resources could have knock-on effects for associated ecosystem services.	Low	Minor	Direct negative short-term
Employment	Local / Regional	Increase in direct and indirect employment	Construction 300 employees are anticipated to be required at the peak of construction. Additional goods and services would also be required to support construction of the project.	Medium	Moderate	Direct and Indirect positive short-term
			Operations 60 permanent employees would be required for project operations. Some associated goods and services would also be required for project operations.	Low	Minor	Direct and Indirect positive long term
Increased demand for social services	Local / District	Daily influx of workers to the area	Construction 300 employees are anticipated to be required at	Low	Minor	Indirect negative short-term

[10] IMPACTS OF THE NATURAL GAS AND OIL INDUSTRY ON THE US ECONOMY IN 2015 July 17, 2017 (PWC multipliers used).

Topic	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
and increased pressure on local infrastructure			the peak of construction. Additional goods and services would also be required to support construction of the project.			
Security risks / crime	Local / District	Daily influx of workers	Construction 300 employees are anticipated to be required at the peak of construction. Additional goods and services would also be required to support construction of the project.	Low	Minor	Indirect negative short-term

7.2 Mitigation

The specific mitigation and enhancement measures to be implemented for the proposed project are detailed below.

7.2.1 Employment

In accordance with the requirements of IFC PS2, it is important that the employment process is well managed and that the local community is able to actively participate in the project where they are appropriately qualified. CECASL will implement the following requirements regarding employment:

- Employment policies requiring preferential hiring of local community members where they are appropriately skilled. Pass through of this policy to the EPC Contractor and supply chain partners including sub-contractors to the EPC contractor;
- Ensure a transparent hiring process is conducted to help the community to understand strategic staffing decisions for the project to avoid conflict;
- Develop a Workforce Development Strategy – a commitment to maximize employment and skills opportunities for local people;
- Develop a training and skills program to impart best practice in the skilling of local people for construction and operational jobs; and
- Encourage contractors to provide apprenticeship opportunities to local people.

The following enhancement measures would contribute to maximizing the benefits of the project and will be considered by CECASL as part of consultations around community benefits:

- Short-term training programs for women and youth: Additional training programs including savings, meeting food and health safety standards and other technology training programs for youth shall be offered that will help them to establish new and/or improved livelihoods; and
- Establish a local job readiness program and encourage the construction supply chain to continue to invest in workers.

7.3 Cumulative Impacts Assessment

Currently, few projects in the vicinity are presently underway. However, given the general lull in business and development at present due to curfews and restrictions from COVID-19, this issue will be revisited during the monitoring phase post-COVID-19 and under business-as-usual conditions. Under current conditions, the impacts associated with economic displacement are likely to be minor adverse. The plant size is relatively small and with few other projects occurring in the area, and most impacts being local, the overall magnitude of cumulative impacts is likely to be low. In future, careful monitoring of the mitigation measures proposed and their effectiveness would help to ensure that cumulative impacts remain minor adverse.

7.4 Residual Impacts

With the measures described above, the residual significance is expected to be minor adverse. In the long-term, employment related impacts are anticipated to improve conditions in the community. The Project will take appropriate measure to ensure socio-economic impacts are minimal.

8 Preliminary Health and Safety Risk Assessment

The General World Bank Group's EHS Guidelines and the WBG EHS Guidelines for Thermal Power Plants provide an overview of the key environmental, health and safety topics that are particularly relevant. IFC PS4 also addresses Community Health and Safety requirements.

The World Bank Group's EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP), as defined in IFC's PS3 on Pollution Prevention and Abatement.

8.1 Community Health and Safety Preliminary Risk Assessment and Management

8.1.1 Risk Identification

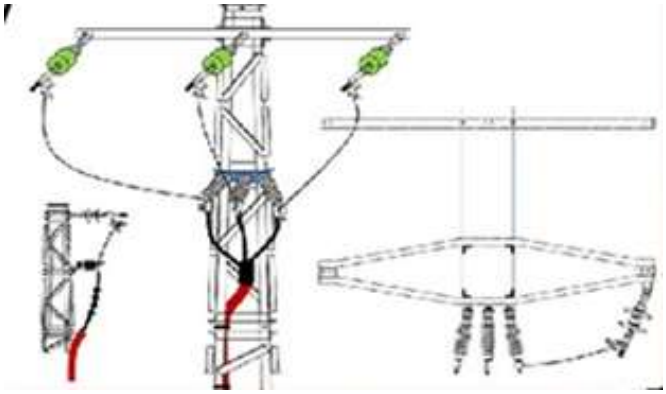
During the construction and operation of the project there are various potential risks to the local community that exist that need to be managed so the local community is not put at further risk. These risks are:

- **Increased Risk of Traffic Related Hazards:** It is expected during the construction phase of the project that the delivery of and materials and equipment will cause increased traffic. This is important since many of the roads near the project site lack sidewalks and other features that provide for pedestrian safety which will lead to an increased risk of pedestrian and traffic incidents. A full detailed description of the increased traffic risks, assessment and management and its impacts on the surrounding community can be found in Section 15 (Traffic and Transport) of this report.
- **Exposure to Noise Related Hazards Associated with Construction and Operational Activities:** During construction, these hazards include noise from construction activities and increased traffic. During operation, these risks include noise from plant operation. These risks are significant because of identified vulnerable populations that are adjacent to the project site. These populations include the adjacent residences and the Islamic Compound which includes a school. A full and detailed explanation of the risks and risk management for noise and its impacts on the surrounding community and sensitive receptors is located in Section 9.
- **Exposure to Air Emission Related Hazards Associated with Construction and Operational Activities:** During construction, these hazards include increased dust in the air from local unpaved roads during the dry season that is produced by the higher traffic volume resulting from construction activities. During operation, these hazards include any unmitigated air emission from particulate matter and NO_x. Once again vulnerable populations adjacent to the project site could be affected by the emissions. A full and detailed explanation of the risks and management for air emissions and its impacts on the surrounding community and sensitive receptors is located in Section 10.
- **Hazards Associated with Fuel Storage:** The project stores LPG in eight mounded storage tanks and diesel in an additional storage tank for use as primary and emergency fuel. These fuels could pose a critical health and safety risk to the surrounding area through the threat of fire and explosion. A fire poses an immediate threat to the adjacent properties and populations while an explosion could devastate the surrounding area. Besides the risk for fire and explosion, a leak in any of the fuel tanks poses a health risk to the adjacent population and properties as well as possibly contaminating the local soil and aquifer. In order to properly identify the threats to the

community of the onsite fuel storage a quantitative risk assessment will be conducted in an expedited manner.

- **Hazards Associated with Fuel Pipeline to Project:** The Project will accept delivery from a fuel pipeline that run from the project site to the Kissy Fuel Jetty and fuel depot in order to accept deliveries of LPG. The pipeline poses similar threats as the fuel storage system in terms of fire and explosion as well as leaks.
- **Exposure to Electrocution from Transmission Lines During Operation:** The project will be installing a number of 33kV lines to evacuate power from the site to substations in the area. Although these lines are not considered to be "high voltage" transmission lines they still have the capacity to electrocute anyone that tampers with them. The local electric utility will be operating these transmission lines and it will be their responsibility to develop and communicate a safety plan to the community. These new transmission lines will either be run along with existing transmission lines or a new line using similar poles will be installed. Figure 8.1 below is an example of the type of pole and line that will be installed.
- **Threats from Increased Capacity to Electrical Substations:** The Project will be installing a number of transformers at local substations to accommodate the evacuation of power from the Project to the local community. These new transformers will be the property of the local electrical utility and it will be the responsibility of said utility to maintain them in proper working order as to prevent fires at the substations.
- **Increased Incidence of Communicable Disease**: Until the population of Sierra Leone is vaccinated for COVID-19 there exists a risk for spreading the virus amongst the local community during both the construction and operational phases of the project.

Figure 8.1



8.1.2 Risk Management

Table 8.1, below, shows identified risks that will require management.

Table 8.1 Summary of Identified Risks Requiring Management

Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
			Magnitude	Significance	Impact Type
Local	Traffic, hazardous material impacts	Construction Increased traffic and the transport and use of hazardous materials during construction could result in accidents.	Medium	Minor	Direct, Negative short-term
		Operation Increased traffic and the transport and use of hazardous materials could result in accidents during operations.	Medium	Minor	Indirect negative short-term
Local	Noise	Construction Noise impacts are anticipated during construction, which could lead to community health effects.	Low	Minor	Direct negative short-term
		Operation Increased noise from plant equipment operation could lead to community health effects	High	Moderate	Direct Negative, Long-term
Local	Air quality	Construction Increased dust impacts are anticipated during construction, which could lead to community health and safety effects.	Low	Minor	Direct negative short-term
		Operation Increased air quality and noise emissions from traffic and plant operation.	High	Moderate	Direct Negative, Long-term

Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
			Magnitude	Significance	Impact Type
Local and District	Fuel Storage Tanks	Operation Increased risk for fire or explosion from fuel stored on-site could lead to devastating events. Risk of leaks from tanks that could lead to health and environmental impacts.	High	Moderate	Direct Negative, Long-term
Local	Fuel pipeline from depot to Project	Operation Increased risk for fire or explosion from fuel stored on-site could lead to devastating events. Risk of leaks from tanks that could lead to health and environmental impacts.	High	Moderate	Direct Negative, Long-term
Local	Close Proximity and Confined Spaces	Construction Increased spread of COVID-19 from close proximity and shared spaces	Medium	Moderate	Direct, Negative, Short Term (with possible unknown long-term impacts)
		Operation Increased spread of COVID-19 from close proximity and shared spaces	Medium	Moderate	Direct, Negative, Short Term (with possible unknown long-term impacts)

8.1.2.1 Traffic

A full in detailed description of traffic impacts, assessment and mitigation can be found in Section 15 of this report. During construction, materials will be delivered to the site and during operations traffic flow is predicted to increase gradually. This would lead to an increase in the potential for other health related impacts associated such as increases in noise, dust, risk of accidents and exposure to hazardous materials. Project deliveries will be scheduled for daytime hours whenever possible due principally to safety reasons and current curfews, but with the secondary benefit of noise reduction throughout the night. The introduction of increased HGV traffic and general increasing traffic volumes presents a safety risk to the community and to workers. In addition, there will be the potential for increased road traffic accidents from increased construction traffic. Emergency response for potential accidents will also be an important consideration. Appropriate health and safety standards would need to be applied at the site to address effects associated with accidents. The ESMP will further address potential traffic impacts and effects on community safety to ensure that the traffic management plan takes full account of community safety.

8.1.2.2 Noise

A full and detailed explanation of the impacts and mitigation strategies for noise and its impacts on the surrounding community and sensitive receptors is located in Section 9. For adjacent properties and sensitive receptors, noise during the construction phase will be limited to daylight hours similar to the strategy employed for traffic management. During operation noise will be mitigated by the use of sound barriers on the project perimeter and by the use of enclosures for high noise generating equipment. The EPC contractor will be responsible for ensuring that any and all local as well as World Bank / IFC standards for noise are met and that noise levels at the boundaries with adjacent properties are routinely checked to prove compliance.

8.1.2.3 Air Quality

A full and detailed explanation of the impacts and mitigation strategies for air emissions and its impacts on the surrounding community and sensitive receptors is located in Section 10.

In addition, an analysis of the ground level concentrations of the emissions from the combustion turbines was conducted to assess the impact and risk to the local community from the emissions from the combustion turbines. For the conceptual design the Project is using a stack height of 65 meters which is the "good engineering practice" as defined by USEPA and this stack height was also used in the analysis of the ground level air emissions concentrations. Table 8.2 shows the results of this analysis.

Table 8.2 Predicted Maximum Results within Grid Location

Pollutant	Averaging Period	AAQG	Background concentration	PC	PC / AAQG	PEC	PEC / AAQG
		(µg/m³)	F(µg/m³)	(µg/m³)	%	(µg/m³)	%
Nitrogen dioxide (NO_2)	Annual mean	40	27.2	5.85	15%	33.05	83
	1 hour mean (maximum)	200	54.4	73.14	37%	127.54	64%
Carbon monoxide (CO)	8 hour running mean (maximum)	10,000	140	16.21	0.2%	156.21	2%
Sulphur dioxide (SO_2)	24 hour mean (maximum)	125	6.3	1.47	1%	7.77	6%
	10 minute mean (maximum)	500	6.3	2.74	1%	9.04	2%
Particulate matter (PM_{10})	Annual mean	70	196.3	0.24	0.3%	196.54	281%
	24 hour mean (99th %ile)	150	392.6	2.26	2%	394.86	263%
Particulate matter ($PM_{2.5}$)	Annual mean	35	31.9	0.24	1%	32.14%	92%
	24 hour mean (99th %ile)	75	63.8	2.26	3%	66.06	88%

The analysis concludes that the ground level ambient air quality levels that result from the Project air emissions are both within the WHO guidelines and are well within the 25% range of the WB/IFC guideline to allow further development in the area. These results were obtained by using the GEP (65m) stack height.

Although LPG is naturally odorless it is usually odorized with a warning agent such as ethyl mercaptan for sake of safety to help detect a leak. This is specifically required for public/domestic use but is not required for industrial use of LPG. In industrial situations there are safety systems involving gas detectors, automatic shutdown, ventilation systems and other requirements that are fulfilled by following NFPA 58 code requirements and that are established by the HAZID/HAZOP studies done by the EPC contractor during detailed design. The use of these systems and the lack of ethyl mercaptan therefore eliminates the odor concerns from use of LPG.

8.1.2.4 Fuel Storage Tanks

Liquefied petroleum gas (LPG) is an emerging fuel source in gas-to-power applications in developing nations. Natural gas, primarily comprised of methane (C1) with trace ethane (C2), is a common fuel for combustion turbines. LPG, by comparison, is comprised of fuels heavier than ethane, primarily propane (C3) and butane (C4).

LPG has similar combustion properties to natural gas (methane/ethane) in thermal engines (LHV, flow rates, etc.). However, these heavier molecules have higher boiling points and is more easily stored in liquid form compared to natural gas. For example, liquefied natural gas (LNG) would need to be cooled below -260° F to remain in liquid form at atmospheric pressure. LPG can remain in liquid form at -44° F for propane or 30° F for butane, making it more attractive for bulk storage without chiller systems. Gasification of the fuel for use in the combustion turbine is performed using small electric or thermal boilers.

The project was initially developed as a reciprocating engine facility, with considerable on-site storage of heavy fuel oil delivered from the New Kissy Jetty. The concept remained the same once the WAPG Project evolved. LPG would be delivered via a new interconnection to the New Kissy Jetty and stored on-site. However, LPG would be fired in a higher efficiency combined cycle power plant.

In the initial stages of the conceptual design, the project team focused on risk mitigation features and defense-in-depth surrounding the safety considerations for the LPG storage system.

LPG's unique characteristics as a liquid fuel near ambient temperatures requires similar risk management to LNG tanks. This is owed to the fact that liquid fuel is stored at lower pressure, and should the fuel boil to gaseous phase, the resulting increase in tank pressure could cause a rupture and release of fuel.

This failure mode is characterized as a boiling liquid expanding vapor (BLEV) event. When coupled with an external ignition source, such as an active fire, a positive feedback loop is established that can cause a rapid release of energy. This has been noted in BLEV accident events involving LPG and LNG fuel.

The Bridge Power Project in neighboring Country Ghana which also uses LM2500 combustion turbines, utilized spherical storage tanks (Horton sphere) to economically store large quantities of LPG. However, aboveground storage was not deemed acceptable for the WAPG project given the proximity to residences and other nearby structures. So, the WAPG project is conceptually designed around a mounded storage tank configuration.

The LPG tank storage system will use eight (8) horizontal bullet tanks designed to ASME Section VIII Division 2 Class 2 standards. Tank sections will be fabricated in the supplier's shop from certified steel plates. Each plate will be certified with heat and plate number, chemical composition, cast and product analysis, heat treatment cycles, mechanical properties from testing, and ultrasonic test results. Welding of the steel plates will be performed in the supplier's shop to the maximum extent practical prior to shipment to the site. Welding on-site will be performed using qualified welders in a controlled environment. All tank welds will be radiographed prior to acceptance by the Owner.

Each of the tanks will undergo extensive testing prior to installation to ensure integrity, including hydrostatic testing.

The tanks will be installed on a sand mound, then surrounded with sand fill on all sides. The tank mound will be overlaid with a masonry composite to prevent erosion and maintain the integrity of the earthen mound during storm events.

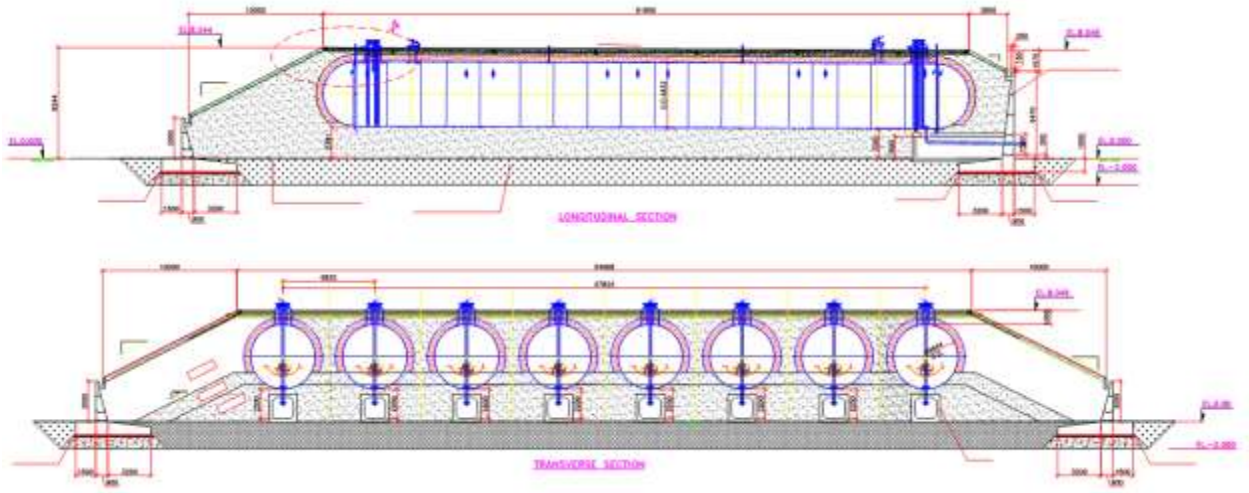
Figure 8.2 and

Figure 8.3 shows an example and diagram of how the mounded LPG will be installed.

Figure 8.2 Example of a Mounded Tank Example of a Mounded Tank

(https://epcmholdings.com/bulk-lpg-layout-requirements-sans-versus-nfpa/)

Figure 8.3 Diagram of Mounded LPG Tanks Diagram of Mounded LPG Tanks



The U.S. National Fire Protection Association (NFPA) assigns stringent requirements to LPG storage facilities in order to mitigate safety risks to the maximum extent practical. NFPA 58 governs fire protection and safety means for LPG storage facilities that support power generation equipment.

NFPA 58 includes enhanced fire protection means for LPG storage tanks of the size considered for the WAPG Project, and the conceptual design has implemented these design features.

The LPG storage tank system for WAPG incorporates the following design features in order to provide the level of safety required for a project of this magnitude:

1. Earthen berm containment. The LPG storage tanks are installed on a sand bed and covered in earth in a "mounded" configuration. This provides three levels of protection:
    a. Protection from external fires. The fill material provides a thermal buffer between an external fire on site and the LPG tank storage system, preventing the fire from heating the contents of the storage tanks and causing the inventory to boil.
    b. Prevention of leaks below the tanks. The presence of compacted sand introduces a torturous path for inventory to escape the tank in the remote event of a leak. LPG is also not permitted to settle beneath the tank, which is a common driver for BLEV events.
    c. Removal of oxygen below tanks. The mounded berm displaces oxygen that would otherwise surround above-grade storage tanks. LPG fires require both fuel and oxygen to propagate into a catastrophic event. By removing oxygen from the LPG storage area, the risk of reacting with LPG fuel is mitigated.
2. Minimum separation distances. The LPG storage tanks are positioned on the General Arrangement with the advised separation distance between individual tanks (2.4m), and between the tank storage area and the property line (15m). The minimum separation distance to the property line would otherwise be set at 91m for above ground LPG storage tanks of this size. The difference in minimum separation distances assigned by NFPA is owed to enhanced passive fire safety of the mounded configuration.

Table 8.3 Separation Distances Between Containers

Table 6.4.1.1 Separation Distances Between Containers, Important Buildings, and Line of Adjoining Property That Can Be Built Upon

Water Capacity per Container		Minimum Distances					
		Mounded or Underground Containers[a]		Aboveground Containers		Between Containers[b]	
gal	m^3	ft	m	ft	m	ft	m
<125[c]	<0.5[c]	10	3	0[d]	0[d]	0	0
125–250	0.5–1.0	10	3	10	3	0	0
251–500	>1.0–1.9	10	3	10	3	3	1
501–2,000	>1.9–7.6	10	3	25[c]	7.6	3	1
2,001–30,000	>7.6–114	50	15	50	15	5	1.5
30,001–70,000	>114–265	50	15	75	23	¼ of sum of diameters of adjacent containers	
70,001–90,000	>265–341	50	15	100	30		
90,001–120,000	>341–454	50	15	125	38		
120,001–200,000	>454–757	50	15	200	61		
200,001–1,000,000	>757–3,785	50	15	300	91		
>1,000,000	>3,785	50	15	400	122		

Safety relief valves and devices will be provided to prevent over pressurization of the LPG system. These devices will be designed to API 520, 521, and 2000 in accordance with industry accepted practices for LPG systems.

All valves shall be leak tested using compressed air to confirm that the valve seals are bubble tight prior to commissioning.

Once the detailed engineering is concluded the EPC contractor will conduct hazard HAZOP assessment of the project and the fuel system. This assessment will be used to design the following safety features in the LPG system to provide enhanced safety mitigation of risk.

The LPG fuel system will include the following engineered safety features to provide enhanced risk mitigation and safety:

- Gas leak detection system
- Firefighting system
- Emergency shut down system
- Automatic excess flow valves
- Earthing system
- Remote operated valves
- High and low level alarm system
- Safety interlock system

The gas leak detection system shall be provided at strategic hazardous areas including the storage tank area, buffer vessel area, forwarding pump skids, vaporizer, and the double-walled LPG pipeline. The detectors shall be set to 20% and 40% of the lower explosive limit (LEL), such that alarming and lockout signaling will be provided to the control room and local equipment programmable logic controllers (PLCs).

The facility is designed and equipped with a fire protection system in accordance with NFPA 30, which includes a fire water main ring, fire hydrants and monitors, deluge water sprinkler system, and fire detection lines.

Safety interlocks are provided throughout the entire LPG facility for safety enhancements and shall activate without operator intervention:

1. High level lockout. Remote operated valves (ROVS) in the liquid inlet and outlet lines of the LPG storage vessel shall be provided, including redundant radar level gauges. Once the high liquid level in the LPG storage tank is reached at 85% volume, a signal is sent to the ROVs to isolate the tank. An independent high-level alarm is initiated a 90% volume, which sends alarm locally and to the control room. This signal will additionally trip the booster pumps and the ship unloading pump.
2. Low level lockout. Low level signaling is initiated at 10% volume in the tank to prevent dry operation of the LPG forwarding pumps. At 5% volume, the LPG forwarded pumps are automatically tripped.

The facility is protected against electrostatic discharge by a robust earthing system that is independent of the plant ground grid system. All transfer hoses are equipped with reinforced wire which are in electrical contact with the end couplings.

Plant operational areas including the plant control room, power block, LPG vaporizer area, buffer tank area, forwarding pump skids, storage tanks, booster pumps, and the jetty will be equipped with an Emergency Shutdown (ESD) system. Activation of the ESD system shall shut down plant operations and activate safety lockouts. The plant is equipped with an uninterruptible power supply (UPS) and an emergency diesel generator (EDG) that will provide backup power to the site's critical safety systems, even in the event of a grid interruption.

8.1.2.5 Pipeline from Kissy Jetty Fuel Depot to Project Site

The WAPG Project includes a pipeline that transfers LPG from the nearby New Kissy Jetty to the Project Site. The pipeline will be routed along the right-of-way that was approved for the heavy fuel oil pipeline.

The LPG pipeline shall be designed to ASME B31.3 standards and constructed as a double-walled piping system ("pipe within a pipe"). The inner piping will be specified to contain the operating pressure of the LPG system in gaseous form with appropriate design margins. The function of the outer piping system is to contain a leak at any point along the pipeline.

All welded joints on the inner pipeline will undergo 100% radiography inspection prior to acceptance by the Owner.

The interstitial space between the outer pipe and the inner pipe will be monitored with leak detection instrumentation. Should a leak occur, the leak detection instruments will issue an alarm to both the Jetty and the plant control room. Tripping signals will simultaneously be issued on redundant circuits back to the ship unloading pump and booster pump to prevent further transfer of LPG inventory. Double isolation valves will close to isolate the leak from the transport vessel and the LPG storage system.

The HAZID/HAZOP study for the LPG fuel system will also include the pipeline from the Kissy Jetty fuel depot and the same safety systems discussed in that section will be applied to the pipeline. Also, the same valve safety enhancements will also be applied to the pipeline.

8.1.2.6 Communicable Disease

Contractors that come from outside the area would rent homes locally increasing the risk and spread of communicable diseases. Community impacts of COVID-19 could be seeing during the construction, commissioning, and operations phases. According to the World Health Organization (WHO), Coronavirus

disease (COVID-19) is spread through infected droplets released when a person coughs, sneezes, talks, or exhales. Most of these droplets fall on nearby surfaces and objects. People could catch COVID-19 by touching contaminated surfaces or objects, and then touching their eyes, nose, or mouth. If they are standing within 1 meter of a person with COVID-19 they can catch it by breathing in droplets coughed out or exhaled by them. [11] The WHO and GoSL have provided guidelines to help prevent or slow the spread of COVID-19.

COVID-19, during the construction phase, could possibly have the greatest impact on the project site and the surrounding communities. As workers, skill allowing, will be hired from the local area, an outbreak could extend to the adjacent districts.

At the time of this ESHIA the best measures to prevent the spread of COVID-19 are:

- Disinfecting shared spaces
    - Surfaces (e.g., desks and tables) and objects (e.g., telephones, keyboards) need to be wiped with disinfectant regularly.
- Promote regular and thorough handwashing by all personnel
    - Put sanitizing hand rub dispensers in prominent places around the jobsite. Make sure these dispensers are regularly refilled with hand sanitizer that is at least 60% alcohol based.
    - Make sure all personnel have access to places where they can wash their hands with soap and water.
- Wearing proper personal protective equipment (PPE)
    - Cloth masks and protective eyewear in combination with the measures above should be utilized.
- Avoid physical contact and keep safe distance (arms'-stretched length) from others.
- Utilize quarantine as necessary for the following purposes:
    - Personnel who are showing signs and symptoms include fever, tiredness, and cough;
    - Personnel who may have come in contact with COVID-19 but do not yet show signs and symptoms or know if they have the virus; and
    - Personnel who have tested positive for COVID-19.

The following mitigation measures are recommended to reduce potential community health and safety effects:

- All workers should comply with international safety standards (helmet, safety boots, gloves, eyeglasses, ear plugs, etc.).
- A Transport Management Plan shall be implemented for any construction traffic to reduce the potential for accidents.
- All project operations vehicles and contractor vehicles will have a speed limit set for travel through settlements and areas where there are no posted speed limits.
- A Worker Policy and Code of Behavior including security personnel shall be developed which includes guidance on visits, prescribed actions for conduct violations and a grievance mechanism for complaints.

[11] https://www.who.int/docs/default-source/coronaviruse/advice-for-workplace-clean-19-03-2020.pdf

- The EPC contractor will adhere to the internationally established Voluntary Principles on Security and Human Rights developed for the extractive energy sectors to ensure that adequate health and safety training of security personnel takes place. If needed, the EPC contractor shall involve external stakeholders (i.e., police or local authorities) in any on-site security incidents and ensure that appropriate incident response procedures are implemented in accordance with the recommendation of the Interactions Between Companies and Public Security included in the Voluntary Principles on Security and Human Rights.
- An important aspect of minimizing the spread of communicable diseases within the community is worker health screening, particularly as many construction workers are expected to be local people. A worker health screening program shall be developed and implemented during the peak construction period or at any time when workers on site number more than 100.
- Community Emergency Response Plans will be developed and tested including workers and nearby residents in the vicinity of project-related traffic. These will include emergency response related to traffic accidents, the potential releases of chemicals and other hazardous materials, and fires.

With the safety measures described above, the residual significance is expected to be reduced to minor as proper traffic management and traffic calming measures are put into place to traffic levels and as proper safety management plans are implemented.

8.1.3 Summary

Community safety impacts from increased roads and traffic, increase in the risk of communicable diseases and safety risks and exposure to hazards would be considered a moderately adverse impact. Effects would likely be short-term and localized, and risks would be highest during the peak construction period lasting approximately 4 months. Children and other vulnerable people including the elderly and those with existing health problems would likely be most susceptible to the community health risks.

A summary of the aforementioned health and safety risks prior to mitigation are presented in Table 8.1 Summary of Identified Risks Requiring Management.

8.2 Occupational Health and Safety

8.2.1 Risk Assessment

Specific occupational health and safety issues associated with power projects include the potential for exposure to confined spaces, heat and air quality and noise impacts.

In addition to these occupational health concerns, there are also health and safety risks associated with construction and operation activities and emergency situations.

- **Confined Spaces:** Confined space hazards in this and any other industry sector are potentially fatal. Confined space entry by workers and the potential for accidents may vary among power facilities depending on design and on-site equipment. Therefore, confined spaces on site could result in adverse health and safety impacts to workers.
- **Heat:** Occupational exposure to heat occurs during construction activities, and during operation and maintenance of pipes, wells, and related hot equipment. Therefore, heat associated with operational and construction equipment on site could result in adverse health and safety impacts to workers.

- **Noise and Air Quality:** Workers could be exposed to noise particulate emissions during construction activities, from diesel engines, drilling and when other heavy machinery is utilized. Operational noise and air quality emissions could also expose workers to excessive noise and air quality emissions.
- **Other Concerns:** Potential occupational health and safety issues during construction activities would also include:
    - Falls and slips;
    - Failures of support systems and/or platforms;
    - Collision with mobile plant or vehicles;
    - Road safety relating to water trucks;
    - Exposure to dust and to hazardous materials;
    - Explosions;
    - Burns;
    - Crushing by heavy plant or collapse of structures;
    - Falling debris;
    - Adverse weather conditions;
    - Falls into voids during piling; and
    - Contact with concrete.

8.2.2 Risk Management

Impacts on worker and occupational health and safety associated with confined spaces, air quality and noise concerns, heat, potential accidents, and emergency concerns, without mitigation, would be considered majorly adverse. Implementation of proper health and safety plans would reduce these risks significantly.

The Health and Safety Mitigation Plan identifies procedures and methods that will be used to minimize the adverse impacts of construction and operational activities.

8.2.2.1 Confined Spaces

Engineering measures will be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces. Other mitigation should include:

- Permits will be required for entry into those locations classed as confined spaces. These spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent practicable.
- Safety precautions will include Self Contained Breathing Apparatus (SCBA), lifelines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available.
- Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary personal protective equipment (PPE), as well as the serviceability and integrity of the PPE will be verified.

8.2.2.2 Heat

Prevention and control measures to address heat exposure include:

- Reducing the time required for work in elevated temperature environments and ensuring access to drinking water;
- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc.;
- Use of PPE as appropriate, including insulated gloves and shoes; and
- Implementing appropriate safety procedures during the exploratory drilling process.

8.2.2.3 Noise

Noise abatement technology includes the use of rock mufflers, sound insulation, and barriers during drilling. These activities will be carried out in the demolition phase of the construction stage. Approximately one month in duration.

Noise limits for different working environments are provided in Table 8.4.

Table 8.4 Noise Limits for Different Working Environments

Noise Limits for Various Working Environments		
Location / Activity	**Equivalent level LAeq 8 hour (dBA)**	**Maximum LAmaxfast dBA**
Heavy Industry (no demand for oral communication)	85	110
Light industry (decreasing demand for oral communication)	50-65	110
Open offices, control rooms, service counters or similar	45-50	-
Individual offices (no disturbing noise)	40-45	-
Classrooms / Lecture Halls	35-40	-
Hospitals	30-35	40

8.2.2.4 Health and Safety Management Systems

A health and safety system for construction and operational activities will be developed as a requirement of the ESMP for routine activities. The operational system will be based on the requirements of ISO18001 for Occupational Safety and Health Management Systems (OSHMS).

A health and safety plan will be developed as a requirement of the ESMP that will include a process hazard analysis and HAZOP will be prepared to cover the full project infrastructure. The information generated from the HAZOP will be used to prepare a pipeline failure safety plan.

The protection of personnel and equipment is of paramount importance. Fire safety and Emergency Response Plans will be developed and implemented as part of the ESMP. The designs for the plant will incorporate provisions for fire prevention (developed procedures), fire detection (sensors and alarms), and fire suppression (water and foam and portable extinguishers). The facility will have equipment installed including gas detection, heat sensors and manual pull stations in the event of a fire and an audible

alarm system. Typically, National Fire Protection Association (NFPA) 850 recommendations will be implemented for insurance purposes.

The Contractor will specify which regulations / guidance will be applied in the safety plan.

8.2.2.5 Additional Occupational Health and Safety Measures

During the construction phase, the contractor shall be solely responsible for the safety of all its employees and its subcontractor employees. It is also mandatory that all personnel at the project site be outfitted with approved PPE and receive associated training for health and safety training including procedures for emergency response.

First Aid and Safety training will be provided to workers and a first aid kit will be available on site.

A worker health monitoring program shall also be established to ensure proper management of occupational health and safety concerns and incidents.

With the safety measures described above, the residual significance of construction impacts is expected to be reduced to minor as workers become more familiar with dealing with health and safety issues.

With the planned safety measures and requirements described, the residual significance of operational impacts is expected to be mitigated to as low as reasonably practicable based upon current practice.

8.2.3 Summary

Overall adverse impacts associated with health and safety for workers would be reduced by the implementation of appropriate health and safety systems. Implementation of appropriate mitigation measures if properly implemented would significantly reduce project effects and address any potential health and safety concerns.

A summary of the aforementioned health and safety risks prior to mitigation are presented in Table 8.5.

Table 8.5 Summary of Occupational Health and Safety Impacts during Each Phase (Prior to Mitigating Measures)

Topic	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Occupational Health and Safety	National	Exposure to confined spaces and heat	Operations Failure to meet legal compliance requirements. Fatality or serious health disability.	Medium	Major	Direct, negative long term
Occupational Health and Safety	National	Accidents, air quality and noise impacts	Construction Failure to meet legal compliance requirements. Fatality or serious health disability.	High	Moderate	Direct, negative short-term
			Operations Increased spread of COVID-19 from close proximity and shared spaces	Medium	Moderate	Direct, Negative, Short Term (with possible unknown long-term impacts)

8.3 Cumulative impacts

Currently, few projects in the vicinity are presently underway. Given the COVID-19 restrictions at present, impacts should be revisited during the monitoring phase. Under conditions at the time of writing, the impacts associated with community health and safety are likely to be minimally adverse. The plant size is relatively small and with few other projects occurring, and most impacts being local, the overall magnitude of cumulative impacts is likely to be low. In the future, careful monitoring of the proposed mitigation measures and their effectiveness would help to ensure that cumulative impacts would be negligible. The Project will take appropriate measure to ensure health and safety risks are minimally adverse.

9 Noise

This section of the ESHIA assesses the potential for construction and operational impacts of the project with respect to noise.

Noise disturbance is frequently raised as a significant issue by local communities concerned about development and is often the focus of complaints relating to operations. In some situations, it can lead to adverse health impacts. It is therefore appropriate to consider, and if necessary, mitigate, the potential noise impacts that the project may have.

9.1 Noise Level Guidelines

International guidelines for ambient noise levels are set out by the IFC / World Bank in their General Environmental, Health, and Safety Guidelines (2007). Furthermore, the World Health Organization (WHO) has set out international guidelines for indoor noise levels to avoid sleep disturbance. Each of these guidelines is described in more detail below.

9.1.1 World Bank Guidelines

The WBG has published EHS Guidelines for Thermal Power Plants (WBG 2008) which set out industry-specific examples of good international industry practice. In respect of noise, these guidelines note that amongst the principal sources of noise in thermal power plants are turbine generators and auxiliaries, boilers and auxiliaries, fans and ductwork, pumps, compressors, piping, valves and cooling towers.

Noise impacts, control measures, and recommended ambient noise levels for thermal power plants are presented in Section 1.7 of the General EHS Guidelines. These noise level guidelines are presented in Table 9.1, below. It is required that noise abatement measures should achieve either the following levels or a maximum increase in background levels of 3dB(A).

Table 9.1 IFC General EHS Guidelines: Noise Level Guidelines (dB)

Receptor	Daytime 07:00-22:00 hrs ($LA_{eq\ 1hr}$)	Night-time 22:00-07:00 hrs ($LA_{eq\ 1hr}$)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Whilst not explicit, the IFC guidelines in practice are commonly applied to the noise from the development only and not to the cumulative level of baseline plus development related noise. The guidelines are also commonly interpreted as being relevant to the long-term operational noise emissions from the project, rather than the short-term construction noise levels.

The IFC EHS guidelines classifies the project as heavy industry and provides the following Occupational Health and Safety Noise Guidelines for workers onsite.

- No employee should be exposed to a noise level greater than 85 dB for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB.
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB, the peak sound levels reach 140 dB, or the average maximum sound level reaches 110 dB. Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB.

- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB, an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.
- Periodic medical hearing checks should be performed on workers exposed to high noise levels.

The IFC EHS guidelines also present examples of noise reduction options that should be considered where noise levels exceed these guideline values, along with recommendations for noise monitoring to be carried out either to establish existing ambient noise levels or to verify operational noise levels.

The noise guidelines presented in Section 1.7 of the General EHS Guidelines are based on the 1999 World Health Organization (WHO) Guidelines for Community Noise.

Although the General EHS guidelines do not stipulate any environmental vibration criteria, the IFC requires potential impacts from vibration to be mitigated.

9.1.2 Variations of World Bank Guidelines

The city of Freetown does not utilize residential and industrial zoning which has resulted the area surrounding the project site to be a heavily industrialized area with fuel terminals and factories interspersed with residents that have built shanties up against facility boundary walls. The Project site was originally categorized by the original lender (IFC) as being in an industrial zone back in 2016 and an exemption was made to usual guidelines by the Lender that allowed noise levels as high as 70 dBA at the Project boundary and 55 dBA, daytime or nighttime, at the receptors themselves. The Project hopes to receive a similar exemption from the current proposed Lender. Regardless of which standard the Lender chooses the Project will take appropriate measures to ensure the standard designated by the Lender is met.

9.2 Potential Noise Impacts

The operation of the equipment associated with the construction and operation phase of the project have the potential to lead to noise impacts at residences, schools, healthcare facilities and other nearby sensitive receptors.

Depending on the magnitude of the impact, and the activities being conducted at the receptor, the following effects may result:

- Small changes in behavior such as turning the volume up, speaking more loudly, occasionally closing windows and a perceived reduction in quality of life.
- Material changes in behavior such as avoiding certain activities during noisy periods, keeping windows closed most of the time, difficulty concentrating on tasks, reduced speech intelligibility and diminished quality of life.
- Health impacts such as annoyance, reduced cognitive performance, sleep disturbance (arousal, motility, sleep quality and reported awakening), the autonomous release of stress hormones, increased risk of hypertension (high blood pressure) and ischemic heart diseases (including myocardial infarction).

9.3 Construction Noise Assessment

Potential construction noise impacts to humans include sleep disturbance, an increased incidence of social and behavioral problems (including annoyance and increased aggressive behavior) and in extreme cases, hearing impairment of construction workers not wearing hearing protection or taking other preventative measures.

Construction noise levels will vary depending on the activity being undertaken, the construction plant being used and with the distance from receptors. Major phases of construction are likely to be:

- Earthworks and Site Preparation,
- Piling,
- Creation of Hard Standings,
- Construction of Foundations,
- Building Erection,
- Creation of Roads, and
- Startup and Commissioning (such as steam blows to clean boiler piping).

The plant associated with the various phases is expected to be similar to that provided in Table 9.2. The predicted noise levels are at 10m from each activity.

Table 9.2 Construction Source Levels

Activity	Equipment						Activity LA_{eq} @ 10m
	BS5228 Ref.	Plant Description	LA_{eq} @ 10m, dB	No.	% Use	Adjusted LA_{eq} @ 10m, dB	
Earthworks & Preparation	C2.3	Tracked excavator; 102kW; 22 t	78	2	75	79.8	86.8
	C2.26	Wheeled loader; 209kW	79	2	75	80.8	
	C2.30	Dump truck (tipping fill); 306kW; 29 t	79	2	75	80.8	
	C2.10	Dozer; 239kW; 41 t	80	2	75	81.8	
Piling	C3.1	Hydraulic hammer rig Hydraulic hammer rig; 145kW; 16m length / 5 t hammer / plywood dolly	89	2	30	86.8	86.9
	C3.7	Power pack; 147kW; 6 t	70	2	50	70.0	
	C3.28	Tracked mobile crane; 184kW; 110 t	67	2	75	68.8	
Foundations	C4.33	Poker vibrator	78	2	75	79.8	83.7
	C4.18	Cement mixer truck (discharging)	75	2	75	76.8	
	C4.32	Concrete mixer truck + truck mounted concrete pump + boom arm	78	2	75	79.8	
Building Erection	C4.38	Wheeled mobile telescopic crane; 610kW; 400 t	78	2	50	78.0	85.6
	C4.32	Concrete mixer truck + truck mounted concrete pump + boom arm	78	1	75	76.8	
	C4.73	Hand-held circular saw (cutting paving slabs); 1.5kW; 7.6 kg / 235 mm diameter	84	2	5	74.0	
	C4.93	Angle grinder (grinding steel); 2.3kW; 4.7 kg	80	2	25	77.0	
	C4.53	Lorry with lifting boom; 50kW; 6 t	77	2	75	78.8	

	C4.56	Wheeled excavator; 63kW; 14 t	83	1	50	80.0	
Hard Standing	C4.18	Cement mixer truck (discharging)	75	2	75	76.8	82.8
	C4.32	Concrete mixer truck + truck mounted concrete pump + boom arm	78	2	75	79.8	
	C4.18	Cement mixer truck (discharging)	75	2	75	76.8	
Roads	C5.18	Tracked excavator; 172kW; 35 t	80	2	75	81.8	83.9
	C5.20	Vibratory roller; 98kW; 8.9 t	75	2	75	76.8	
	C5.30	Asphalt paver (+ tipper lorry); 112kW; 12 t hopper	75	2	75	76.8	

As Table 9.2 demonstrates, construction works are estimated to generate high noise levels in the range 83-87 dB LA_{eq} at a distance of 10m and therefore personal hearing protection should be worn by construction workers.

Based on the table above, estimated construction equipment noise levels for the various activities at the offsite receptors are presented in Table 9.3.

Table 9.3 Estimated Construction Noise Levels

Location	Estimated Activity LA_{eq}					
	Earthworks & Preparation	Piling	Found-ations	Building Erection	Hard Standing	Roads
	87 dB	87 dB	84 dB	86 dB	83 dB	84 dB
R1: Residential Properties	70 - 75 dB	70 - 75 dB	65 - 70 dB	65 - 75 dB	65 - 70 dB	65 - 70 dB
Y1: Primary School	55 - 70 dB	55 - 70 dB	55 - 65 dB	55 - 65 dB	50 - 65 dB	55 - 65 dB
Y2: Mosque	55 - 70 dB	55 - 70 dB	55 - 65 dB	55 - 65 dB	50 - 65 dB	55 - 65 dB
U Shanty Houses and Stores	70 - 90 dB	70 - 90 dB	65 - 85 dB	70 - 90 dB	65 - 85 dB	65 - 85 dB
M: German Technical Academy	60 - 75 dB	60 - 75 dB	60 - 70 dB	60 - 75 dB	55 - 70 dB	60 - 70 dB
R2: Residential / Permanent Dwellings	60 - 65 dB	60 - 65 dB	60 - 65 dB	60 - 65 dB	60 - 60 dB	60 - 65 dB
W: Polio Compound	60 - 65 dB	60 - 65 dB	55 - 60 dB	55 - 65 dB	55 - 60 dB	55 - 60 dB

The IFC Guidelines do not set limits for temporary noise from construction, and nor are there any in Sierra Leonean legislation. However, due to the temporary nature of the construction, it is likely that noise levels as high as 70 dB(A) during the day would be tolerable at residential receptors during the day. However, construction noise may impair the ability for speech to be understood at the School and German Technical Academy. It is therefore recommended that if teaching within these establishments is to take place during the construction period, then consultation is held between the relevant developers and educational establishments to ensure that potential impacts on pupils are mitigated.

Construction noise levels are estimated to be extremely high and would likely require additional mitigation during the construction works. There are also shanty houses located near the entrance to the site that could be affected. A Noise Management Plan will be developed for the project that will consider

construction noise and measures to further reduce it and the EPC contractor will develop and submit a construction noise management plan.

Estimated levels of vibration associated with the construction works are not expected to be significant and no damage to nearby properties in anticipated.

9.4 Operational Noise Assessment

This report considers noise emissions arising from the operation of the plant associated with the project which, briefly, comprise:

Phase I:

- Two (2) Combustion Turbine Generators;
- Two (2) Heat Recovery Steam Generators (HRSG);
- Two (2) Exhaust Stacks
- One (1) Steam Turbine Generator
- Four (4) Air Cooled Condenser Fans
- Three (3) Generator Step Up Transformers;
- One (1) Fin Fan Cooler;
- One (1) Air Compressor Skid; and
- Associated infrastructure and buildings.

During off-normal grid operation, the Project may also require the use of a black start diesel generator (BSDG) to provide emergency power to the site.

All the scenarios consider operation under steady-state conditions, rather than during start-up, maintenance or emergency conditions.

9.4.1 Noise Modeling

9.4.1.1 Noise Sources

The key noise sources associated with phase 1 of the project are as follows:

- **Combustion Turbines:** The turbine generator equipment generates noise as a result of combustion, the movement of the mechanical components, and the use of exhaust fans to cool the turbine enclosure. Noise is emitted from the turbine enclosure, air intakes, and enclosure exhaust fans.
- **Combustion Air Intake:** Air required for the combustion process is drawn into the combustion turbines through elevated air filters. A direct ducted connection from the air filters to the outside of the turbine enclosure is used to supply fresh air to each combustion turbine.
- **Heat Recovery Steam Generators:** In the combined cycle power plant, the Heat Recovery Steam Generator (HRSG) uses waste heat from the combustion turbine exhaust gases to boil water. The HRSGs typically produce less noise than the turbines themselves but will produce some noise emissions from the enclosure and the boiler drums.
- **Steam Turbine Generator:** Steam from the HRSG is admitted to the steam turbine generator (STG), converting thermal energy to electricity. The STG radiates noise from the valving, turbine

casing, and auxiliary equipment. The STG and auxiliary equipment are located in a sound attenuating enclosure as a noise mitigation feature.

- **Air Cooled Condenser:** Steam leaving the STG must be cooled and condensed to water in order to return to the boiler's steam cycle. An air-cooled condenser (ACC) is used on the project for this purpose. The fans are a noise source and are specified as a low-noise design as a mitigation measure.
- **Exhaust Stack:** Exhaust gases from the engine pass through silencers (or mufflers) to reduce the noise before entering a vertical stack via metal ductwork. Exhaust noise is emitted from the mouth of the stack, as well as from metal ductwork.
- **Electrical Transformers:** Noise from electrical transformers is caused by magnetostriction (where the metal sheets forming the core extend and contract in response to the alternating magnetic field), and from the cooling system. 11kV to 33kV step-up transformers are located externally to the north of the turbines in the current design.
- **Fin Fan Coolers:** The plant is designed with a closed cooling water system, which provides cooling water to various components in the plant including the turbine generators, pumps, heat exchangers, and other equipment. Hot water returning from cooled components is pumped through a fin-fan cooler, which rejects heat from the cooling circuit to the air. Fans are used on the fin-fan cooler to reject heat from the hot water circuit to the air. These fans generate noise; however, low-noise fans have been specified as a mitigation measure.
- **Air Compressors:** The plant uses compressed air stored in large air receivers (tanks) to operate valves and other equipment. Air compressors are used to fill the air receivers with compressed air once pressure drops below a minimum level. As a result, the air compressor will be an intermittent noise source during operations.

9.4.1.2 Model Assumptions

In order to estimate the noise impacts during phase 1 of operation, the proposed CTG manufacturer ran various noise modeling scenarios using their equipment with various proposed general arrangements for the project. Their analysis assumed that all equipment would be provided by the manufacturer so the EPC contractor will need to update this analysis based on the final equipment selected and the final chosen site layout., The site layout involved optimizing the positions of the mounded LPG tanks to act as a sound wall in order to reduce noise from power block area to the residential area located on the southern boundary.

9.4.1.3 Sound Power Levels with Standard Mitigation

Table 9.4 Sound Power Levels without Mitigation

Salone 1391139, Sound Power Levels											
GE 2X1 LM2500 Express, Multi-Shaft, Combined-Cycle											
Spreadsheet prepared by Etienne Mangin in April 05, 2020											
Estimate of Sound Power Levels at Base Load, dB (Ref. 1 picowatt)											
Please note the sound power levels below are being provided only for use in modeling the noise of the plant. They are not guaranteed. The values are per unit.											
	31,5	63	125	250	500	1000	2000	4000	8000	A-Wt	Note
GT / GEN Package											

GT Enclosure	113	114	110	106	102	94	91	86	83	103	
GT Fan	118	114	119	104	96	93	88	84	80	105	
Air Inlet Plenum	107	108	12	80	97	89	85	86	69	96	
Air Inlet Filter House	120	119	113	100	91	87	97	91	89	103	Two sides
GT / GEN Coupling	105	105	116	88	89	88	85	79	70	101	
Generator Package	114	116	120	100	96	93	91	87	79	106	Including open air system
TLO / GLO	105	112	102	97	94	92	90	83	74	98	Including lube oil fans
Bypass Stack	-	-	-	-	-	-	-	-	-	103	Only for Simple Cycle
operation											
ST / GEN Package											
Full enclosure for ST, GEN											
ST / GEN Enclosure	117	115	113	102	97	94	95	84	75	102	Full enclosure for ST, GEN and lube oil module
HRSG											
Inlet and Body	109	103	102	96	92	96	91	85	69	99	
Accessories	88	88	88	88	88	88	88	88	88	95	
Stack Top	95	95	92	89	86	88	77	71	55	90	With 90° of directivity effect
Feed Water Pump	101	101	99	97	88	90	88	85	76	95	
ACC											
ACC	114	111	111	107	104	101	93	89	85	106	4 x fans
ACC	108	105	105	101	98	95	87	83	79	100	1 x fan
ACC duct	90	90	90	90	90	90	90	90	90	97	
Service ejector	-	-	-	-	-	-	-	-	-	90	
Fin Fan Coolers	104	104	103	102	101	96	92	88	82	102	
Main Transformer	96	94	97	96	91	87	83	78	69	93	Each

9.4.1.4 Generated Noise Maps

The proposed CTG manufacturer, GE, underwent their own noise modeling for the project based on initial site layouts for the plant. There are two scenarios they ran and are shown in Figure 9.1 and Figure 9.2.

Figure 9.1 Noise Map of Site Layout Option 1

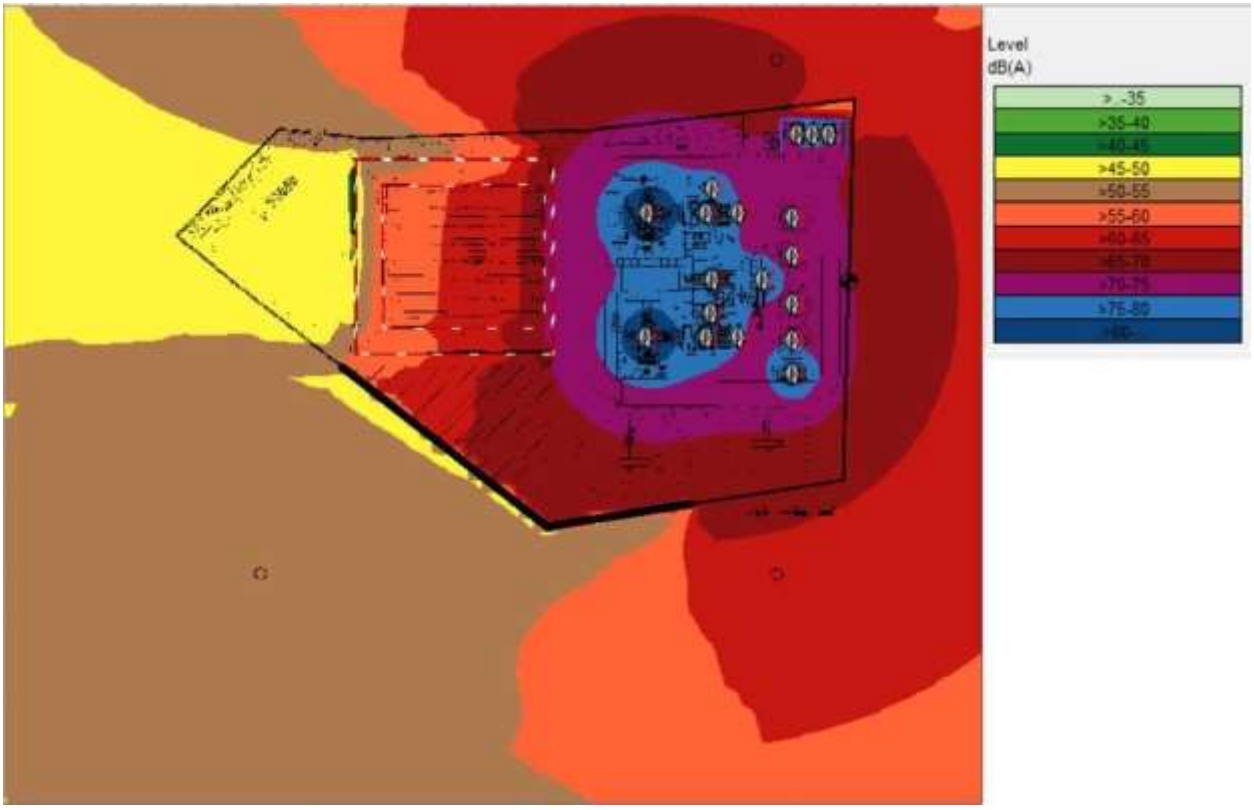
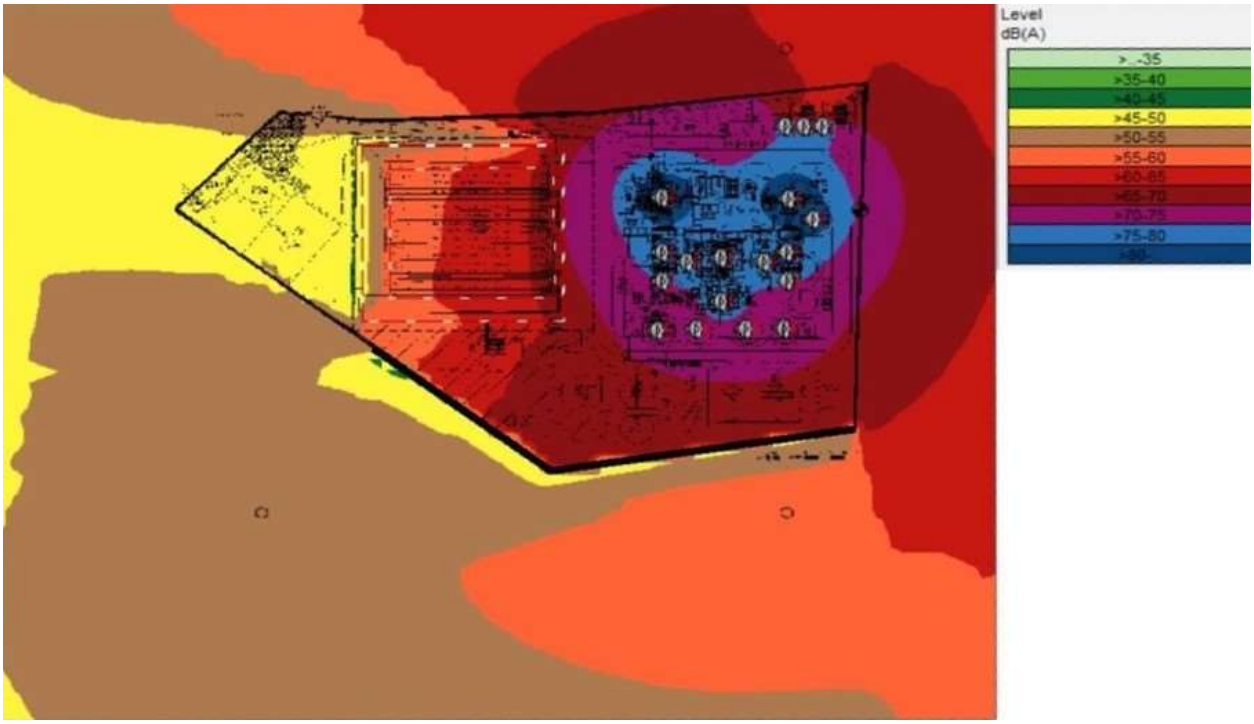


Figure 9.2 Noise Map of Site Layout Option 2



The two scenarios shown in Figures 9.1 and 9.2 depict different site arrangement noise maps that take advantage of the LPG tanks. Both scenarios include the use of sound walls along the southern and southwestern perimeter, as denoted in bold black lines. The sound walls are 7 feet high made with concrete and metal cladding.

The ground areas around the closest dwellings are generally natural scrub land and are therefore the area is considered to be acoustically porous.

9.4.1.5 Sound Power Levels with Enhanced Mitigation

Enhanced Mitigation would further limit the impacts to certain sensitive receptors in the area. The enhanced mitigation strategies would entail:

- Strategically positioning tanks and building between noise sources and sensitive receptors;
- Enclosing the CTGs in a sound attenuating structure; and
- Adding solid sounds walls around the site perimeter, particularly near the residential and institutional / school receptors.

9.4.2 Noise Sensitive Receptors

A total of nine sensitive receptor areas in close proximity to the project site have been defined for the noise study, which are listed in Table 9.5 below. These have been identified from Figure 2.3.

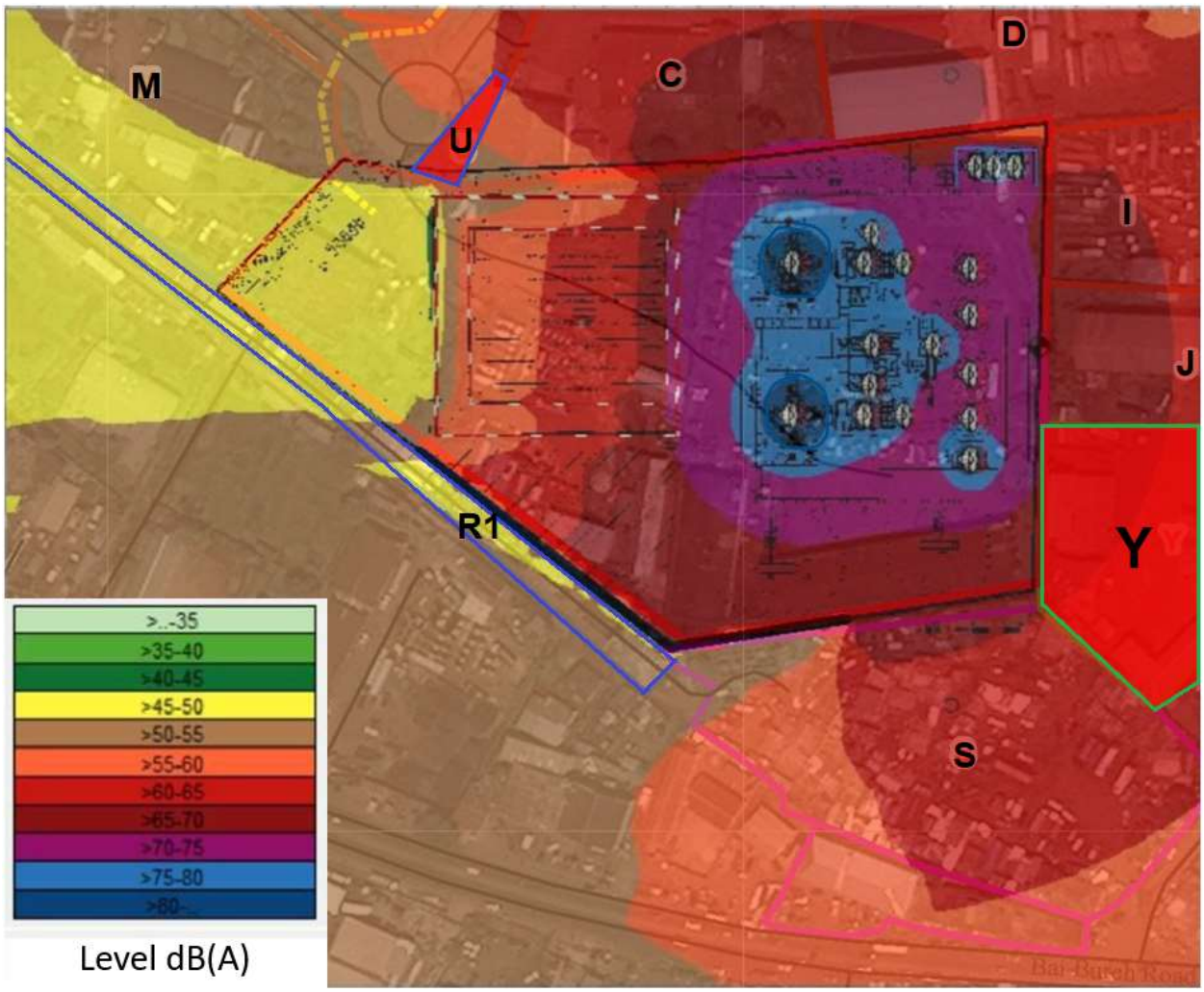
Table 9.5 Modeled Sensitive Receptor Locations with Predicted Sound Levels

Ref.	WGS 84 / UTM Z29N		Predicted Sound Pressure Level	Enhanced Mitigation Required
	X	Y	Standard (dBA)	
R1: Residential Properties	699043	937336	45-55	No
Y: Primary School	699245	937293	65-70	Yes
Y: Mosque	699265	937327	65-70	Yes
U: Shanty Houses and Stores	699030	937440	55-60	Yes
M: German Technical Academy	698958	937443	50-55	No
R2: Residential / Permanent Dwellings	699075	937504	60-65	Yes
W: Polio Compound	699153	937528	55-60	Yes

In addition, all the buildings in the building dataset which are not known to be industrial were considered to be residential dwellings for the purposes of this assessment in order to be conservative.

Noise plots showing the predicted noise contour levels due to the operation of the site with standard level of mitigation are shown on **Error! Reference source not found.**

Figure 9.3 Noise Plot with Standard Mitigation



9.4.3 Consideration of IFC Guidelines

The IFC guideline state that:

"Noise impacts should not exceed the levels presented in Table 1.7.1, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site".

Compliance with the IFC guidelines therefore requires two comparisons; firstly with the absolute noise levels presented in Table 1.7.1 of the guidelines, and secondly the predicted change in noise levels due to the operation of the site must be compared with the 3 dB criterion.

9.4.3.1 Absolute Noise Levels

It can be seen from Figure 9.1 that with the standard mitigation, the IFC guideline noise level for industrial areas of 70 dB(A) is predicted to be complied with at the site boundary. Therefore, the project is predicted to meet the IFC limits implied by the official zoning for the area.

However, since many of the identified sensitive receptors are actually residential, institutional, or educational buildings, the IFC limit that would apply at night is 45 dB LA_{eq}, or an increase of no greater than 3 dB from current levels.

A comparison of the predicted noise levels with the 45 dB LA_{eq} criterion demonstrates that with the standard and enhanced mitigation package, the noise levels will exceed this criterion for considerable distances from the site boundary.

9.4.3.2 Change in Noise Levels

A comparison with the existing baseline noise levels has also been conducted, to determine whether the proposed development will result in a change of 3 dB or more from the current noise levels. To facilitate this analysis, the building has been grouped into zones and attributed with the most appropriate baseline noise levels measured during the previous surveys. The noise measurement position that is considered to be most representative for each zone has been selected depending on proximity, the distance of the buildings in that zone from major roads, and the character of the area. The baseline noise levels attributed to buildings in each zone is shown on Figure 5.1.

Calculations have been undertaken to identify how the predicted operational noise from the proposed development would change the baseline night-time noise at each building. The results of these calculations showed that because the night-time noise levels measured during the September 2015 are consistent with those which could be expected in a predominantly industrial area, the predicted change in noise level does not exceed 3 dB at any building in the project vicinity. A change of 3 dB in fluctuating environmental noise is generally considered the minimum that is perceptible, and therefore these noise changes of less than 3 dB that would result from the project would not be considered to result significant adverse impacts.

The city of Freetown does not utilize residential and industrial zoning which has resulted the area surrounding the project site to be a heavily industrialized area with fuel terminals and factories interspersed with residents that have built shanties up against facility boundary walls. The Project site was originally categorized by the original lender (IFC) as being in an industrial zone back in 2016 and an exemption was made to usual guidelines by the Lender that allowed noise levels as high as 70 dBa at the Project boundary and 55 dBa, daytime or nighttime, at the receptors themselves. The Project hopes to receive a similar exemption from the current proposed Lender. Regardless of which standard the Lender chooses the Project will take appropriate measures to ensure the standard designated by the Lender is met.

9.4.4 Health Endpoints

Although this is an industrial area, there are still residential and institutional areas and health effects for those living close to the proposed development, as shown in Figure 2.3, that will be considered for additional noise reductions. A Noise Management Plan will be developed including additional engagement with the houses shown to consider further measures to reduce nighttime noise levels to 45 dB LA_{eq} at these dwellings.

9.5 Enhancement Measures

To comply with the IFC guidelines predicted noise levels will have to be limited to 55 dB LA_{eq} at the nearest dwellings or raise 3 dB LA_{eq} above current ambient noise levels. The onsite noise levels will have to follow the occupational health and safety section of the IFC guidelines. Enhancement measures to reduce noise at the surrounding site area and onsite include:

- Turbine and Equipment Enclosures
- Sound Walls at site boundary
- Changing main Equipment Arrangement

A Noise Management Plan will be developed for the project that could include a noise insulation grant scheme but will be developed in consultation with the relevant sensitive receptors. The EPC contractor will be responsible for developing the Construction Noise Management Plan and the final Operation Noise Management Plan that complies with the IFC guidelines.

A summary of the potential impacts on noise-sensitive receptors expected due to the proposed project is presented in Table 9.6, along with details of any relevant mitigation or enhancement, as appropriate.

Table 9.6 Summary of Impacts on Noise for Each Attribute During Each Phase (Prior to Mitigating Measures)

Attribute	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
			Magnitude	Significance	Impact Type
Noise-sensitive receptors, such as residences, schools and healthcare facilities	Construction activities: ● Demolition ● Earthworks and Site Preparation ● Piling ● Creation of Hard Standings ● Construction of Foundations ● Building Erection ● Creation of Roads	<u>Construction noise</u> Construction noise levels are estimated to be extremely high, albeit temporary and likely to be tolerable at residential receptors during the day. Construction noise may impair the ability for speech to be understood at the School and German Technical Academy.	Low	Minor	Direct, negative, short-term
		<u>Construction vibration</u> Levels of vibration associated with the construction works are not expected to be significant and no damage to nearby properties is anticipated.	Negligible	Negligible	n/a
	Phase 1 - Operation activities: ● CTGs ● HRSGs ● STGs ● ACC ● Exhaust Stack ● Electrical Transformers ● Fin Fan Coolers ● Air Compressors	<u>Operation</u> In order to address noise concerns, the plant layout was revised to move potentially noisy equipment further from the houses located along the southern project boundary. Standard design mitigation and	Negligible	Negligible	n/a

Attribute	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
			Magnitude	Significance	Impact Type
		enhanced mitigation is included within the assessment. No significant operation noise increases are predicted associated with the project. However, enhancement measures to reduce noise levels to 55 dBA are proposed to address possible health effects associated with high night-time noise levels over a prolonged period.			

9.6 Residual Impacts

With implementation of enhancement measures, the site will not perceptibly worsen the current noise environment at the closest noise sensitive receptors, and therefore there will be no residual adverse impacts.

9.7 Cumulative Impacts

There is potential development in the vicinity. Therefore, under current conditions, the cumulative impacts associated with noise are likely to be moderately adverse with few other projects occurring, and most impacts being local.

9.8 Conclusions

Based on the findings presented above, there is the potential for significant construction noise impacts, which will require the EPC contractor(s) to implement noise control measures during the construction works. The construction noise impacts will be temporary in nature and will be addressed in the Noise Management Plan. The predicted operational noise levels indicate that the IFC guideline absolute noise levels are likely to be exceeded at some of the nearest sensitive receptors and will need enhanced levels of acoustic mitigation to comply. With enhanced mitigation there should be no significant adverse noise impacts as a result of the operations. When the Project was originally conceived as a HFO generation project, the lender at the time (the WB/IFC) provided an exception in 2016 from the standard WB/IFC noise regulations and allowed the Project to exceed the 3 DBA rule as long as the noise levels met the 55/45 DBA noise levels for residential receptors. The Project hopes to receive the same exception to the 3 dBA requirement again because the project site is in an empty lot in an industrial zone with sensitive receptors adjacent that are not zoned to be in the area.

It is recommended that a Noise Management Plan be developed to reduce noise levels at residential and institutional areas shown in Figure 2.3 to 55 dB LA_{eq} during the day and consider more noise enhancement measures to reduce nighttime levels at the residential areas to 45 dB LA_{eq}. This Plan will consider a noise insulation grant scheme and any other feasible design measures and would be developed based on further consultation with the residents of these households. The Project will take appropriate measure to ensure that Lender approved guidelines are met.

It is recommended that worker safety be taken into account when developing the Noise Management plan. The plan should follow IFC occupational health and safety guidelines stated in Section 9.1.

10 Air Quality

This section provides an assessment of the potential air quality impacts associated with the proposed project. The Project will have multiple emission sources to the air which will give rise to emissions of pollutants during the operational phase. This section also describes the potential air quality impacts and relevant mitigation measures associated with the construction phase of the proposed project.

The key elements of the assessment are:

- Construction phase: identify the potential impacts from nuisance dust and exhaust emissions associated with construction activities, and where required, identify appropriate mitigation measures; and
- Operational phase: to assess and describe the significance of the potential air quality impacts resulting from the combustion of LPG in the turbines with due regard to relevant human exposure and also sensitive vegetation and ecosystems.

The main pollutants of concern in this assessment are those associated with the combustion of LPG, vehicle exhaust emissions and nuisance dust from construction activities and vehicle movements.

The assessment has primarily been undertaken using the emissions data provided by the proposed turbine manufacturer and assessing the emissions coming out of the stack and the potential impacts as those emissions are dispersed. A screening model is currently being done to predict concentrations at sensitive receptors and will be compared to relevant ambient air quality guidelines specified for the protection of human health.

The best engineering practice stack height of 65m is used for the initial dispersion screening model. The screening model can be found in the Air Quality Technical Report in Appendix F.

10.1 Relevant Legislation, Conventions and Standards

WBG IFC EHS Air Emission Guidelines for combustion turbines (2008)

10.2 Air Quality Emissions Limits

The project will comprise a number of aeroderivative turbines fueled by LPG. The WBG, EHS Guidelines for Thermal Power Plants" (WBG, 2008) specifies emission guidelines for a range of electricity generating combustion plants and those applicable to Phase 1 of the proposed LPG power plant are shown in Table 10.1.

These emission guidelines make provision for the current state of ambient air quality in the project area, by means of categorizing the receiving atmospheric environment as either a "non-degraded airshed" or a "degraded airshed", with the following definitions:

- **Non-degraded airshed (NDA):** if all nationally legislated air quality standards are complied with, or in their absence, if all applicable World Health Organization (WHO) Ambient Air Quality Guidelines (AAQG) or other internationally acceptable standards are complied with; and
- **Degraded airshed (DA):** if any nationally legislated air quality standards are significantly exceeded or, in their absence, if any applicable WHO AAQG or other internationally acceptable standards are exceeded significantly.

Table 10.1 WBG Air Emission Guidelines for combustion turbines (mg/Nm^3, or as indicated)

Combustion Turbine	Particulate matter (PM)		Sulphur dioxide (SO_2)		Nitrogen oxides (NO_x)	
	NDA	DA	NDA	DA	NDA	DA
Natural Gas (Unit >50 MW_{th})	N/A	N/A	N/A	N/A	50(~25ppm)	30(~15ppm)
Non Natural Gas Gaseous Fuels	50	30	Use of 1% or less S fuel	Use of 0.5% or less S fuel	150(~74ppm)	100(~50ppm)

10.2.1 Ambient Air Quality Standards / Guidelines

An air quality standard or guideline is considered to be the level of an air pollutant, such as the concentration in ambient air that is adopted by a regulatory authority as enforceable. Guideline values provide a concentration below which no adverse effects or indirect health significance is expected, although it does not guarantee the absolute exclusion of effects at concentrations below the given value.

Sierra Leone does not currently have any nationally legislated air quality standards or guidelines. Therefore, the approach outlined within the WBG, EHS Guidelines on Air Emissions and Ambient Air Quality (WBG, 2007) was used in the assessment of air emissions set out within the ESHIA, as requested by the EPA-SL.

The WBG guidelines state that in the absence of national air quality standards or guidelines, the WHO AAQG or other internationally recognized standards should be used to assess the potential impact of projects with significant emissions to air. The WBG guidelines specifies that the United States National Ambient Air Quality Standards or the European Council Directive (2008/50/EC) (EC, 2008) setting limit values for a number of pollutants as suitable alternative sources of air quality standards or guidelines.

For the purposes of undertaking an air quality assessment as part of this ESHIA, the predicted ambient concentrations of air pollutants determined using a detailed quantitative technique were compared against the relevant WHO AAQG and the EC Directive Air Quality Limit values, which are presented in Table 10.2. These are specified in Table 1.1.1 of the WBG EHS Guidelines (WBG, 2007) and supplemented with additional ambient air quality guidelines set out in the WHO air quality guidelines (WHO, 2000).

Table 10.2 WHO Ambient Air Quality Guideline Values

Pollutant	Averaging Period	WHO AAQG values/ Interim targets (µg/m^3)
Protection of Public Health		
Nitrogen dioxide (NO_2)	1 hour mean	200
	Annual mean	40
Sulphur dioxide (SO_2)	10 minute mean	500
	24 hour mean	125[a]
Particulate matter (PM_{10})	24 hour mean	150[a]
	Annual mean	70[a]
Particulate matter ($PM_{2.5}$)	24 hour mean	75[a]
	Annual mean	35[a]
Carbon monoxide (CO)	8 hour mean	10,000
Protection of vegetation and ecosystems		
	24 hour mean	75

Pollutant	Averaging Period	WHO AAQG values/ Interim targets (µg/m³)
Nitrogen oxides (NO_x) Ecosystems	Annual mean	30
Sulphur dioxide (SO_2) Ecosystems	Annual mean	20

[a] *Interim target 1 source Table 1.1.1(WBG, 2007)*

The averaging periods are designed to protect sensitive receptors where exposure to a concentration above a respective time period may cause adverse effects. For example, for a one hour averaging period the maximum concentration of that pollutant should not exceed that value in any one hour in the year, whereas for a 24-hour averaging period, the maximum 24 hour mean concentration of that pollutant should not exceed that value for any one day of the year. For an annual averaging period, the average concentration of that pollutant over the calendar year should not exceed the relevant value.

Emissions of oxides of nitrogen (NO_x) and sulfur dioxide (SO_2) from a power plant can potentially lead to effects on vegetation and ecosystems through deposition of acid and nutrient nitrogen. The WHO air quality guidelines (WHO, 2000) set out critical loads, or a method to derive the appropriate critical load, to enable assessment of emissions to air at sensitive sites. The critical loads are a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur, according to present knowledge. Compliance with these benchmarks is likely to result in no significant adverse effect on the natural environment at these locations.

Further information on the critical loads used within the assessment of air emissions as part of this ESHIA is provided in the Air Quality Technical Report.

10.3 Sources of Emissions to Air

Air pollution can have both chronic (long term) and acute (short term) adverse effects on human health and ecosystems.

10.3.1 Construction Phase

During the construction phase of the proposed project, the most significant issues that could potentially impact on ambient air quality are combustion gas emissions and nuisance dust.

The principal sources of combustion gases for the construction elements are the exhausts of vehicles, construction equipment and temporary power generation (if required). However due to the expected minor and temporary impact of the emissions arising from these sources due to the relatively low traffic numbers and the scale and density of on-site plant / machinery, these do not form part of this air quality impact assessment. Further details on the expected road traffic movements associated with the construction of the power station components are provided in Section 15 this ESHIA.

As with any construction site, dust may be generated as a result of surface preparation and earthworks, including earth moving and materials handling. Internal site traffic moving on un-surfaced routes / roads within the development site may cause sufficient mechanical disturbance of loose surface materials to generate dust, particularly during the dry season. The proposed development includes the following main components which may, without sufficient management or mitigation, potentially generate dust:

- demolition activities associated with the demolition and removal of existing buildings and structures on the project site;

- preparatory earthworks to allow the construction of the power plant including, clearing of vegetation, soil stripping and stockpiling;
- bulk earthworks including site grading and excavation work; and
- the construction of the main components of plant including establishing and preparing concrete foundations for major plant and buildings, construction of buildings and installation of equipment.

Due to the nature of the construction process, potentially dust emitting activities will not be constant and emissions would fluctuate according to the operating periods for each item of plant, weather conditions and the combination of machinery being used at any one time. The location of emission sources will also change as the construction progresses.

10.3.2 Operational Phase

During the operational phase of the proposed project, point source emissions of combustion gases from the proposed plant could potentially have an effect on local air quality. The atmospheric emissions will be generated by the combustion of LPG by the turbines and will predominately consist of oxides of nitrogen (NO_x), sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$) and carbon monoxide (CO).

- **Oxides of nitrogen:** NO_x produced from gas turbines comprise nitric oxide (NO) and NO_2 – the proportion of NO and NO_2 within the exhaust gas varies, but typically NO is the predominant species and generally comprises greater than 90% of the emitted NO_x at release. The NO_x emissions are produced during combustion (i.e., the reaction of LPG with air). NO is potentially less harmful than NO_2 and it is NO_2 that is associated with adverse effects upon human health. NO in the exhaust gas is oxidized in the atmosphere to form NO_2 and the amount that is converted to NO_2 in the atmosphere increases with distance from the source.
- **Carbon monoxide:** CO emissions are a measure of combustion completion as higher values of CO indicate more incomplete combustion or less oxidation of CO to CO_2. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues.
- **Sulfur dioxide:** SO_2 primarily arises from anthropogenic activities and more specifically combustion of fuels containing sulfur and sulfur compounds. SO_2 is emitted in negligible quantities during the combustion of LPG. SO_2 can affect the pulmonary function and lead to respiratory symptoms.
- **Particulate matter:** fine particulate matter such as PM_{10} (particulate matter with aerodynamic diameter of 10 microns or less) or $PM_{2.5}$ (particulate matter with aerodynamic diameter of 2.5 microns or less) is emitted during the combustion of liquid fuels such as LPG and are related to the combustion efficiency and characteristics of the LPG. The range of potential health effects from exposure to PM_{10} or $PM_{2.5}$ is broad, but effects are predominantly to the respiratory and cardiovascular systems.

Emissions of NO_x and SO_2 can react in the atmosphere and contribute to acid deposition, which can affect the pH balance in water and soils with the potential for detrimental impacts. Increased nitrogen deposition can also affect sensitive vegetation and the biodiversity of sensitive ecosystems.

Emissions to air from staff, maintenance and delivery road vehicles accessing the site during the operational phase of the project would comprise some of those substances described above. However, these emissions are considered to be insignificant as the volume of road traffic will be relatively low (and

is not considered further within this assessment). Further details on the expected road traffic movements associated with the operation of the project are provided in Section 15.

10.4 Assessment of Impacts

This air quality impact assessment considers the impact on human health associated with the emission and dispersion of emissions to air from the combustion of LPG and LNG during operation as well as the displacement and subsequent dispersion of dust during the construction of the proposed project.

10.4.1 Construction Phase

Due to the temporal and varying nature of pollutant emissions associated with the construction phase of the proposed project, use of quantitative techniques such as dispersion modeling is not appropriate. The potential impacts during the construction phase are described in Section 10.5 through the consideration of the nature of site activities, nearby sensitive receptors, and the prevailing weather conditions. The recommended mitigation measures required to reduce any potential impact to negligible or low levels are set out in Section 10.7.

10.4.2 Operational Phase

The relevant air quality impact assessment criteria have been identified following a review of the standards and established guidelines for the protection of air quality for the relevant pollutants.

A review of existing ambient air quality in the area has been undertaken to understand the baseline conditions with respect to the pollutants mentioned above. The review of existing ambient air quality and details of the project specific air quality monitoring is set out in more detail in the Air Quality Technical Report in Appendix F.

To assess the likely air quality impact from the proposed project, Screen3 or similar air pollutant dispersion screening software will be used. Pollutant dispersion screening using appropriate software is an internationally accepted tool that can be used to determine if the design and location of emission sources result in acceptable air quality in the vicinity of a proposed project. This determination is made by comparing the maximum predicted dispersion modeling results at appropriate locations to the ambient air quality guideline stated in the applicable government regulations or other international standards. As such, if the predicted dispersion modeling results are within the air quality limits and the plant contribution is within acceptable thresholds, the plant design is assumed to be acceptable for regulatory approval.

A full description of the screening methodology, emissions data, study inputs, associated uncertainties and assumptions will be presented within the Air Quality Technical Report in Appendix F. A brief outline of the approach is presented below.

- Determination of likely background concentrations of the relevant pollutants (NO_x / NO_2 SO_2, CO, PM_{10}, $PM_{2.5}$ and including nutrient nitrogen and acid deposition), established from available monitoring data or relevant air quality information.
- Based on the current design for the Project, undertake computer dispersion modeling of the relevant releases from the LPG turbines using representative meteorological data, to identify likely concentrations of pollutants at relevant exposure on a modeled receptor grid with dimensions 5km x 5km and also at specific sensitive ecological receptor locations.

- Evaluation of significance by comparing predicted concentrations against the WHO ambient air quality guideline values and other accepted air quality standards where appropriate, taking the existing background concentrations into account where possible.

The EHS guidelines (WBG, 2007) specify that "Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognized sources; and
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed."

The WBG EHS guidelines (WBG, 2007) also specify the following in relation to facilities which are located within a degraded airshed:

"facilities should ensure that any increase in pollution levels is as small as feasible and amounts to a fraction of the applicable short-term and annual average guidelines or standards".

The WBG Thermal Power Plants guidelines (WBG, 2008) also specifies that facilities in degraded airsheds should minimize incremental impacts by achieving the emission guideline values set out in Table 6 of the Thermal Power Plants guidelines.

10.4.3 Ecological Receptors

Air pollution has the potential to adversely impact terrestrial and fresh-water ecosystems. The sites of ecological interest identified within 10km of the proposed project site include the following:

- Sierra Leone River Estuary (including Aberdeen Creek) (SLRE) RAMSAR, and
- Western Area Peninsular National Park (WAPNP).

The Sierra Leone River Estuary is a designated RAMSAR for its mangrove wetlands and bird interest. The habitat area of interest extends to include much of the coastline east of the proposed site and the shorelines around Tagrin Bay and the Bunce River. Aberdeen Creek is located approximately 9km west of the proposed site.

The WAPNP is an area of equatorial rainforest located approximately 2km south, south-west of the proposed site at its nearest point. The forest is not protected despite its status and has become degraded through suburban sprawl and anthropogenic influence. High density forest likely to be of higher ecological importance starts at approximately 6km SSW of the proposed site (approximately at the location of receptor ID E6-3).

Ecological receptors at worst case locations (i.e., likely highest concentrations) were selected at each site of ecological interest as presented in Table 10.3. The locations of the ecological receptors are shown in the Air Quality Technical Report, Appendix F.

Table 10.3 Modelled Sensitive Ecological Receptor Locations

Receptor ID	Habitat Type / Direction from site	UTM co-ordinate (WGS (1984) Zone 29N)	
		X	Y
E1-1	Mangrove – Aberdeen Creek, West	690137	939080
E1-2	Mangrove – Aberdeen Creek, West	689877	938206
E1-3	Mangrove – Aberdeen Creek, West	689618	938237
E1-4	Mangrove – Aberdeen Creek, West	689335	938226
E1-5	Mangrove – Aberdeen Creek, West	689080	938214
E2-1	Mangrove – North east	703931	942924
E2-2	Mangrove – North east	704057	943092
E2-3	Mangrove – North east	704500	943047
E2-4	Mangrove – North east	704301	943154
E2-5	Mangrove – North east	704454	943177
E2-6	Mangrove – North east	706761	944349
E3-1	Mangrove – South southeast	701562	935520
E3-2	Mangrove – South southeast	701513	935410
E3-3	Mangrove – South southeast	701748	935368
E3-4	Mangrove – South southeast	701932	935206
E3-5	Mangrove – South southeast	702686	934810
E3-6	Mangrove – South east	705017	934689
E3-7	Mangrove – East south east	706978	936341
E3-8	Mangrove – East south east	708253	936990
E3-9	Mangrove - East	708514	938472
E4-1	Mangrove – North east	702788	942741
E5-1	Mangrove – North	699268	937914
E6-1	Rainforest – WAPNP, South southwest	697874	935652
E6-2	Rainforest – WAPNP, South southwest	697367	934321
E6-3	Rainforest – WAPNP, South southwest	697055	931644
E6-4	Rainforest – WAPNP, South southwest	699085	934712

10.5 Construction Phase Impacts

The level of dust generation and dispersion is dependent upon a number of factors including:

- the type of construction activities taking place;
- the occurrence of hot, dry weather;
- the prevailing wind speed and direction; and
- the mitigation measures adopted.

The potential for dust to be generated during the construction phase at the proposed project site will be short-term and temporary in nature. Site clearance, demolition and bulk excavation works (the construction works of greatest potential impact) will be carried out during the initial phase of

construction. Excavation and site levelling will use machinery such as front loaders, bulldozers and similar plant, with spoil material which will not be incorporated into the development and landscaping being removed from site.

Residential and other sensitive receptors downwind of the predominant wind direction (that is wind blowing from the west of the site towards the east) would typically be the most susceptible to dust emissions. The wind roses for four years of meteorological data recorded at the Lungi International Airport are shown in the Air Quality Technical Report in Appendix F.

The nearest downwind sensitive property to the site is adjacent to the eastern site boundary (the Mosque compound with primary school, clinic and mosque). There is a high potential for unmitigated windblown dust emissions to reach this property and other sensitive or residential properties further downwind of this location.

The nearest residential properties to the east of the site are those located on the opposite side of the Wellington Creek, approximately 300m from the site boundary. However, there are also many residential properties adjacent to the southern site boundary and some properties on the northern site boundary. A technical academy is located to the north west of the site boundary.

Although many of these locations are not downwind of the prevailing wind direction from the site, there remains a risk that dust emitted from construction activities could lead to impacts due to their close proximity to the site.

The wind direction (based on data from Lungi International Airport weather station) is towards the Mosque compound for approximately 40% of the year (wind directions between 260° and 340°) and is therefore at high risk of experiencing dust impacts unless appropriate mitigation measures are implemented to prevent or minimize dust emissions.

Although emissions will fluctuate and sources will vary according to the combination of machinery used, the location on site and prevailing weather conditions. There is potential for significant dust impacts to potentially affect human health and also generate nuisance dust, without mitigation measures in place.

Mitigation measures are proposed to minimize dust impacts at nearby properties and other more distant receptors and to prevent potential dust nuisance events from occurring. In the event that visual monitoring finds that dust emissions are unacceptable on the site during certain meteorological conditions (i.e., a hot dry period with high winds) or justified complaints are received, construction work will be tailored or additional mitigation put in place to ensure that dust emissions due to the construction works reduce to acceptable levels.

The nearest potential ecological receptor (SLRE) is approximately 450m to the north of the site boundary. There is unlikely to be any construction dust impacts at ecologically sensitive areas.

10.6 Operational Phase Impacts

This section presents the potential pollutant emissions from the proposed turbine stack. The potential pollutant concentrations will also be modeled at the sensitive receptors that will affect specific human health and ecological receptors for the operational phase of the proposed project.

A Screen3 model will be done to model the pollutant concentrations at the sensitive receptors. The results will be for the scenario, assuming 2 x GE LM2500 turbines are emitting via a common stack grouping with stack heights of 65m. The results are in the Air Quality Technical Report in Appendix F.

10.6.1 Stack Emissions

The proposed turbine emissions data in Table 10.4 shows the maximum emissions coming from the Stack of the turbine using the proposed fuel. The emissions coming from the stack meet all of the WBG, EHS Guidelines for Thermal Power Plants (WBG, 2008).

Table 10.4 GE LM2500 Maximum Emissions

Engine: TM2500
Deck Info: G0166B-8al.scp
Generator: Andritz 030PT 50Hz, 11kV, 0.85PF
Fuel: Site Gas Fuel#801-2994, 19634 Btu/lb,LHV

Date: 30/07/2020
Time: 13:37:57

Case #	100	101	102	103	104	105	106	107
Ambient Conditions								
Dry Bulb, °F	68	79	86	95	68	79	86	95
Dry Bulb, °C	20	26	30	35	20	26	30	35
Wet Bulb, °F	61.6	71.4	77.9	86.1	61.6	71.4	77.9	86.1
RH, %	70	70	70	70	70	70	70	70
Attitude, ft	131.2	131.2	131.2	131.2	131.2	131.2	131.2	131.2
Ambient Pressure, psia	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Comp Inlet Temp, °F	68	79	86	95	68	79	86	95
Heating kBtu/hr(Heating)	None	None	None	None	None	None	None	None
Heat Input, MMBtu/hr, LHV	311.6	296.6	286.9	272.7	173.4	167.7	164.0	157.9
Heat Input MMBtu/hr, HHV	338.1	321.9	311.4	295.9	188.1	182.0	178.0	171.3
Partload %	100	100	100	100	50	50	50	50
GT EMISSIONS*								
NOx ppmvd Ref 15% O2 (with water injection)	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0
NOx as NO2 mg/Nm3 Ref 15% O2	151.9	151.9	151.9	151.9	151.9	151.9	151.9	151.9
NOx, US T/yr	368.7	351.1	339.6	322.8	204.7	198.0	193.7	186.5
CO2, kg/MWt	220	220	220	220	220	220	220	220
CO2, kg/Mwe	715	717	718	723	796	811	821	838
CO2, pph, Calculated	50661	48233	46653	44335	28190	27263	26669	25673
CO ppmvd Ref 15% O2	38.5	32.5	28.5	24.0	37.5	30.5	26.0	21.0
CO as mg/Nm3 Ref 15% O2	48.1	40.6	35.6	30.0	46.9	38.1	32.5	26.2
CO, US T/yr	117.1	93.8	79.8	63.5	63.4	49.7	41.6	32.2
HC ppmvd Ref 15% O2	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
HC, US T/yr	31.3	26.9	24.2	20.7	17.1	14.8	13.0	11.2
VOC ppmvd Ref 15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
VOV, US T/yr	6.3	5.4	4.8	4.1	3.4	3.0	2.6	2.2
PM10, lb/hr	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
PM10 US T/yr	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
SOX, ppm	1.648	1.623	1.605	1.585	1.283	1.286	1.288	1.286
SO2 + SO3, US T/yr	11.386	10.838	10.483	9.965	6.336	6.128	5.993	5.770
Formaldehyde, US T/yr	0.996	0.948	0.917	0.872	0.554	0.536	0.524	0.505
Formaldehyde, ppm	0.324	0.319	0.316	0.312	0.252	0.253	0.253	0.253
Exhaust temp. T8, F	1017	1017	1017	1022	884	904	918	934
Exhaust gas Velocity fps	132	126	121	115	80	78	75	72
Exhaus ACFM	452609	437765	428096	413291	294570	288373	284405	277507
Exhaust SCFM (14.7,60F)	163679	158234	154759	148919	117048	112919	110251	106316
GT Emissions Rates								
FUEL, PPH	15868	15108	14613	13887	8830	8539	8353	8041
HHV, Btu/lb	21308	21308	21308	21308	21308	21308	21308	21308
MMBtu/hr, HHV	356	339	328	311	198	192	187	180
C %	82.656	0.000	0.000	0.000	17.344	0.000	0.000	0.000
H %	17.344	0.000	0.000	0.000	0.000	100.000	0.000	0.000
O %	0.000	100.000	0.000	0.000	0.000	0.000	0.000	0.000
N %	0.000	0.000	17.344	0.000	0.000	0.000	0.000	100.000
S %	0.000	0.000	0.000	100.000	0.000	0.000	0.000	0.000
Fc, (SCF CO2/MMBtu HHV)	1245	1245	1245	1245	1245	1245	1245	1245
CO2, pph, Calculated	50661	48233	46653	44335	28190	27263	26669	25673
Fd, SCF/MMBtu	8898	8898	8898	8898	8898	8898	8898	8898
NOX as NO2 Cd, lb/scf	8.84E-06	8.84E-06	8.84E-06	8.84E-06	8.84E-06	8.84E-06	8.84E-06	8.84E-06
NOX as NO2 E, lb/mmbtu	0.2785	0.2785	0.2785	0.2785	0.2785	0.2785	0.2785	0.2785
NOX as NO2 E, lb/hr	99	94	91	87	55	53	52	50
CO Cd, lb/scf	2.80E-06	2.36E-06	2.07E-06	1.74E-06	2.73E-06	2.22E-06	1.89E-06	1.53E-06
CO E, lb/mmbtu	0.0882	0.0745	0.0653	0.0550	0.0859	0.0699	0.0596	0.0481
CO E, lb/hr	31	25	21	17	17	13	11	9
HC Cd, lb/scf	4.16E-07	4.16E-07	4.16E-07	4.16E-07	4.16E-07	4.16E-07	4.16E-07	4.16E-07
HC E, lb/mmbtu	0.0131	0.0131	0.0131	0.0131	0.0131	0.0131	0.0131	0.0131
HC E, lb/hr as CH4	5	4	4	4	3	3	2	2
VOC Cd, lb/scf	8.33E-08	8.33E-08	8.33E-08	8.33E-08	8.33E-08	8.33E-08	8.33E-08	8.33E-08
VOC E, lb/mmbtu	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
VOC E, lb/hr (as CH4)	0.9	0.9	0.9	0.8	0.5	0.5	0.5	0.5
PM10, lb/MMBtu	0.0112	0.0118	0.0122	0.0128	0.0202	0.0209	0.0213	0.0222

Note: * Emissions are for ambient temperature range of 68 F to 95 F at 100% load, supperior filtration and clean ambient.

10.6.2 Ground Level Pollutant Concentrations

Ground level pollutant concentrations were modeled with Screen3. These results are shown in SCREEN3 is an air screening software package that is internationally recognized. Based on the results of the study the best engineering practice stack height of 65m the is more than enough to disperse the pollutants to meet WHO air quality and WB Guidelines for sustainable development. The EPC contractor will be responsible to do a full ground dispersion model using ADMS or AERMOD if the stack is lowered from 65m.

A screening-level air dispersion modeling analysis was conducted of the Western Area Power Generation Project (WAPGP) in order to compare the model-predicted ambient impacts resulting from the emissions of WAPGP's two Combustion Turbines (CTs) to the WHO Ambient Air Quality Guidelines (AAQG). The following summarizes the relevant inputs to the analysis:

- Emission Sources: two GE TM2500 CTs firing Site Gas Fuel. Inputs below are for a single emission source:
    - Maximum Heat Input: 356 MMBtu/hr
    - Exhaust Stack Height: 65m
    - Exhaust Stack Exit Diameter: 2.6m
    - Exhaust Gas Flow Rate: 207,354 acfm
    - Exhaust Gas Exit Velocity: 60.5 fps
    - Exhaust Gas Exit Temperature: 217°F
    - NO_x Emission Rate: 99.15 lb/hr
    - CO Emission Rate: 31.40 lb/hr
    - $PM_{10}/PM_{2.5}$ Emission Rate: 3.99 lb/hr
    - SO_2 Emission Rate: 2.60 lb/h

We modeled one CT's exhaust in combined-cycle mode (multiple point sources are not able to be modeled simultaneously in SCREEN3). Simple cycle operation will have higher stack temperature which would result in lower ground level concentrations than combined cycle operation.

EPA's SCREEN3 dispersion model is a single source Gaussian plume model that provides maximum ground-level concentrations for point sources, as well as concentrations in the cavity zone, and concentrations due to inversion break-up and shoreline fumigation. To yield conservative results (i.e. overestimate of ground level concentrations), the model-predicted ambient impacts from the single CT were doubled to account for the second, identical CT. Model options included:

- Flat and complex terrain.
- Urban dispersion coefficients.
- All wind speeds and stability classes (default).
- Ambient temperature of 68°F (default).
- Flat terrain receptor distances from 1-meter to 50,000 meters from the emission source.
- One discrete complex terrain receptor at the final calculated plume height (~162 meters) under stable atmospheric conditions (Stability Class E, per EPA's screening model guidance), at the closest approximate distance from the source that such terrain exists and would be impacted by the plume (1.34km to the southwest). The complex terrain receptor was used only to determine maximum 24-hour ambient impacts, per screening model guidance.
- No buildings were input to the model.

- SCREEN3's model output is a 1-hour maximum concentration; other averaging periods are calculated from the maximum 1-hour concentration using default scaling factors.
    - 8-hour scaling factor: 0.7
    - 24-hour scaling factor: 0.4
    - Annual scaling factor: 0.08
    - No scaling factor exists for 10-minute impacts. Thus, it was assumed that a scaling factor proportional to the 1-hour/8-hour impacts (i.e., 1.0/0.7) would yield a conservative result.
- SCREEN3 results are unable to account for the statistical nature of the 24-hour PM_{10} and $PM_{2.5}$ AAQGs. Thus, the Process Contributions for those two pollutants and averaging periods in the table below is an overestimate.
- SCREEN3 results assume that all emitted NO_x is NO_2, yielding a conservative result.

Presented below is a table displaying the Process Contribution (PC=WAPGP's specific impact) and Predicted Environmental Concentration (PEC=cumulative impact of WAPGP and ambient background). Note that model-predicted ambient impacts of SO_2, PM_{10}, and $PM_{2.5}$ are all less than those predicted for the previous design of this power plant, which is primarily due to firing a cleaner fuel (LPG gas vs. heavy fuel oil). Impacts of NO_2 and CO are slightly higher than those previously predicted. It is anticipated that a refined air dispersion modeling analysis will result in less conservative (i.e., lower) model-predicted ambient impacts than screening results listed below.

Table 10.5 Predicted Maximum Results within Grid Location

Pollutant	Averaging Period	AAQG	Background concentration	PC	PC / AAQG	PEC	PEC / AAQG
		(µg/m³)	F(µg/m³)	(µg/m³)	%	(µg/m³)	%
Nitrogen dioxide (NO_2)	Annual mean	40	27.2	5.85	15%	33.05	83
	1 hour mean (maximum)	200	54.4	73.14	37%	127.54	64%
Carbon monoxide (CO)	8 hour running mean (maximum)	10,000	140	16.21	0.2%	156.21	2%
Sulphur dioxide (SO_2)	24 hour mean (maximum)	125	6.3	1.47	1%	7.77	6%
	10 minute mean (maximum)	500	6.3	2.74	1%	9.04	2%
Particulate matter (PM_{10})	Annual mean	70	196.3	0.24	0.3%	196.54	281%
	24 hour mean (99th %ile)	150	392.6	2.26	2%	394.86	263%
Particulate matter ($PM_{2.5}$)	Annual mean	35	31.9	0.24	1%	32.14%	92%
	24 hour mean (99th %ile)	75	63.8	2.26	3%	66.06	88%

Note that background concentrations of PM_{10} alone are significantly above the WHO AAQG. WAPGP's model-predicted ambient air impacts of PM_{10} represent less than 1% of the background concentrations.

10.7 Mitigation Measures

10.7.1 Construction Phase

Though not considered quantitatively in this assessment, the risk appraisal undertaken indicates that there is the potential for dust emission caused by construction activities to potentially affect the nearest sensitive receptors, particularly those located downwind of the prevailing wind direction. The potential impact can be reduced to a minor residual impact providing appropriate mitigation measures are implemented.

Dust generation and dispersion during construction will be minimized through good construction practice and appropriate monitoring throughout the construction period. The mitigation measures will aim to prevent dust from being dispersed offsite and, thereby, protect nearby properties from significant dust impacts.

It is recommended that mitigation measures such as those listed below should be adopted where practicable and necessary during the construction phase:

- Plant and equipment will be designed and used in a manner which minimizes dust generation;
- Water (or other suitable or some other environmentally benign dust-suppressant material) spray dampening of un-surfaced areas, soils and spoil may be undertaken to prevent dust blow during hot, dry weather conditions with relatively high wind speeds;
- Careful location, grading and management of stockpiles of soil and similar materials will be undertaken to prevent wind-blow;
- Sealing and / or re-vegetation of completed earthworks will be undertaken as soon as reasonably practicable;
- Where possible, site roads will be surfaced early in the construction program – with vehicle speeds limited to an appropriately low speed to minimize re-suspension of dust from surfaced and un-surfaced roads;
- Regular cleaning of surfaced roads and maintenance of un-surfaced roads on site will be undertaken to reduce offsite transport of soils and to avoid dust generation;
- Lorries will be sheeted during transportation of friable construction materials and spoil and wheel wash facilities made available during adverse conditions;
- Drop heights will be minimized during material transfer activities, such as unloading of friable materials; and
- Positioning and movement of construction equipment will be undertaken in a manner which minimizes dust generation.

In addition, provision will be made in the CECA SL Stakeholder Engagement Plan (SEP) for receiving and resolving any local community complaints regarding nuisance dust via a grievance mechanism.

With regard to combustion emissions from on-site plant and machinery, the following should be considered:

- Diesel powered construction equipment and vehicles will be well maintained to minimize exhaust emissions; and
- Idling reduction awareness activities for onsite diesel powered equipment and mobile vehicles.

It is anticipated that the specific mitigation measures would be agreed with the EPA-SL prior to construction and these would be incorporated into the CMP. The plan will include provision for on-site visual inspections / monitoring and other measures to enable corrective or preventative actions to be implemented based on the outcome of the inspections / monitoring or on receipt of complaints.

10.7.2 Operational Phase

The Project will take appropriate measure to ensure that the Plant will be designed to meet all relevant EB/IFC and WHO regulations. In order to ensure this, a number of mitigation measures will be integral to the design and operation of the proposed plant. These will include:

- The plant will need to comply with the relevant emissions guidelines, where appropriate.
- The use of modern combustion technology and effective combustion to minimize the generation of emissions to air.
- The maintenance of correct temperature control on the incinerator in order to avoid the generation of dioxins and will need to comply with the relevant emissions and operational guidelines.

Continuous Emissions Monitoring Systems (CEMS) will be installed on the exhaust stacks to monitor the emissions of the relevant pollutants and associated emissions parameters in accordance with the appropriate monitoring and reporting requirements of the EPA-SL and WBG. Provision shall be made for manual sampling of pollutants such as PM where required and sampling points and safe access to the monitoring points shall be designed into the plant. PM will be measured at regular frequency to ensure compliance with WB/IFC Guidelines.

An ambient air quality monitoring program (AAQMP) will also be developed in consultation with the WBG and EPA-SL to monitor concentrations of NO_2, SO_2 and particulates (PM_{10} and $PM_{2.5}$) in the project vicinity during the operational phase of the project. Potential monitoring locations for NO_2 and SO_2 have been identified based upon the maximum annual mean and 24-hour mean concentration results presented in the Air Quality Technical Report in Appendix F. These measurements could be undertaken using passive diffusion tubes changed on a monthly basis, which is consistent with the measurements undertaken for the two baseline surveys. As the tubes are small and do not require any power, it is feasible for these long-term monitoring locations to be outside of the project site boundary. With regard to particulates, it is unlikely that a permanent monitoring location outside of the project site boundary will be feasible as a continuous source of power is required and robust 24-hour security measures would need to be in place to protect the sophisticated equipment required for measuring particulates. The requirement and value of undertaking long term monitoring of particulates within the site boundary, where power and appropriate security measures are available, will be discussed in more detail with WBG and EPA-SL during the development of the AAQMP. The duration of the AAQMP and other specific details such as the number and location of monitoring locations will also be agreed with WBG and EPA-SL during the development of the AAQMP. It is anticipated that the AAQMP would be undertaken for at least a full year after operation of the project commences and the requirement for the AAQMP to continue beyond Year 1 would be dependent on the results of the monitoring, to be agreed in consultation with the WBG and EPA-SL.

10.7.3 Summary

This section has addressed the potential for long term and short term impacts on air quality arising from emissions of NO_2, CO, particulate matter (primarily PM_{10} and $PM_{2.5}$) and SO_2, of the proposed project, and the shorter term impacts associated with emissions of dust from its construction.

For the operation of the power plant, the predicted impact on air quality has been assessed against the relevant WHO ambient air quality guidelines and reference is made to the EC Directive for context. The results presented show that the relevant ambient air quality guidelines are predicted to be complied with for all substances. The predicted process contributions comply with the WBG 25% of the AAQG threshold for all pollutants assessed. It is very unlikely that neighboring facilities' maximum short-term concentration will occur at the same peak hour or 24 hour period for an exceedance of the AAQG to occur, and the 25% threshold is more relevant for long term averaging periods. Incidentally, applying the EC Directive Limit Values to 1 hour mean NO_2 concentrations would result in compliance of the 25% threshold.

For the purposes of this air quality assessment, the particulate concentrations included in the appended Air Quality Technical Appendix report are based upon the emission concentration of 100 mg/Nm^3. Based on the current fuel specification and predicted emission rates, the predicted process contributions from the proposed plant would result in small increases of particulates at the locations of the maximum.

Considering the small incremental increase in particulate emissions that the plant would generate, which equates to less than 5% of the short and long term AAQG, measures such as continuous monitoring and raising the stack height as needed, were considered sufficient, given the costs and benefits for a project of this scale. The use of emission concentrations above the WBG recommended limit results in predicted ground level concentrations which are considered to be insignificant, representing a fraction of the relevant air quality guidelines or limit values.

The large differences in the particulate concentrations measured in the short periods during the wet and dry season supports the need for ongoing ambient air quality monitoring to ensure that the project is assessed appropriately with regard to the WBG requirements for degraded airsheds (WBG, 2007). It is unlikely that the average concentration applied in this assessment accurately represents the ambient particulate concentrations and in reality concentrations may be lower than those presented. Elevated 'spikes' in the measured concentrations recorded during the wet season monitoring which were attributed to local events or sources may also have been present in the dry season monitoring but were not able to be identified. If the percentage increase in PCs for particulates changes significantly, consideration will be given to raising the stack height for future Phases.

The potential impact due to emissions from road traffic or mobile plant during the construction and operational phases is considered to be insignificant. With the use of mitigation measures outlined in this section, the impacts of dust generation on sensitive receptors in close proximity of the project site will be minimized and no significant impact is predicted during the construction phase. However, given the close proximity of sensitive areas adjacent to the project site, a high level of management will need to be employed to ensure best practice is continually adopted throughout the construction phase.

This ESHIA has identified that the best engineering practice stack height of 65m appropriately manages the project's potential impacts on ambient air quality. This assessment uses the generally accepted approach for international ESHIAs of application of the WHO ambient air quality guidelines regarding acceptable impacts on human health and worst-case operational scenario and assumptions.

Table 10.6 Summary of Impacts on Air Quality for Each Attribute During Each Phase (Prior to Mitigating Measures)

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
All human health receptors – Air Quality	National	Emissions of NO_x (NO_2), SO_2, CO and Particulates (PM_{10} and $PM_{2.5}$) from construction vehicles and non-road mobile plant exhaust emissions	<u>Construction</u> Potential increases in the concentrations of pollutants at relevant exposure locations and potential for air quality guideline values to be exceeded.	Low	Minor	Direct, negative, temporary
	Local	Re-suspension of dust by construction related traffic on unsurfaced roads within or surrounding the proposed site and dust emissions from other onsite construction phase activities	Potential increase in dust emissions as a result of construction activities and vehicles on unsurfaced roads which could lead to nuisance dust impacts	High	Moderate	Direct negative temporary
	National	Emissions of NO_x (NO_2), SO_2, CO and Particulates (PM_{10} and $PM_{2.5}$) from the operation of the proposed power plant turbines	<u>Operation</u> Potential increases in the concentrations of pollutants at relevant exposure locations and potential for air quality guideline values to be exceeded.	Medium	Moderate	Direct, negative, long term
	National	Emissions of NO_x (NO_2), SO_2, CO and Particulates (PM_{10} and $PM_{2.5}$) from road vehicles associated with the operation of the proposed power plant	Potential increases in the concentrations of pollutants at relevant exposure locations and potential for air quality guideline values to be exceeded.	Low	Minor	Direct, negative, long term
SLRE – Air Quality	International	Re-suspension of dust by construction related traffic on unsurfaced roads within or surrounding the proposed site and dust emissions from other onsite construction phase activities	<u>Construction</u> Potential increase in dust emissions as a result of construction activities and vehicles on unsurfaced roads which could lead to impacts on vegetation	No effect anticipated	No effect anticipated	N/A

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
		Emissions of NO_x (NO_2) and SO_2, from the operation of the proposed power plant turbines	<u>Operation</u> Potential increases in the concentrations of pollutants which could lead to impacts on vegetation Potential for additional of nutrient nitrogen and acid deposition causing an impact on the ecosystems and vegetation	Low	Minor	Direct, negative, long term
WAPNP – Air Quality	National	Re-suspension of dust by construction related traffic on unsurfaced roads within or surrounding the proposed site and dust emissions from other onsite construction phase activities	<u>Construction</u> Potential increase in dust emissions as a result of construction activities and vehicles on unsurfaced roads which could lead to impacts on vegetation	No effect anticipated	No effect anticipated	N/A
		Emissions of NO_x (NO_2) and SO_2, from the operation of the proposed power plant HFO engines	<u>Operation</u> Potential increases in the concentrations of pollutants which could lead to impacts on vegetation Potential for additional of nutrient nitrogen and acid deposition causing an impact on the ecosystems and vegetation	Low	Minor	Direct, negative, long term

10.8 Residual Impacts

The residual impacts associated with the proposed project after implementation of the mandatory mitigation measures during the construction phase are detailed in Table 10.7.

Table 10.7 Residual Impact after Mitigation Measures for Construction

Attribute	Importance	Significance pre mitigation	Significance post mitigation
All human health receptors – Air Quality	Local	Moderate	Negligible / Minor
SLRE – Air Quality	International	No impact	No impact
WAPNP – Air Quality	National	No impact	No impact

The residual impacts associated with the proposed project after implementation of the mandatory mitigation measures during the operation phase are detailed in Table 10.8.

Table 10.8 Residual Impact after Mitigation Measures for Operation

Attribute	Importance	Significance pre mitigation	Significance post mitigation
All human health receptors – Air Quality	National	Moderate	Minor / Moderate
SLRE – Air Quality	International	Minor	Minor
WAPNP – Air Quality	National	Minor	Minor

10.9 Cumulative Impacts

Under current conditions, the impacts associated with cumulative air emissions are likely to be minor. However, future cumulative construction and operational particulate emissions should be carefully monitored in the project area and proper mitigation measures proposed to ensure that impacts do not become more significant.

10.10 References

- IAQM, 2014 – Institute of Air Quality Management: Guidance on the Assessment of Dust from Demolition and Construction, February 2014.
- Taylor & Nakai (2012) - Monitoring the levels of toxic air pollutants in the ambient air of Freetown, Sierra Leone. African Journal of Environmental Science & Technology, 6 (7) 283-292.
- WBG, 2007 – World Bank Group (WBG) Environmental, Health and safety Guidelines - General EHS Guidelines: Environmental – Air Emissions and Ambient Air Quality, April 30, 2007.
- WBG, 2008 – World Bank Group (WBG) Environmental, Health and safety (EHS) Guidelines for Thermal Power Plants, December 19, 2008.
- WHO, 2000 – World Health Organization – Air Quality Guidelines for Europe, 2nd Edition, WHO Regional Publications, European Series, No.91.

11 Desalination Plant

The main water demand for this plant is the combustion turbines' need for demineralized water to control NO_x production. Seawater will be drawn from the harbor, screened to eliminate debris and then cleaned using dissolved air flotation and granular filters. That filtered water will be processed in a reverse osmosis (RO) system to produce fresh water which will be demineralized prior to use in the combustion turbines. Brine reject from the RO system will make up about 97% of the plant's water discharge. Please see the water balance on the next two pages. The remaining 3% is anticipated to come from various non-process uses on site and from sanitary waste.

Sanitary waste will be treated and monitored to ensure it meets IFC standards. Then, it will be mixed with RO reject brine and non-process wastewater for discharge back to the harbor.

The RO system is anticipated to operate with a recovery rate of between 35% and 40%. To conservatively estimate the concentration of the reject brine, we assume recovery will be 40% which would result in a factor of concentration of 1.67.

Seawater sampling performed in the harbor for this project found that salinity of the water in the vicinity of the proposed intake location is about 13000 mg/l in the wet season and 35000 mg/l in the dry season. So, the worst-case discharge salinity will be about 58000 mg/l.

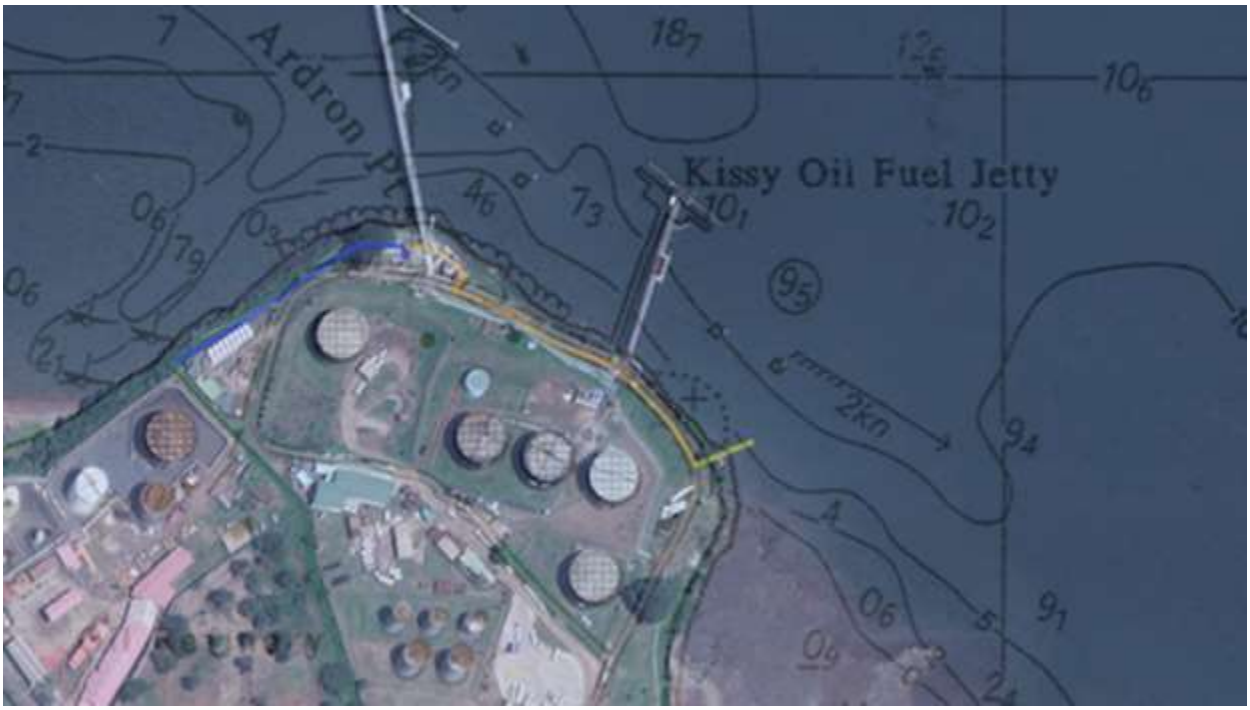
The temperature of water discharged from the plant will be essentially the same as the water in the harbor.

The Base Load, 20C water balance is referenced as a high flow case. That water balance shows a discharge flow rate of 43.3 m^3/hr.

The discharge water's salinity concentration is greater than what prevails naturally in the harbor. So, it should be discharged in a way to ensure it mixes readily to minimize impact on marine biota that might be sensitive to salinity. Other characteristics of the water discharges are anticipated to be compatible with the prevailing environment.

The location of the discharge point will be selected to minimize environmental impact and to avoid recirculation with the project's intake location. The project proposes to discharge the reject brine southeast of the Kissy Oil Fuel Jetty a short distance offshore where water depth is about 5 meters and the seabed drops rapidly away from shore. See the yellow line within the Figure 11.1 below.

Figure 11.1 Overlay of Project Water Discharge Pipeline (Orange/Yellow) and Site Bathymetry



Based on the concentrations cited above, the brine is expected to be about 1.7% denser than the ambient water so it can be expected to drop while mixing with ambient water. To minimize the impact of high salinity on the marine environment, the discharge will be designed to enhance rapid mixing and to avoid contact of high-salinity water with the seabed. To allow rapid mixing, the discharge will use two 75 mm nozzles with exit velocity of 1.5m/sec. The arrangement of the nozzles will be designed to induce mixing with ambient water. The nozzles will be set at least one meter above the seabed and angled upward to minimize the chance the saline plume will impinge on the seabed where it could affect biota living there.

Figure 11.2 Water Balance - Western Area Generation Project - CEC Africa -Sierra Leone (Page 1 of 2)

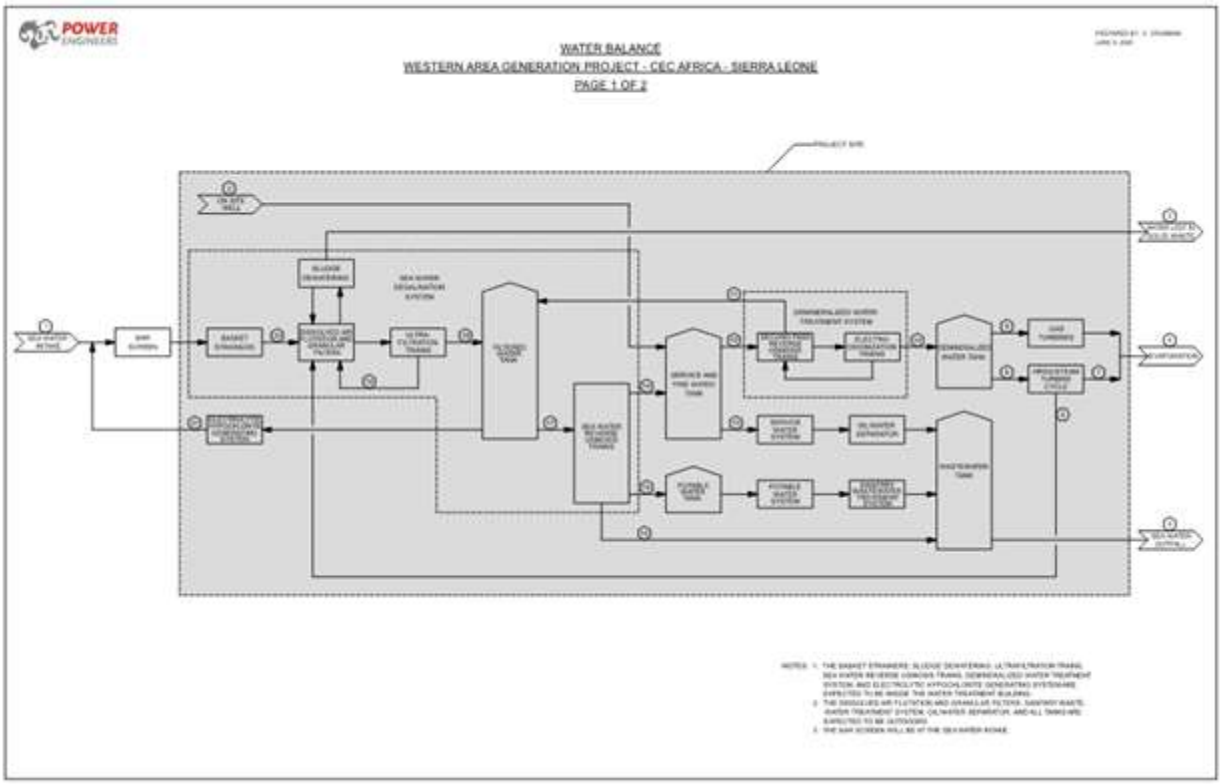
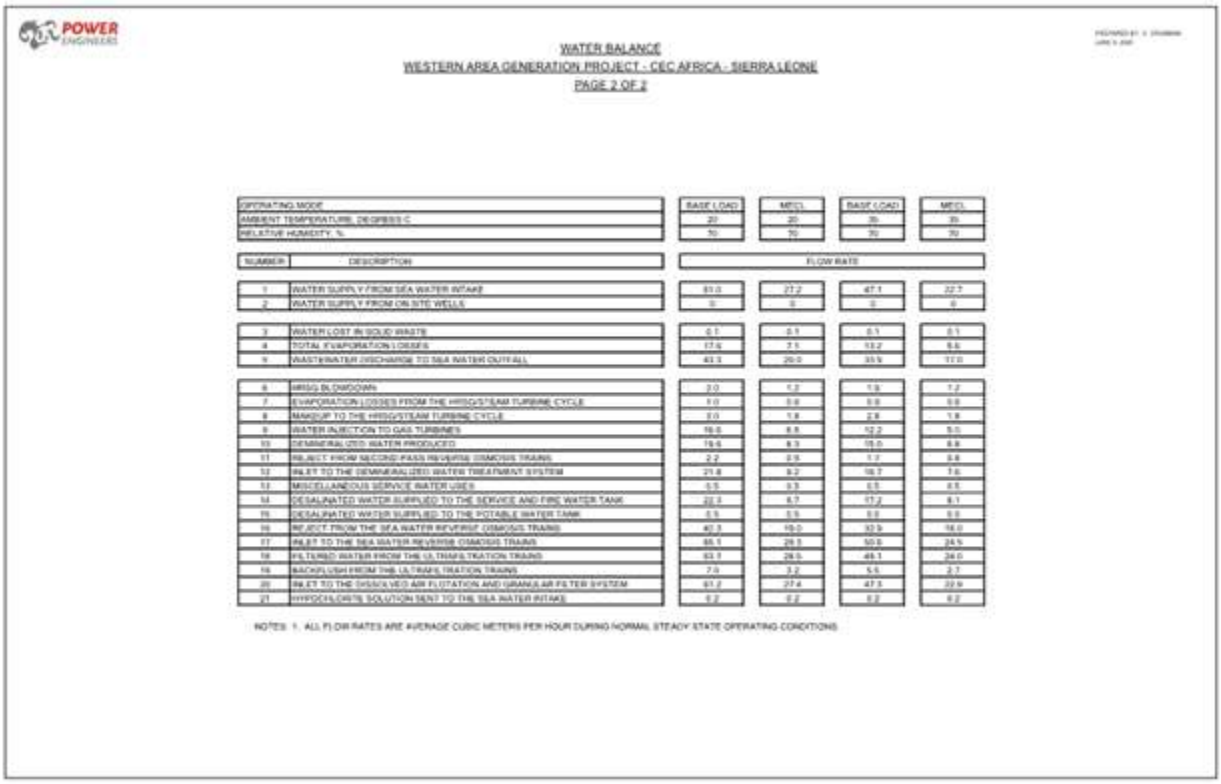


Figure 11.3 Water Balance - Western Area Generation Project - CEC Africa -Sierra Leone (Page 2 of 2)



WATER BALANCE
WESTERN AREA GENERATION PROJECT - CEC AFRICA - SIERRA LEONE
PAGE 2 OF 2

OPERATING MODE		BASE LOAD	MED.	BASE LOAD	MED.
AMBIENT TEMPERATURE, DEGREES C		20	20	35	35
RELATIVE HUMIDITY, %		70	70	70	70
NUMBER	DESCRIPTION	FLOW RATE			
1	WATER SUPPLY FROM SEA WATER INTAKE	61.0	27.2	47.1	22.7
2	WATER SUPPLY FROM ON SITE WELLS	0	0	0	0
3	WATER LOST IN SOLID WASTE	0.1	0.1	0.1	0.1
4	TOTAL EVAPORATION LOSSES	17.6	7.5	13.2	6.6
5	WASTEWATER DISCHARGE TO SEA WATER OUTFALL	43.3	20.0	33.9	17.0
6	HRSG BLOWDOWN	2.0	1.2	1.9	1.2
7	EVAPORATION LOSSES FROM THE HRSG/STEAM TURBINE CYCLE	1.0	1.0	1.0	1.0
8	MAKEUP TO THE HRSG/STEAM TURBINE CYCLE	3.0	1.8	2.9	1.8
9	WATER INJECTION TO GAS TURBINES	16.0	8.8	12.2	5.0
10	DEMINERALIZED WATER PRODUCED	19.6	8.3	15.0	8.8
11	REJECT FROM SECOND PASS REVERSE OSMOSIS TRAINS	2.2	0.9	1.7	0.8
12	INLET TO THE DEMINERALIZED WATER TREATMENT SYSTEM	21.8	9.2	16.7	7.6
13	MISCELLANEOUS SERVICE WATER USES	0.5	0.3	0.5	0.5
14	DESALINATED WATER SUPPLIED TO THE SERVICE AND FIRE WATER TANK	22.3	9.7	17.2	8.1
15	DESALINATED WATER SUPPLIED TO THE POTABLE WATER TANK	0.5	0.5	0.5	0.5
16	REJECT FROM THE SEA WATER REVERSE OSMOSIS TRAINS	40.3	19.0	33.9	16.0
17	INLET TO THE SEA WATER REVERSE OSMOSIS TRAINS	65.1	28.5	50.6	24.5
18	FILTERED WATER FROM THE ULTRAFILTRATION TRAINS	63.1	28.5	48.1	24.0
19	BACKFLUSH FROM THE ULTRAFILTRATION TRAINS	7.5	3.2	5.5	2.7
20	INLET TO THE DISSOLVED AIR FLOTATION AND GRANULAR FILTER SYSTEM	61.2	27.4	47.5	22.9
21	HYPOCHLORITE SOLUTION SENT TO THE SEA WATER INTAKE	0.2	0.2	0.2	0.2

NOTES: 1. ALL FLOW RATES ARE AVERAGE CUBIC METERS PER HOUR DURING NORMAL STEADY STATE OPERATING CONDITIONS

The Project's impact, expected to be minimal, will be reduced to acceptable levels to ensure compliance with IFC Project Standard 6 (PS 6) levels regarding biodiversity in the SLRE. The Project will take appropriate measures to ensure that the effluent from the desalination plant meets all WB/IFC guidelines.

12 Soils, Geology, Hydrogeology, and Hydrology

12.1 Introduction

This section assesses the potential quantitative and qualitative impacts on hydrology, hydrogeology and geology such as the flood risk implications of the proposed project during the construction and operational phases. New receptors or attributes will be added and evaluated upon completion of the baseline field study.

12.2 Discharge Standards

The Environment Protection Agency (EPA) Act of 2008 does not specify any discharge standards, the Environmental, Health, and Safety (EHS) Guidelines, World Bank / IFC will be used ("the EHS Guidelines"), specifically:

- EHS Guidelines General: Section 1.3 Environmental Wastewater and Ambient Water Quality;
- EHS Guidelines General: Section 1.4 Environmental Water Conservation;
- EHS Guidelines for Water and Sanitation; and
- EHS Guidelines for Thermal Power Plants.

Table 12.1 details the effluent discharge requirement from thermal power plants that are to be applied to the proposed project.

Table 12.1 Effluent Guideline Values for Process Emissions from Thermal Power Plants

Parameter (pollutant or pollutant property)	Maximum concentration mg/L (except pH and temperature)
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium - Total	0.2
Copper	0.5
Iron	1.0
Zinc	1.0
Lead	0.5
Cadmium	0.1
Mercury	0.005
Arsenic	0.5
Temperature	The effluent should result in a temperature change of no more than 3°C at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors, and assimilative capacity. The EA for a specific project may specify a more stringent temperature change guideline. Elevated temperature areas due to discharge of once-through cooling should be minimized by adjusting intake and outfall

Parameter (pollutant or pollutant property)	Maximum concentration mg/L (except pH and temperature)
	design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point. The mixing zone may be established by local regulatory agencies or through the project's EA process. It should also be minimized as far as practicable.

Table 12.2 details the effluent from standards that are to be applied in relation to sanitary discharges for the proposed project.

Table 12.2 Guideline Values for Treated Sanitary Sewer Discharges [a]

Pollutants	Units	Guideline Value
pH	pH	6-9
BOD	mg/l	30
COD	mg/l	125
Total Nitrogen	mg/l	10
Total phosphorous	mg/l	2
Oil and grease	mg/l	10
TSS	mg/l	50
Total coliform bacteria	MPN[b]/10ml	400

Notes:
[a] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
[b] MPN = Most Probable Number.

12.3 Sensitive Receptors

12.3.1 Soils – Geology

Table 12.3 summarizes the importance of the geological attributes / receptors within the study area. There are no expected changes to the geological attribute importance.

Table 12.3 Geological Attribute Importance (Quality) within the Study Area

Receptor / Attribute	Importance	Rationale
Construction workers	Local	Exposure to contamination in soils during construction activities on site
Future site users	Local	Exposure to contamination in soils on site
Surrounding land	Local	Local migration of contamination to surrounding land

12.3.2 Hydrogeology

With no foreseen changes, Table 12.4 summarizes the importance of the groundwater attributes / receptors within the study area.

Table 12.4 Groundwater Attribute Importance (Quality) within the Study Area

Receptor	Importance	Rationale
Boreholes in surrounding area	Local	Groundwater use by the local population from small boreholes
Onsite borehole	Local	Value to onsite operations
Municipal Water Supply – GVWC	Regional	Value on a regional scale as this is the only water supply which is currently constrained.
Sierra Leone River Estuary (SLRE)	International	Designated as a Ramsar Site
Wellington Stream or Creek	Regional	Value on a regional scale due to connectivity with the wider Sierra Leone River Estuary which is designated as a Ramsar Site
Old Railway Road Stream	District	Value on a local scale

12.3.3 Hydrology

Table 12.5 summarizes the importance of the surface water attributes / receptors within the study area based on the ESHIA methodology set out in Section 6.

Table 12.5 Surface Water Attributes Importance within the Study Area

Attribute	Importance	Rationale
Sierra Leone River Estuary (SLRE) Water Quality	International	Designated as a Ramsar Site
Wellington Stream Water Quality	Regional	Value on a regional scale due to connectivity with the wider SLRE which is designated as a Ramsar Site and its importance to Freetown (drainage)
Old Railway Road Stream Water Quality	District	Value on a local scale due to importance to eastern Freetown and Kissy Docks area drainage system
Drainage Network Water Quality	Local	Value on a local scale (drainage)
Commercial Fishery Resources	Regional	Value on a regional scale
Local Municipal Water Supply	Regional	Value on a regional scale as this is the only municipal water supply which is currently constrained
Flood Risk	Local	Value on a local scale due to importance to eastern Freetown and Kissy Docks area (drainage)

12.4 Soils and Human Health Impact Assessment

This section considers and assesses the impact of the proposed development with regards to soil quality during the construction and operation phases - these are summarized in Table 12.6.

12.4.1 Construction Phase Impacts

Based on available information, no significant soil contamination has been identified on site with no obvious signs of surface contamination and the majority of contaminants in borehole soil samples below screening criteria for commercial land use. Non-asbestos fibers were detected in two soil samples. It is important to note that the soil samples taken in the ground investigation are from targeted borehole locations on site and whilst they give an indication of the likely contamination levels on site they do not represent the entire site. Therefore, it is possible for further existing contamination to be uncovered during construction activities, in particular the area of the old fuel pump. It should also be anticipated that

further non-asbestos fibers may be encountered during construction activities on the site, however the risk is considered low.

There is the potential for further contamination of soils from any spills of hazardous materials during construction activities including fuel and oils. Risks to human health include exposure of construction workers to any existing or construction made soil contamination as potential contamination pathways are opened up during construction activities.

12.4.2 Operational Phase Impacts

Risks to human health will be limited during the operational phase unless any major spills or contamination events occur. The majority of the site will be hard standing therefore there will be limited pathways for contact with potential contamination in the unlikely event that any previously unidentified contamination remains present.

There is the potential for health risks to site users if additional contamination events occur, in particular spills of hazardous materials such as fuel. In these instances, it is likely that any health risks are limited to those in the immediate vicinity of the spill and to any workers involved in the cleaning up of the materials.

Table 12.6 Summary of Impacts on Soils and Human Health for Each Attribute During Each Phase (Prior to Mitigating Measures)

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Construction workers	Local	Potential exposure of construction workers to any contamination of soils on site during construction activities.	<u>Construction</u> Potential for existing on-site soil contamination to be mobilized during construction, resulting in exposure of contamination to construction workers.	Low	Minor	Negative temporary
			<u>Operation</u> Potential for pollution from spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term
Future site users	Local	Potential exposure of future site users to any contamination of soils on site.	<u>Construction</u> Potential for pollution from spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term
			<u>Operation</u> Potential for exposure of future site users from contamination of soil in the event of a spill or other type of accident from hazardous materials stored on site during operation (including fuel and diesel tanks, oils, lubricants and other hazardous materials).	Medium / High	Minor	Negative long-term

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Surrounding land	Local	Contamination of soils resulting in potential pollution of groundwater impacting water quality abstracted by offsite boreholes.	<u>Construction</u> Potential for existing on-site soil contamination to be mobilized during construction, resulting in migration of contamination to offsite soils.	Low	Minor	Negative long-term
			<u>Operation</u> Potential for migration and contamination of offsite soils in the event of a spill or other type of accident from hazardous materials stored on site during operation (including fuel and diesel tanks, oils, lubricants and other hazardous materials).	Medium / High	Minor / Moderate	Negative long-term

12.5 Hydrogeology Impact Assessment

This section assesses the potential impacts on both the quantity and quality of groundwater beneath the site and in the surrounding area. This includes consideration of the use of groundwater as a water supply both for the site and by the local population.

12.5.1 Construction Phase Impacts

This section considers and assesses the impact of the construction phase of the proposed development with regards to groundwater quality and groundwater supply, with potential impacts to receptors that are linked to groundwater in the local area, including groundwater abstractions from boreholes, and surface water features such as the Sierra Leone River Estuary. These are summarized in Table 12.7.

12.5.2 *Groundwater Quality*

Results of the site investigation indicate that the soils beneath the site are permeable and vulnerable to contamination. During the construction phase there is the potential that any existing contamination within the soil, due to current / historical use of the site, will be mobilized as a result of earthworks and excavations within the site. This mobilized contamination would have the potential to infiltrate to groundwater causing a deterioration of the groundwater quality and could be transported in groundwater. This therefore has the potential to impact water abstracted from the existing onsite borehole, or any offsite boreholes in the surrounding area.

In addition, there is the potential for the contamination of groundwater during construction process as a result of spills of hazardous materials during construction which may also impact groundwater quality in the local area and on site.

It is understood that groundwater in the area is used by the local population as a water source, with boreholes in the surrounding area used to abstract the water. Such water is also used for farming activities including those on or near to the site. Therefore, there are potential health risks to the local population if contaminated groundwater is used as drinking water supply or for watering of crops.

Potential risks to the onsite production borehole for contaminated groundwater could also impact the use of this borehole both during construction and the operation of the site. Water quality samples were taken from this borehole during the pumping test

Groundwater flow beneath the site is understood to be northwards, towards the Sierra Leone River Estuary. There is the potential that groundwater discharges to the SLRE and therefore contamination of the groundwater as a result of the construction phase could potentially be transported to the SLRE.

Other watercourses in the surrounding area also have the potential to be in hydraulic continuity with groundwater, including the Wellington Creek, located 200m to the east of the project site, and Old Railway Road Stream, located to south of the site. The fractured nature of the geology beneath the site means that groundwater flow patterns may be complex and as a result there are potential contamination pathways from groundwater to these water courses.

The site investigation indicates any significant contamination sources identified during the site construction will be either removed from site or treated as appropriate to reduce potential risks of associated contamination of groundwater.

Any hazardous materials and wastes used as part of the construction of the site will be appropriately stored (e.g., on areas of fully bunded hard standing, as necessary). Appropriate accident and spill control

and countermeasure response plans will be required to manage any spills that might occur during the construction of the plant.

12.5.2.1 Groundwater Supply

It is proposed that the existing onsite production borehole will be only used with the level of treatment needed for the intended use. The level of coliform bacteria and chromium measured in the groundwater poses a major risk without properly treating the water first. The EPC contractor will use municipal water during construction with the possibility of using water from the borehole while being properly treated.

12.5.3 Operational Phase Impacts

This section considers and assesses the impact of the operational phase of the proposed development with regards to groundwater quality and groundwater supply. Potential impacts to receptors that are linked to groundwater in the local area, including groundwater abstractions from boreholes, and surface water features such as the Sierra Leone River Estuary, are also considered. These are summarized in Table 12.7.

12.5.3.1 Ground Water Quality

The main risk to groundwater quality is from potential contamination of groundwater in the event of a spill or other type of accident from hazardous materials stored on site during operation. This includes the proposed diesel tanks, oils, lubricants and other hazardous materials. Any potential spills or leaks from the fuel and diesel tanks have the potential to see significant volumes of contamination infiltrate into the ground and the groundwater beneath the site.

As a mitigation measure, the diesel fuel oil should be stored in double containment or concrete bund tanks with leak indication. Underground piping containing fuel and hazardous materials is also specified as double walled piping with a leak detection system in the interstitial space.

As with the construction impacts, pollution of groundwater beneath the site has the potential to impact groundwater quality in the surrounding area and affect the quality of groundwater abstracted from any nearby boreholes used by the local population as a water supply. Therefore, there are potential health risks to the local population if contaminated groundwater is used as drinking water supply.

As outlined in more detail below, it is proposed that the existing borehole onsite will be used to provide part of the water supply required for the construction of the site. Potable water during operations will be generated from the desalination and water treatment system. Any contamination of the groundwater abstracted from the borehole could present a health risk to anyone drinking this water. Therefore, the water quality of the water abstracted should be regularly tested during construction to ensure the suitability for drinking.

Contaminated groundwater could also impact the water quality of surface water that is connected to groundwater, including the Sierra Leone River Estuary (SLRE), the Wellington Creek and the Old Railway Road Stream. The fractured nature of the geology beneath the site means that groundwater flow patterns may be complex and as a result there are potential contamination pathways from groundwater to these water courses.

Hazardous materials and wastes should be appropriately stored (e.g., on areas of fully bunded hard standing, as necessary). Appropriate accident and spill response plans will be required to manage any spills that might occur during the operation of the plant.

12.5.3.2 Ground Water Supply

It is proposed that all water for the operation of the plant be taken from the desalination plant.

It is understood that a total daily volume of 547 m^3/day is anticipated to be needed during the operation of the plant. This is based on the following requirements:

- Potable water: 12 m^3/day
- Service Water: 12 m^3/day
- Demin Water: 523 m^3/day

Purchase of water from GVWC will also be considered as a source during construction. If GVWC water is required, an assessment of potential impacts on water availability to other water users on the network will be undertaken at that time.

Table 12.7 Summary of Impacts on Groundwater Quality for Each Attribute During Each Phase (Prior to Mitigating Measures)

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Groundwater supply - Boreholes in surrounding area	Local	Potential overuse of groundwater from abstraction from onsite borehole with potential to restrict water availability to existing users, including boreholes in the surrounding area used by local population or artisanal farmers (if using groundwater for farming purposes).	Construction Construction sites need relatively limited supplies of water for cement manufacture.	Low	Minor	Negative temporary
			Operation The plant will use the desalinated sea water.	Low	Minor	Negative long-term
			Decommissioning Decommissioning of the site likely to need limited supplies of water for damping down for dust control and messing purposes.	Low	Minor	Negative temporary
Groundwater quality - Boreholes in surrounding area	Local	Potential pollution of groundwater impacting water quality to existing users in local area, including boreholes used by local population or artisanal farmers (if using groundwater for farming purposes). Potential health risks to local population if use polluted water for drinking supply and possible restrictions on water availability.	Construction Potential for existing on-site soil contamination to be mobilized during construction, resulting in contamination of groundwater abstracted by local boreholes. Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
			<u>Operation</u> Potential contamination of groundwater in the event of a spill or other type of accident from hazardous materials stored on site during operation (including fuel and diesel tanks, oils, lubricants and other hazardous materials).	Medium / High	Minor / Moderate	Negative long-term
			<u>Decommissioning</u> Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term
Groundwater quality - Onsite borehole	Local	Potential pollution of groundwater impacting water quality abstracted by onsite borehole.	<u>Construction</u> Potential for existing on-site soil contamination to be mobilised during construction, resulting in contamination of groundwater abstracted by onsite borehole. Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term
			<u>Operation</u> Potential contamination of groundwater in the event of a spill or other type of accident from	Medium / High	Minor / Moderate	Negative long-term

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
			hazardous materials stored on site during operation (including fuel and diesel tanks, oils, lubricants and other hazardous materials).			
			<u>Decommissioning</u> Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term
Groundwater supply - Municipal Water Supply - GVWC	Regional	Reliance and overuse of municipal supply with potential to restrict water availability to existing users. Potential groundwater contamination restricts the use of the onsite borehole as water supply, resulting in reliance on municipal supply.	<u>Construction</u> Construction sites need relatively limited supplies of water for cement manufacture, damping down for dust control and messing purposes.	Low	Minor	Negative temporary
			<u>Operation</u> Sea water is proposed for the operation of the plant so limited municipal water will be used.	Low	Minor	Negative long-term
			<u>Decommissioning</u> Decommissioning of the site likely to need limited supplies of water for damping down for dust control and messing purposes.	Low	Minor	Negative temporary
Groundwater quality - Sierra Leone	National	Groundwater flow beneath the site to the north, towards the SLRE – therefore potential that SLRE is in	<u>Construction</u> Potential for existing on-site soil contamination to be mobilised	Low	Minor	Negative long-term

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
River Estuary (SLRE)		hydraulic continuity with groundwater. Potential pollution at the site could be transported through groundwater to SLRE.	during construction, resulting in contamination of groundwater. Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.			
			<u>Operation</u> Potential contamination of groundwater in the event of a spill or other type of accident from hazardous materials stored on site during operation (including fuel and diesel tanks, oils, lubricants and other hazardous materials).	Medium	Moderate	Negative long-term
			<u>Decommissioning</u> Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term
Groundwater quality - Wellington Creek	Regional	Potential pollution at the site could be transported through groundwater to Wellington Creek, located 200m to the east of the project site. The likely fractured geology means that groundwater flow patterns may be complex and	<u>Construction</u> Potential for existing on-site soil contamination to be mobilised during construction, resulting in contamination of groundwater. Potential for pollution for spills or other accidents from hazardous materials used during	Low	Minor	Negative long-term

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
		may not necessarily be towards the north.	construction, including oils and fuels.			
			Operation Potential contamination of groundwater in the event of a spill or other type of accident from hazardous materials stored on site during operation (including fuel and diesel tanks, oils, lubricants and other hazardous materials).	Low	Minor	Negative long-term
			Decommissioning Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	Low	Minor	Negative long-term
Groundwater quality - Old Railway Road Stream	District	Potential pollution at the site could be transported through groundwater to Old Railway Road Stream, located to south of the site.	Construction Potential for existing on-site soil contamination to be mobilised during construction, resulting in contamination of groundwater. Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	No effect anticipated	No effect anticipated	N/A
			Operation	No effect anticipated	No effect anticipated	N/A

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
			Potential contamination of groundwater in the event of a spill or other type of accident from hazardous materials stored on site during operation (including diesel tanks, oils, lubricants and other hazardous materials).			
			<u>Decommissioning</u> Potential for pollution for spills or other accidents from hazardous materials used during construction, including oils and fuels.	No effect anticipated	No effect anticipated	N/A

12.6 Hydrology Impact Assessment

This section considers and assesses the impact of the construction phase of the proposed project with regards to surface water quality, water supply and flooding.

12.6.1 Construction Phase Impacts

This section considers and assesses the impact of the construction phase of the proposed project with regards to surface water quality, water supply and flooding; these are summarized in Table 12.8.

12.6.1.1 Surface Water Quality

During the construction phase there is the potential for pollution of surface water features due to sediment loading as a result of surface water runoff. In addition, a variety of construction materials and chemicals are likely to be used during works which could have varying polluting potential if spilled adjacent to or within a watercourse. Accidental spills and leaks may include seepage if storage locations were poorly protected, fuel spillages, lubricants spills and leaks / discharges from vehicles. Potential pollution sources during the construction phase of the proposed project include:

- Construction works within and adjacent to watercourses such as drainage ditches and streams;
- Excavations including those associated with the provision of drainage works;
- Site clearance works;
- Stockpiling of materials;
- Accidental spillage of polluting substances in or adjacent to watercourses;
- Construction plant and vehicle washing; and
- Liquid effluent including domestic wastewater / sewage.

No significant construction works will be undertaken within or immediately adjacent the SLRE, however there is the potential for works to be undertaken within and adjacent to streams and/or drainage channels that are hydraulically connected to the SLRE therefore, there is a potential for indirect impacts to the water quality of the SLRE. The importance (international) of the receptor, combined with the low magnitude of the effect (short-term, minor damage) would result in an impact to the water quality of the SLRE from the construction works as indirect (runoff, spills), temporary, negative, and of medium significance prior to mitigation.

No construction works will be undertaken within or adjacent to Wellington Stream, however there is the potential for works to be undertaken within and adjacent to streams and/or drainage channels that are hydraulically connected to this watercourse therefore there is a potential for indirect impacts to the water quality of the Wellington Stream. The importance (regional) of the receptor, combined with the low magnitude of the effect (short-term, minor damage) would result in an impact to the water quality of the Wellington Creek from the construction works as indirect (runoff, spills), temporary, negative, and of medium significance prior to mitigation.

There is a potential for construction works to be undertaken within or adjacent to the Old Railway Road Stream therefore there is a potential for direct and indirect impacts to the water quality of this watercourse. The importance (district) of the receptor, combined with the low magnitude of the effect (short-term, minor damage) would result in an impact to the water quality of the Old Railway Road Stream from the construction works as direct (construction of drainage connections / culverts) and indirect (runoff, spills), temporary, negative, and of minor significance prior to mitigation. However, it is noted that this watercourse does run through the grounds of the Winston Churchill Secondary School. At this time, it is not known if the children have access to the water and/or the existing water quality. The EPC

contractor should confirm the access to this watercourse and confirm the assessment of this impact as required.

Construction works are likely to be undertaken within or adjacent to the existing drainage network in and around the site therefore there is a potential for direct and indirect impacts to the water quality of the drainage network. The importance (local) of the receptor, combined with the low magnitude of the effect (short-term, minor damage) would result in an impact to the water quality of the existing drainage network from the construction works as direct (construction of drainage connections / culverts) and indirect (runoff, spills), temporary, negative, and of negligible significance prior to mitigation.

Commercial and artisanal fishery resources may theoretically be impacted by any decrease in the water quality of the SLRE during the construction activities as a result of accidental discharges or contamination from the site entering the SLRE via the streams or storm water. The importance (regional) of the receptor combined with the low magnitude of the effect (short-term, minor damage) and the distance of fishery activities from Kissy Bay would result in an impact to this resource from the construction works as indirect (runoff, spills), temporary, negative, and of minor significance prior to mitigation.

12.6.1.2 Water Supply

Water volumes associated with construction activities are unknown at present, but as no water-intensive construction activities are anticipated, the associated volumes required will not be significant. The construction sites will need relatively limited supplies of water for cement manufacture, damping down for dust control and messing purposes. Water requirements during construction will be the responsibility of the EPC contractor and it is anticipated that this will be delivered to site via tankers until infrastructure is in place to supply the site (borehole, see Section: Hydrogeology). Potable water will also be provided in bottles / drums and delivered to site via trucks.

There is also a risk that construction activities could disrupt or accidentally cut off the existing local water supply. The importance (regional) of the receptor combined with the low magnitude of the effect (short-term, minor damage) would result in an impact on the municipal water supply from the construction works as direct (disruption), temporary, negative, and medium significance prior to mitigation.

12.6.1.3 Flooding

The change in land use at the site from brownfield use to include laydown areas and other construction activities associated with the site development has the potential to increase the volume of surface runoff that discharges into the surface drainage network due to a reduction in the available permeable areas. This is in addition to the existing context of significant high intensity rainfall events throughout the wet season which results in very rapid overwhelming of soil infiltration capacity and surface flooding.

The importance (local) of the receptor combined with the low magnitude of the effect (short-term, minor damage) would result in an impact on flooding from the construction works as direct (increase in surface runoff), temporary, negative, and minor significance prior to mitigation.

12.6.2 Operational Phase Impacts

Specific potential impacts on surface water receptors expected due to the proposed operational phase are described below and summarized in Table 12.8.

12.6.2.1 Surface Water Quality

Potential discharges from the operational plant will include:

- Sewage plant effluent;

- Industrial wastewater (IWW - including wash down water and separated water from the Oil / Water separator); and
- Potentially contaminated & clean storm water.

All domestic wastewater will be sent to either an onsite septic tank for storage and disposal or to an onsite effluent treatment plant, depending on the final design. In the event that a treatment plant is required, discharges will be required to meet the WBG EHS Guidelines before discharge to any watercourse.

IWW generation resulting from the oily water treatment and effluent from the operation of the proposed project is anticipated to be small. Details of the treatment of this effluent are not finalized however all wastewater generated on site will be adequately treated, to be in line with WBG EHS Guidelines.

The final discharge point(s) for the plant has not been established but is likely to be the local stream (the old Railway Road Stream) or alternatively, adjacent storm water drains may be used. The risk of each option will be weighed and discussed with EPA-SL and the project will deigned to ensure that WBG and national standards for wastewater are met.

A storm water drainage system will drain areas of hard standing unlikely to be contaminated by the project's processes. The majority of the rainwater drainage will be uncontaminated and drain to the local storm drainage system.

Areas of hard standing with the potential to be contaminated by process will be constructed with curbs to direct any accidental spills and potentially contaminated storm water to an oil / water separator. Oil from the oil / water separator will be recycled or disposed of in the incinerator. Water from the oil / water separator will be treated prior to discharge to WBG EHS Guidelines (WBG, 2007).

Potential impacts from the operation of the proposed project in the absence of mitigation measures but with the assumption that IFC standards will be met are described below.

There will be no direct discharges to the SLRE, however there is the potential indirect via streams and/or drainage channels that are hydraulically connected to the SLRE therefore there is a potential for indirect impacts to the water quality of the SLRE. Considering that all discharges will be required to meet IFC discharge standards and given the importance (international) of the receptor, combined with the low magnitude of the effect (compliance with legal requirements) impacts to the water quality of the SLRE from operational discharges are considered to be indirect, long term, negative, and minor.

There will be no direct discharges to the Wellington Stream, however there is the potential for indirect discharges via streams and/or drainage channels that are hydraulically connected to the Wellington Creek. Considering that all discharges will be required to meet IFC discharge standards and given the importance (regional) of the receptor, combined with the low magnitude of the effect (compliance with legal requirements) impacts to the water quality of the Wellington Stream from operational discharges are considered to be indirect, long term, negative, and minor.

There is a potential for direct discharges to the Old Railway Road Stream therefore there is a potential for direct impacts to the water quality of the Old Railway Road Stream. Considering that all discharges will be required to meet IFC discharge standards and given the importance (District) of the receptor, combined with the low magnitude of the effect (compliance with legal requirements) impacts to the water quality of the Old Railway Road Stream from operational discharges are considered to be indirect, long term, negative, and minor. However, it is noted that this watercourse does run through the grounds of the Winston Churchill Secondary School. At this time, it is not known if the children have access to the water

and/or the existing water quality. The EPC contractor should confirm the access to this watercourse and confirm the assessment of this impact as required.

There is a potential for direct discharges to the existing drainage network therefore there is a potential for direct impacts to the water quality of the existing drainage network. Considering that all discharges will be required to meet IFC discharge standards and given the importance (local) of the receptor, combined with the low magnitude of the effect (compliance with legal requirements) impacts to the water quality of the existing drainage network from operational discharges are considered to be indirect, long term, negative, and negligible.

Commercial and artisanal fishery resources may be impacted by any decrease in the water quality of the SLRE from operation discharges. Considering that all discharges will be required to meet IFC discharge standards and given the importance (regional) of the receptor combined with the low magnitude of the effect (compliance with legal requirements) and the distance of fishery activities would result in an impact to this resource as indirect (runoff, spills), temporary, negative, and of minor significance prior to mitigation

12.6.2.2 Water Supply

The Water supply is proposed from desalinated sea water therefore there will be little impact to the local municipal water supply for the operational phase. Water used for the purpose of drinking shall be treated to World Health Organization (WHO) Standards as specified in the Guidelines for Drinking-water Quality.

12.6.2.3 Flooding

The change in land use at the site to include new buildings, access roads, hard standing that have the potential to increase the volume of surface water runoff that discharges into the surface drainage network. The importance (local) of the receptor combined with the high magnitude of the effect would result in an impact on flooding from the operation of the plant as direct long term, negative, and medium significance prior to mitigation.

It is also noted that there is the potential for wet season rainfall-related flooding to be exacerbated by the impacts of climate change and mitigation through increased storm drainage capacity is included in the design to address this.

Table 12.8 Summary of Impacts on Water Quality for Each Attribute During Each Phase (Prior to Mitigating Measures)

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
SLRE - Water Quality	International	Indirect impacts associated with the transport of sediment or accidental release during construction. Discharge of effluent from operations	<u>Construction</u> Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Low	Moderate	Indirect negative temporary
			<u>Operation</u> Potential for pollutants to be transported to water environment via the drainage system. However, discharges will be required to meet the IFC EHS Guideline values.	Low	Moderate	Indirect negative long term
Water Quality	International	Accidental Spills	<u>Operation</u> Potential accidental spills during HFO transfer during operations which could also affect the local RAMSAR site.	Medium	Moderate	Indirect negative temporary
Wellington Creek - Water Quality	Regional	Indirect impacts associated with the transport of sediment or accidental release during construction. Discharge of effluent from operation Indirect impacts associated with the transport of sediment or accidental release during decommissioning. Stormwater Discharge.	<u>Construction</u> Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Low	Minor	Indirect negative temporary
			<u>Operation</u> Potential for pollutants to be transported to water environment via the drainage system. However, discharges will be required to meet the IFC EHS Guideline values.	Low	Minor	Indirect negative long term

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Old Railway Road Stream - Water Quality	District	Direct impact on the watercourse from construction work in and within closed proximity and indirect impacts associated with the transport of sediment or accidental release during construction. Discharge of effluent from operation. Direct impact on watercourse from decommissioning work in and within closed proximity and indirect impacts associated with the transport of sediment or accidental release during decommissioning.	<u>Construction</u> Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Low	Minor	Indirect & direct negative temporary
			<u>Operation</u> Potential for pollutants to be transported to water environment via the drainage system. However, discharges will be required to meet the IFC EHS Guideline values.	Low	Minor	Direct negative long term
Drainage Network - Water Quality	Local	Direct impact on the watercourse from construction work in and within closed proximity and indirect impacts associated with the transport of sediment or accidental release during construction. Discharge of effluent from operation. Direct impact on watercourse from decommissioning work in and within closed proximity and indirect impacts associated with the transport of sediment or accidental release during decommissioning.	<u>Construction</u> Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Low	Negligible	Indirect & direct negative temporary
			<u>Operation</u> Potential for pollutants to be transported to water environment via the drainage system. However, discharges will be required to meet the WBG EHS Guideline values.	Low	Negligible	Direct negative long term

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Commercial Fishery Resources - Water Quality	Regional	Indirect impacts associated with the transport of sediment or accidental release during construction. Discharge of effluent from operation and desalination plant. Potential accidental spills. Indirect impacts associated with the transport of sediment or accidental release during decommissioning.	<u>Construction</u> Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Low	Minor	Indirect negative temporary
			<u>Operation</u> Potential for pollutants to be transported to water environment via the drainage system. However, discharges will be required to meet the IFC EHS Guideline values. Potential spills during fuel transfer during operations which could result in contamination.	Low	Moderate	Indirect negative long term
Municipal Water Supply	Regional	Disruption of resource.	<u>Construction</u> There will be no tie in to the municipal water supply during these stages however, construction activities could disrupt or accidentally cut off the water supply.	Low	Minor	Indirect negative temporary
			<u>Operation</u> There will be no tie in to the municipal water supply.	No effect anticipated	No effect anticipated	N/A
Flooding	Regional	Increase the risk or magnitude of flooding.	<u>Construction</u> Change in land use at the site has the potential to increase the volume of surface runoff that discharges into the surface drainage network.	Low	Minor	Indirect negative temporary
			<u>Operation</u> Change in land use at the site has the potential to increase the volume of surface	High	Major	Indirect negative long term

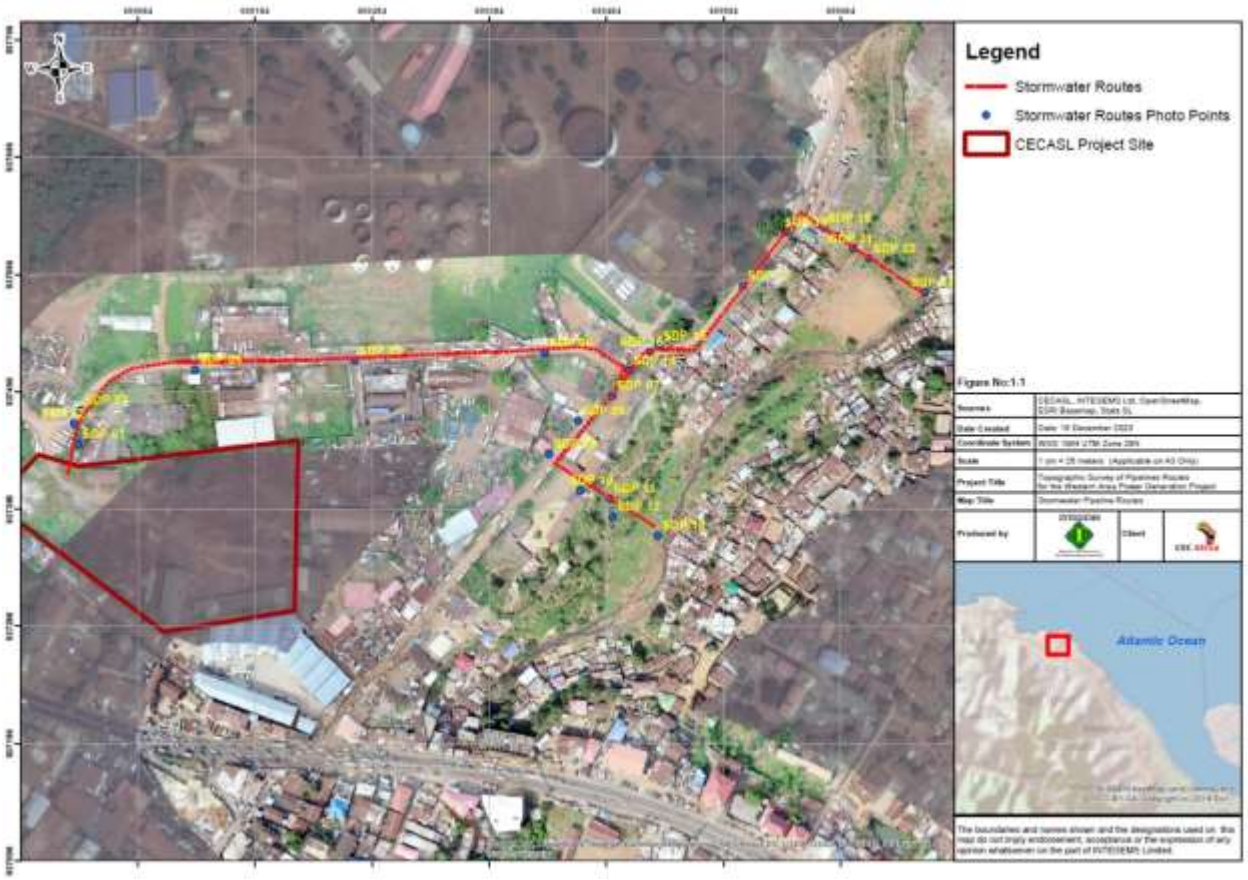
Attribute	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
			runoff that discharges into the surface drainage network			

12.7 Flooding Mitigation

Stormwater has the potential to be an impact to the site and immediate local area. To mitigate stormwater impacts, a stormwater management system should be installed onsite and direct the stormwater runoff to nearest acceptable tributary that can handle excess water which in this case would be Wellington Creek. A proposed route is shown in Figure 12.1 Proposed Stormwater Routes to direct stormwater to Wellington Creek. The EPC contractor will determine the appropriate route that will create the least number of impacts and will mitigate flooding during a 100 year flood scenario.

Figures and Data can be found in the Appendix I Topographic Survey Report.

Figure 12.1 Proposed Stormwater Routes



12.8 Residual Impacts

The residual impacts associated with the proposed project after implementation of the mandatory mitigation measures during all the project phases will be detailed in tables below. The Project will take appropriate measure to ensure proper mitigation measures are met.

Table 12.9 Soils – Geology: Residual Impact after Mitigation Measures for Construction

Attribute	Importance	Significance pre mitigation	Significance post mitigation
Construction Workers	Local	Minor	Negligible

Future site users	Local	Minor	Negligible
Surrounding land	Local	Minor	Negligible

Table 12.10 Soils – Geology: Residual Impact after Mitigation Measures for Operation

Attribute	Importance	Significance pre mitigation	Significance post mitigation
Construction Workers	Local	Minor	Negligible
Future site users	Local	Minor	Negligible
Surrounding land	Local	Minor / Moderate	Negligible

Table 12.11 Hydrogeology: Residual Impact after Mitigation Measures for Construction

Attribute	Importance	Significance pre mitigation	Significance post mitigation
Boreholes in surrounding area	Local	Minor	Negligible
Onsite borehole	Local	Minor	Negligible
Municipal Water Supply – GVWC	Regional	Minor	Minor
Sierra Leone River Estuary (SLRE)	International	Minor	Minor
Wellington Stream or Creek	Regional	Minor	Negligible
Old Railway Road Stream	Distinct	Minor	Negligible

Table 12.12 Hydrogeology: Residual Impact after Mitigation Measures for Operation

Attribute	Importance	Significance pre mitigation	Significance post mitigation
Boreholes in surrounding area	Local	Minor / Moderate	Negligible
Onsite borehole	Local	Minor / Moderate	Negligible
Municipal Water Supply – GVWC	Regional	Moderate	Negligible
Sierra Leone River Estuary (SLRE)	International	Moderate	Negligible
Wellington Stream or Creek	Regional	Minor	Negligible
Old Railway Road Stream	Distinct	Negligible	Negligible

Table 12.13 Hydrology: Residual Impact after Mitigation Measures for Construction

Attribute	Importance	Significance pre mitigation	Significance post mitigation
SLRE	International	Moderate	Negligible
Wellington Creek - Water Quality	Regional	Minor	Negligible

Old Railway Road Stream - Water Quality	District	Minor	Negligible
Drainage Network - Water Quality	Local	Negligible	Negligible
Commercial Fishery Resources - Water Quality	Regional	Minor	Negligible
Municipal Water Supply	Regional	Minor	Negligible
Flooding	District	Minor	Negligible

Table 12.14 Hydrology: Residual Impact after Mitigation Measures for Operation

Attribute	Importance	Significance pre mitigation	Significance post mitigation
SLRE	International	Moderate	Negligible
Wellington Creek - Water Quality	Regional	Minor	Negligible
Old Railway Road Stream - Water Quality	District	Minor	Negligible
Drainage Network - Water Quality	Local	Negligible	Negligible
Commercial Fishery Resources - Water Quality	Regional	Minor	Negligible
Municipal Water Supply	Regional	No Impact	No Impact
Flooding	District	Major	Negligible

13 Ecology

This section evaluates the ecology of the proposed project site and discusses the potential impacts in the context of the proposed project. It presents an assessment of the significance of impacts on sensitive ecological receptors and mitigation measures that will be incorporated into the design.

13.1 Relevant Legislation, Conventions and Standards

This assessment was completed with reference to the following legislation:

- The National Environmental Policy, 1994.
- Environment Protection Act, 2008 (as amended).
- Fisheries Management and Development Act, 1988.
- National Protected Area Authority and Conservation Trust Fund Act, 2012.

Sierra Leone is also a signatory to the following international conventions and standards that are relevant to this assessment:

- Abidjan Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the West and Central African Region.
- Convention on the Conservation of Migratory Species of Wildlife.
- Ramsar Convention on Wetlands of International Importance.
- Convention on the Trade in Endangered Species.
- African Convention on the Conservation of Nature and Natural Resources.
- Convention on Biological Diversity, as interpreted by the IFC Performance Standards on Social and Environmental Sustainability ("the IFC standards") (IFC, 2012).

Sierra Leone's Second National Biodiversity Strategy and Action Plan (2017-2026) (Government of Sierra Leone, 2017) is the primary document identifying conservation priorities in Sierra Leone. This updated NBSAP has five Strategic Objectives consistent with the five Strategic Goals of the CBD, followed by at total 23 Strategic Outputs.

National Strategic Objective A	Sierra leone's biodiversity is well conserved through sound and holistic national legislation and policy implementation across all relevant sectors
National Strategic Objective B	Practical methods and mechanisms enhanced and functioning to safeguard biodiversity, resulting in improving conservation status of threatened and rare species
National Strategic Objective C	Practical and robust conservation actions are significantly enhancing the status of species, habitats, sites and ecosystems in and outside protected areas
National Strategic Objective D	Improved living standards, services and opportunities provided to people, particularly local communities, through sustainable and inclusive biodiversity conservation actions
National Strategic Objective E	Improved sectoral and public involvement, and enhanced expertise and awareness are contributing to effective, result-oriented planning and execution of conservation projects and programs.

13.2 Potential Impacts

13.2.1 Designated Sites

As a Ramsar Wetland and IBA, the Sierra Leone River Estuary and its designated habitat and bird interest features are considered to be of international value. There is ongoing degradation of interest features within the Ramsar Wetland and IBA, but the relatively intact mangroves and coastal habitats within the designated site, especially away from the Freetown area, are considered Natural habitats with respect to the IFC classification (IFC, 2012). Mangroves serve as important refugia, foraging habitat and spawning grounds for marine and freshwater fish species and may be critical for several such species. Mangroves also qualify as a highly threatened ecosystem with respect to IFC Criterion 4 - Guidance Note 6 (Appendix S). In addition, mangroves may locally serve as traditional fishing grounds for local people and are also likely to provide ecosystem services through provision of timber as well as through carbon storage and sequestration.

As a designated National Park, the Western Area Peninsula National Park is considered to be of national value. In 2015, the original ESIA cited the rare species within this National Park, notably white-necked rockfowl, green-tailed bristlebill, western chimpanzee, red colobus, western black-and-white colobus, sooty mangabey and Diana monkey, leopard, Jentinks duiker, black duiker and Maxwell duiker are considered of national value. The toad *Cardioglosus aureolli* and the Freetown long-fingered frog as assumed to be of value at the regional value. The Second National Biodiversity Strategy and Action Plan (2017-2026) includes recommendations to develop guidelines on the conservation of threatened and endangered species (Government of Sierra Leone, 2017), but strict protection of such species is not currently proposed.

13.2.1.1 Habitats

All habitats within the project site are concluded to be Modified with respect to the IFC classification (IFC, 2012). They are common and widespread habitats in Western Sierra Leone and are not of conservation concern in their own right. They are not critical habitats with respect to the IFC Criteria (Appendix S).

All habitats in the wider area within 2km of the project site are also concluded to be Modified with respect to the IFC classification. Apart from habitats within the designated sites, only the watercourses are considered to provide some value for native species of plants and animals. However, given their condition the watercourses are concluded not to be critical habitats with respect to the IFC Criteria, and they are assigned a local value only. Urban gardens in the local area also include vegetable plots, which provide an Ecosystem Service to local people through the provision of food, but considering their small scale, they are considered of value at the local level only. Apart from those included within the designated sites, all other habitats within 2km of the site are considered of value at the less than local level.

The degraded nature of the mangroves and costal habitats within 2km of the project site means that they are unlikely to support species of conservation concern. Nor are they used for fishing or foraging by local people. Being designated features in the Ramsar Wetland, these habitat areas have an international value, although being so fragmented and degraded they are unlikely to significantly contribute to the integrity of the designated site. The Second National Biodiversity Strategy and Action Plan (2017-2026) (Government of Sierra Leone, 2017) includes recommendations to support and promote the conservation and rehabilitation of mangroves and promote policies that reduce the infrastructural development of mangroves, coastal areas and the marine environment. However, such measures are unlikely to rehabilitate habitats within 2km of the project site, because these comprise very small and fragmented patches with little or no room for expansion. It will be more cost effective to focus efforts on less degraded, larger and more contiguous areas of mangrove and coastal habitats away from Freetown that

have fewer pressures from pollution and disturbance and which provide a better potential to support the species and processes associated with high-quality mangroves.

Similarly, although areas within the National Park close to Freetown, within 2km of the project site, are degraded and although none of the Park's species of conservation interest are likely to occur within this distance, they have a national value by default. The habitats within the 2km distance might act as a buffer between the high-density forest habitat in the center of the National Park and surrounding land uses, notably the urban sprawl in the north, although they are unlikely to significantly contribute to the integrity of the National Park.

13.2.1.2 Fauna

The species recorded on the project site and in the local area are mainly common and widespread species of little conservation interest. The only exceptions include the Western reef heron, which is an assemblage species in Sierra Leone River Estuary Ramsar Wetland and IBA, and the hooded vulture which IUCN considers to be endangered. Neither species was reported to be breeding in the local area, but they may occasionally forage on or near the site. In the absence of abundance data for the two species in the local area, they are each assigned a district value.

The two butterflies listed in Section 5.5.4 are endemic to West Africa but are not species of conservation concern.

The five turtle species are listed on CITES Appendix I and are, as such, threatened with extinction. They do not appear to breed on local beaches but could occur in local waters. Taking a conservative approach in the absence of an abundance of data for the five reptile species in the local area, they are each assigned a district value.

13.3 Construction Phase Impacts

The brownfield site and pipeline route will be cleared as part of the development works, and only minor losses of vegetation will occur within the site and potentially along new sections of the pipeline. During this process and the subsequent construction of the facility, habitats and species adjacent to the site have the potential to be disturbed and displaced.

Sierra Leone River Estuary Ramsar Wetland and IBA: Sierra Leone River Estuary is located c.400m north of the project site. The pipeline route will follow a road within the NP Facility until it turns northwards across the coastal zone to the Addax jetty. There will be no direct loss of designated habitat within the Ramsar Wetland / IBA. Confidence in this prediction is considered near-certain.

Indirect construction impacts on the estuary are possible, for example from surface runoff and accidental spills. Spillages may locally destroy conditions for shoreline organisms and species feeding on those. Given the existing level of degradation, including relatively high sedimentation and pollution levels, the magnitude of this effect is likely to be Low, and it is uncertain if construction impacts would significantly impact on the local habitats within the Ramsar Wetland and IBA. Nevertheless, taking a precautionary approach, in the absence of any mitigation, the magnitude of the effect is considered Medium, and the significance of the impacts is also considered Medium. Confidence in this prediction is probable only, owing to the precautionary approach being taken.

Disturbance impacts from construction machinery and people have the potential to result in temporary displacement of any bird species roosting or feeding in the local area, although because construction at the project site and LPG pipeline will be set back from the coast, this is likely to occur only when working on or adjacent to the jetty. However, with the exception of Western reef heron, the local area is unlikely

to consistently support qualifying bird species, in parts owing to the existing high levels of disturbance from industry and maritime traffic. The magnitude of construction disturbance on qualifying bird species is therefore concluded to be Low, and the significance of the effect is concluded to be Minor. Confidence in this prediction is considered near-certain.

Western Area Peninsula National Park: No pathway for significant impacts on the National Park during construction has been identified. Confidence in this prediction is considered near-certain.

Hooded Vulture: Hooded vulture is unlikely to breed on the project site or in adjacent areas but may occasionally enter the area to roost or forage. Individual birds are likely to avoid any construction impacts, notably visual or noise disturbance, by simply moving out of the zone of impact. The magnitude of effect is therefore concluded to be Low, and the significance of the effect is concluded to be Minor. Confidence in this prediction is considered certain / near certain.

Marine Turtles: Disturbance impacts from construction machinery and people have the potential to result in temporary displacement of any marine turtle present in the open water or on the coast in the local area. As construction at the project site and LPG pipeline will be set back from the coast, impacts are only potentially possible during works adjacent to the jetty. Animals impacted by desalination intake and outfall impacts could suffer reduced fitness as a result. However, given the existing high levels of disturbance from industry and maritime traffic and the degraded nature of local habitats, marine turtles are unlikely to be present near the zone of impact in any significant numbers. Any individuals present in the zone of impact are likely to simply move away from the zone and the magnitude of the effect is concluded to be Low. The significance of the effect is therefore concluded to be Minor. Confidence in this prediction is considered near-certain.

Indirect construction impacts from accidental spills could impact marine turtles, although turtles do not appear to be breeding on local beaches, the impact would be on individuals swimming in the water. Accidental hydrocarbon spills into the estuary may have a significant effect on marine turtles, both through chemical exposure from contaminated food but also from swimming in the fuel itself (Vargo et al., 1986). Oil on a turtle's skin may result in skin and eye problems and increased potential for infection, and fumes inhaled when a turtle comes to the surface to breathe may also result in irritation of the turtle's eyes or mouth and cause internal damage, such as irritation to the respiratory system, injured tissues or pneumonia. Owing to the small disturbance zone and the likely very limited extent of any spillage, the magnitude of the effect is concluded to be Low, and the effect of spillages on the five turtle species is therefore concluded to be Minor. Confidence in this prediction is considered near-certain.

13.4 Operational Phase Impacts

The 2015 ESIA concluded during operation, the most likely potential impacts include accidental spills on the estuary as well as air pollution effects on habitats and species. A 0.4 MGD desalination plant has been added to the project scope. Its capacity is modest and its discharge is configured to minimize the area of high salinity and to avoid impingement on the seabed. So, only monitoring of the impact of its discharge on the marine environment during the project's operation phase is being recommended.

Sierra Leone River Estuary Ramsar Wetland and IBA: The main potential for significant impacts on the Ramsar Wetland and IBA during operation of the plant relates to accidental, fuel spillages into the estuary. Given the existing high levels of activity in the area, and the fact that the project site itself is set back from the coast, disturbance impacts on qualifying species from machinery, ships and people are likely to be Low, and the significance of the effect is considered Minor. Confidence in this prediction is considered near-certain.

As described in Section 10. Air Quality, the maximum predicted annual mean process contributions for NO_x and SO_x are unlikely to result in an exceedance of the air quality guideline or lead to any significant impacts. The magnitude of effects is therefore predicted to be Low and the significance of the effects is concluded to be Minor. Confidence in these predictions is considered probable only, owing to uncertainty over background deposition rates.

Western Area Peninsula National Park: As no data is available on the background acid deposition rates, owing to the distance of the rainforest to industrial areas guideline thresholds are unlikely to be exceeded even when combined with existing concentrations. As such, the magnitude of effects is predicted to be Low and the significance of the effect concluded to be Minor. Confidence in this prediction is considered probable, owing to the lack of background deposition rates.

As no data is available on background Nitrogen deposition rates, owing to the distance of the rainforest to industrial areas, guideline thresholds are unlikely to be exceeded even when combined with existing concentrations. As such, the magnitude of effects is predicted to be Low and the significance of the effect concluded to be Minor. Confidence in this prediction is considered probable, owing to the lack of background deposition rates.

Hooded Vulture: During operation, there is a potential for impacts on hooded vultures from noise and visual disturbance. However, the magnitude of this effect is likely to be Low, as any vultures currently present will be at least partially habituated to disturbance impacts from existing developments in the local area. As such, the significance of the effect is concluded to be Minor. Confidence in this prediction is considered near-certain.

Marine Turtles: Disturbance impacts from ship traffic and jetty operations have the potential to result in displacement of any marine turtles present in the open water or on the coast in the local area. However, given the existing high levels of industrial disturbance in the area, and the degraded nature of local habitats, marine turtles will be unlikely to be present near the jetty and the magnitude of the effect is likely to be Low. The significance of the effect is therefore concluded to be Minor. Confidence in this prediction is considered near-certain.

The ocean intake of a desalination plant poses a high risk to marine turtles. However, few studies have been performed on the impacts of increased salinity, reduced dissolved oxygen, or increased temperature of the returned water. As this project's water demand is low and marine turtles are unlikely to be present near the intake and outfall structure the magnitude of the effect is likely to be Low. The significance of the effect is therefore concluded to be Minor. Confidence in this prediction is considered certain.

However, as described for potential spills during the construction phase, accidental fuel spills into the estuary may have a significant effect on marine turtles, both through chemical exposure from contaminated food but also from swimming in the fuel itself. Oil on a turtle's skin may result in skin and eye problems and increased potential for infection. Additionally, fumes inhaled when a turtle comes to the surface to breathe may also result in irritation of the turtle's eyes or mouth and cause internal damage, such as irritation to the respiratory system, injured tissues or pneumonia. The effect on marine turtle numbers could last several years, and the magnitude of the effect is therefore concluded to be Medium. In the absence of any mitigation, from the significance of the effect of spillages on the five turtle species is concluded to be Medium. Confidence in this prediction is considered near-certain.

Table 13.1 provides a summary of the predicted effects during the construction and operation phases, and in the absence of any mitigation.

Table 13.1 Summary of Predicted Effects in the Absence of Any Mitigation

Topic	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Sierra Leone River Estuary Ramsar Wetland and IBA	International	**Construction**				
		Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works	Reduced abundance of organisms at the bottom of food chain as food base for qualifying species	Medium	Moderate	Indirect negative temporary
		Disturbance from construction machinery and people	Displacement of qualifying species resulting in poor fitness	Low	Minor	Indirect negative temporary
		Operation				
		Large fuel spillage	Reduced abundance of organisms at the bottom of food chain as food base for qualifying species	Low	Minor	Indirect negative medium term
			Direct toxicity, poor feeding and increased predation			
		Disturbance from construction machinery and people	Displacement of qualifying species resulting in poor fitness	Low	Minor	Indirect negative temporary
		Air deposition	Deposition leading to dieback or changed habitat structure	Low	Minor	Indirect negative temporary
	National	**Construction**				

Topic	Importance	Source of Effect	Effect Summary Description	Potential Effect Unmitigated		
				Magnitude	Significance	Impact Type
Western Area Peninsula National Park		N/A	N/A	N/A	N/A	N/A
		Operation	N/A	N/A	N/A	N/A
		N/A	N/A	N/A	N/A	N/A
Hooded vulture	District	**Construction**				
		Disturbance from construction machinery and people	Displacement resulting in poor fitness	Low	Negligible	Indirect negative temporary
		Operation				
		Disturbance from machinery and people	Displacement resulting in poor fitness	Low	Negligible	Indirect negative temporary
Marine turtles	Local	**Construction**				
		Disturbance from construction machinery and people	Displacement resulting in poor fitness	Low	Negligible	Indirect negative temporary
		Potential hydrocarbon spillage during construction works	Direct toxicity	Low	Negligible	Indirect negative temporary
		Operation				
		Disturbance from machinery and people	Displacement resulting in poor fitness	Low	Negligible	Indirect negative temporary

13.5 Mitigation

This section defines measures to be implemented to reduce significant impacts on sensitive ecological receptors as part of the development.

The measures described will be assembled in the ESMP, which provides the management framework needed to implement the proposed strategies. The ESMP will describe actions to be taken to eliminate or reduce key identified impacts related to ecological receptors to acceptable levels, as well as considering other biophysical, socioeconomic and health issues. It will also stipulate monitoring regimens required to track these. The ESMP will be a live document that will last the lifetime of the project and will be updated regularly as the project proceeds.

13.5.1 Construction Phase

The following mitigation measures will be implemented during the construction phase:

- Minimizing direct impacts on intertidal and coastal habitats:
    - Use temporary fencing to prevent inadvertent damage to mudflat, mangrove and coastal habitats adjacent to the construction zone;
    - Ensure the way-leave area width is at its minimum for least removal of vegetation; and,
    - Site temporary works areas away from coastal habitats where practicable.
- Minimizing indirect habitat impacts:
    - Minimize potential for pollutants and surface water runoff to migrate offsite through use of silt traps or similar measures and adherence GIIP regarding pollution prevention guidelines;
    - Carry out toolbox talk to educate site staff about the sensitivity of coastal and intertidal habitats; and
    - Re-plant areas left undeveloped with native vegetation to prevent the incursion of opportunistic invasive species.
- Minimizing impacts on species:
    - Adherence to pollution prevention guidelines;
    - Carry out toolbox talk to educate site staff about the sensitivity of threatened species and their protection; and
    - Use floating barriers to contain any spillages and deter species from moving into work zone.

13.5.2 Operation phase

The following mitigation measures will be employed during the operation phase:

- Treatment of sanitary discharges to IFC Water Quality Discharge Standards prior to release to remove pollutants.
- Fuel spillage mitigation.

No significant impacts are expected from the desalination plant. Monitoring during operations will be conducted to confirm expectations.

13.6 Cumulative Impacts

Disturbance impacts from construction machinery and people have the potential to result in temporary displacement of any bird species roosting or feeding in the local area is unlikely to be significant as the LNG pipeline will be set back from the coast. In addition, with the exception of Western reef heron, the local area is unlikely to consistently support qualifying Ramsar Wetland / IBA bird species, in part owing to the existing high levels of disturbance from industry and maritime traffic. Cumulative disturbance impacts are therefore unlikely to be significant.

Spillages may locally destroy conditions for shoreline organisms and the species feeding on those and as described earlier, spillages can directly affect marine turtles and Western reef heron. However, both developments include a range of mitigation measures to contain spillages. These include an Emergency Response Plan, which will be prepared to deal with spillages, and spill containment and clean-up materials will be available on permanent standby at the jetty. Waste disposal plans will also be in place relating to the safe disposal of recovered oil and used clean-up materials. Implementation of these measures makes it unlikely that spillages will have significant impacts on birds and turtles in the estuary.

13.7 Residual Impacts / Conclusions

The projects impact, expected to be minimal, would be reduced to acceptable levels to ensure compliance with IFC PS 6 levels. Provided that the mitigation measures described in the previous section are implemented, all residual negative impacts on valued ecological features will not be significant. Confidence in this prediction is considered near-certain.

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14 Waste

This Section presents an evaluation of the potential impacts resulting from the generation of wastes, their storage, treatment and/or or disposal and the associated management activities during the lifetime of the CECASL WAPGP.

The WBG EHS Guidelines on Waste Management define waste as "any solid, liquid or contained gaseous material that is being discarded by disposal, recycling, burning or incineration. It can be by-product of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal"

Waste management is recognized as in integral and critical component of the ESHIA.

Information relating to expected waste generation has been used to assess potential environmental impacts resulting from waste generation, storage, treatment and disposal during the construction and operation phases of the proposed development.

14.1 Relevant Legislation, Convention and Standards

International Finance Corporation Guidelines for Waste Facilities: The operation of the onsite incinerator will follow the IFC 2007 Environmental, Health and Safety guidelines for waste management facilities, with specific regard to the guidelines for hazardous waste incineration

Waste management facility guidelines include recommended measures to prevent, minimize and control air emissions, water effluents and solid waste. The EPC Contractor and Operator will implement these guidelines during the construction and management of the onsite incinerator.

Environmental, Health, and Safety (EHS) Guidelines: Environmental Waste Management: The proposed development will also follow the WBG EHS Guidelines for waste management, which apply to the management of non-hazardous and hazardous waste, The Guidelines outline recommendations on the development of a waste management system that addresses issues linked to waste minimization, generation, transport, disposal and monitoring.

IFC Performance Standard 3, Resource Efficiency and Pollution Prevention: The proposed development will meet the relevant provisions of this standard with particular regard to paragraph 12, wastes.

14.2 Potential Impacts

It was identified that Sierra Leone does not have appropriate waste processing facilities to receive sludge waste. The original projects design incorporated an incinerator for treatment of fuel prior to combustion. The design still has an on-site incinerator facility to combust waste, with ashes disposed of at Central Dump landfill. The waste to be incinerated will be less than the original project but will still require an onsite facility. Chemical constituents of this ash waste will be confirmed later. Operations of the incinerator will be infrequent and intermittent and are likely to occur once or twice a week. Emissions from the incinerator are considered in the air quality impact assessment.

Two distinct phases are envisaged for waste management, the first encompassing the initial construction activities, and secondly, the operational phase of proposed development.

14.2.1 Waste Streams – Construction

A major component of construction wastes will be the generation of soil arisings through excavation, other solid wastes generated in construction include:

- Building rubble,
- General construction waste, e.g., cement bags and waste concrete,
- Plastics,
- Electrical cabling,
- Scrap metals (mixed metals) including spent welding rods,
- Empty chemical containers,
- Packaging materials of cardboard and plastic,
- Fiberglass,
- Spilled oils and waste oils,
- Spilled oil clean-up materials,
- Paint,
- Waste wood,
- Paper,
- Domestic waste,
- Sewage effluent, and
- Grass / vegetation from stripping.

Due to the scale of the project, it is likely that a significant amount of waste will be generated during the site preparation and construction phase, some of which is likely to be classified as hazardous. At this stage, it is not possible to provide accurate figures related to the quantities of waste generated as part of the construction phase although concrete wastage can amount to 5-10% of the total used.

Hazardous materials will be a part of the waste streams during demolition and construction, these can be shown in Table 14.1 Hazardous Waste Streams. In particular, Asbestos has a large impact on human health and will need to be taken into consideration when putting together the ESMP for the demolition and construction phase.

14.2.2 Waste Streams – Operation

Once operational, there will be few significant sources of solid waste generated and the additional burden placed on the existing waste management infrastructure in the project area should be low.

- Domestic and commercial waste (cardboard, paper, pallets, packaging material from spares, waste printer cartridges, food wastes, dirty oil etc.);
- Wastes produced during maintenance, including:
    - Sludge removed from oil separators;
    - Sludge from water treatment;
    - Scrap metals from maintenance; and,
    - Miscellaneous wastes (e.g. air filters).
- Paper and plastic packaging materials.

The vaporization of the LPG will produce blowdown stream which will need to be incinerated. The LPG vaporizer blowdown will be burned in a small on-site incinerator, with the resulting ash disposed of in the central dump.

A very small volume of items which cannot be incinerated (e.g., batteries) will need to be stored and appropriate disposal determined as part of the Waste Management Plan.

Table 14.1 below provides a list of the expected hazardous waste.

Table 14.1 Hazardous Waste Streams

Project Phase	Hazardous Waste
Demolition	Asbestos
Construction	Excavated materials which may contain heavy metals, hydrocarbons / other contaminants.
Construction	Scrap metals
Construction and operation	Empty chemical containers
Construction and operation	Paints and solvents associated with construction and maintenance activities.
Construction	Waste fiberglass
Operation	Spent water treatment filters / sludge and medical waste
Construction and operation	Land based spilled treated and untreated oil
Construction and operation	Waste oil clean up materials
Construction and operation	Chemicals and greases
Construction and operation	Batteries

14.2.3 Assessment of potential impacts

The generation of solid wastes and potentially improper and/or indiscriminate disposal of solid waste in and around the project facilities are potentially adverse effects associated with the development. Likely sensitive receptors are considered to be:

- Uncontaminated surface and near surface soils;
- Controlled waters – surface water and groundwater;
- Ecological receptors; and
- Human receptors – groundworkers, site workers and nearby communities.

The methodology adopted for assessing the significance of effects is presented in Section 6 of this ESHIA.

The impacts from the management of inert wastes, should they occur, would be at a local level i.e., within 1km of the project site. However, wider district or regional impacts could occur if the waste removed from the site for disposal by third parties is not disposed of appropriately by the waste contractors. For hazardous wastes it is possible that arrangements will need to be made to transport wastes further afield, and even possibly overseas dependent on the availability of suitable disposal contractors. As such the sensitivity of the site and surrounding areas with respect to land and water quality is considered to be of "district" geographical context (see Section 6 for geographical context definitions).

The potential impacts to these receptors from wastes during the construction and operation phase and the management methods and mitigation measures in place to reduce the significance of potential impacts are outlined below.

14.3 Construction Phase Impacts

The following impacts have been identified for onshore and offshore components:

- Contamination of soils by direct exposure to contaminated wastes and or migration of contaminants in surface runoff or migration of contaminants such as oils / hydrocarbons;
- Contamination of groundwaters through leaching of contaminants from waste materials which are not properly contained or illegally dumped;
- Contamination of surface waters through improper storage and disposal of wastes, either directly or by migration of contaminants in groundwaters;
- Harm to ecological receptors through improper waste disposal / illegal dumping of wastes in ecologically sensitive areas;
- Harm to ecological receptors through migration of contaminants leached from poorly managed waste materials and pollution of waterbodies;
- Human health impacts from direct contact with contaminated waste materials generated during excavation;
- Human health impacts through contamination of surface waters and ground waters (drinking water) with implications for human consumption;
- Human health impacts from fugitive dusts generated from stockpiled waste materials;
- Human health impacts from fugitive dusts caused by transportation of waste materials;
- Visual impact from improper waste disposal / illegal dumping of wastes;
- Impacts to sensitive receptors following accidental release / spillages of materials used during the construction process;
- Human health impacts from odors generated by waste materials or from vermin infestation;
- Human health impacts through inappropriate re-use of waste materials; and
- Unnecessary disposal of materials and use of natural resources.

Without appropriate waste storage options there is a chance that environmental contamination could occur. Furthermore, given that the nature of some of the wastes that may could be potentially hazardous, then the receiving environment would likely suffer lasting effects should solid waste of a hazardous nature be discharged.

The magnitude of any effect that construction of the development may have on land or water quality or the effect that existing land or water quality may have on human health or the environment is assessed as medium. The significance of the effect from construction activities is therefore assessed as minor without mitigation.

14.4 Operational Phase Impacts

The following impacts previously identified for the construction phase apply to the operational phase of the project:

- Contamination of soils, groundwaters and surface waters following improper storage and disposal of wastes;

- Harm to ecological receptors through improper waste disposal / illegal dumping of wastes in ecologically sensitive areas or through migration of contaminants leached from poorly managed waste materials and pollution of waterbodies;
- Human health impacts following improper storage and disposal or re-use of wastes through contamination of surface waters and ground waters (drinking water) with implications for human consumption;
- Impacts to sensitive receptors following accidental release / spillages of waste materials used during operation;
- Human health impacts from odors generated by waste materials or from vermin infestation; and
- Unnecessary disposal of materials and use of natural resources.

As discussed above, in construction without appropriate waste storage options there is a chance that environmental contamination could occur. This would represent a breach of environmental legislation on the basis that inappropriate waste disposal was taking place. Furthermore, given that the nature of some of the wastes that may could be potentially hazardous, then the receiving environment would likely suffer lasting effects should solid waste of a hazardous nature be discharged.

The magnitude of any effect that construction of the project may have on land or water quality or the effect that existing land or water quality may have on human health or the environment is assessed as medium. The significance of effect of on and offshore from construction activities is therefore assessed as minor without mitigation.

14.5 Cumulative Impacts Assessment

The operation of the Power Plant will add to the loading on district waste disposal facilities which may already be unsuitable to accept certain types of waste. There is a risk that the existing facilities will not be able to cope with the quantities and types of wastes that are being produced. An audit of the waste disposal facilities is required to be undertaken by the EPC Contractor and project operator prior to use of the facilities to ensure they are appropriate for use.

Additional shipping will also increase the potential for waste generation and disposal facilities onshore.

The magnitude of any cumulative effects that the construction and operation of the development may have on land or water quality is assessed as high. This assessment is conservative and has been made considering the known lack of disposal facilities for wastes and the problems faced by developing countries in appropriate waste management. The cumulative significance of effect of the development is therefore assessed as medium without mitigation.

14.6 Waste Management and Mitigation

The potential impacts as a result of the generation and disposal of waste at the site have been recognized as a potential impact if not adequately addressed from the outset. This section outlines the mitigation measures proposed to be employed at the site and represent best practice.

14.6.1 Waste Disposal

Where disposal of wastes is required for construction and operation phases, this will be undertaken using a suitable waste contractor. All contractors and waste disposal facilities will be audited by the project prior to use.

According to the waste hierarchy principle, the primary objective for waste management should be the reduction of the amount of waste generated through the prudent and efficient use of raw materials. Where waste generation is unavoidable, there is a need to ensure that waste storage on site and final disposal is suitable for the types and quantities of wastes being generated.

The following principal options for the control of wastes generated from sites have been identified:

- Application of the waste hierarchy (reduce, reuse, recycle and dispose);
- Disposal of waste materials;
- Storage facilities for waste materials;
- Control of non-hazardous and hazardous wastes; and
- Reduce the risk of accidental spillage of waste materials.

The application of each of these for the project is discussed below.

Waste Hierarchy and Disposal of Wastes: Wastes will be suitably managed with the implementation of the Waste Management Plan (WMP) and standard mitigation options (such as hierarchy of reuse, recycling, and disposal).

Where possible, any waste soils at the site generated during the installation of the plant equipment (pile arisings and excavated materials) will be re-used on site. Where this is not possible (e.g., because of contamination or because they are geotechnically unsuitable) contamination will be neutralized utilizing the services of suitable waste contractors and/or they will be disposed to a suitable disposal site.

Waste disposal contractors and waste disposal sites are to be audited to ensure they meet the required national regulatory, EPA-SL and international IFC standards.

Storage: Prior to disposal the wastes generated may need to be stored on site. Provisions will be made to store wastes within designated areas located on hard surfaces to prevent infiltration to ground and covers will be provided where necessary. Suitable storage containers for wastes will be used where appropriate.

For arisings generated through excavation work, these will be placed on an impermeable membrane which also covers the spoil heap to prevent rain washing out contaminants. Rainwater collection bunds and trenches around the spoil heaps should be used as necessary.

Adequate containment for fuels and oils used in construction, including the use of secondary containment systems (for example bunds and drip trays) and provision of drainage trenches where necessary will be used to prevent pollution entering clean surface soil, water and groundwater.

All dry materials will be stored to minimize dust and wastage. Materials will be stored in containers where possible and all bagged materials will be stored on pallets and covered. Cements will be stored on original packaging pallets and within enclosed storage compounds where possible. If outside storage is required cement will be stored off the ground on pallets and covered with tarpaulin. No polluting materials will be stored on wetland areas or in the vicinity of any watercourses.

Control of Hazardous and Non-hazardous Waste: Hazardous wastes may be generated through the disturbance and excavation of contaminated land and by use of hazardous materials in construction.

In order to identify potentially hazardous waste and prevent pollution of clean soil, surface water and/or groundwater staff will be trained in identification of potential contamination (e.g., discolored soils, odors etc.). If contamination is suspected the following measures will be implemented:

- Works will be stopped, and the area covered as far as possible;
- Any contaminated spoil waste will be covered and stored in an impermeable, bunded area, away from drains and watercourses;
- Contaminated material will be segregated from inert material to avoid cross contamination; and
- Materials will be tested and disposed of as hazardous waste if appropriate via suitable waste disposal contractors. For hazardous wastes it is possible that arrangements will need to be made to transport wastes further afield, and even possibly overseas dependent on the availability of suitable disposal contractors.

Hazardous wastes generated from materials used in construction will be stored separately from inert wastes and sent for disposal using an appropriate disposal contractor. Workers will be trained in the handling of hazardous wastes and appropriate PPE (e.g., gloves, safety glasses etc.) will be provided where necessary.

Asbestos Waste Mitigation and Removal Strategy: Asbestos has been found within the construction materials of the current building slated to be demolished. Any of the materials containing Asbestos fibers will be handled, removed, and stored appropriately.

Given the use of appropriate management and mitigation measures for construction wastes, there will be no significant impacts from wastes during the construction phase. There will be residual impact from use of landfill and natural resources, but this will be minimized as far as possible by reduction of wastes and reuse of inert wastes where possible.

14.6.2 Solid Wastes Management in Operation

The management and mitigation measures stated for the construction phase also apply for wastes generated during operation. Less waste will be generated throughout the operation of the facility. Some of this waste will include hazardous waste sludge which cannot currently be processed / disposed of within Sierra Leone and therefore an incinerator will form part of the design. Careful management of the incinerator operation will be required to ensure the correct burn temperatures are maintained to prevent production of harmful emissions.

Detailed waste management procedures will be developed for the operational phase in accordance with the requirements of the Waste and Environmental Management Plans and the ESMP. An Environmental Control Officer / Manager (title to be confirmed) will be appointed to ensure the management systems are implemented correctly.

As for the construction phase the waste hierarchy will be applied as far as practicable to reduce, reuse and recycle in preference to disposal. Following segregation, inert wastes reused as far as possible.

Provisions will be made for segregation of waste materials on site. For general wastes receptacles will be provided for different waste streams (e.g., for food wastes, plastics, metals etc.). The receptacles will be clearly marked and fit to hold the type of waste they will contain. There will be frequent emptying of waste receptacles and transfer to appropriate storage facilities on site and/or transfer and disposal by suitable waste disposal contractors.

Waste storage areas will be suitably located on hard surfacing and covered where appropriate to ensure containment of wastes. Containers will be provided for storage of wastes where appropriate. There will be special provisions for the storage of any hazardous wastes, and these will be segregated from inert wastes.

All storage areas will be regularly emptied and periodically cleaned and disinfected.

Staff will be fully trained in the handling and suitable disposal of waste streams and provided with PPE where appropriate.

The development of a detailed waste management plan for operations and implementation of the required mitigation measures will ensure that the impacts from waste are minimized. The main impact will be from use of landfill resources and this will be minimized as far as possible by reduction of wastes and reuse of inert wastes where possible. The WMP will include information requirements for the recording of waste and waste disposal activities.

14.6.3 Accidental Releases

Accidental release / spillages may arise through activities during both the operational and construction phase. In the event of an accidental release, measures are in place to contain wastes to prevent direct discharge to sewer outfall. Measures will be in place to contain these wastes and ensure they are appropriately treated and disposed. Measures will ensure there are no inappropriate discharges of wastes to sea.

14.7 Residual Impacts

Following implementation of the mitigation measures identified above, the magnitude of any effect that the construction and operation of the development may have on land or water quality is assessed as low. The significance of effect is therefore assessed as negligible with the implementation of appropriate mitigation measures.

14.8 Conclusions

Environmental effects are associated with the generation of solid waste and potentially improper and/or indiscriminate disposal of solid waste in and around the project site and the marine environment with implications for subsequent land contamination, visual impact and public health issues. Mitigation measures to reduce the occurrence of these effects included appropriate use of the waste hierarchy (reuse, recycling, and disposal), adequate provisions for storage and segregation of wastes and appointment of approved waste contractors for removal and disposal of wastes to an approved facility. More detailed waste management procedures will be developed prior to operation and the EPC construction contractor will implement a WMP for the construction phase.

A residual impact is inevitable given that waste will be generated throughout the lifespan of the project, however the implementation of recommended mitigation measures will ensure the significance of this effect is reduced.

The Project will take appropriate measures to ensure that Lender approved guidelines are met.

14.9 References

- WBG (2007) Environmental, Health, and Safety Guidelines for Waste Management Facilities
- WBG (2007) Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINES: ENVIRONMENTAL WASTE MANAGEMENT

- IFC (2012) Performance Standard 3 Resource Efficiency and Pollution Prevention

15 Traffic and Transport

This section of the report outlines the existing traffic and transport, and access-related conditions in the vicinity of the proposed development. The likely significant effects of the proposed development are also identified for the construction and operational phases, followed by any necessary mitigation measures required to prevent, reduce or offset potential effects. Finally, the significance of the likely residual effects of the proposed development are described taking into account the mitigation measures.

15.1 Relevant Legislation, Convention and Standards

The Ministry of Transport and Aviation has the mandate of ensuring safe and reliable transport systems in Sierra Leone. This mandate covers all the modes of transport including road, air, and sea. Their vision statement reads, "The transport Ministry seeks to promote the well-being of quality transport and effective road networks. The transport Ministry also ensures that people have access to well-functioning safe and reasonable priced transportation system."

Over the years, specific agencies have been set up to manage various modes of transport, including the Sierra Leone Airports Authority, Sierra Leone Maritime Administration, and the Sierra Leone Road Transport Corporation.

The Ministry maintains oversight over policy development and implementation and is responsible for ensuring efficient, sustainable, and affordable transportation networks to facilitate economic development.

The key policy directives for the key modes of transportation include:

- ensure safe and smooth everyday travel and maintain competitiveness in the transport sectors;
- ensuring physical access to services and revenue-generating opportunities;
- lowering transport costs to ensure affordability of transport;
- increasing efficiency in the delivery of transport services; and
- promote safety in the roads, air, and marine sectors.

Liaison with these bodies will be undertaken by the contractor prior to construction.

In addition to the above local governance, the Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of good practice, published by the World Bank / IFC. They are designed to provide guidance to users on EHS issues in specific industry sectors.

Recommendations and best practice guidance provided in relation to traffic safety include:

- Emphasizing safety aspects among drivers;
- Adopting limits for trip duration and arranging driver shifts to avoid overtiredness;
- Avoiding dangerous routes and times of day to reduce the risk of accidents;
- Use of speed control devices on trucks;
- Employing safe traffic control measures, including road signs and flag persons / banksmen to warn of dangerous conditions; and
- Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction / failure.

It also recommends the following guidelines where a proposed development may contribute to a significant increase in traffic along existing roads, or where road transport is a significant component of a scheme:

- Minimizing pedestrian interaction with construction vehicles;
- Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present;
- Collaborating with local communities on education about traffic and pedestrian safety;
- Using locally sourced materials, whenever possible, to minimize transportation; and
- Locating associated facilities such as staff accommodation close to project sites and arranging worker bus transport to minimize staff motorized trips.

15.2 Potential Impacts

15.2.1 Vehicle Route

The majority of the raw / construction materials will be sourced locally wherever possible. However, these materials then need to be transported to site using vehicles which are appropriate for the type, class and quantity of goods being transported. The entrance to the proposed development is off Factory Road; this is accessed from Bai Bureh Road either through Africanus Road / Factory Road or through Parsonage Street. The access roads between the site entrance and Bai Bureh Road are tarmac routes, although some parts are in poor repair.

It is also understood that some construction materials / equipment will be transported to the Proposed Development via the Queen Elizabeth II Quay container terminal, located approximately 3 km north-west of the proposed site. Figure 15.1 shows the vehicle route between the container terminal and the proposed development and highlights the key junctions along this route, as well as the access points to the proposed development. The proposed route will see vehicles using the Bai Bureh Road, a dual carriageway route, for the majority of the journey (3.5km) from the container terminal to the proposed development. To access the Bai Bureh Road, vehicles leave the container terminal and use Racecourse Road, and Cline Street.

Figure 15.1 Vehicle Route from Dock

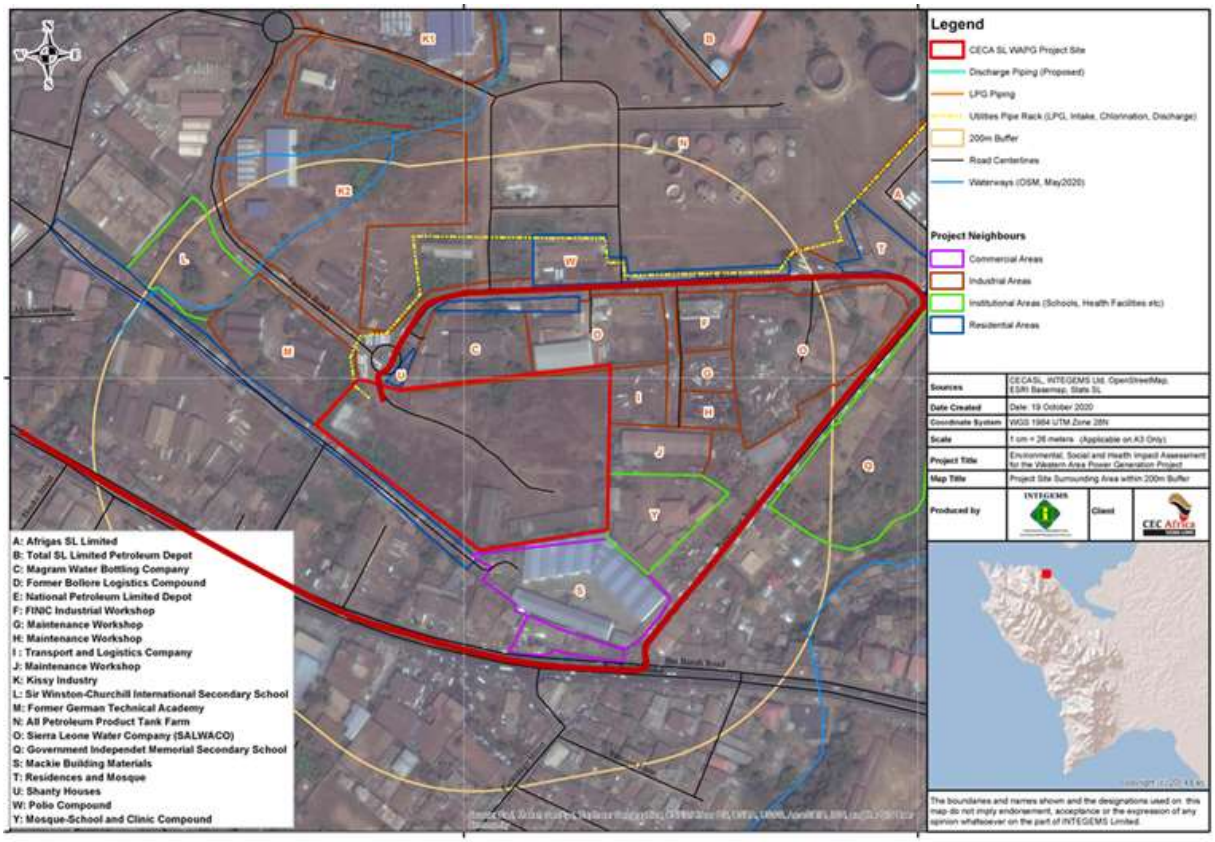
The key junctions identified on Figure 15.1 above are:

1. Bai Bureh Road / Racecoure Road / Cline Street (5 arm junction)
2. Bai Bureh Road / Africanus Road
3. Africanus Road / Factory Road (4 arm roundabout)
4. Bai Bureh Road / Parsonage Road

The local access route for the project and surrounding residences is illustrated in red in Figure 15. below. This roadway is currently unpaved, but is regularly utilized by trucks at present. Approximately 55 HGVs per day are anticipated to visit the site during project construction and 20 total vehicles during operations. While 55 HGVs per day is not considered a particularly high number of trips, the area is heavily used by school children due to the presence of two nearby schools and the adjacent Islamic compound (whose entrance is directly on the access road). There are also shanty houses located in close proximity to the road and site entrance. On the basis of this and the current condition of the road, the community safety risks associated with the project would be considered moderately significant.

Therefore, a Transportation Management Plan will be developed for the project that will include limited road grading and maintenance (of the construction route from the west during the construction period) and will carefully consider additional measures around community health and safety (particularly regarding risks to school children along the access road route and shanty houses adjacent to site entrance) to reduce these risks to as low as is reasonably practicable. These and other possible measures will be agreed in consultation with IFC and EPA-SL during development of the Traffic Management Plan.

Figure 15. Local Access Route



15.2.2 Assessment Methodology

The Institute of Environmental Assessment (IEA) document 'Guidelines for the Environmental Assessment of Road Traffic' sets out a recommended list of environmental impacts which could be considered as potentially significant whenever a new development is likely to give rise to changes in traffic flows. This section deals with the following subjects listed in these guidelines:

- Road user delay and congestion,
- Highway user safety,
- Pedestrian delay and amenity,
- Dust and Dirt, and
- Hazardous Loads.

The Guidelines for the Environmental Assessment of Road Traffic suggest that highway links should be separately assessed when traffic flows have increased by more than 30%. Other sensitive areas could be affected by traffic increases of at least 10%, or where Heavy Goods Vehicles (HGV) flows have increased significantly (by more than 30%). Since no traffic data is currently available for the highway networks around the proposed site it is not possible to identify where increases of this magnitude may occur. It is our understanding from site visits that the existing volume of traffic on Bai Bureh Road is such that the Proposed Development will at no time generate additional traffic that would create a 30% increase in traffic volumes. Therefore, any future analysis, to be undertaken by the contractor prior to construction, should focus on Racecourse Road / Cline Street near the container terminal and Africanus Road / Factory Road / Parsonage Street near the proposed development.

The impacts of the proposed development will be considered under two scenarios: construction and operation of the site. This analysis was based upon available traffic data and professional judgement to assess the findings in relation to each of the criteria listed to give an assessment of significance for each effect. Effects are considered to be major, minor or negligible and can be negative or positive. Where positive impacts are identified mitigation is not required.

15.3 Construction Phase Impacts

15.3.1 Impact Description

Traffic generated during construction of the proposed development will arise from the following:

- delivery of construction materials and equipment to the Proposed Development;
- long distance delivery of large operational infrastructure, e.g., boilers, condensers, engines and storage tanks;
- spoil removal; and
- Construction staff access / egress.

Information provided by the client indicates that approximately 300 local people will be employed during the construction period. While it is not yet known where construction workers will be accommodated, the contractor will provide buses to transport workers to and from the construction site. Based on a capacity of 10 people per bus, it is estimated that a maximum of 20 two-way vehicle movements will be generated during the morning and evening peaks.

In addition, HGV traffic associated with the construction phase will likely be in the order of 55 vehicles (i.e. 110 vehicle movements) per day at the peak of construction. It is estimated that Light Goods Vehicle (LGV) during the construction phase will be in the order of 29 vehicles per day (i.e., 58 vehicle movements). These movements include both the delivery of construction materials and the removal of construction waste. This level of trip generation is not considered to be significant when considered against the road capacities provided in Table 5.21 National Road Link Capacities (Section 5.7).

Vehicles delivering items to the proposed development will include the following:

- HGVs delivering items such as aggregate and steel work;
- Low Loaders delivering steel work, pre-cast pile foundations, boiler components and turbine components;
- Road Tankers delivering items such as fuel and chemicals;
- Ready mixed cement vehicles; and
- LGVs.

15.3.2 Impact Significance

Road User Delay and Congestion: The level of traffic generated during the construction of the proposed development is relatively small when compared to the notional capacities of the local roads, which are identified in Section 5.7 of this report. This level of traffic would add very little to the volumes of traffic already in existence, and it is important to note that this is temporary traffic. It is considered that the increases are unlikely to result in an adverse impact. Notwithstanding this point, as outlined previously it is recognized from site visits that many of the roads surrounding the proposed development are already congested and therefore operating at or close to saturated traffic conditions.

It will be important to manage the flow of vehicles to and from the proposed development site as they will be adding vehicles to an already "congested" highway network. Without any mitigation there is the potential for minor negative impacts to occur.

Highway User Safety: Due to the increase in construction traffic there is a potential for increases in road accidents between vehicles and pedestrians. Without mitigation there is the potential for major negative impacts to occur.

Pedestrian Delay and Amenity: Pedestrian delay is closely related to traffic flow along a link and the increases in traffic flow during the construction phase are unlikely to lead to any significant change to pedestrian delay. However, pedestrian amenity can be broadly defined as the relative pleasantness of a journey and this could potentially be affected by traffic flow and traffic composition. The minor increase in traffic flow as a result of construction staff travelling to and from the site is unlikely to result in any notable change to pedestrian amenity. Furthermore, while it is acknowledged that there will be additional HGV trips associated with the construction phase, this is likely to be no more than seven vehicles per hour when spread across a 12-hour day and is therefore also not likely to have a significant impact on pedestrian amenity.

Overall, the effect of the construction phase of the proposed development on pedestrian delay and amenity is likely to be negligible.

Dust and Dirt: The effect of dust and dirt impacting on the local area and highway network is likely to be mostly felt during the construction period. Without mitigation there is the potential for minor negative impacts to occur.

Hazardous Loads: It is acknowledged that there may be hazardous loads associated with the construction of the proposed power plant, increased accidents and incidents with hazardous materials during transportation have the potential to result in damage to property and the environment, injury, and death. Without mitigation there is the potential for major negative impacts to occur.

Measures to manage and mitigate all the above impacts are provided in Section 14.5 of this report.

15.4 Operational Phase Impacts

15.4.1 Impact Description

During the operation the proposed development will be operational on a 24-hour basis. It is anticipated that the proposed development will employ a total of approximately 60 staff, and these staff will work in three shifts.

Using data from Transport Assessments for two comparable power stations (100mW), it is estimated that approximately 75% of staff (36) would be office-based staff working standard daytime office hours whilst the other half would be split between two further shifts. The anticipated shift patterns and split of employees is as follows:

- Shift 1 – 36 employees – 0800-1700
- Shift 2 – 12 employees – 1700-0000
- Shift 3 – 12 employees – 0000-0800

Employees at the site are likely to reside within the western urban area of Freetown.

In addition to staff travelling to the site, there will also be routine maintenance and delivery vehicles access the site, and this will only be undertaken during daytime hours. Furthermore, there may be an occasional delivery from the nearby container terminal. However, this is expected to constitute no more than 1 or 2 vehicles per day.

15.4.2 Impact Significance

Road User Delay and Congestion: The level of traffic generated during the operational phase of the proposed development is significantly less than the construction phase, and again is relatively small when compared to the notional capacities of the local roads, as outlined in Section 5.7 of this report. This level of traffic would add very little to the volumes of traffic already in existence. Notwithstanding this, even this low level of increase could have the potential to have a minor negative impact on community safety in the local area on routes which are already congested, without appropriate mitigation measures.

Highway User Safety: Due to the increases in traffic there is a potential for increases in road accidents between vehicles and pedestrians. Without mitigation major negative impacts could occur.

Pedestrian Delay and Amenity: The relatively small increases in traffic flow as a result of the development are unlikely to result in any significant change to pedestrian delay.

It is acknowledged than there will be additional HGV trips associated with deliveries to the site during the operational phase, however again these are unlikely to have a significant impact on pedestrian amenity.

Overall, the effect of the operational phase of the proposed development on pedestrian delay and amenity is likely to be negligible.

Measures to manage operational traffic are presented in the Section 15.5 below, as it will be important to manage the flow of vehicles to and from the proposed development site.

15.5 Mitigation Measures

15.5.1 Construction Phase Mitigation Measures

All of the traffic and transport related impacts described above can be mitigated and managed effectively during construction. A Construction Traffic Management Plan (CTMP) will be prepared by the Contactor and updated regularly as construction plans / sequences change / develop. The Contractor shall consult with the relevant government and local agencies in order to identify vehicle routes, timing of construction related trips, and to discuss / agree appropriate mitigation measures.

The key issues addressed by the CTMP in terms of mitigation measures will include:

- Access to construction areas;
- Construction vehicle routing;
- Temporary traffic control and management;
- Road crossings;
- Construction staff transport facilities;
- Keeping highways clean of mud and dust;
- Speed controls in residential areas;
- Road safety and awareness training for locals;
- Mechanisms for dealing with complaints about road safety; and

- Reducing the probability of traffic related incidents.

Notwithstanding the estimates of construction vehicles, which are outlined in Section 14.3, the CTMP will also outline the number of vehicle movements expected at the various stages of construction, as well as the vehicle types expected to deliver materials and equipment. Given the level of congestion on the highway network in the morning and evening peak periods it is likely that the majority of construction traffic movements will be outside of these periods and limited to daylight hours where possible.

The following mitigation measures will be adopted within the CTMP to reduce the impacts from the construction stage of the proposed development:

- Identify those responsible for carrying out and managing the procedures;
- Reference the procedures and activities that are required to be developed and implemented;
- Identify any enabling works to be undertaken on the roads prior to construction activities to upgrade or stabilize the roads / structures should these be required;
- Identify any key sensitivities along proposed access routes;
- Measures to prohibit off-road driving;
- Outline speed limits and methods of enforcement;
- Means to inform and educate the community of traffic risks;
- Outline measures that will be used to ensure the safety of the community and minimize the nuisance impact of traffic movements;
- Develop strategy for moving materials and people to / from and within the proposed development area, including abnormal loads, e.g., ensuring that delivery of materials does not coincide with the start / end of the highway network peak periods;
- Procedures for monitoring construction generated traffic movements and associated environmental problems;
- Measures to ensure that employees travelling to and from the site are able to do so in a safe manner, e.g., provision of mini buses;
- Measures to prevent the use of unsuitable roads;
- A notification process to be developed to give residents / affected people advance warning of abnormal deliveries; and
- Implement good management practices such as provision of wheel washing facilities for all departing vehicles and sheeting of HGVs carrying loads likely to shed debris.

15.5.2 Residual Impact

Following the development and implementation of a CTMP which includes the mitigation measures presented above, it is considered that there should be a minor negative residual impact on the transport network.

15.5.3 Operational Phase Mitigation Measures

It should be noted that the levels of traffic generated when the proposed development is fully operational are significantly lower than during the construction period. Notwithstanding this, mitigation measuresare proposed and will be implemented as part of an operational management plan for the proposed development. The following mitigation measures will be adopted within the management plan to reduce the impacts from the operational phase of the proposed development:

- Outline appropriate strategies for moving materials and people to / from and within the proposed development areas, including ad hoc deliveries vehicles, e.g., ensuring that deliveries do not coincide with the highway peak periods;
- Procedures for monitoring the generated traffic movements and associated environmental problems;
- Measures to ensure that employees travelling to and from the site are able to do so in a safe manner, e.g., provision of minibus(es) if appropriate;
- Measures to prevent the use of unsuitable roads;
- A notification process to be developed to give residents / affected people advance warning of unusual deliveries / delivery times (e.g., during maintenance works required to replace a large item of plant or equipment); and
- Safety education for those located in close proximity to the site, that have the potential to be impacted by the operation of the proposed development.

15.5.4 Residual Impact

Following the application of an operational traffic management plan, it is considered that there will be minor negative residual impacts as a result of the operation of this proposed development.

15.6 Marine Components

15.6.1 Construction and Operation

There will be a negligible increase in marine vessel movements during the construction phase, with one shipment a month required during mobilization and civil works to transport materials and two shipments a month required during operation to transport LPG.

The current NP facility has the capacity for mooring and offloading vessels with a maximum dead weight of 15,000 tons berth at the jetty and the Addax jetty allows the berthing of tankers of up to 55,000 tons water displacement. This capacity is sufficient to meet this project's requirements.

15.6.2 Assessment, Management and Mitigation

Analysis of the impacts of new vessels on existing vessel movements and fishing fleets will be undertaken prior to construction. Communication with the fishing community throughout the stakeholder engagement process prior to construction will be completed to establish exclusion zone limits and to confirm there is no impact on fish reserves.

To ensure timely supply of materials at construction and adequate supply of LPG at operation, planning and scheduling of activities will take place in partnership with operators of the Jetty.

As vessel movements are minimal these will have no impact further to those addressed in the scope of the ESHIA for the Addax Jetty. Additionally, ship to shore transfer of materials is also addressed as part of the Addax Jetty ESHIA.

15.7 Cumulative Impacts Assessment

15.7.1 Construction and Operation

The initial desktop analysis, performed for the 2015 ESIA, indicates that the issues arising from the project are manageable. However, there is potential for construction of other sites in the region to coincide with

construction of the site considered in this report. Further analysis of cumulative impacts will be undertaken by the contractor, during the preparation of the CTMP, and the operational management plan, at which point further information on timescales and development phasing will be known.

15.8 Conclusions

Based on the 2015 desktop analysis undertaken, impacts of the proposed development during both the construction and fully operational stages can be mitigated through the implementation of traffic management plans. In addition to the above, the following actions are also identified and will be undertaken by the contractor prior to commencing on-site:

- Marine vessel movement assessment.
- Discussions with Ministry of Transport and Aviation, and other local groups including consultation with local communities and project affected parties.

15.9 References

- Institute of Environmental Assessment: Guidance Notes No.1 – Guidelines for the Environmental Assessment of Road Traffic (1993)
- UK Design Manual for Roads & Bridges (DMRB) Volume 5, Section 1, Part 3 TA 79 / 99 'Traffic Capacity of Urban Roads'.
- Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Community Health and Safety World Bank Group, 2007.

16 Climate Change

16.1 Climate Change in Sierra Leone

A wide range of data sources is available concerning observed and projected future climate conditions globally. These can be applied to assess how changing climate conditions may affect the performance of a project over its lifetime and gain an understanding of the range of possible outcomes, depending on various scenarios.

Projections at a given location can be drawn from a wide range of climate models called General Circulation Models (GCM). The Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report[12] used data from a large number of models to inform the most extensive global study of climate change undertaken. Based on modelled results the future direction of climatic parameters such as temperature, rainfall, and extreme events can be forecasted and this can be factored into design considerations.

There is some inconsistency between models, which is perhaps not surprising given their individual assumptions and input data. The summary of predicted changes in precipitation, temperature and other weather phenomena is provided, based on information from Sierra Leone's Third National Communication on Climate Change (2018)[13] and from a journal article Changes in Rainfall in Sierra Leone: 1981–2018 from the Department of Biological Sciences, Njala University, in Freetown, Sierra Leone[14].

16.1.1 Precipitation

Within the Third National Communication, projections of future changes in rainfall were assessed based on a number of models which used raw data from 1961 – 1990, sourced from five meteorological stations across the country. Some of the models, including ECHAM4 and HDCM2 showed little change in precipitation by 2100 compared with current averages. Other models however, including CSIRO-TR and UKTR, showed a decrease in rainfall of 3-10% for both monthly and annual values. Assuming an approximately linear decrease in precipitation between 2012 (the date of issue of the Second National Communication) and the end of the century, the change by 2050 can be expected to be 1.5–5% lower than current levels.

Mid-century predictions can be useful for assessments of projects such as this one, which has an expected operational lifespan of 30-50 years, with the duration of the current power purchase agreement (PPA) being 20 years. It is critical to note, however, that past activity has resulted in climate change happening at the present time. Thus, the impacts felt as a result of the described 1.5-5% decrease in precipitation in 50 years' time will occur in addition to those changes already being felt. Already there is evidence for increased temperature and increased storm incidence, and the potential for these current changes to impact the project must be considered also.

From the cited climate reports, it appears a slight increase in precipitation during the wet season, although a decrease during the dry season (March to May); however, the data are not conclusive.

Extreme rainfall events will determine the stormwater design needed to mitigate major impacts to the local area. From the cited reports the largest one-day rainfall event was recorded at 248mm of precipitation and the largest 7-day event as recorded at 399mm of precipitation.

[12] (IPCC 2014)
[13] (Government of The Republic of Sierra Leone; Dr. Johnson, Reynold G., 2017)
[14] (Richard Wadsworth, 2019)

16.1.2 Temperature

The whole of the African continent is very likely to warm during the 21st century, with the warming very likely to be greater than the global annual mean warming.

Amongst the models used to model temperature change were a GCM used in in the IPCC Third Assessment Report called the Hadley Centre Coupled Model, version 3 (HADCM) and the ECHAM model. Temperature projections were again based on data from 1961 – 1990 from across the country. Based on these models, the average temperature is expected to increase from 26.7°C to between 28.6°C – 29.1°C, a change of 1.9 - 2.4°C. Assuming an approximately linear increase in temperature over the course of the century, the average value in 2050 can be expected to be approximately 27.7°C – 27.9°C. Again, this should be considered in addition to the changes currently being experienced with respect to increasing temperature. Seasonal change in temperature

The climate data indicates that the temperature change is during the height of the wet season is broadly similar to the annual average (around 1.6°C), whilst the increase during the dry season is a little larger.

16.1.3 Extreme Weather Events

The global expected trend in extreme weather events is for increasing frequency and increasing magnitude, or in some cases, both. Such events may include drought, flooding, tsunamis and hurricanes. Indeed, there is already evidence for increased storm incidence, which is the result of previous activity, of whatever nature.

16.1.3.1 Flooding

Flooding and inundation affects the coast around the Freetown peninsular although accurate assessment of future sea level rise is limited by the lack of accurate topography data for the area around Freetown. The Third National Communication suggests that for the year 2025 the sea level rise will be 1m. The population potentially at risk from such a rise is about 2.3 million people – a significant proportion of Sierra Leone's total population of 5.9 million. It is expected that in the absence of any mitigation, 26.4km2 could be lost as a result of climate change induced sea level rises.

45% of the coastal zone of Sierra Leone could be inundated, with mangrove systems and many of the low-lying beaches in the Freetown area likely to be lost.

16.1.3.2 Drought

Under extreme scenarios, a temperature rise of 3.0°C or more is possible, and could result in serious impacts from drought, particularly in the agricultural sectors of arable and livestock farming, and fisheries. Although Sierra Leone has large resources of water, management of resources is relatively limited, and demand for water for industry has increased dramatically in recent decades. Thus, the potential for decreasing rainfall in future to result in drought is considerable.

16.2 Project Climate Risk Assessment

16.2.1 Methodology

The following steps are usually taken when undergoing a climate risk assessment:

- Set up scope
- Identify Climate Risks
- Assess Adaptive Capacity

- Assign Risk Rating
- Identify any Opportunities

16.2.2 Scope

The scope for evaluating the Project has been set up in the overall feasibility study and in the project descriptions in this document.

16.2.3 Identify Climate Risks

Based on the descriptions of expected climate change in Sierra Leone the following internationally accepted hazards have been determined to be risks to the Project:

Sea Level Rise – moderate risk: Although the Project itself is located at an elevation that will not have to deal with sea level rise during the life of the project the adjacent facility that provides the terminal and unloading point for the LPG fuel is located at almost sea level along the Sierra Leone River Estuary. This depot is not under control of the Project and the depot owners will have to adjust to any sea level rise.

Extreme Temperature (Heat Wave) – moderate risk: Increasing temperatures during the time frame of the Project could result in higher ambient temperatures which can negatively impact the heat rate and fuel consumption of the combustion turbines.

Extreme Precipitation and Flooding – moderate risk: maximum rainfall and intensity is expected to increase in Sierra Leone due to climate change during the lifespan of the project. This will result in a more intense and longer rainy season with the potential to cause flooding on the site if adequate drainage is not available.

16.2.4 Assess Adaptive Capacity

The project possesses the capacity to adapt to the hazards described above in the following manner:

- Sea Level Rise: although the fuel depot a potential risk is not under control of the Project there will be the opportunity to switch to LNG in about five years and use a new depot for LNG that is being constructed as part of a World Bank project that will be already designed to deal the sea level rise.
- Extreme Temperature: the Project has the option of purchasing and installing equipment such as inlet air chillers at a later date that reduce or eliminate the change in the heat rate.
- Extreme Precipitation and Flooding: the Project can design the storm water and drainage system to accommodate the future rainfall levels and future 100 years events as opposed to current conditions.

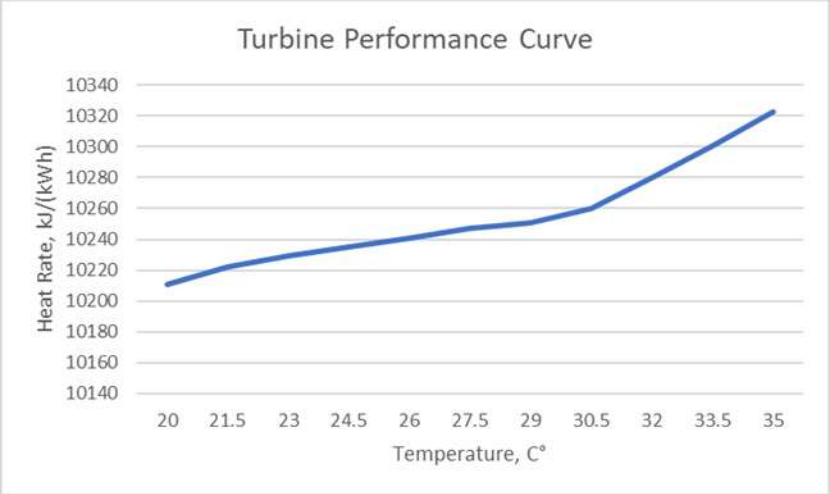
16.2.5 Assign Climate Risk Rating

Sea Level Rise: given the adaptative capacity to potentially switch to another depot this hazard can be assigned a risk of Low.

Extreme Temperature: given the adaptative capacity to install inlet chillers this hazard can be assigned a risk of Low. In addition, the turbine manufacturer has confirmed in writing that the turbines will be operating in the part of the curve in **Error! Reference source not found.** that is level and that the projected increase in daily ambient temperatures will not result in any significant degradation of the heat rate. This will have the additional impact of further reducing the risk to Very Low.

Extreme Precipitation and Flooding: given the adaptative capacity to design the storm water and drainage system to accommodate the predicted increases in rainfall and intensity by designing the system to a larger 100 year event this hazard can be assigned the risk of Low.

Figure 16.1 Turbine Performance Curve



16.2.6 Identify Opportunities

There is a very significant opportunity present that can be taken advantage of. Due to the lack of a storm drainage system in the area there exists a possibility that the Project can enter negotiations with the local or national government provide the community with a functional drainage system that can drain the heavy rains during the wet season and reduce the risk of flooding in the area.

16.3 Project Impact on Climate Change

Based on provided information from the combustion turbine manufacturer and the provided LPF fuel specification each of the combustion turbines is expected to produce between 155,000 to 184,000 metric tonnes per annum of CO_2 equivalent greenhouse gases depending on temperature and total yearly availability for a total of over 450,000 tonnes of CO_2 equivalent per annum.

According to Sierra Leone's INDC the nation contributes very little to global climate change in the form of greenhouse gas emissions. The nation plans to already reduce their minimal existing carbon footprints by engaging in various strategies that include:

- Energy efficiency and conservation;
- Enhancement of waste management systems;
- Adoption and application of climate-smart and conservation agriculture; and
- Increased use of hydropower resources in parts of the country where feasible.

Appropriate steps will also be described within the ESMP regarding annual reporting of greenhouse gas emissions in line with the requirements of the IFC Performance Standard 3.

17 Hazardous Materials

17.1 Construction

Due to the scale of the project, it is likely that a significant amount of waste will be generated during the site preparation and construction phase, some of which is likely to be classified as hazardous.

Hazardous materials will be a part of the waste streams during demolition and construction, these can be shown in Table 17.1. In particular, asbestos has a large impact on human health and will need to be taken into consideration when putting together the ESMP for the demolition and construction phase.

Table 17.1 Hazardous Waste Streams

Project Phase	Hazardous Waste
Demolition	Asbestos
Construction	Excavated materials which may contain heavy metals, hydrocarbons / other contaminants.
Construction	Scrap metals
Construction and operation	Empty chemical containers
Construction and operation	Paints and solvents associated with construction and maintenance activities.
Construction	Waste fiberglass
Operation	Spent water treatment filters / sludge and medical waste
Construction and operation	Land based spilled treated and untreated oil
Construction and operation	Waste oil clean up materials
Construction and operation	Chemicals and greases
Construction and operation	Batteries

Asbestos Waste Mitigation and Removal Strategy: Asbestos has been found within the construction materials of the current building slated to be demolished. Any of the materials containing Asbestos fibers will be handled, removed, and stored appropriately.

Given the use of appropriate management and mitigation measures for construction wastes, there will be no significant impacts from wastes during the construction phase. There will be residual impact from use of landfill and natural resources, but this will be minimized as far as possible by reduction of wastes and reuse of inert wastes where possible.

The management of non-hazardous types of waste is discussed in Section 14.

17.2 Operations

17.2.1 LPG

There are several hazards involved in dealing with LPG. These hazards are:

- Fire and explosion hazards described fully in Section 8.1;
- Formation of “cold burns” from contact with skin and eye;
- Irritation of nose and throat, dizziness and nausea from inhalation; and
- Unconsciousness and death from excessive inhalation;

Plans to deal with the various hazards posed by LPG will developed as part of the ESMP and Emergency Plans discussed in Section 18.

17.2.2 Diesel Fuel

The hazards involving diesel are:

- Fire and explosion hazards described fully in Section 8.1; and
- Contamination of soil and aquifers due to leaks and spills.

Plans to deal with the hazards associated posed by diesel fuel will be developed as part of the ESMP and Emergency Plans discussed in Section 18.

17.2.3 Material Safety Data Sheets (MSDS)

As part of the Project's Safety Plan and ESMP described in Section 18, MSDS's will be kept on file at the Project and will also be available throughout the site where workers come in contact with the material.

18 Environmental & Social Management Plan and Emergency Response Plans

This section presents the draft ESMP for the CECA WESTERN AREA POWER GENERATION project. The ESMP provides the management framework needed for planning and implementation of monitoring and management activities. The ESMP will be prepared in accordance with environmental commitments of CECA, and in compliance with the legal and regulatory requirements of Sierra Leone and the World Bank / IFC Performance Standards and EHS Guidelines.

The final ESMP will provide the management framework needed for planning and implementation of monitoring and management activities associated with environmental and social protection. The ESMP will be prepared in accordance with environmental commitments of CECA, and in compliance with the legal and regulatory requirements of Sierra Leone and the World Bank / IFC Performance Standards and EHS Guidelines.

The objective of an ESMP is to collate in one place and describe all mitigation measures and actions identified with the ESHIA which require implementation during the design, construction and operation (and decommissioning where appropriate) phases of the project to enhance positive benefits or eliminate or reduce key identified biophysical, socioeconomic and health issues and impacts to acceptable levels.

The final ESMP will identify organization roles and responsibilities (e.g., within the client organization, designers, contractors and operators) in administering the various actions and obligations. It must also state any reporting requirements, such as audits of performance against the ESMP requirements and GHG emissions reporting and the appropriate standards and legal requirements against which compliance will be measured.

An ESMP is a live document that will last the lifetime of the project and will be updated as appropriate as the project proceeds. It concerns both general environmental requirements that are common to most construction projects, and specific environmental initiatives unique to the development phases and infrastructure of this project, including:

- Construction;
- Operation; and
- Decommissioning.

Table 18.1 presents the draft ESMP for the project.

Table 18.1 Draft ESMP for the Project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Actions Requiring Implementation Prior to Construction						
Prior to construction	Develop and implement a construction management plan to minimize community health and safety and security issues.	A Construction Management Plan and procedures shall be designed to help to minimize land and community disturbance.	CECASL	IFC PS4 requirements	Surveying and observation	Throughout the construction phase
Prior to construction	Re-visit the ESHIA and modelling assessments following detailed design and confirmation of rights of way for associated infrastructure (pipelines, plant and roads). If the elements change significantly and additional properties could be affected, undertake appropriate environmental and social assessment of these facilities.	Verify findings within the ESHIA following detailed design.	CECASL	EPA-SL and WBG/IFC requirements	EPA-SL / lenders monitoring of implementation of requirements	Following detailed design
Waste Management						
Prior to construction	Pollution of the surrounding environment through improper management and disposal of wastes.	An audit of the proposed hazardous and non-hazardous land fill facilities to be undertaken prior to construction phase to ensure they meet the requirements of the project in both quantity and type of materials they take and their management of wastes.	EPC contractor(s)	EPA-SL and WBG/IFC requirements	Visual inspection Audit reports	Prior to construction activities commencing

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Prior to construction	Asbestos Exposure/ Contamination	A full building survey Demolition Plan	EPC Contractor	WBG/ International Labor Organization (ILO)	Emissions monitoring, inspection, and observations	At project design stage and during construction
Construction, operation and decommissioning.	Pollution of the surrounding environment through improper management and disposal of wastes.	A Waste Management Plan to be developed and implemented for the life span of the project. The plan is to identify waste streams, treatment, management, temporary management and final disposal procedures. The plan will define the roles and responsibilities of relevant departments and waste management contractors.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Visual inspection. Waste records and audit reports	Throughout the lifetime of the project
Construction, operation and decommissioning	Potential to harm human health and environment through uncontrolled disposal of wastes.	Provision of an on-site collection service. Waste streams to be kept segregated (hazardous, inert, industrial and domestic). Adequate provision of waste disposal containers at strategic locations around the site. Training of workers in waste management and safe handling of wastes.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Visual inspection and maintenance of site inspection and disposal records	Throughout the lifetime of the project
Construction and decommissioning	Unnecessary disposal of materials and use of natural resources.	Waste management procedures to be implemented which reduce the need for disposal of materials by	EPC contractor(s)	EPA-SL and WBG/IFC requirements	Visual inspection	Throughout the construction and

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		re-use on and / or offsite where possible.	Decommissioning contractor(s)			decommissioning works
Construction, operation and decommissioning	Odor from wastes	All wastes to be contained where possible. Regular uplift of normal domestic and inert wastes via municipal arrangements where appropriate.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Visual inspection. Waste management monitoring procedures to be implemented	Throughout the lifetime of the project
Terrestrial Ecology						
Construction	Minimizing direct impacts on intertidal and coastal habitats	Use temporary fencing to prevent inadvertent damage to mudflat, mangrove and coastal habitats adjacent to the construction zone Site temporary works areas away from coastal habitats where practicable;	EPC contractor(s)	EPA-SL and WBG/IFC requirements	Visual Inspection	Construction phase
Construction, operation and decommissioning	Introduction of non-native species into the terrestrial environment.	Implementation of procedures requiring the cleaning and visual inspection of machinery/ equipment entering and leaving the area. Material and construction / decommissioning equipment to be sourced locally where possible	EPC contractor(s) Plant operator (s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Visual Inspection	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Construction	Minimizing impacts on species and habitats	Minimize potential for pollutants and surface water runoff to migrate offsite through use of silt traps or similar measures and adherence GIIP regarding pollution prevention guidelines; Carry out tool-box talk to educate site staff about the sensitivity of coastal and intertidal habitats; Re-plant areas left undeveloped with native vegetation to prevent the incursion of opportunistic invasive species; Adherence to pollution prevention guidelines; Carry out tool-box talk to educate site staff about the sensitivity of threatened species and their protection; and Use floating barriers to contain any spillages and deter species from moving into work zone;	EPC contractor(s)	EPA-SL and WBG/IFC requirements	Visual Inspection	Construction phase
Marine Ecology						
Construction operation and decommissioning	Release of contaminants causing damage to sensitive marine receptors	Spill Response Procedures will be developed within the Emergency Response Plan and implemented following any accidental release of hazardous substances e.g., during refueling, and this plan shall include details of measures to be adopted	EPC contractor(s) Plant operator (s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Visual inspection	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		to stop, contain as far as practical on site, and clean up spills. As per provisions of maintaining land quality in "Contamination"				
Construction operation and decommissioning	General disturbance of the marine environment and aquatic flora and fauna	Marine areas encroached on to be restricted as far as possible, including areas used by vessels and cargos in the transportation of materials and equipment. Provision of fenders and/ or screens to prevent entrapment of aquatic life if necessary	EPC contractor(s) Plant operator (s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Monitoring of indicator species in vicinity of operations / construction and decommissioning activities	Throughout the lifetime of the project
Construction operation and decommissioning	Introduction of alien species into the marine environment	The requirement for the International Convention for the Control and Management of Ship's Ballast Water and Sediments (IMO) will be met at all times	Vessel operator (s)	EPA-SL and WBG/IFC requirements IMO Requirements	Visual inspection	Throughout the lifetime of the project
Climate Change/Greenhouse Gas Emissions						
Prior to construction	Climate change results in increased wet season rainfall which could overwhelm drainage if not considered.	Incorporation of appropriate increase in design drainage capacity (e.g., 20% on current best practice design) to account for potential increased rainfall relative to historical norm.	Owner's Engineer (OE) and EPC Contractor	EPA-SL and IFC requirements	OE sign off	As part of detailed design
Prior to construction	Greenhouse gas and emissions reporting.		Owner's Engineer (OE) and EPC Contractor	EPA-SL and WBG/IFC requirements	OE sign off	As part of detailed design

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Prior to construction	Climate events and hazards that impact on the development could lead to fuel spills and other impacts that could impact on the local environment	A detailed hazard assessment of the materials and fuels that are likely to be stored on site that may be released into the environment should be undertaken. Measures to minimize the risk of any substance that may be harmful to the environment or local population should be identified and mitigation strategies developed to minimize the risk. Strategies should also be developed if these mitigation strategies fail.	OE and EPC Contractor	EPA-SL and WBG/IFC requirements	NA	Pre-construction and maintained/updated throughout the lifetime of the project
Operation	Generation of Green House Gas (GHG) emissions during plant operation.	Use of monitoring and emissions data (see Air Quality section within this table) to calculate and disclose GHG emissions from the project the project annually.	Plant operator(s).	IFC PS3	Use monitoring and emissions data (see Air Quality within this table) to calculate and disclose annual GHG emissions from the facility.	Throughout operational lifetime of the project
Construction, operation and decommissioning	Generation of GHG emissions associated with transport movements.	Development of management plans and procedures to ensure traffic flow is minimized as far as possible and that all transportation vehicles used throughout the project are fit for purpose and adequately maintained High-efficiency low-emission vehicles to be preferentially used where possible.	EPC contractor(s) Plant Operator(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	N/A	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Contamination (for issues specific to waters see also water and wastewater measures)						
Prior to construction	Potential sources of contamination onsite and offsite	A contamination assessment will be carried out and any identified mitigation measures would need be included in the design. To support early tendering for the EPC role, contractors may wish to include a worst case assumption for protection of construction workers and end site users from potential ground and/or groundwater contamination.	OE and EPC Contractor	EPA-SL and WBG/IFC requirements	Inspection and observation Soil and groundwater monitoring and remediation plans if needed	Design, Construction and Operation
Construction and decommissioning	Contamination of ground, sediments, groundwaters, freshwaters and marine waters and groundwater following spills, leaks of chemicals used.	Chemicals to be stored at suitable location (preferably on hard surfacing to minimize potential for infiltration) and secondary containment to be provided. Workers to be trained in the handling, storing, and disposal of hazardous materials and emergency procedures in place for action following accidental release of hazardous materials. Emergency spill containment material and clean up equipment to be available to construction workers.	EPC contractor(s) / Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements Site inspection records.	Regular site inspections to monitor conditions Monitoring and Reporting Plan to include requirement regarding monitoring of river and estuarine water quality during construction	Throughout construction and decommissioning phases
Construction and decommissioning	Mobilization of contaminants into soils, sediments, marine waters and groundwater by	See mitigation for spillages, above. Drainage design and management to ensure that potentially	EPC contractor(s) /	EPA-SL and WBG/IFC requirements	Regular site inspections to monitor conditions	Throughout construction and

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
	water applied in construction or rainfall/storm water.	contaminated surface runoff does not flow directly into waterbodies.	Decommissioning contractor(s).	Site inspection records		decommissioning phases
Construction	Introduction of contamination to the site from imported soils.	Imported materials to be obtained from a reputable source. Soil testing to be taken on any imported soils to verify suitability	EPC contractor(s)	EPA-SL and WBG/IFC requirements	Periodic sampling of soil/fill materials brought for use in construction	Throughout the construction period.
Construction and decommissioning	Unknown contamination encountered (either within soils or groundwater) poses risks to human health and sensitive environmental receptors.	It is recommended that land quality assessments are undertaken prior to and following construction and demolition works and appropriate remediation of any contaminated materials found. Regular inspection of materials laboratory analysis of samples if contamination suspected. Upon identification of any suspected contamination, works are to cease until the source of contamination or the contaminated materials are removed. Any contaminated materials to be removed and disposed to an appropriately licensed waste disposal site. Security due diligence/ audit of waste disposal/landfill facilities to be undertaken prior to use. Workers to be trained in the identification and handling of potentially contaminated materials.	EPC contractor(s) / Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements Where laboratory analysis is thought necessary the WBG EHS guidelines recommend screening results against US EPA risk-based screening criteria .	Soil and groundwater monitoring as part of land quality assessments Regular inspections of materials removed to be undertaken as work progresses. If contamination is suspected this can be confirmed by laboratory testing A waste register to be used to record any contaminated soil taken offsite	Throughout construction and decommissioning phases.

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Appropriate Person Protective Equipment (PPE) to be provided. If any contaminated soils are identified they are to be isolated and maintained to prevent generation of dusts and the loss to surface runoff / drains/ watercourses.				
Construction, operation and decommissioning.	Release of pollutants into the environment through vandalism and theft	Lockable valves to be fitted on all storage tanks, fences should be secure, and doors and gates kept locked. Where possible, materials should be stored under cover and potential pollutants should be transferred into safe storage without delay.	EPC contractor(s) / Plant operator(s) / Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Regular inspection	Throughout the lifetime of the project
Operation	Contamination from unintended discharges / spills of fuel from the pipeline	All pipeline joints will be welded and the welds will be checked to insure that they will not leak. The area is fenced to insure no one would enter and tamper with the fuel The pipeline will have a CCTV network to insure security as far as is practicable. All valves be placed in adequately sized pits	CECASL in design EPC contractor(s) / Plant operator(s)	International standards regarding pipeline construction and fuels handling. Maintenance and inspection records to verify integrity of containment / ground surfacing	Pipeline commissioning Regular inspection	Commissioning and operation

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Operation	Contamination of ground, groundwater and surface water bodies following spills, leaks, failure of tanks or pipelines or deliberate discharges. Substances may include raw materials, fluids, intermediate produces, wastes and effluents.	Chemicals to be stored in designated bunded areas, bunds having the capacity to contain at least 110% of the volume of chemicals stored). Operational areas and roads to be constructed in concrete to minimize potential for infiltration of contaminants to ground. Tanker loading areas to be situated within bunds to ensure containment of spillage. Workers to be trained in the handling, storing, and disposal of hazardous materials and emergency procedures in place for action following accidental release of hazardous materials. Emergency spill containment material and clean up equipment to be readily available.	CECASL in plant design. Plant operator(s) in implementation of response measures	EPA-SL and WBG/IFC requirements Maintenance and inspection records to verify integrity of containment / ground surfacing WBG EHS and EPA discharge limits and soil and water quality standards	Visual inspection of containment systems. Monitoring of effluent prior to discharge	Throughout the operational lifetime of the project
Operation	Mobilization of contaminants in storm and firewater and subsequent contamination of land and waterbodies.	Stormwater and firewater will be routed to a storm water basin. If contamination is suspected stormwater can be routed to appropriate treatment / disposal facility. Plant designed to include capacity for potential firewater.	CECASLSL in plant design EPC contractor(s) in construction phase Plant operator(s) in the appropriate treatment /	EPA-SL and WBG/IFC requirements	Collected streams to be analyzed to determine appropriate discharge/ treatment/ disposal method	Throughout lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
			disposal of contaminated waters			
Local Air Quality						
Prior to construction	Generation of exhaust fumes and fugitive dusts from construction vehicles and traffic	Any road upgrades to ensure dust deposition on nearby receptors (e.g., roadside farmers) is minimized	EPC contractor and operator		Inspection and observation.	At project design stage and during construction as required
Design	Power plant to be designed to meet the relevant IFC emission limits for combustion turbines for the relevant pollutants (NO_x, SO_2 and Particulate Matter). Robust design and effective maintenance of the reciprocating engine is significant to the management of emissions to air during operation.	Careful and considered selection of technology provider and associated reciprocating engine and components. Selection of engine to ensure appropriate monitoring and controls are available to monitor turbine performance and identify malfunctions or failures which could affect emissions to air. Selection of engine to include consideration of ongoing maintenance aspects and demonstration of robust turbine design.	CECASL	WBG/IFC requirements	Operation phase monitoring regime in accordance with WBG EHS guidelines/ EPA-SL	At project design / procurement stage and detailed design stage
Design	Appropriate stack design and height has been undertaken to ensure ground level concentrations of NO_2, SO_2, particulates and CO are minimized.	This ESHIA will identify the stack height in order to appropriately manage the project's potential impacts on ambient air quality. Appropriate stack height assessment should be undertaken during any future phases of the project to ensure that future design	CECASL	WBG/IFC requirements	Operation phase monitoring regime in accordance with WBG EHS guidelines/ EPA-SL	At detailed design stage

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		phases are consistent with WBG/IFC requirements.				
Construction	Increase in fugitive dust release from plant vehicles moving to and from site and from construction activities on-site (demolition, earthworks and construction phases). Increase in construction vehicle and non-road mobile plant exhaust emissions.	Construction contractor to use best practice to minimize dust emissions. These could be formalized in a management plan and include mitigation such as: Hard surface roads at earliest opportunity in the construction program. Hoarding of the site boundary or appropriate fencing to capture dust release. Use of dust covers on all vehicles transporting materials with the potential for dust release. Stockpiles located away from receptors and covered and dampened. Impose speed limits for vehicles. Procurement of construction vehicles, with low emissions. Best practice when operating all vehicles and generators, e.g., no idling engines Use of bowsers to dampen site grounds/ stockpiles to reduce potential for dust.	EPC contractor(s)	EPA-SL and WBG/IFC requirements. Dust related complaints.	Inspection and observation. Auditing of activities against agreed management plan Obtain verbal and documented feedback from construction workers and neighboring communities.	Throughout construction and decommissioning phase

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		The use of wheel washers on entering and leaving site and between site areas as appropriate to prevent transfer of mud on site and onto public roads, which can be re-suspended. Engines to be switched off when vehicles are not in use. Marine transport to be minimized with engines switched off whenever feasible.				
Operation	Release of emissions during operation above the IFC emission limits during normal or abnormal operating conditions which could lead to adverse air quality impacts at offsite locations.	Continuous emissions monitoring (using Continuous Emissions Monitoring Systems (CEMS)) of required pollutants and emissions parameters to monitor emission performance and compliance with the emission limit values. Regular equipment checks and maintenance to ensure optimum efficiency is maintained Use of fuel with sulfur content which is within IFC guidelines	CECASL Plant operator	WBG EHS air emission limits and ambient air quality guidelines	Operation phase monitoring regime in accordance with WBG EHS guidelines as specified in Table 7 of the Thermal Power Plant EHS Guidelines.	Throughout the operation of the plant.
Operation	Release of emissions during operation above the IFC AAQ guidelines during normal or abnormal operating conditions which could lead to adverse air quality impacts at offsite locations.	An ambient air quality monitoring program (AAQMP) will be developed in consultation with the WBG and EPA-SL to monitor concentrations of NO_2, SO_2 and particulates (PM_{10} and $PM_{2.5}$) on a monthly basis in the project vicinity	CECASL Plant operator	WBG EHS air emission limits and ambient air quality guidelines	Operation phase monitoring regime in accordance with WBG EHS guidelines as specified in Table 7 of the Thermal	Throughout the operation of the plant

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		during the operational phase of the project. NO_2 and SO_2 measurements shall be undertaken using passive diffusion tubes changed on a monthly basis. For particulates, secure monitoring locations and a continuous source of power would need to be in place to protect the sophisticated equipment required for measurement, so this is most likely to be feasible within the project site. Details of the monitoring locations for the AAQMP will be agreed with EPA-SL and the IFC/WBG prior to project operations.			Power Plant EHS Guidelines	
Decommissioning	Increase in fugitive dust release from plant vehicles moving to and from site and from decommissioning activities on-site (demolition, earthworks etc.). Increase in decommissioning vehicle and non-road mobile plant exhaust emissions.	Similar approach as specified for "Construction". Arisings / wastes with potential to generate fugitive dust emissions to be covered prior to removal and disposal / re-use. Mitigation for decommissioning vehicles as for construction vehicles.	Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements Dust related complaints	Inspection and observation. Auditing of activities against agreed management plan Obtain verbal and documented feedback from construction workers and neighboring communities	Throughout decommissioning period
Noise						

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Design and Operation	The plant shall be designed including the standard and enhanced measures considered in the noise modelling conducted for the project. Since these design measures will be incorporated, the project would not result in any noise impacts from operations. However, additional enhancement measures are proposed to address the potential health effects associated with the high nighttime noise levels predicted in the project area.	A Noise Management Plan will be developed to minimize nighttime noise at nearby residential receptors. Measures could include a noise insulation scheme or other measures developed in consultation with the community and EPA-SL and IFC/AfDB to reduce nighttime noise levels to 55dBA or lower.	CECASL	WBG/IFC EHS noise limits WHO AAQG Interim Targets Noise related complaints	Operational monitoring and reporting to EPA / lenders	Following detailed design
Construction	Generation of noise though construction activities, particularly during excavation works.	Construction contractor to use good international industry practice in terms of working practices and working hours to minimize impacts to workers.	EPC contractor(s).	EPA-SL and WBG/IFC requirements	Verbal and documented feedback from construction workers and neighboring communities. Noise related complaints	Throughout construction phase.
Construction	Generation of noise by construction vehicle movements.	Scheduling of road traffic movements to avoid noise sensitive periods (e.g., night-time).	EPC contractor(s)	EPA-SL and WBG/IFC requirements.	Verbal and documented feedback from construction	Throughout construction phase

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Route traffic away from noise sensitive receptors. Consultations with local communities to be undertaken, which may be impacted to be undertaken in advance of any noisy activities or works being undertaken outside of normal working hours.		Noise related complaints	workers and neighboring communities	
Design and Operation	Generation of noise from operational activities. The main sources of noise will be: boilers, steam and gas turbines, large pumps and fans (including inlets, outlets and stacks), cooling system and transformers.	Power plants to be designed to meet a maximum of 85dBA one meter from the source in line with international requirements. Mitigation in plant design to minimize noise exposure through equipment attenuation and the procurement of inherently quieter plant equipment. For example: • Use of silencers/ acoustic barriers on noisy equipment (e.g., cladding); • Use of physical barriers (e.g., machine housing, enclosures, walls); • Location of noisy plant equipment away from offices; Noise management and operational procedures to ensure safe working practices with respect to noise and limitations on working	CECASL in plant design. Plant operator(s).	WBG/IFC EHS noise limits and EPA noise limits Noise related complaints	Monitoring of noise levels at sensitive receptors	Throughout operational lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		hours and noise exposure where appropriate.				
Decommissioning	Noise generation through decommissioning and removal of exiting equipment	Good international industry working practices to ensure safety of workers with respect to noise exposure. Limitations on durations and timing of activities to avoid noise sensitive periods. (Nighttime)	Decommissioning contractor(s)	WBG/IFC EHS noise limits and EPA-SL noise limits Noise related complaints	Monitoring of noise levels at sensitive receptors	Throughout decommissioning period
Traffic and Transport						
Prior to construction	Assessment of traffic levels on and offshore including consultation with relevant statutory bodies and affected parties over proposed traffic routes. Cumulative traffic impacts associated with other development projects and existing developments in the area.	Assessment of traffic routing and existing traffic/vessel movements if required to ensure routes and minims disruption to existing users. Consultations with other developers and operators to be undertaken prior to commencement of project and throughout the project lifetime to identify any potential cumulative traffic impacts. Scheduling of deliveries to site/exports from site to avoid busy periods.	OE and EPC Contractor	N/A	Period monitoring of traffic levels in the development are to help inform the scheduling of activities	Throughout the lifetime of the project
Construction and operation	Impacts on fishing / fishermen encroaching into the exclusion zone presenting a security and health and safety risk.	Communication with fishing community throughout stakeholder engagement process prior to operation to inform them of inclusion zone limits.	Plant operator(s)	EPA-SL and WBG/IFC requirements. Marine Pollution (MARPOL) / International Maritime	Reporting and documenting of any security incidents	Throughout construction and operational period.

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Clear signposting to be placed delimiting exclusions zone and warning marine traffic.		Organization (IMO) requirements		
Construction and operation	Health and safety impacts from the currently poor local roadways.	A Traffic Management Plan will be developed for construction and operations that will include limited road grading and maintenance (of the construction route from the west during the construction period) and will carefully consider additional measures around community health and safety (particularly regarding risks to school children along the access road route and shanty houses adjacent to site entrance) to reduce these risks to as low as is reasonably practicable. Detailed mitigation measures will be determined as part of the detailed Traffic Management Plan.	OE and EPC Contractor	EPA-SL and WBG/IFC requirements	Reporting and documenting of any road safety incidents	Throughout construction and operational period
Construction, operation and decommissioning	Risk of accidents and congestion.	Develop a Traffic Management Plan for construction and operations for the project including limited grading of the construction route to from the west and other minor improvement as necessary to ensure safe transport for the project such as filling in potholes or improving uneven surfaces and ensuring that the project entrances, exits, and local access	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements Offshore aspects to meet requirements of MARPOL / IMO	Pre-construction and pre-demolition baseline traffic flow assessment to enable construction works to be planned to mitigate cumulative traffic impacts	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		routes meet good international industry safety standards. Warning signs and lighting to be installed on key transport routes / to aid marine navigation. Offshore transport routes to be clearly defined and marked appropriately. Roads and embankments to be strengthened as necessary to ensure they are adequate for safe transportation of heavy goods vehicles (HGVs). Access roads across the shoreline for offshore components to be developed prior to construction/ demolition, ensuring they are adequate for safe use by construction vehicles. Onshore and offshore transport routes to be agreed with planning authority. Schedule onshore transport movements (particularly HGV movements) to avoid peak transport movements associated with adjacent power stations and local communities (mitigate against cumulative impacts).				

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Emergency response plan for road traffic and barge incidents to be prepared and implemented.				
Construction, operation and decommissioning	Pollution of the environment associated with air emissions.	Mitigation as outlined within air quality assessment.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Baseline air quality assessment undertaken as part of air quality impact assessment	Throughout the lifetime of the project
Construction and decommissioning.	Transport of contaminated soils on vehicles during construction and decommissioning activities.	Mitigation measures and outlined within land quality assessment.	EPC contractor(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements. Offshore aspects to meet requirements of MARPOL / IMO	Visual inspection. Laboratory analysis of soils if contamination is suspected	Throughout construction and decommissioning periods
Construction, operation and decommissioning	Cumulative traffic impacts associated with other development projects and existing developments in the area.	Shift timings to be made in consideration of nearby operations and staggered to avoid cumulative impacts from movement of workers as far as possible.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	EPA-SL and WBG/IFC requirements	Periodic monitoring of traffic flows in the development area to help inform the scheduling of activities	Throughout the lifetime of the project
Water Resources						
Prior to construction	Potential contamination or overuse of groundwater or municipal supply with potential to restrict water availability for existing users.	Mitigation through design will consider hierarchical water supply options of rainwater harvesting (wet season), borehole supply and municipal network supply, with a potential backup via seawater from the firewater pumps on the National Petroleum jetty facility (if this is feasible)	OE and EPC Contractor	EPA-SL and WBG/IFC requirements	Inspection and observation (of records of water use and source)	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Construction	Potential contamination or overuse of groundwater or municipal supply with potential to restrict water availability for existing users.	Provisions for adequate and appropriate drainage to be made during the construction phase. A monitoring and management plan for monitoring of river water quality and estuarine water quality is to be developed and implemented. Provisions to be in place for the collection of sediments generated as far as possible. Stockpiled sediments to be covered where practicable. For marine aspects stockpiled extracted sediments to be located away from the shoreline. Stockpiled sediments to be placed in contained/ bunded areas such that any runoff generated is collected.	EPC contractor(s)	EPA-SL and WBG/IFC requirements Site inspection records.	Regular site inspections to monitor conditions Monitoring and Reporting Plan to include requirement regarding monitoring of river and estuarine water quality during construction	Throughout construction period
Construction	Contamination of soils, groundwater and surface water through release of wastewaters generated in construction.	All contaminated stormwater and waste waters from construction activities to be drained into a collection pit for either recycling / re use or disposal. Laboratory testing of waste waters may be required the most appropriate action. Monitoring of river water quality to be undertaken throughout construction period to identify any	EPC contractor(s)	EPA-SL and WBG/IFC requirements	Monitoring of river water quality Monitoring of wastewaters generated by visual inspection and laboratory testing Soil and groundwater monitoring as part	Throughout construction period

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		adverse impacts and enable appropriate mitigation measures to be implemented. It is recommended that land quality assessments are undertaken prior to and following construction works and appropriate remediation of any contaminated materials found.			of land quality assessments	
Construction and Operation	Potential contamination or overuse of groundwater or municipal supply with potential to restrict water availability for existing users.	Undertake surface and groundwater quality monitoring local to the project site to confirm no construction or operation impacts. If GVWC water is required, an assessment of potential impacts on water availability to other water users on the network will be undertaken at that time.	OE, EPC and operator	EPA-SL and WBG/IFC requirements Monitoring and Reporting Plan	Inspection and observation (sampling and monitoring)	Construction and operation phase
Construction	Contamination of groundwaters and surface waters following spillages.	Use appropriate storage with secondary containment where possible for potential pollutants such as fuels or cementitious material. Placement of pollution substances on hard ground and within secure, bunded areas where possible to minimize potential of infiltration to ground.	EPC contractor(s)	EPA-SL and WBG/IFC requirements Site inspection records	Regular site inspections to monitor conditions Soil and groundwater monitoring as part of land quality assessments and Monitoring and Reporting Plan	Throughout construction period

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		All workers to be trained in the handling, storing, and disposal of hazardous materials. In the event of an accidental release, emergency procedures will be in place. Emergency spill containment material and clean up equipment to be available to construction workers. It is recommended that land quality assessments are undertaken prior to and following construction works and appropriate remediation of any contaminated materials found.				
Operation	Contamination of groundwater and surface waters following spillages	Designated refueling and vehicle maintenance areas will be constructed. These will comprise bunded and sealed areas and all scheduled refueling and maintenance of construction and transportation vehicles will be undertaken within these areas. Procedures within the Emergency Response Plan developed by the EPC contractor will be implemented following any accidental release of hazardous substances e.g., during refueling, and this plan shall include details of measures to be adopted to stop, contain as far as practical on site,	OE, EPC and operator	Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors' (CIRIA, 2001) Environment Agency (EA) UK: Pollution Prevention Guidelines (PPG) 5: Works and Maintenance in/ or near Water;	Inspection and observation (sampling and monitoring)	Construction and operation phase

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		and clean up spills, and to inform the relevant authorities in the event that a spill migrates (or occurs) offsite. Hazardous material storage tanks, including for fuels, will be located within bunded and hard surfaced areas with adequate capacity for the volume of hazardous materials stored within. An adequate quantity of drip trays and spill kits/mitigation materials will be provided to contain and recover potential releases of hazardous substances. Pollution skill kits will be held at strategic locations on site and site personnel will be trained in their use. Lines of communication in the event of an emergency will be established, documented within the Emergency Response Plan and communicated to site personnel prior to commencement of works. Any accidental spill / leak will be fully cleaned immediately, and if required polluted soil / sand will be excavated and removed from site. Any accidental spill / leak will be recorded.		PPG21: Incident Response Planning; PPG22: Dealing with Spills; and PPG26: Drums and Intermediate Bulk Containers.		

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Hazardous effluents such as used oils will either be incinerated during construction using temporary facilities or stored and incinerated once the main incinerator is operational. Storage tanks and area will be maintained and inspected regularly. Records will be kept of all liquids/ tanks / containers on site.				
Construction	Contamination of waterbodies following discharge of sanitary wastes from contractor facilities	Sewage generated from domestic facilities will be treated in a temporary treatment facility before discharged to outfalls	EPC Contractors	WBG IFC EHS and, EPA-SL water discharge standards	Monitoring of effluent discharge	Throughout construction period
Impacts on Landscape						
Prior to construction	Disturbance of the baseline landscape through the introduction of foreign features into the baseline urban landscape	Selecting finishes to the building/infrastructure so that they blend into the surrounding urban landscape Designing the buildings to reduce the height/spread where possible	Architect, OE and EPC Contractor	N/A	OE Oversight	Design and construction
Post-construction / pre and during operation	Visual amenity of the plant.	Landscaping of the site upon completion of construction works. This will both mitigate visual impact and reduce erosion from any surface waters during heavy rains and flood periods Soils excavated	EPC contractor(s)	N/A	Visual inspection	Post-construction. Maintenance of landscaped areas may be required in operational period

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		during construction could be used for landscaping if suitable.				
Construction, operation and decommissioning	Increase in lighting may impact nearby residential receptors and road users at night. For offshore aspects lighting may attract fish, birds and other species. This may deplete fish reserves elsewhere and encourage fishermen to encroach into the exclusion zone presenting a security risk.	Lighting will be minimized as far as reasonably practicable and safe. Use of unnecessary floodlights will be avoided. Light sources to be hooded and directed downwards. Use of low-intensity lighting used where possible.	EPC contractor(s) Plant operator(s)	Feedback from communities	Visual inspection	Throughout the lifetime of the project
Socio-economics						
Prior to construction	Implement community gain measures through social development initiatives in communities neighboring the proposed project.	Develop and implement a social investment strategy that will support social development initiatives in communities neighboring the proposed project.	CECASL	EPA-SL and IFC requirements	Surveying and observation	Throughout the lifetime of the project
Prior to construction and construction	Prepare a Livelihood Restoration Plan (LRP)/Abbreviated Resettlement Action Plan (ARAP).	The LRP/ARAP will be developed in consultation with the NPA and the affected farmers, prior to commencement of project per the requirements of IFC PS5. Continue consultation with the Affected Community including the local farmers and ensure that the stakeholder engagement for the project meets the requirements of	CECASL	IFC PS5 IFC PS1	CECASL monitoring SL government implementation of livelihood restoration action planning	Resettlement required prior to ground works commencing, and during construction

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		IFC PS1 including the establishment of a grievance mechanism for the project that would be available to the local community. Provide training and livelihood assistance programs to the community including the potential to diversify, savings and credit opportunities, and business and enterprise training.				
Prior to construction and construction	Potential for chance finds of cultural significance during pre-start update of ESIA and construction period	With no identified cultural resource features within the study area the topic has been scoped out of this ESHIA. In the event that evidence is identified during construction that indicates items of cultural significance may be present, a cultural resource expert should be appointed.	CECASL EPC Contractor(s)	IFC PS7 IFC PS1	Updated ESIA EPC Monitoring	Pre-construction and construction
Construction, operation and decommissioning	Exploitation of workers and contractors.	CECA SL to develop and implement a PS2 compliant HR policy with a requirement for contractor adherence. Comply with national law regarding workers' rights to join organizations for workers of their choosing and to allow workers to elect representatives. Measures to be taken to prevent and address any harassment,	CECASL EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2	Human Resources (HR) management systems to include the monitoring and document details of all workers and contractors Reporting of any incidents to be documented and monitored to	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		intimidation and exploitation in the workplace. Provision of a grievance mechanism for workers to raise workplace concerns. Ensure there is no forced labor. Ensure contractors have access to a grievance mechanism. Implement policies on the quality and management of the accommodation offered to workers.			enable appropriate action to be taken Implementation and monitoring or an appropriate workers grievance mechanism	
Construction, operation and decommissioning	Exploitation of workforce by contractors.	Measure to be in implemented to ensure contractors are legitimate enterprises with appropriate Environmental and Social; Management Strategies. Management procedures to be established for managing and monitoring the performance of contractors.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2	Reporting of any incidents to be documented and monitored to enable appropriate action to be taken	Throughout the lifetime of the project
Construction, operation and decommissioning	Unfair dismissal of workers.	Ensure that all workers receive notice of dismissal and timely severance payments mandated by law and any outstanding back pay and social security benefits and pension contributions	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2	Human Resources (HR) management systems to include the monitoring and documentation of dismissals and their circumstances	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Carry out an analysis of alternatives to retrenchment prior to implementing any dismissals. Where there are no alternatives to retrenchment development and implementation of a retrenchment plan to be undertaken. The retrenchment plan is to be based on the principle of non-discrimination and will follow consultation with workers, their organizations, and, where appropriate, the government. It is to be compliant with collective bargaining agreements, legal and contractual requirements related to notification of public authorities, and provision of information to, and consultation with workers and their organizations				
Health, Safety and Security						
Construction, operation and decommissioning	Workers exposed to unsafe working conditions.	A health and safety system for construction and operational activities will be developed for routine activities. The operational system will be based on the requirements of ISO18001 for Occupational Safety and Health Management Systems (OSHMS). The health and safety plan will include a process hazard analysis and HAZOP will be prepared for the	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2	Construction and Operation phase Training Plan Continued monitoring, reporting and documentation of any incidents	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		steam extraction facilities and specifically focusing on the issue of well blowouts and pipeline failures, hydrogen sulfides (H_2S) emissions and monitoring. The information generated from the HAZOP will be used to prepare the blowout and pipeline failure safety plan. Fire safety and Emergency Response Plans will be developed and implemented as part of the EMMP. Develop a training and skills program (Training Plan) to impart best practice in the skilling of local people for construction and operational jobs. First Aid and Safety training will be provided to workers. Preventative and protective measures to be implemented where necessary. Workers to have access to appropriate personal protective equipment.				
Construction, operation and decommissioning	Confined space hazards in this and any other industry sector are potentially fatal. Confined space entry by workers and the potential for accidents may vary among	Engineering measures will be implemented to eliminate, to the degree feasible, the existence and adverse character of confined	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	WBG EHS Guidelines for Thermal Power Plants	Construction and Operation phase Training Plan Continued monitoring,	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
	power facilities depending on design and on-site equipment. Therefore, confined spaces on site could result in adverse health and safety impacts to workers.	spaces. Other mitigation should include: • Permit-required confined spaces will be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible; • Safety precautions will include Self Contained Breathing Apparatus (SCBA), life lines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available; and, • Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary personal protective equipment (PPE), as well as the serviceability and integrity of the PPE will be verified.			reporting and documentation of any incidents.	
Construction, operation and decommissioning	Occupational exposure to heat occurs during construction activities, and during operation and maintenance of pipes, wells,	Prevention and control measures to address heat exposure include: • Reducing the time required for work in elevated temperature	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	WBG EHS Guidelines for Thermal Power Plants	Construction and Operation phase Training Plan Continued monitoring,	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
	and related hot equipment. Therefore, heat associated with operational and construction equipment on site could result in adverse health and safety impacts to workers.	environments and ensuring access to drinking water; • Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc.; • Use of PPE as appropriate, including insulated gloves and shoes; and, • Implementing appropriate safety procedures during the exploratory drilling process.			reporting and documentation of any incidents.	
Construction, operation and decommissioning	Workers could be exposed to noise particulate emissions during construction activities diesel engines, drilling and other heavy machinery are utilized. Operational noise and air quality emissions could also expose workers to excessive noise and air quality emissions.	Noise abatement technology includes the use of rock mufflers, sound insulation, and barriers during drilling. Adherence to mitigation measures outlined in "noise" section.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	WBG EHS noise limits Noise related complaints.	Construction and Operation phase Training Plan Continued monitoring, reporting and documentation of any incidents.	Throughout the lifetime of the project
Construction, operation and decommissioning	Injury or harm to site workers / communities as a result of badly designed plant and construction / decommissioning management.	The designing, construction, operation, and decommissioning of the structural elements or components of the project to be in accordance with industry best practice.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2 and PS4	Continued monitoring, reporting and documentation of any incidents	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Use of competent personnel in design and construction. Design and construction to consider safety risks to third parties or Affected Communities as well as project workers. The designs for the plant will incorporate provisions for fire prevention (developed procedures), fire detection (sensors and alarms), and fire suppression (water and foam and portable extinguishers). The facility will have equipment installed including gas detection, heat sensors and manual pull stations in the event of a fire and an audible alarm system. Typically, National Fire Protection Association (NFPA) recommendations will be implemented for insurance purposes.				
Construction, operation and decommissioning	Injuries to workers / communities as a result of transportation of deliveries and exported good on surrounding roads.	A Transport Management Plan shall be implemented for any construction/operation traffic to reduce the potential for accidents. All project operations vehicles and contractor vehicles will have a speed limit set for travel through settlements and areas where there are no posted speed limits.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2 and PS4	Continued monitoring, reporting and documentation of any incidents	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Mitigation measures as specified in section on traffic and transport. Measures include routing of loads away from sensitive receptors and timing pf delivers to avoid busy periods. Community Emergency Response Plans will be developed and tested including workers and nearby residents in the vicinity of project-related traffic. These will include emergency response related to traffic accidents and potential releases of chemicals and other hazardous materials.				
Construction, operation and decommissioning	Increased incidence of communicable disease	An important aspect of minimizing the spread of communicable diseases within the community is worker health screening, particularly as many workers are local people. A worker health screening program (including considerations for AIDS/HIV) shall be developed and implemented during the peak construction period or at any time when workers on site number more than 100.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2 and PS4	Continued monitoring, reporting and documentation of any incidents	Throughout the lifetime of the project
Community safety and site security	Prevent access to the site by community members	Ensure appropriate fencing is in place preventing non-construction personnel from entering the construction site.	EPC contractor(s) Plant operator(s)	Requirements of IFC PS 2 and PS4	Continued monitoring, reporting and	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		Construction of fences of adequate height to prevent unlawful access to the site. Hire staff to be responsible for control of access to the site. Establish a registry / identification system for employees and visitors to and from the site. Establish a visitor orientation program. A Worker Policy and Code of Behavior shall be developed which includes guidance on visits, prescribed actions for conduct violations and a grievance mechanism for complaints. Ensure appropriate signage around site perimeter especially in areas of high security and hazardous installations.	Decommissioning contractor(s)		documentation of any incidents	
Community safety and site security	Prevent community unrest and conflicts security guards	The EPC contractor shall involve external stakeholders (i.e., police or local authorities) in any on-site security incidents and ensure that appropriate incident response procedures are implemented.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2 and PS4	Continued monitoring, reporting and documentation of any incidents. No complaints received. Implementation of effective grievance mechanism.	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
Community safety and site security	Enhance employment opportunities	Employment policies requiring preferential hiring of local community members where they are appropriately skilled. Pass through of this policy to the EPC Contractor and supply chain partners including sub-contractors to the EPC contractor; Ensure a transparent hiring process is conducted help the community to understand strategic staffing decisions for the project to avoid conflict. A Construction Management Plan and procedures shall be designed to help to minimize land and community disturbance. Develop a Workforce Development Strategy – a commitment to maximize employment and skills opportunities for local people. Develop a training and skills program to impart good international industry practice in the skilling of local people for construction and operational jobs. The following enhancement measures would contribute to maximizing the benefits of the project and will be considered by	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2 and PS4	Continued monitoring, reporting and documentation of any incidents. No complaints received. Implementation of effective grievance mechanism.	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		CECASL as part of consultations around community benefits: Short term training programs for women and youth: Additional training programs including savings, meeting food and health safety standards and other technology training programs for youth shall be offered that will help them to establish new and/or improved livelihoods. Encourage contractors to provide apprenticeship opportunities to local people. Establish a local job readiness program and encourage the construction supply chain to continue to invest in workers.				
Construction, operation and decommissioning	Exposure of workers and communities to hazardous materials.	The potential for workers and communities to be exposed to hazardous materials to be minimized (see wastes section within this table). Exposure should be avoided by modifying, substituting, or eliminating the condition or material causing the potential hazards. Deliveries and transportation of hazardous materials to be effectively managed. Appropriate and legitimate waste disposal	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS2 and PS4	See section on waste	Throughout the lifetime of the project

Project Phase	Environmental Aspect and Identified Impacts	Action/ Mitigation Measures	Responsible Party	Applicable Standard(s)/ recommended basis of assessment	Monitoring Means	Time Frame
		contractors to be used (see wastes section within this table).				
Construction, operation and decommissioning	Exposure of communities to water borne diseases as a result of project activities.	See section on waters and wastewater and solid waste. Monitoring of river water quality is to be undertaken throughout the lifetime of the project. Operations will be stopped and mitigation measure employed if any adverse impacts are detected which exceed the relevant standards.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS4 EPA-SL and WBG/IFC requirements	Monitoring of river water quality	Throughout the lifetime of the project
Construction, operation and decommissioning	Risks to plant operations workers and communities from security personnel.	All security personnel to be fully trained and competent and not implicated in past abuses. Due diligence of security staff to be undertaken.	EPC contractor(s) Plant operator(s) Decommissioning contractor(s)	Requirements of IFC PS4	Continued monitoring, reporting and documentation of any incidents	Throughout the lifetime of the project

In addition to the mitigation actions listed above, the EPC Contractor and / or the O&M Contractor will be required to prepare management plans as appropriate to the actions above including, but not limited to:

- Environmental and Social Management System;
- Construction Management Plan;
- Health and Safety Plan including Emergency Response Plan;
- Community Safety Plan (including traffic management plan);
- Fire Safety Plan;
- Community and Stakeholder Consultation Plan;
- Monitoring and Reporting Plan;
    - HIV/AIDS management Plan;
- COVID-19 management Plan;
- Worker Rights Protection Plan;
- Security and Use of Force Training Plan;
- Anti-discrimination Training Plan;
- Population Displacement Plan; and
- Waste Management Plan.

All plans produced will need to demonstrate compliance with legal and IFC requirements and will be reviewed and approved by the Developer and its advisors at draft stage. The draft of these plans will also be shared with the EPA-SL and project lender(s) to ensure that all necessary requirements are accounted for.

19 Stakeholder Consultation

19.1 Introduction

The purpose of this section is to describe the consultation carried out in relation to the proposed project and to outline the key issues raised by stakeholders to date. This section also outlines the requirements and commitments in relation to further consultation for the project going forward.

Consultations play a major role in identifying the potential impacts of any proposed project and can assist in the identification of socio-economic, religious, and cultural impacts. The main objectives of the consultation process undertaken to date are as follows:

- To inform the relevant stakeholders about the proposed project;
- To capture views and concerns of the relevant stakeholders with regard to the proposed project;
- To enhance ownership of the project within the host community; and
- To provide a basis for stakeholder participation in the ESHIA process.

The project has been in development since early 2013. However, from June 2014 and through 2020 there have been many issues significantly impacting Sierra Leone, this has resulted in a limited amount of survey work which has in turn restricted the consultation process undertaken to date. On that basis the current approach under COVID-19 conditions is to produce an ESHIA which focuses on the key issues relevant to the project, in order to progress the design and to develop the ongoing consultation process.

As the project progresses and detailed design is concluded, a greater level of detail will be available regarding the project's impacts and the environmental and social aspects that will require management during construction and operation. Further consultation, as outlined in Section 19.2 below, will be undertaken prior to and during the construction phase.

19.2 Stakeholder Consultation

During August 2020, a number of informal and formal meetings were held with various Stakeholders including the following:

- Government (National, Regional and Local) Ministries, Departments and Agencies;
- Community Leaders (e.g., Religious, Educational);
- Local NGOs;
- International Financial Institutions;
- Vulnerable Groups (e.g., women, youth and elderly);
- Business Organizations; and
- Communities & Community-Based Organizations (CBO).

Appendix J, of this ESHIA presents a summary of the key observations / outcomes from the consultation meetings.

In addition to the various stakeholder meetings, two Key Community Stakeholders Workshops took place on the 17th August 2020. The community consultation found that there is clear support for the project, but also there exists expectations that the project will provide tangible benefits in the form of job provision, electricity supply, and economic and community development. It is also expected that potential

adverse impacts will be predicted and prevented or managed. Payment to the Project Affected People (PAPs) was highlighted as being of particular importance.

The issues raised were unanimous across all the districts and communities and in general consisted of the following:

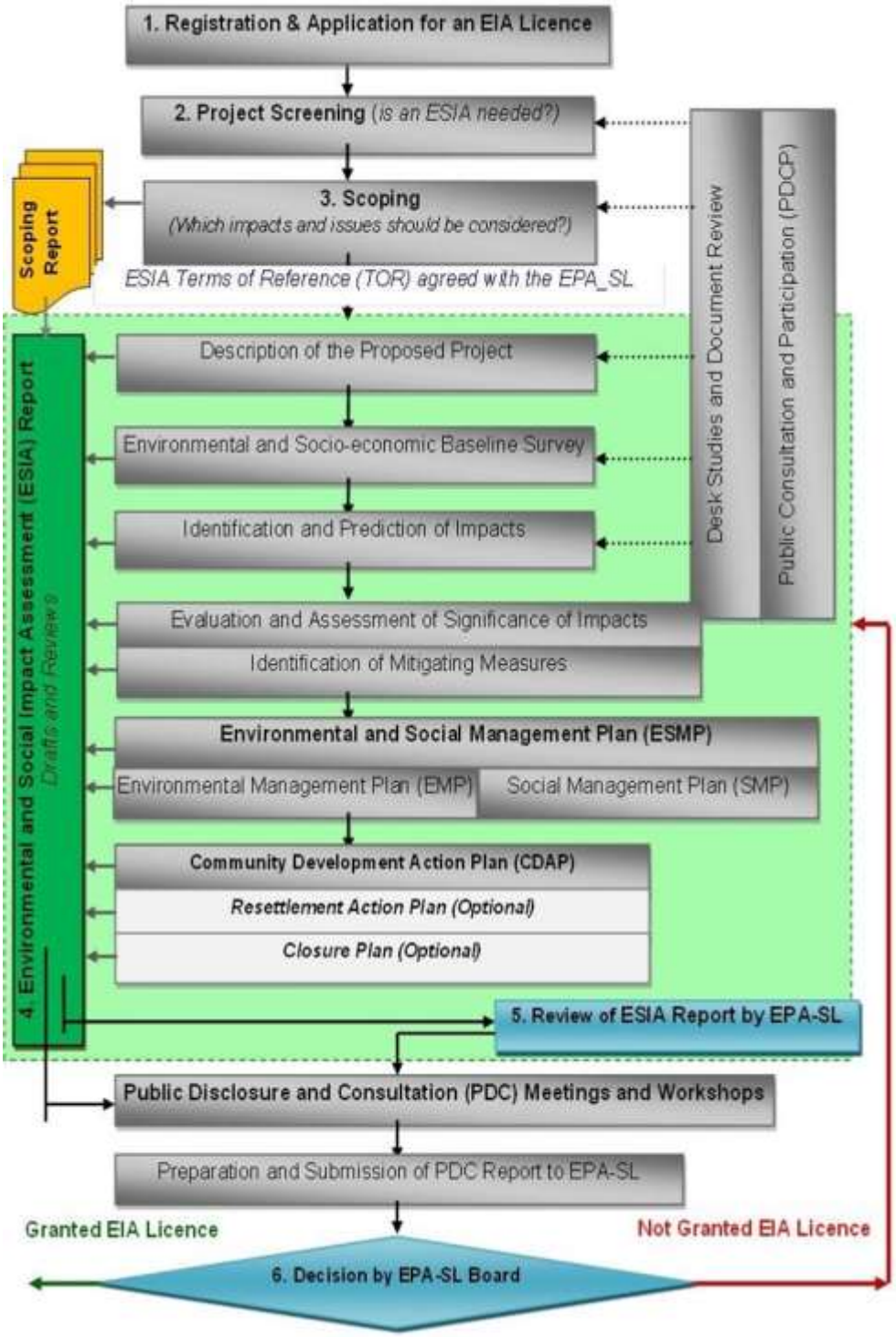
- Current and future payments to the PAPs;
- Job creation for the youth – there was a cyclical request for employment, particularly unskilled labor, to be sourced from the various affected communities;
- Support for the rehabilitation of the roads within the community;
- Extension of electric power to the communities who are not yet connected to the national grid;
- Upholding and respect of community values – reverence towards the communities' cultural heritage-shrines, sacred groves, etc.;
- The noise and air pollution that will be generated from project operations; and
- Request for the provision of basic social amenities, not necessarily in the context of the proposed project.

It should be noted that some of the issues raised are beyond the remit of the project, for example connection to the National Grid for unconnected communities and there may be limits on the provision of basic social amenities. However, where reasonable and possible the project will endeavor to respond to community requests.

Overall, the project is highly welcomed and the concerns raised were reflective of those raised during the consultation process. A summary of the consultations of the Key Community Stakeholders Workshops held are provided in Section 4 and summary tables and full details are provided in Appendix J. The majority of these concerns are addressed within this ESHIA and/or within the specialized sections of the ESHIA.

The environmental permitting process in Sierra Leone requires certain steps to be followed before holding the Public Disclosure and Consultation (PDC) meetings and workshops. These steps usually involve registration, screening, submission of a Scoping Report and preparation and approval of the ESHIA before the PDC step can be held. Figure 17.1 below shows the process.

Figure 19.1 Steps to be Followed Before Holding the Public Disclosure and Consultation (PDC) Meetings and Workshops



The Scoping Report was submitted in September of 2020 and the Project received approval to prepare the ESHIA. Once the ESHIA is completed it will be submitted to the Sierra Leone EPA for review and approval before being posted and PDC meetings and workshops held.

INTEGEMS has performed all local engagement, Household Surveys, Focus Group Discussions, and Key Informant Interviews, for the original HFO project and the restructured LPG project. As further community and stakeholder engagement is required for Public Disclosure and Consultation (PDC) Meetings and Workshops, INTEGEMS will be an effective and beneficial point of contact to assist in the process.

19.3 Actions Going Forward

19.3.1 Pre-Construction

While stakeholder engagement is an iterative process, constantly adapted to changing stakeholder requirements, effective engagement is supported by three key phases:

Phase I – Data Gathering: Understanding the location, needs, agendas and motivations of the stakeholders. Ascertaining potential project impacts on them.

Phase II – Implementation: Designing, scheduling & conducting engagement activities in a systematic fashion. Different methods will be used at different stages of the project.

Phase III – Monitoring & Evaluation: Checking to ensure the engagement meets the desired objective and is meaningful and effective.

19.3.2 CECASL

To ensure the continued involvement of key stakeholders and the community, CECA will:

- Present the completed ESHIA to key stakeholders and the community as per the environmental permitting process of Sierra Leone;
- Ensure any specific consultation requirements identified within the ESHIA specialist sections are undertaken; and
- Implement (and further develop if required) the CECASL Stakeholder Engagement Plan (SEP) so that all concerns identified to date are managed and factored into the design development for the project.

Appendix A: Original ESIA

Appendix B: List of Report Preparers – Individuals and Organizations

Appendix C: General Arrangement Drawing

Appendix D: Site Survey and Basemaps

Appendix E: Noise Levels and Figures

Appendix F: Air Quality Report

Appendix G: Land Contamination Report

Appendix H: ESHIA Scoping Report

Appendix I: Topographic Survey Report

Appendix J: Stakeholder Consultations and Key Observations

Appendix K: Fuel Specification

Appendix M: EPC Contractor Scope from Power Engineers

Appendix N: Relevant Data Tables

Appendix Q: LRP-ARAP Update

Appendix R: Mitigation Action Plan

Appendix S: Guidelines and Standards

Appendix T: Questionnaires

Appendix U: References