



RURAL AND RENEWABLE ENERGY AGENCY

**GBEDIN MINI HYDROPOWER PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT**

FINAL REPORT

JUNE | 20 | 2019



Multiconsult

IN ASSOCIATION WITH:



RURAL AND RENEWABLE ENERGY AGENCY

GBEDIN MINI HYDROPOWER PROJECT

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JUNE | 20 | 2019

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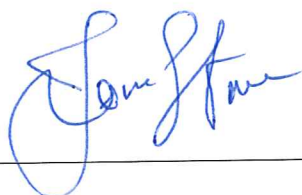
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EXECUTIVE SUMMARY

Introduction

With support from the African Development Bank (AfDB), the Rural and Renewable Energy Agency (RREA) is proposing to develop a hydropower project at Gbedin Falls on the Saint John River in Nimba County, Liberia. The project is referred to as Gbedin mini hydropower project and is intended to provide reliable, affordable and sustainable electricity supply to rural and urban communities connected to the cross-border network between Liberia and Côte d'Ivoire.

The ESIA Study

As part of planning and licensing of the Gbedin mini hydropower project, RREA is committed to carry out an Environmental and Social Impact Assessment (ESIA) process in accordance with the Environmental Protection and Management Law of Liberia (2003) and the applicable international safeguard policies, including the AfDB Integrated Safeguards System. For this purpose, Multiconsult of Norway in collaboration with Diffusion Inc. of Liberia were been appointed to carry out the ESIA study.

The ESIA is based on the technical design and layout described in the feasibility study by Tractebel in 2016. Field studies included a detailed biodiversity inventory, socio-economic household survey, property valuation and a series of consultations with affected communities and other stakeholders. A separate Resettlement Action Plan (RAP) has been prepared to guide the compensation and livelihood restoration process.

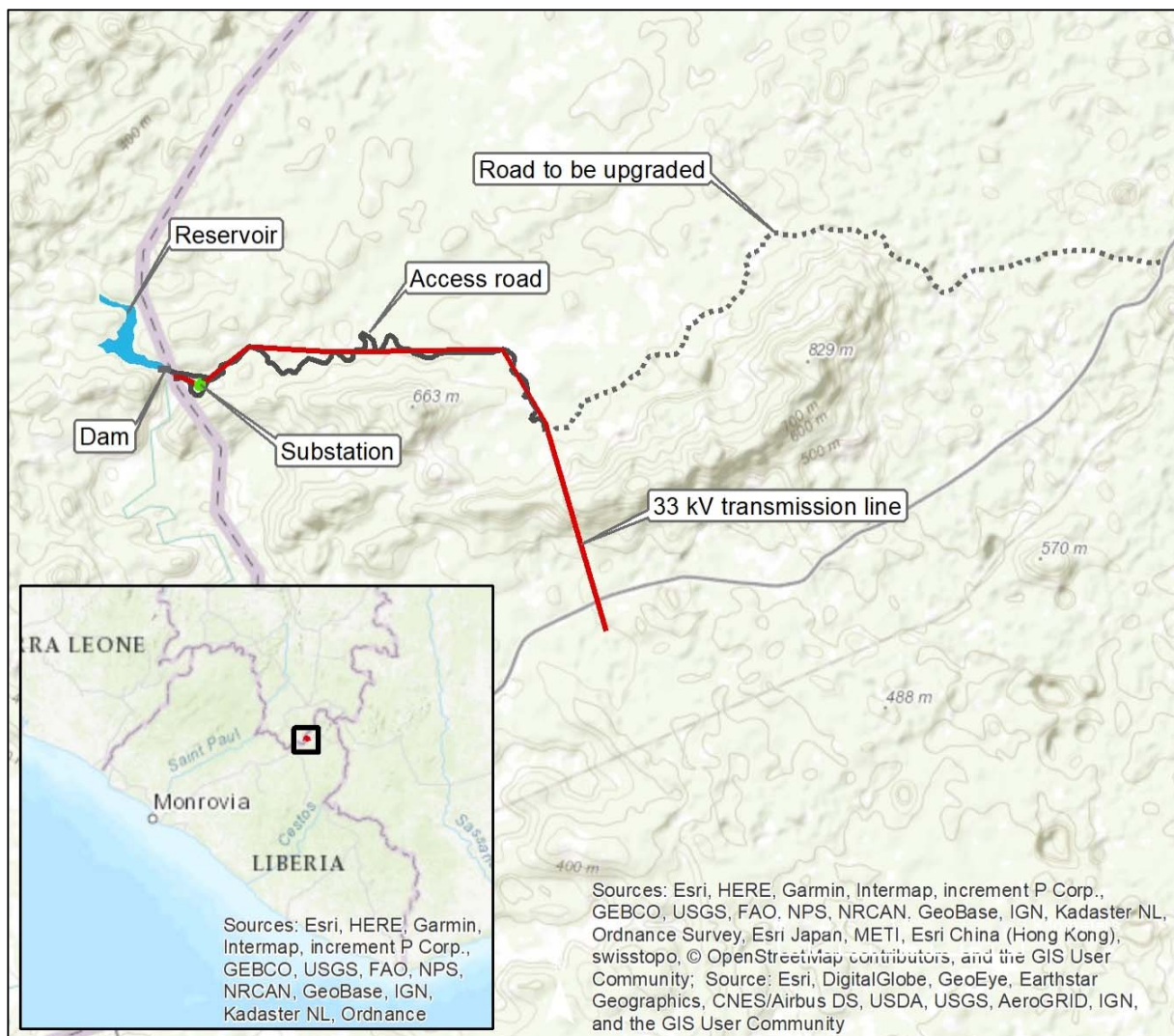
Project Description

Geographical location: The Gbedin Falls is located in a remote area of heavy forest about 280 km northeast of Monrovia and 7 km from Gbedin town in the district of Sanniquellie Mahn, Nimba County. The access and all operation components will be on the Liberian side of the river, while the other side belongs to Guinea. It should be noted that Guinea territory will not be touched expect for the forested riverbanks in the small inundation zone (where there is no active land use).

Hydropower plant: The proposed layout consists of a low-height, free overflow weir at the top of Gbedin Falls and a powerhouse with total installed capacity of 9.34 MW at the foot of the waterfalls. The length of the penstocks is less than 100 m, while the small reservoir created by the weir will have a surface area of about 6 ha. The power plant will be operated as a run-of-river scheme with an average annual generation of 56.4 GWh.

Transmission line: A new 33 kV transmission line will be constructed from the substation at the powerhouse to the existing cross-border grid. The connection point will be close to Kitoma town along the main Ganta-Sanniquellie road. The total length of the transmission line is 7.8 km.

Access road: In order to access the project site, it will be necessary to rehabilitate 9.5 km of existing road (from the Ganta-Sanniquellie road through Gehwee town) and to a construct a new road of 7.8 km length to Gbedin Falls.



Impacts and Mitigation

Biophysical Environment

Gbedin Falls are steep and about 20 m high with a small pool below. The landscape is pristine and surrounded by undulating hills with thick vegetation consisting of both primary and secondary forest as well as scattered smallholder farms. The land clearing and construction works will affect a relatively small portion of this landscape. The most significant impact after commissioning will be the reduced flow in the waterfalls and the submergence of riverbanks upstream of the dam.

With an installed turbine discharge of $52 \text{ m}^3/\text{s}$ (compared to the mean annual inflow of $58 \text{ m}^3/\text{s}$), all the dry season flow will be diverted to the powerhouse before being returned back into the Saint Paul River in the pool below the waterfalls. In the rainy season, however, there will be substantial spilling of water into Gbedin Falls. The downstream flow regime will not be affected due to the run-of-river operation mode of the power plant.

In order to minimise the impacts on the physical environment, including air, soil and water as well as the landscape, the construction works should comply with best industry practice as specified in the Environmental and Social Management Plan (ESMP) for the contractors. In addition, a minimum environmental flow of $5.8 \text{ m}^3/\text{s}$ (10% of mean flow) should be released into Gbedin Falls, and the reservoir area should be cleared of trees prior to impoundment.

The rich biodiversity at Gbedin Falls and the surroundings is not expected to be significantly affected, mainly due to the limited project footprint and the run-of-river operation. The waterfall is already a natural barrier to upstream fish migrations, hence the flow diversion and small dam will not change the natural migration patterns.

The project will not interfere with any protected areas or key biodiversity areas. However, the presence of many threatened and near threatened species of plants, mammals, bird, reptiles and fish adds importance to the strict enforcement of best industry practice in construction works. This includes pollution spill preparedness and response, restrictions on tree felling outside the defined wayleaves, no night time construction noise, and prohibition of all hunting and purchase of bush meat by the workforce. Special attention needs to be given to the occurrence of chimpanzees in the adjacent forest areas north of Gbedin Falls. A detailed survey of chimpanzees should be conducted prior to construction to verify that the project's area of influence is not used as a nesting habitat at that time.

Human Environment

Land use at Gbedin Falls and the areas along the planned transmission line and access road is dominated by slash and burn agriculture, sugarcane farming and tree crop plantations (oil palm and cocoa). Farms are found scattered inside the forest while the settlements are confined to the neighbouring towns at some distance from the proposed project footprint. The main impact in terms of land loss is thus limited to economic displacement and no physical displacement. The directly affected farmers are from the towns of Gbalasonoh, Gehwee, Kitoma and Tonwee in Sanniquellie-Mahn District.

A total of 148 farmers will lose parts of their farmland and crops at Gbedin Falls and within the right of way (RoW) of the transmission line and access road. These project affected persons (PAPs) will be compensated and supported to restore their livelihoods. The magnitude of economic displacement is significant in the sense that a large number of households will be affected. However, as physical displacement is fully avoided and only small portions of farms will be lost, the overall impact can be considered acceptable for a project of this size and importance. Provided that the Resettlement Action Plan (RAP) is successfully implemented, the affected livelihoods are expected to be restored to pre-project levels.

The most significant risk in terms of access to land is a potential conflict with future iron ore mining within the RoW of the transmission line at Kitoma hill (between Gbedin Falls and the connection point to the existing electricity grid). The company Cavalla Resources holds a mineral exploration license and they are intending to develop bulk mining operations at Kitoma hill and the nearby areas (possibly also affecting the proposed access road, but not Gbedin Falls). This issue can either be addressed by re-routing the transmission line (and access road) or by assuming that mining operations will not materialise and then to relocate the transmission line in case there is future interference from mining. It is recommended that an engineering consultant be appointed to make the necessary adjustments to the project layout if any.

Except for the issues related to land acquisition, project impacts on livelihoods and community health and safety include restrictions on fishing in the pool below Gbedin Falls and the induced impacts associated with in-migration of workers, job seekers and 'camp followers'. In addition, construction traffic will create safety risks as well as noise and dust pollution along the access route.

Fishing at Gbedin Falls is limited to artisanal fisheries by local farmers who rely on fishing as a supplementary source of food (and income). The best fishing grounds are in the main river further downstream but the small pool at the foot of the waterfalls is used especially in the rainy season. The construction and operation of the power station will prevent access to this pool (either fully or partially). The fishermen have no objection to the project and they can continue fishing in other reaches of the river. However, it is recommended that the access to the pool is maintained, if possible, and that fishermen be allowed to fish in the reservoir after commissioning. The affected fishermen should also be given priority for employment during construction and be enrolled in the livelihood restoration programme.

The community health and safety risks should be mitigated by provision of public water supply and sanitation facilities combined with awareness creation related to public health, traffic safety and community-workers interactions. The contractors will be responsible to provide safe water, sanitation and health care to workers and their families to avoid exerting additional pressure on public services and infrastructure.

The major project benefits include employment creation (mainly during construction), local economic development (business opportunities and rural electrification), and provision of renewable energy as replacement for fossil fuel based power generation. These positive impacts should be enhanced by maximising the local content, especially by recruiting local people and PAPs for unskilled and semi-skilled labour. Local businesses should also be prioritised for provision of services and sub-contracts. This will also help reduce the impacts from population influx.

Impact Rating

The impact ratings for the Gbedin mini hydropower project are summarised in the table below. Provided that all the mitigation measures are successfully implemented, none of the impacts will be worse than 'small negative' (i.e. residual risks that can still be avoided) while the majority will be insignificant or positive.

Theme	Impact Rating			
	Construction Phase		Operation Phase	
	Pre-Mitigation	Post-Mitigation	Pre-Mitigation	Post-Mitigation
Physical Environment				
Topography/landscape	Medium negative	Small negative	Medium negative	Small negative
Geology and soils	Medium negative	Small negative	Medium negative	Small negative
Climate and air quality	Small negative	Insignificant	Large positive	Large positive
Noise	Medium negative	Small negative	Insignificant	Insignificant
Hydrology	Medium negative	Small negative	Medium negative	Small negative
Water quality	Medium negative	Small negative	Medium negative	Small negative
Biological Environment				
Protection status	Insignificant	Insignificant	Insignificant	Insignificant
Biodiversity	Medium negative	Small negative	Medium negative	Small negative
Human Environment				
Population	Medium negative	Small negative	Medium positive	Medium positive
Land tenure and use	Medium negative	Small negative	Small negative	Insignificant
River use	Medium negative	Small negative	Small negative	Small positive
Livelihoods/economy	Medium negative	Small positive	Small positive	Medium positive
Infrastructure/services	Medium negative	Small negative	Small positive	Medium positive
Health, safety/security	Medium negative	Small negative	Small negative	Insignificant
Cultural heritage	Small negative	Insignificant	Insignificant	Insignificant
Tourism	Insignificant	Insignificant	Insignificant	Insignificant

Conclusion

The Gbedin mini hydropower plant can become an environmentally friendly and sustainable project. However, being located in an area with rich biodiversity and in communities that are vulnerable in terms of livelihood impacts, project implementation will require careful planning and coordination.

The necessary preconditions and requirements for successful project implementation have been detailed in an Environmental and Social Management Plan (ESMP) and in a separate Resettlement Action Plan (RAP). These plans include the organisational framework for mitigation management and monitoring as well as the estimated costs.

The overall conclusion of this ESIA is that the detailed planning and implementation of the Gbedin mini hydropower project should continue under the condition that adequate measures are taken to implement and monitor the prescribed mitigation and enhancement measures. This also includes a formal agreement with the neighbouring riparian state Guinea.

ACRONYMS

AfDB	African Development Bank
ARI	Acute respiratory infection
CHT	Community Health Team
CLSG	Côte d'Ivoire – Liberia – Sierra Leone – Guinea
EBA	Endemic Bird Area
EHS	Environment, Health and Safety
EPA	Environmental Protection Agency of Liberia
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FGM	Female genital mutilation
FSL	Full Supply Level
GoL	Government of Liberia
GRM	Grievance Redress Mechanism
HFO	Heavy Fuel Oil
HPP	Hydropower Project
IFC	International Finance Corporation
ISS	Integrated Safeguards System
kV	Kilo Volt
kWh	Kilo Watt hours
LEC	Liberia Electricity Corporation
LHS	Liberia Hydrological Service
LIREP	Liberia Renewable Energy Project
masl.	Meters above sea level
MLME	Ministry of Lands, Mines and Energy
MW	Mega Watt
N/A	Not applicable
NEP	National Energy Policy
NGO	Non-Governmental Organisation
NOI	Notice of Intent
OS	Operational Safeguard
PCHS	Partners for Community Health Services
PS	Performance Standard
RAP	Resettlement Action Plan

RoW	Right of Way
RREA	Rural and Renewable Energy Agency
SAC	Soguipah Agricultural Company
SGBV	Sexual and Gender Based Violence
SREP	Scaling Up Renewable Energy Program for Low Income Countries
STI	Sexually transmitted infection
ToR	Terms of Reference
UGF	Upper Guinea Forest
USD	United States Dollar

1 INTRODUCTION

1.1 Background

Liberia has one of the lowest electricity access rates in the world presently, with less than 2% of households having access to electricity services nationwide. The population of Liberia is expected to grow approximately from 3.9 million currently to 4.5 million by 2020. According to the Least Cost Power Development Plan, the demand for electricity is expected to grow at an average rate of 8% until 2033, with slightly higher growth rates from 2015 to 2020.

Energy consumption in Liberia is dominated by biomass that accounts for more than 80% of the primary energy needs of the population. Most of Liberians still depend on firewood and charcoal for cooking and heating needs and palm oil for lighting. The most recent census data, shows that 70% of the urban population still use charcoal for cooking while 91% of the rural population uses firewood.

Much of Liberia's infrastructure was greatly damaged, destroyed or looted during the civil war. This included the Mt. Coffee Hydro Power Plant (HPP), other generation facilities and electricity transmission and distribution networks. As a consequence, Liberia has a big deficit in electricity generation, transmission and distribution. It is noted that the Mt. Coffee HPP has been rehabilitated and is operational since December 2016. The total installed capacity of Liberia's public generation facilities is 191 MW. Around 98% of the country installed capacity is located in and around Monrovia and serves a total of 35,000 customers from a total population of 1 million inhabitants. These are served by the public network which is operated by the LEC. The public electricity network is supplemented with an installed capacity of 216 MW from private sources and an additional ten isolated mini-grids based on units powered by heavy fuel oil with a total installed capacity of 13 MW. Liberia currently has one of the highest electricity tariffs in Sub-Saharan Africa (and among the highest in the world) at more than USD 0.56 /kWh due to high generation costs that are essentially based on fossil fuel production costs which range from USD0.32-0.6/kWh.

The Government of Liberia (GoL) has further intensified its commitment to the provision of energy services through the recent development of a National Energy Policy (NEP) and supportive legislation, which calls for universal and sustainable access to affordable and reliable energy supplies in order to foster the economic, political, and social development of Liberia. One of the key pieces of the NEP related to rural energy is the creation of a Rural and Renewable Energy Agency (RREA) whose long-term goal is to facilitate the economic transformation of rural Liberia by accelerating the commercial development of modern and renewable energy services in rural areas.

It is against this background that the African Development Bank (AfDB) wants has engaged itself in supporting the energy sector in Liberia, targeting the renewable rural energy under the Scaling Up Renewable Energy Program for Low Income Countries (SREP). The Liberia Renewable Energy Project LIREP aims to build a 9.34 MW run of river hydropower plant at Gbedin Falls on the Mani River in Nimba County and connect the existing cross-border line between Liberia and Cote d'Ivoire, through the construction of a 7.8 km 33kV transmission line. In order to ensure that these development activities are carried out while ensuring environmental and social safeguards in accordance with the AfDB Operational Safeguards requirements; there is need to carry out detailed Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP).

1.2 Project Objective

The overall purpose of the Gbedin mini hydropower project is provide reliable, affordable and sustainable electricity supply to rural and urban communities connected to the cross-border network between Liberia and Côte d'Ivoire. The power supply will allow grid expansion to isolated communities and remote areas, and encourage the connection of a larger amount of households, businesses and industries to the grid. This

will significantly reduce the number of self-generation (fossil energy) units and increase the electrification rate in the region and beyond.

1.3 ESIA Process

1.3.1 ESIA Requirements

As part of the project preparation stage of the Gbedin mini hydropower project, the Rural and Renewable Energy Agency (RREA) with support from the African Development Bank (AfDB) is committed to carry out an Environmental and Social Impact Assessment (ESIA) process in compliance with the Environmental Protection and Management Law of Liberia (2003) and the applicable international safeguard policies. For this purpose, Multiconsult Norge AS of Norway in collaboration with Diffusion Inc. of Liberia have been appointed to carry out the ESIA and RAP studies.

The proposed Gbedin mini hydropower project falls under the 'Energy Industry' category (Number 7) in Annex I of the Environmental Protection and Management Law of Liberia, and as such is required to undergo a full Environmental and Social Impact Assessment (ESIA).

Additionally, the Gbedin mini hydropower project is a category one project of the African Development Bank (AfDB), requiring a full Environmental and Social Impact Assessment (ESIA) an Environmental and Social Management Plan (ESMP) and a separate Resettlement Action Plan (RAP) in accordance with the AfDB Integrated Safeguards System; Environmental and Social Assessment Procedures (ESAP), Bank's Policy on the Environment (2004); and Bank's Involuntary Resettlement Policy (2003).

In order to meet the requirements of potential international financiers other than the AfDB, the ESIA and RAP process has also been carried out in compliance with the IFC Performance Standards.

1.3.2 Screening and Scoping

The Project Brief along with a permit request was submitted to the Environmental Protection Agency (EPA) on October 25, 2018 (Multiconsult 2018). The approval of the Project Brief was then delayed until Multiconsult as international consultant had paid the accreditation fee and obtained accreditation certification. The accreditation fee was paid on February 19, 2019.

The scoping exercise was carried out in a compressed timeframe and based on the earlier consultations that had been undertaken by RREA and the consultant. The Scoping Report and draft Terms of Reference for the ESIA was submitted on March 21, 2019 (Multiconsult 2019).

The present ESIA report presents the outcome of the ESIA studies for the Gbedin mini hydropower project.

1.4 Objectives of the ESIA Studies

The main objective of the Environmental and Social Impact Assessment (ESIA) is to provide decision-makers with an indication of the likely consequences of the proposed project. According to the Terms of Reference (ToR), the objectives of this ESIA (and the RAP) include the following:

- Review of preliminary ESIA and project design documentation and any other project related documentation.
- To identify all potential significant adverse environmental and social impacts, of the project and recommend measures for mitigation.
- To develop an Environmental and Social Management Plan (ESMP) and RAP.
- To prepare an Environmental and Social Impact Assessment, RAP and ESMP reports that are compliant to the relevant authorities and African Development Bank Integrated Safeguards System requirements and that detail all findings and recommendations.

- The RAP will carry out a census of the expected number of affected persons and properties as well as their socioeconomic status. Value affected persons' assets and other sources of livelihood.

1.5 ESIA Report Structure

The ESIA report has been organised into ten chapters covering all the items listed in the EIA Procedural Guidelines (EPA 2006). The report structure also includes all the items required by the African Development Bank (AfDB) and other international financial institutions.

Following the executive summary and the introduction (Chapter 1), the ESIA report provides a description of the project design and layout (Chapter 2) and the study approach and methodology (Chapter 3). Chapter 4 outlines the policy, legal and administrative framework within which the project and the ESIA will be carried out.

Chapter 5 presents the baseline environmental and social conditions, while Chapter 6 provides an overview of the public consultations and stakeholder engagement process. The impacts and mitigation measures are described in Chapter 7 followed by the analysis of alternatives, including the no-project alternative, in Chapter 8.

Finally the Environmental and Social Management Plan (ESMP) and monitoring plan are presented in Chapter 9 and Chapter 10, respectively. The ESIA report also includes references and appendices.

It should be noted that the Resettlement Action Plan (RAP) is presented as a stand-alone document.

2 PROJECT DESCRIPTION

2.1 Introduction

The proposed Gbedin mini hydropower project consists of a 9.34 MW run-of-river hydropower plant at Gbedin Falls on the Mani River in Nimba County and a 7.8 km long 33 kV transmission line connecting to the existing cross-border line between Liberia and Cote d'Ivoire. The general layout described below is based on the feasibility design by Tractebel (2016). It should be noted, however, that the feasibility study recommended further technical investigations, especially related to hydrology and topographic surveys, hence the project design is likely to be (slightly) modified during the detailed design phase.

2.2 Geographical Location

The Gbedin Falls is located in a remote area of heavy forest about 280 km northeast of Monrovia and 7 km from Gbedin town in the district of Sanniquellie Mahn. The Gbedin Falls are on the Mani River, a tributary of the Saint John River, in Nimba County.¹ Access to the site is possible from the left bank only as the right bank forms the border with Guinea. The location of the Gbedin Falls is shown in the figure below.



Figure 1: Location of Gbedin Falls and Gbedin mini hydropower project in Liberia.

¹ Most local people refer to the river as Saint John, not Mani River.

2.3 Project Design and Layout

The Gbedin mini hydropower project is planned as a run-of-river scheme. The key features of the feasibility design and project implementation arrangements are as outline below:

- A low-height, free overflow weir is proposed at the top of the falls which would provide a small storage for daily flow regulation (i.e. run-of-river).
- A powerhouse is proposed with 2 x 5.15 MW Kaplan turbines and 2x 5.9 MVA generators giving a total installed capacity of 9.34 MW. The average annual generation is 56.4 GWh (power factor 0.71) which is split between the wet and dry seasons as follows:
 - Dry season (December to April): average power 3.4 MW, average generation 14.7 GWh (26% of annual average), power factor 0.45, firm power 1.5 MW (90% reliability).
 - Wet season (May to November): average power 9.1 MW, average generation 41.8 GWh (74% annual average), power factor 0.90, firm power 4.3 MW (90% reliability).
- The budget cost estimate is 27.4 MUSD including a 7.8 km long 33 kV transmission line, 7.8 km of new access roads and 9.5 km of rehabilitated access roads. The unit costs are: 2.93 MUSD/MW and 5.31 USD/kWh.
- The expected construction duration is 3 years.

Key details of the project are provided in the following summary table.

Table 1: Salient features of the Gbedin mini hydropower project.

Parameter	Description
Reservoir	Full supply level 318.70 masl, storage volume 350 ML, surface area 6 ha
Gross head	21.7 m (50% exceedance flow)
Design turbine flow	52 m ³ /s
Turbines and generators	2x 5.15 MW Kaplan turbines 2x 5.9 MVA generators Total installed capacity of 9.34 MW
Electricity generation	Average power 6.4 MW, average annual generation 56.4 GWh, power factor 0.71, firm power 2.1 MW (90% reliability), firm annual generation 18.4 GWh Dry season (December to April): average power 3.4 MW, average generation 14.7 GWh (26% of annual average), power factor 0.45, firm power 1.5 MW (90% reliability) Wet season (May to November): average power 9.1 MW, average generation 41.8 GWh (74% of annual average), power factor 0.90, firm power 4.3 MW (90% reliability)
Weir	Maximum height 5.4 m to FSL and 10.4 m to abutment crest level Total length 65 m, spillway length 29.5 m
Transmission Line	7.8 km long, 33 kV connection to the cross-border network
Access roads	7.8 km long sealed access road (new) plus 9.5 km long sealed access road (rehabilitation)
Construction time schedule	Total 51 months (4.25 years) comprising 15 months for detailed engineering design and international tendering and 36 months for construction
Budget cost estimate	27.4MUSD; 2.93MUSD/MW

The general and detailed layout of the Gbedin mini hydropower plant is illustrated in Figure 2, Figure 3, Figure 4 and Figure 5 below.

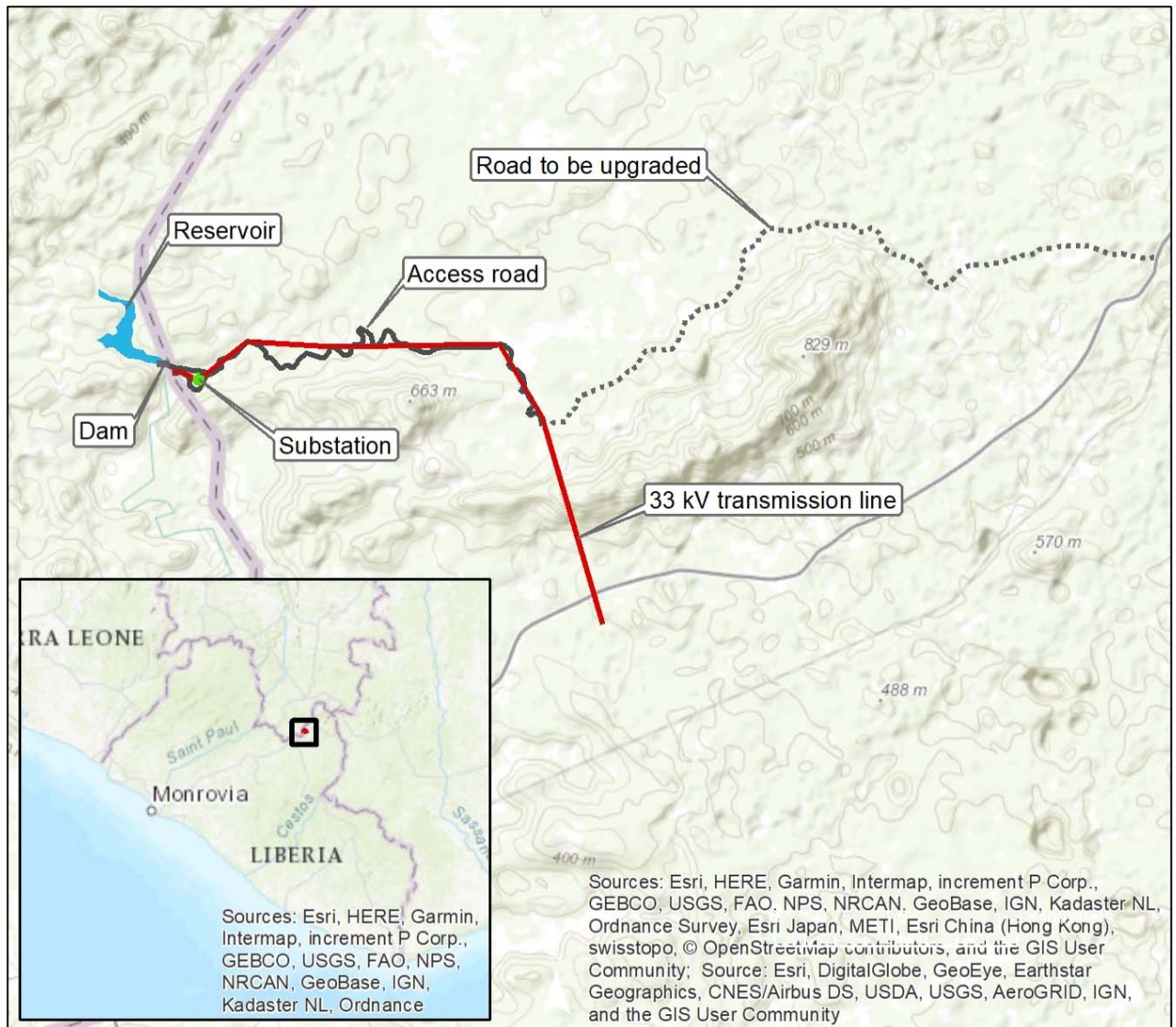


Figure 2: Project location and general layout.

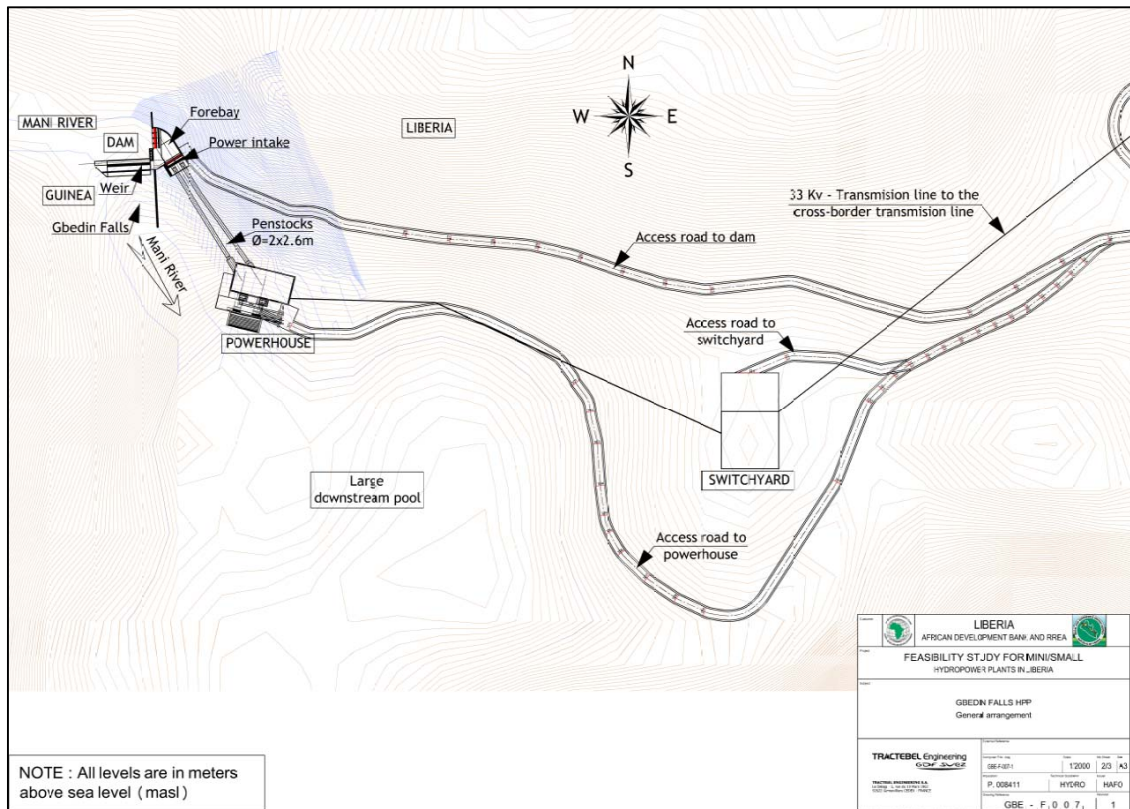


Figure 3: The principal layout of Gbedin mini hydropower plant. Source: Tractebel (2016).

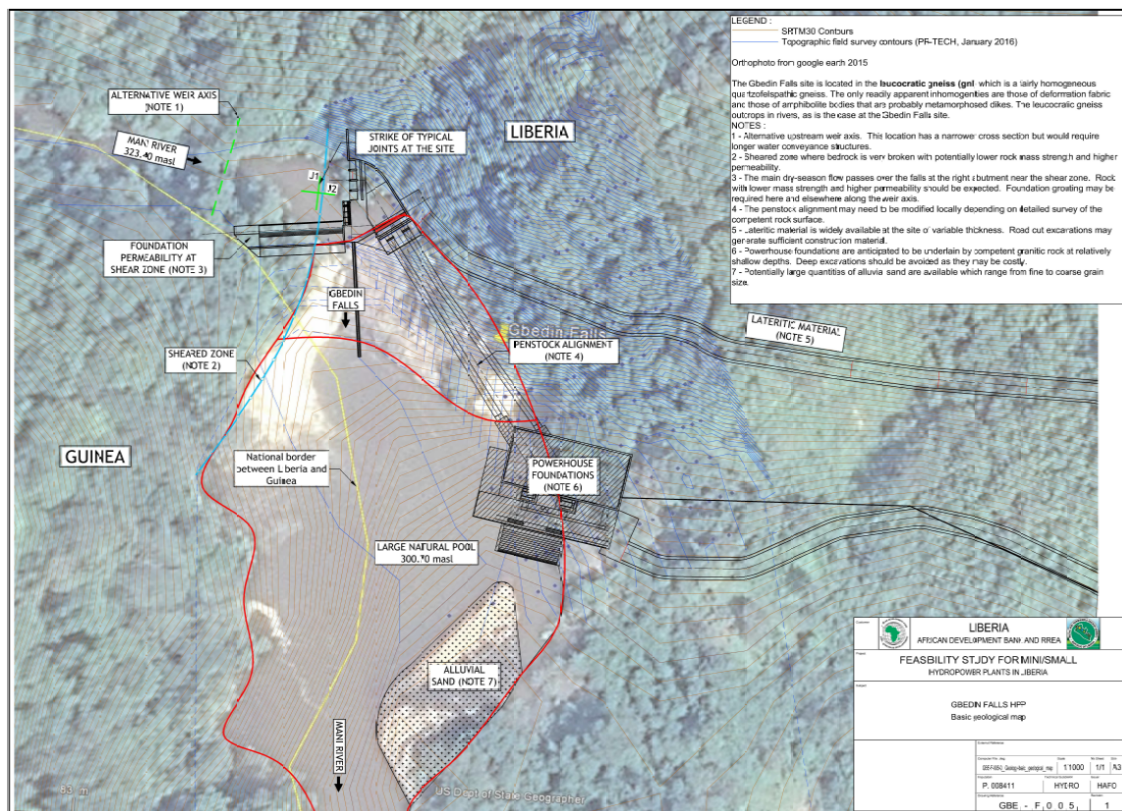


Figure 4: Layout and detailed view of Gbedin Falls. Source: Tractebel (2016).

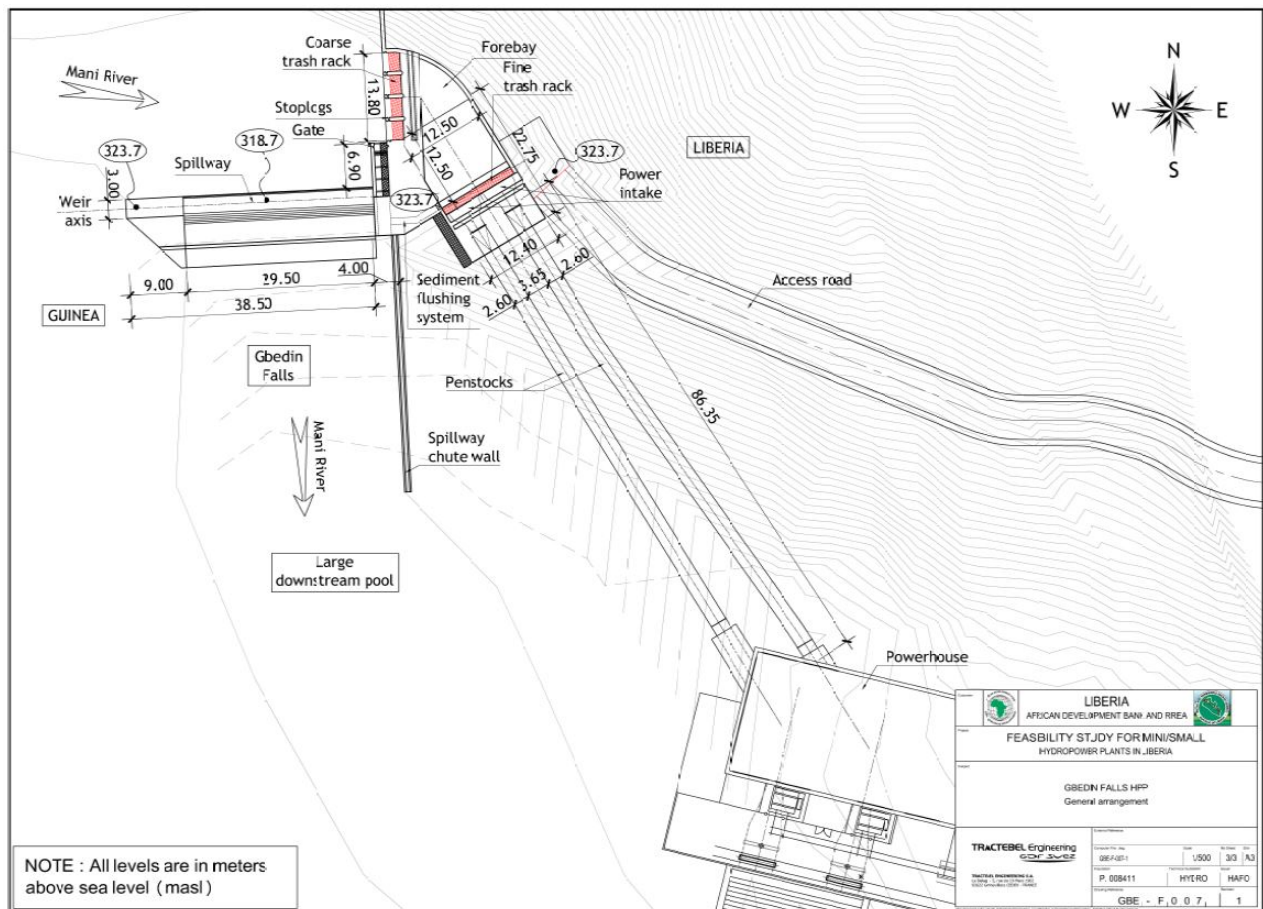


Figure 5: Detailed layout of Gbedin mini hydropower plant. Source: Tractebel (2016).

The main project structural components of the Gbedin mini hydropower project are as follows:

- I. **Weir:** The weir traverses the river at the top of the falls and includes the fore bay and the power intake structure on the left abutment, a centrally located free overflow spillway and a no overflow gravity section on the right abutment. The total length of the weir is 65 m.

The run-of-river scheme includes a low height, free overflow weir to create a small storage sufficient to divert flow to the forebay, provide sufficient head over the penstocks to avoid the creation of vortices and to provide limited flow regulation for variations in daily power demand.

The weir has been designed for the following flood events:

- Design flood: 100 years return period.
- Maximum flood: 1000 years return period.

- II. **Spillway:** The spillway section has a vertical upstream face and a free overflow crest. The main characteristics of the spillway are as follows:

- Shape coefficient: $m = 0.494$.
- Crest length: 29.50 m.

Due to uncertainties in hydrology and the risk of transported debris constricting the spillway capacity, and additional 0.3 m of freeboard is proposed above the maximum flood level. Therefore the design levels are as follows:

- Spillway crest level: 318.70 masl.

- Design flood level: 323.00 masl.
 - Maximum flood level: 323.40 masl.
 - Abutment crest level: 323.70 masl.
- III. **Forebay:** The forebay and power intake structure has been located on the left abutment which is on the outer bend of the river course where hydraulic conditions are most suitable. The left abutment is readily accessible and is in Liberian territory. The features of the forebay and power intake are as follows:
- Lateral river offtake structure comprising four 3 m wide bays each equipped with a coarse trash rack and stop logs for dewatering and routine maintenance.
 - Sediment management system designed to flush sediment accumulated upstream of the river offtake. The system includes a manually actuated gate located at the downstream end of the offtake and a 2.00 m x 2.00 m culvert of structural concrete. The system can also be used as part of the river diversion works and to provide riparian flows during when the powerhouse is out of service during the dry season.
 - Forebay of dimensions 12.5 m wide by 12.5 m long running parallel to the river designed to create stable hydraulic conditions appropriate for the power intake. The invert of the forebay is sloped towards the power intake. Just upstream of the fine trash rack is a sump and sediment scour outlet for flushing accumulated sediment. The outlet gate is manually actuated and a conduit connects with the main sediment flushing culvert.
- IV. **Power intake** including a fine trash rack and a progressively reducing section to ensure stable hydraulic conditions as the flow enters the penstocks. Velocities through the fine trash rack are limited to 1 m/s.
- V. **Penstock** For a design turbine flow of 52 m³/s, two penstocks each of 2.60 m diameter and stable hydraulic conditions, ht = 4.3 m was estimated. The entrance of the penstocks is 6.9 m below full supply level, or 311.80 masl. The velocity in the penstocks is limited to 5 m/s at the design turbine flow. The length of each of the penstocks is 92 m. The penstocks are proposed to be manufactured of rolled steel and thrust blocks will be constructed for support at appropriate locations.
- VI. **Surface powerhouse:** The powerhouse is proposed to be located at the toe of the falls on the left bank. The powerhouse and draft tube outlets will be aligned such that they are protected from high flood flows. The powerhouse shall be founded on the underlying gneissic bedrock. Removal of large boulders and other overburden will be required and competent bedrock is expected to be reached at relatively shallow depths. The powerhouse is 49.20 m long, 34.1 m wide and 22 m high. Access to the powerhouse will be from the left bank. Flat hardstand areas will be provided around the powerhouse for machine assembly during construction and car parking during operation.
- The powerhouse foundations will be mass concrete and will be poured progressively with the installation of the electro-mechanical equipment. The powerhouse walls shall be of reinforced concrete to protect the building from flooding. The powerhouse roof shall be of galvanized iron. A crane will be provided inside the powerhouse for the installation and maintenance of the electro-mechanical equipment.
- VII. **Tailrace canal:** A tailrace canal will be excavated in the river stream direction from the powerhouse to the existing river bed and will be short with less than 20 m excavation.
- VIII. **Access roads:** The main access to the Gbedin Falls site currently consists of:
- Paved road from Monrovia to Ganta
 - Unpaved road from Ganta to Gbedin town (good quality)

- Unpaved road ~7 km length from Gbedin town to a car stop point (from good to poor quality)
- Foot track of ~1.5 km length to Gbedin Falls travelling in a roughly northwards direction

To limit environmental and social impacts, a site access road alignment is proposed which follows the existing road as far as possible. It will be necessary to rehabilitate 9.5 km of existing road which passes through Mr Kona town (near Sanniquellie) and Gehwee. A new road alignment of 7.8 km length will also need to be constructed which follows the hills on the northern side. At the site, the road will split into two spurs: an upper spur to the weir, forebay and power intake and a lower spur to the powerhouse. All roads will be sealed, single lane and 4 m width.

The road rehabilitation works will require the following: vegetation management, widening, cut and fill stabilization, drainage works and placement of sealed surface with appropriate supporting layers.

The creation of the new road alignment will require the clearing of vegetation, stripping of topsoil, excavation (cut) and fill works to create the road alignment (including stabilisation measures), drainage works and placement of sealed surface with appropriate supporting layers.

No permanent access is proposed to the non-overflow section on the right abutment as there are no operable components. A temporary culvert crossing or bridge will be required during construction.

- IX. **Transmission line:** The closest connection to the cross-border network is 7.8 km which could be achieved with a 33 kV line. The transmission scheme includes:
- A substation at the powerhouse designed to evacuate electricity by a 33 kV transmission line towards the existing cross-border line.
 - A 7.8 km long 33 kV transmission line running in an easterly direction (i.e. north of the mountain range) and then turning south crossing Kitoma hill towards the main road between Ganta and Sanniquellie.
 - A substation close to Kitoma town to connect the new 33 kV transmission line with the cross-border line.²

The substation is proposed to be situated as close as possible to the powerhouse in an area which is not at risk of flooding and where cut and fill volumes are minimised. The substation will include all necessary electrical equipment such as power transformers, instrument transformers (such as current transformers and voltage transformers), reactive compensation banks (capacitors or reactors), circuit breakers (CB), busbars, disconnectors, lightning/surge arrestors, control panels, fire-fighting equipment, protection systems, etc. The exact location and size (land requirement) of the substation has not yet been decided.

- X. **Other auxiliary facilities:** The Gbedin mini hydropower project will also require other facilities which have not yet been planned in detail:
- Camp
 - Batching plant
 - Crushing plant
 - Stores
 - Workshop

² Kitoma is referred to as the substation site in the feasibility study (Tractebel 2016), but it should be noted that the connection point to the existing grid is more than 2 km west of Kitoma, closer to Tonwee town.

- Offices
- Staff houses

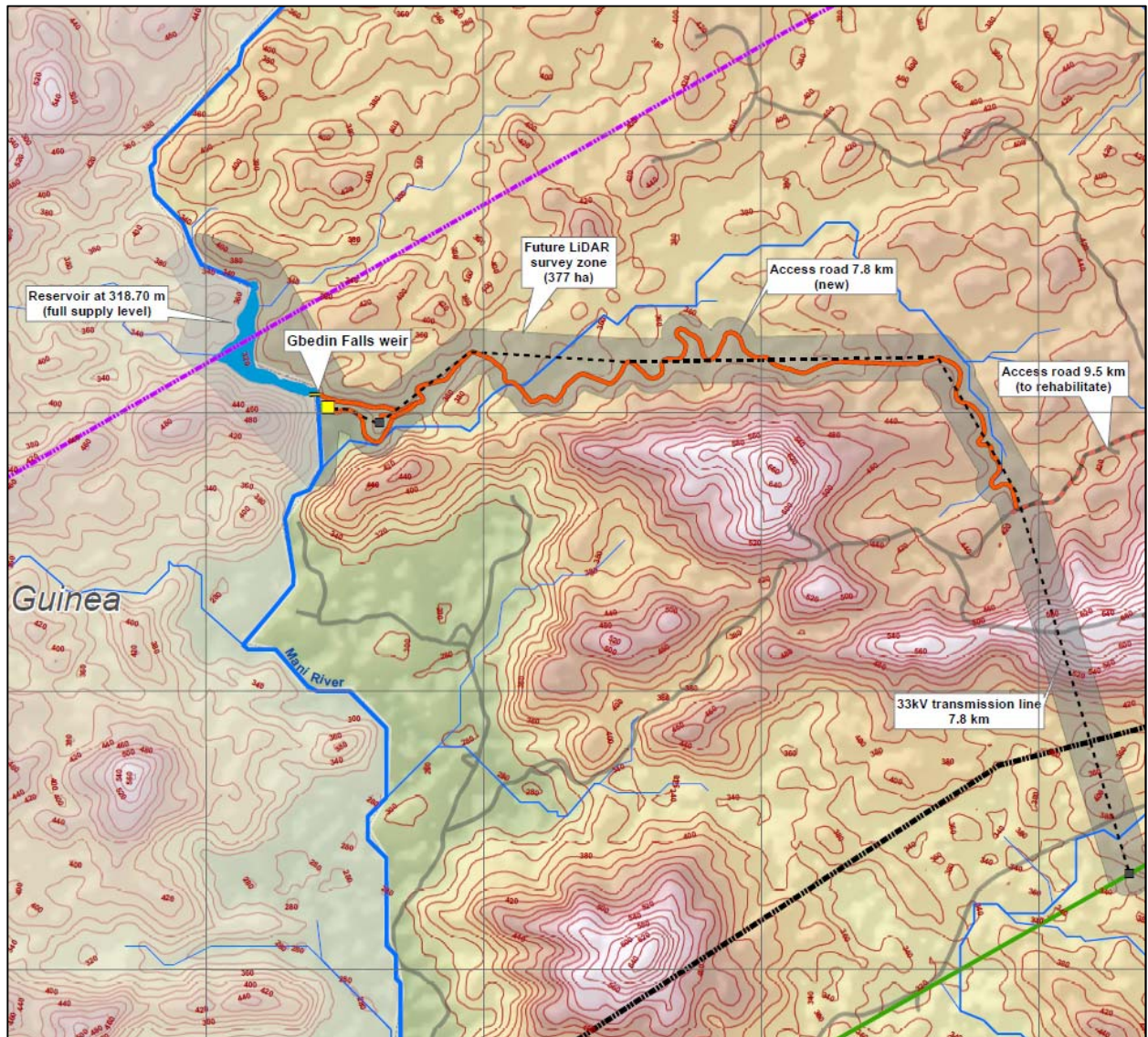


Figure 6: Routing of transmission line and access road. Source: Tractebel (2016).

2.4 Land Requirements

The land than will be acquired for construction and operation of the Gbedin mini hydropower project consists of the following components:

- Gbedin dam and reservoir area
- Gbedin power station, substation/switchyard and auxiliary infrastructure
- Right of way (RoW) for 33 kV transmission line
- Road reserve for access road
- Kitoma substation (not yet defined)
- Other auxiliary facilities (not yet defined, see above)

The demarcation of land boundaries has been part of the land acquisition and resettlement planning (see Resettlement Action Plan, RAP). It should be noted that the exact land requirements have not been

described in any project documents. However, based on a review of the technical design drawings and maps (Tractebel 2016) as well as consultations with RREA, AfDB and own field observations, the following key assumptions were defined as basis for the RAP (and ESIA):

- The reservoir area (on both side of the border) will be acquired as it will be permanently submerged by the impoundment of the Saint John River.
- All the land at Gbedin Falls between the two spur roads going to the powerhouse and the dam/weir, respectively, will be permanently acquired to accommodate the construction and operation of the power station, substation/switchyard and auxiliary infrastructure. In addition, a piece of land immediately south of the lower spur road (to the powerhouse are) have been included as this was considered as more suitable for construction purposes due to flat topography.
- The existing road will be upgraded and all the land within the road reserve (RoW) will be acquired. The RoW for rural roads in Liberia is 50 feet (15 m), i.e. 25 feet on both sides of the road centre line. The existing rural road between Gehwee and the main road is roughly 4 m wide (i.e. similar to what is required by the project for the single lane access road) while the section from Gehwee to the transmission line (from where a new road will be constructed) is very narrow track (less than 4 m wide).
- Due to the lack of detailed design for the new access road that will run along the transmission line from Gbedin Falls, a wider corridor has been considered for the transmission line (see below) to allow for the utilisation of the same wayleave for the road. It should be noted that the preliminary alignment of the new access road in Tractebel (2016) is at conceptual design stage and has not been surveyed. Tractebel (2016) recommended that a combination of field (ground) and LiDAR (aerial) topographical survey be conducted in order to define the road alignment.
- The RoW for the 33 kV transmission line has been assumed to be 15 m, i.e. 7.5 m on each side of the centre line. The conventional RoW for 33 kV lines is 10 m, but the height of the trees along the line route suggests that a wider RoW is required to prevent trees from falling over the poles and conductors. In addition, this wider RoW can also accommodate the new access road (with certain adjustments/realignments) as described above.

It should be noted that the alignment of the access road and transmission line might have to be reconsidered in the detailed design phase. The main reason is that iron ore mining is being planned in the areas where the 33 kV line will pass at Kitoma hill. An alternative routing would be along the existing road/track from Gbedin town and Gampa. While this option was not preferred by Tractebel (2016), further technical investigations could possibly lead to a different conclusion.

The total land requirements for the Gbedin mini hydropower project are given in Table 2.

Table 2: Project land requirements.

Project Component	Land (ha)
Dam and reservoir	6
Power station area	13
Access road (upgrade)	14
Transmission line (incl. new road)	11
Total	44

2.5 Construction Materials and Waste

The source of construction materials has not yet been defined, but Tractebel (2016) suggests that local supplies are possible. There are large quantities of river sand of different grain sizes in (and along) the pool below Gbedin Falls. These sediments can be a useful source of construction materials such as filters and aggregates, provided that sufficiently large quantities are identified. No clay has been observed in the

immediate vicinity of the site but laterite is widely available. The rock observed at the site is expected to have mechanical properties which are appropriate for the manufacture of aggregates. A suitable quarry should be identified during further investigation.

The typical waste to be generated from such type of projects includes the following:

- Non-hazardous waste: Waste from the camps and canteens, paper, cardboard, plastics, wood and vegetation, inert wastes from construction and demolition (concrete, scrap iron, bricks, etc.)
- Hazardous waste: Engine oils and used hydraulic fluids, residues of paint, solvents and resins, fluids from transformers, medical wastes from first aid stations, sludge from septic tanks, and various concrete additives

2.6 Workforce

The number of workers will be decided by the construction contractors. However, based on experience from other similar projects, the construction of the hydropower plant is likely to require roughly 200 labourers, of which typically 80% are casual workers. In addition, there will probably be several teams working with the road upgrade/construction and installation of the transmission line and substation, each comprising an estimated 20-25 workers including casual workers. The peak construction period is during the dry season (June-November) when the overall workforce can reach an estimated 300 labourers in total.

2.7 Project Cost

The project cost has been estimated at USD 27.5 million (Tractebel 2016). This should be considered as a preliminary estimate that can be subject to change during the detailed design and also by taking into account the updated environmental and social costs included in this ESIA (and RAP) report. The total cost of 27.4 million USD (MUSD) is equivalent to 2.93 MUSD/MW.

Table 3: Project cost (Source: Tractebel 2016).

Items	Total amount (MUSD)	Comments
A. CIVIL WORKS		
Capital cost	6.66	
Contingencies	1.00	15% of the capital cost
Total cost	7.66	
B. HEM EQUIPMENTS		
Capital cost	12.39	
Contingencies	1.24	10% of the capital cost
Total cost	13.63	
C. ELECTRICITY DISTRIBUTION		
Capital cost	2.59	
Contingencies	0.26	10% of the capital cost
Total cost	2.85	
D. Env. & social		
Capital cost	0.20	
Contingencies	0.02	10% of the capital cost
Total cost	0.22	
E. Non capital cost		
Non capital cost	2.78	
Contingencies	0.28	10% of the capital cost
Total cost	3.06	
Total cost	27.42	

3 APPROACH AND METHODOLOGY

3.1 Impact Zones and Study Area

The study area has been defined based on a preliminary analysis of the direct (primary) and indirect (secondary) impacts of the proposed project. Accordingly, it has been divided into a direct impact zone and an indirect impact zone. These zones constitute the project's area of influence where risks and impacts will be further analysed during the detailed ESIA study.

The *direct impact zone* covers all areas that will be physically affected by the construction and operation of the Gbedin mini hydropower project. It includes the proposed dam site and reservoir area; the penstock and bypassed river section; the powerhouse and its tailrace; the downstream river reaches (that might be subject to flow modifications); the upgraded and new sections of the access road; the wayleave of the 33 kV transmission line; and the locations occupied by all associated facilities (e.g. camp, batching plant, crushing plant, stores, workshop, offices, staff houses).

The *indirect impact zone* consists of an area beyond the direct impact zone where the construction and operation of the power plant and auxiliary facilities may indirectly affect the physical, biological and human environment through, among others, impacts on long-distance migration corridors for wildlife, in-migration of workers and job seekers to neighbouring communities, etc. The exact size of this zone depends on the themes being studied but is generally assumed to include the districts of Sanniquellie Mahn and Bain Garr.

3.2 General Approach

This ESIA employs a standardised three-step approach to impact assessment in order to make the findings, conclusions and recommendations more objective and transparent. The key principle of the procedure is to combine the 'value' of the affected environment and the 'magnitude' of impacts to arrive at an overall assessment of impact.

- Step 1 attempts to attach a 'value', as judged from the baseline situation, for that specific issue or theme within the project area, giving a ranking on a scale from "low" to "high". The setting of value is based on the absolute value, if applicable, and its value in the local, regional, national and international perspective. It also takes into account uniqueness and vulnerability.
- Step 2 consists of a description and an identification of the 'magnitude' of the potential impacts on that specific issue or theme. The magnitude is considered in terms of the extent (local, regional, national, international), duration, severity/intensity, reversibility, and probability/risk of the different impact sources. The magnitude is measured on a scale from "large positive" to "large negative" (see Table 4).
- Step 3 combines the results from the two first steps based on the criteria illustrated in Figure 7. The outcome of this exercise is the final 'impact assessment' and results in a ranking of the impacts on a scale from "very large positive" to "very large negative". In the summary tables, this ranking is illustrated by "plusses" and "minuses". Uncertainty will be indicated with the symbol ?, and no impact or irrelevant is marked with a 0.

Table 4: Definitions of different levels of impact magnitude.

Impact		Definition
None or Minimal		No detectable change to the environment.
Positive and Negative	Low	A small but detectable and permanent change to the environment; or A larger short-term / temporary change to the environment.
	Medium	A larger, but non-fundamental permanent change to the environment; or A short-term / temporary large change to the environment.
	Large	A fundamental change to the environment.

Note: Fundamental changes are those which are permanent, detrimental and would result in widespread change to the baseline environment.

Source: Multiconsult

The three steps are reported in Chapter 5 and Chapter 7:

- **Baseline situation:** The value is derived from an assessment of the existing environment (physical, biological and human) at the inception of the construction works. Given the nature of the proposed works and the likely short lead time, the baseline can be considered as the current environmental and social conditions. The specific methodology for collecting and analysing baseline data is presented below. For themes that cannot easily be valued, such as parts of the physical environment (e.g. geology and soils) and the human environment (e.g. livelihoods and economic activities), the value is by default assumed to be high.
- **Assessment of impacts:** Based on available knowledge of hydropower projects in general and the proposed project in particular, potential impacts can be predicted for each theme under the physical, biological and human environment. Following the identification and description of each of these impacts, the magnitude of the impacts on each theme is determined (see Table 4). The final impact assessment is then summarised at the end of the chapter by combining the baseline value and the impact magnitude, as described above.

The assessment of impacts in Chapter 7 also includes the relevant mitigation measures, i.e. all actions that can eliminate, offset, or reduce potentially adverse environmental and social impacts to acceptable levels. The net impact remaining with mitigation measures in place is referred to as “residual impact”.

3.3 Specific Methodology

3.3.1 Physical Environment

Topography and Landscape

The physical features and composition of the landscape was observed during field visits in November 2018 and February 2019. The data included topography, vegetation cover, land use, river characteristics and human settlements. Photos were taken at different locations to document the existing landscape characteristics. Visual impacts were illustrated by photomontages based on the design drawings in Tractebel (2016).

Geology and Soils

The description of bedrock and soils were taken from the feasibility study (Tractebel 2016) and the Geological Map of Liberia (Tysdal and Thorman 1983) combined with own field observations.

Climate and Air Quality

Climate data were obtained from Tractebel (2016) and URS/Scott Wilson (2010). Air quality measurements were not undertaken because there are no local sources of significant air pollution and the airshed over the project area is not considered to be degraded. Any background concentrations would be extremely low and difficult to detect without sophisticated instrumentation.

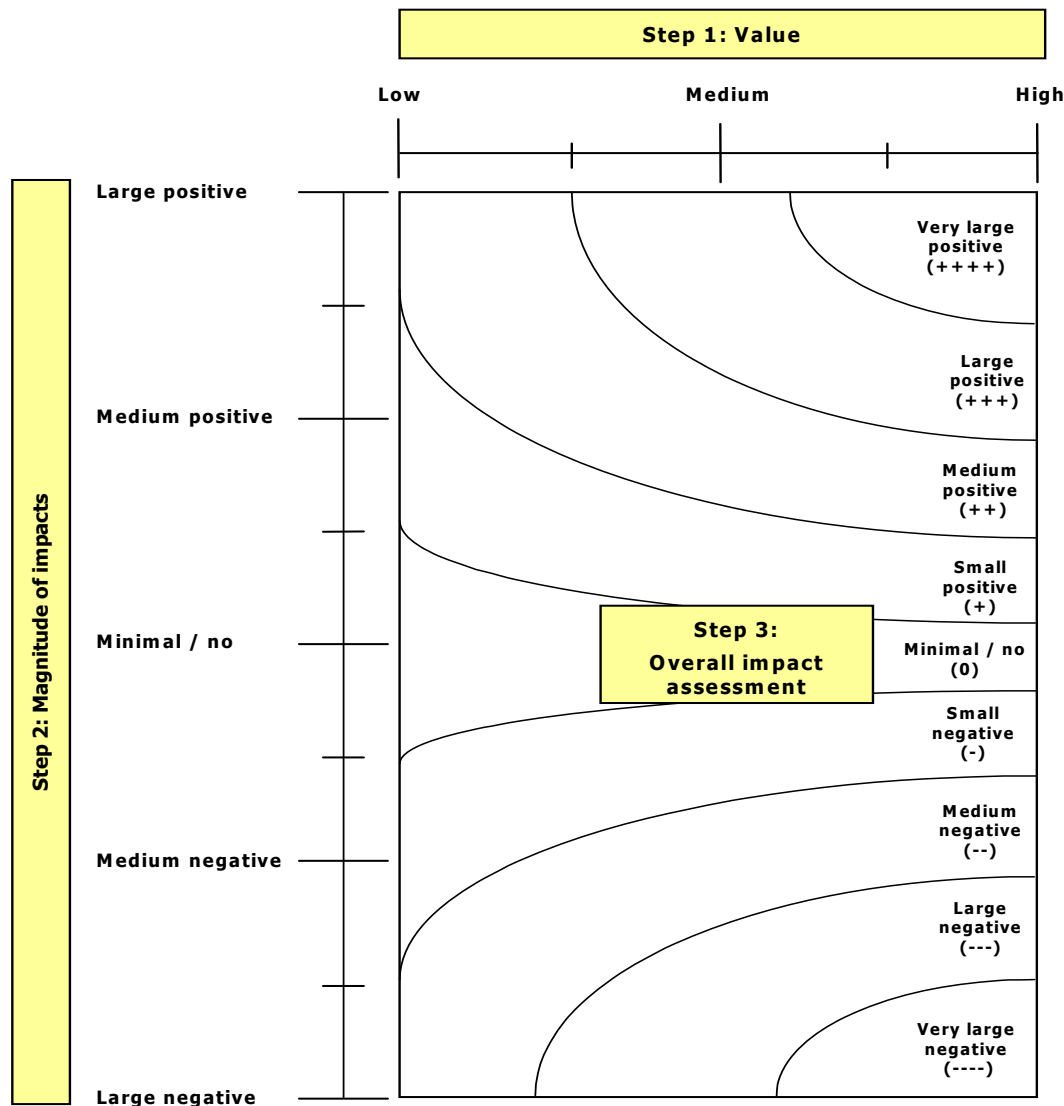


Figure 7: Impact assessment methodology.

Source: Multiconsult

Noise

Ambient noise levels were not recorded due to the absence of industrial sources of noise emissions and the very low traffic volumes on the local roads. Gbedin Falls is located in a very remote location without any noise pollution.

Hydrology

All hydrological data were compiled from the feasibility study (Tractebel 2016).

Water Quality

Water quality readings were taken on 1st March 2019 from four sites: (i) upstream of Gbedin Falls, (ii) the pool below the waterfalls, (iii) the river channel immediately downstream of the pool, and (iv) Gampa town at the crossing point approx. 5 km downstream of Gbedin Falls. Figure 8 shows the locations where water quality readings were performed. The water samples were tested *in situ* using YSI Professional Digital Sampling System (ProDSS) for the following parameters:

- Temperature (°C)
- Turbidity (NTU)
- pH
- Dissolved oxygen, DO (mg/L)
- Conductivity (µs/cm)

3.3.2 Biological Environment

The study methodology for collection and analysis of baseline data on flora and fauna is described in the thematic report enclosed in Appendix 10. The samplings sites are shown in Figure 8.

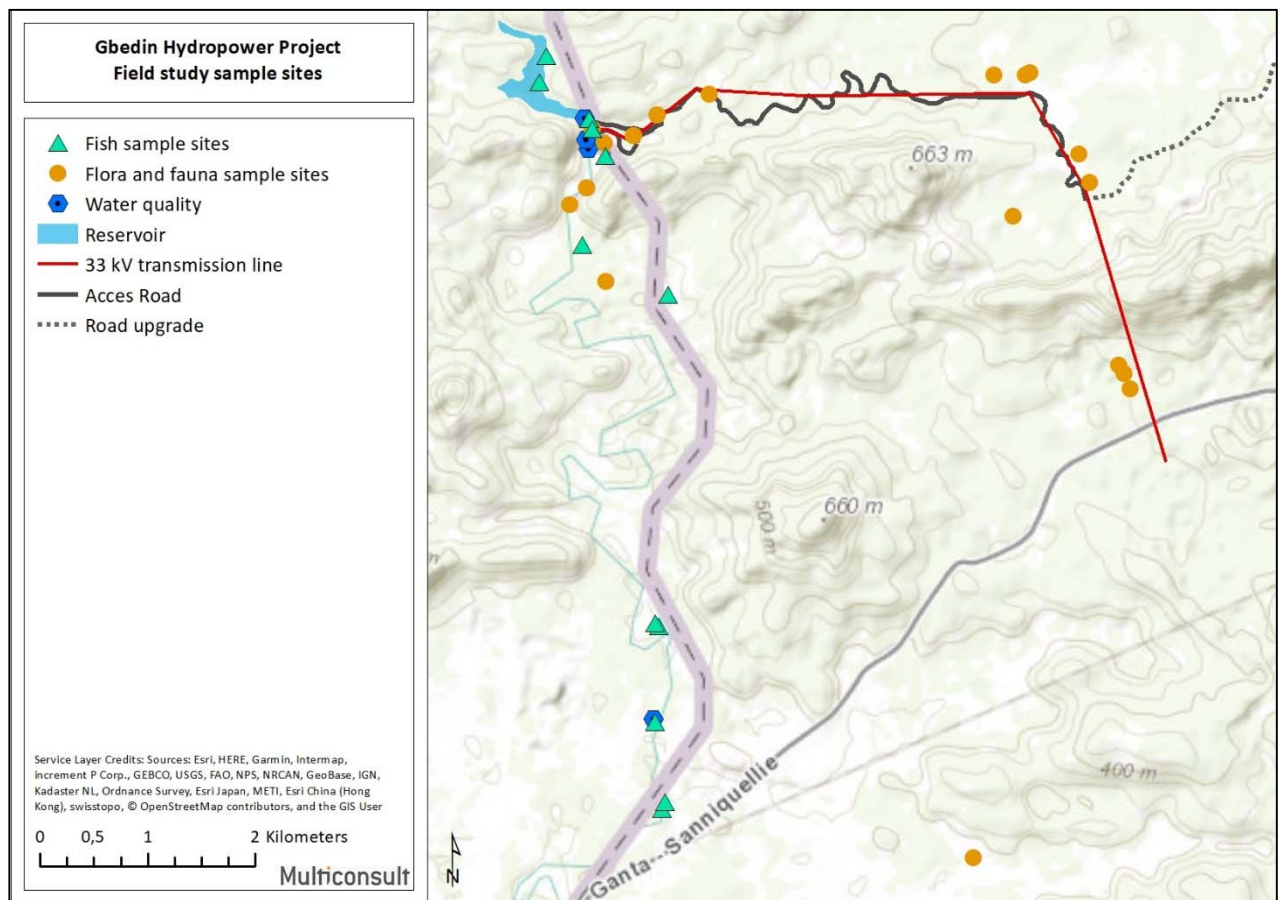


Figure 8: Sampling sites for fish, flora and fauna (mammals, birds, reptiles, amphibians), and water quality.

3.3.3 Human Environment

Socio-economic Assessment

A combination of both qualitative and quantitative techniques were used during the collection of socio-economic data. Quantitative methods included household socio-economic surveys and land and asset inventories, while the qualitative methods included community meetings, key informant interviews, focus group discussions, field observations and transect walks.

A census socio-economic survey of all the directly affected households was undertaken for purposes of analysing the key issues under the following themes:

- Demographic characteristics

- Livelihood income and expenditure patterns
- Networks, support systems and living conditions
- Household welfare
- Land tenure, ownership and relocation priorities
- Gender and vulnerability

The results of the socio-economic survey are referred to in this ESIA and reported in detail in the Resettlement Action Plan (RAP).

Community meetings were organised for sharing project information with the communities in the project's area of influence. The first round of consultations (November 2018) involved a presentation of the project and its impacts allowing the communities to express their opinions and suggestions, while the second round of consultations (February/March 2019) was to prepare the communities for the census surveys as part of resettlement planning. Follow up sessions were held with the directly impacted households to ensure that they had a full understanding of the land acquisition procedures.

Focus group discussions involved in-depth discussions with special segments of society that are likely to be disproportionately affected by the project. These included the farming, hunting and fishing communities, herbalists and the elderly among others. Focus group discussions were held with the representatives of these different groups for purposes of gathering a clear understanding of the livelihood systems in the project area, including existing challenges, opportunities and social support systems.

Key informant interviews were held with representatives of institutional stakeholders to gather a better insight into the socio-economic context as well to assess the available institutional capacity to support project implementation. Such stakeholders included the County Health Team, Education Team, Gender Children and Social Protection Unit, security service providers, landlords and town chiefs among others.

Property assessment and valuation was undertaken in two steps. First, the affected households, land users, landlords and all their affected assets were recorded in the field. This was done using a participatory approach whereby representatives of each affected household were actively involved and the town chiefs acted as witnesses to the process. Results from the inspections were recorded in property inspection forms, which were counter-signed by all parties present at the time of the asset inventory.

The second step was the property valuation. The data from the asset inventory were entered into a database and monetary values were attached accordingly. Standard compensation rates were adopted for crops. More details regarding the computation of compensation packages are given in the Resettlement Action Plan (RAP).

Stakeholder Engagement

The stakeholder engagement process was preceded by literature review to facilitate the process of stakeholder identification and analysis. Consultations started at early inception stage when RREA and AfDB were engaged to agree on the scope of work, the status of the project design and the approach towards the neighbouring riparian state (Guinea). The outcomes of these early discussions were integrated into the overall study approach and provided guidance for the detailed investigations.

During the scoping phase, the consultations were rolled out to include the key institutional stakeholders at the local government level. The priority stakeholders at this point included the Nimba County authorities, the district authorities and the affected towns as well as service providers that were considered to have a direct influence on the project (or whose activities could be impacted by the project). Main methodologies adopted at this stage were group discussions, brainstorming sessions, key informant interviews and community meetings.

The community level consultations targeted entire communities within the project's area of influence. First, meetings were held with the town chiefs in order to introduce the project and to request for mobilisation of all residents in the town for the community meeting. Then, public meetings were organised targeting all households in each town. The approach was time-consuming but very fruitful as it prevented distortion of project information and ensured that all stakeholders had an opportunity to share their thoughts, submit their opinions, discuss their worries and accurately understand the project objectives, benefits, procedures and challenges.

As a result of the discussion with the communities, follow-up sessions were organised with different segments of the society like women, fishermen, the elderly, the youth and institutions with the potential to support RREA to implement the mitigation measures and community development projects.

A second round of public consultations was conducted in February/March 2019. The main objective of these meetings was to disseminate information about the procedures for land acquisition, compensation and resettlement. This helped to prepare the communities for their participation in the census surveys while also providing an opportunity to gather detailed input to the ESIA/RAP. For that reason, some of the institutional stakeholders were also consulted. The consultation methods included public meetings for communities, group discussions for the local leadership, socio-economic surveys for affected households, and in-depth discussions with affected institutions.

3.4 Limitation and Data Quality

The major parts of the ESIA study have been carried out over a compressed time frame of only five months due to the tight project deadlines.

Conventionally, twelve months of baseline monitoring is usually required to capture seasonal fluctuations in the biological environment, while inter-annual data would ideally be needed for the certain aspects of the physical and human environment. The data set presented herein is nevertheless considered sufficient for establishing a baseline and predicting the major project risks and impacts, mainly because:

- Existing data series were used to capture climatic and hydrological characteristics, as well as certain socio-economic indicators.
- Small run-of-river hydropower schemes have a limited physical footprint and few indirect and long-term impacts compared with many other energy/industry developments.

Thus, the scope and depth of the ESIA studies is considered appropriate to the nature and scale of the proposed project and commensurate with the level of its environmental and social risks and impacts.

It should be noted, however, that the resettlement planning (see Resettlement Action Plan, RAP) was hampered by issues related to project design and layout. While it was confirmed that the RAP should be based on the feasibility level design in Tractebel (2016), it became clear during the course of the ESIA/RAP study that the detailed routing of the transmission line and access road is likely to be modified (to a larger or smaller extent). In fact, Tractebel (2016) had recommended that further topographic survey be carried out to define the exact alignments. However, as the design consultant was no longer under contract and the additional topographic surveys had not yet been undertaken, the RAP (and ESIA) had to be based on the available information in the feasibility study (Tractebel 2016).

4 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

4.1 Introduction

This chapter provides an overview of the applicable national and international policy, legal and administrative framework within which the Gbedin mini hydropower project and the ESIA study will be carried out.

Based on consultations with the project proponent RREA, the project will be executed as a purely Liberian investment and all issues related to the neighbouring riparian state (Guinea) will be handled at government level and be spearheaded by RREA together with Nimba County.

The physical impacts on Guinean territory are very few and minor as there will be no permanent access or operation components on the right abutment of the dam/weir (i.e. on the Guinean side) and no change in downstream river flow (along the international border). The Guinean part of the impoundment (reservoir) is limited to about 4 ha of land on the riverbanks where there is no active land use.

For these reasons, it has been assumed that the Gbedin project will not be subject to a separate ESIA study in Guinea and that it might be exempted from environmental licensing. This review of national regulatory framework is therefore mainly focussed on Liberia. However, the Guinean regulatory framework related to land administration has been summarised in Section 4.6. Trans-boundary impacts, including notification procedures, are addressed in Section 7.7.5 and a copy of the notification letter to Guinea is enclosed in Appendix 8.

It should be noted that the neighbouring community in Guinea (at Gampa town centre) has been consulted as part of the ESIA/RAP, but no authorisation has yet been provided to the consultant for further follow up with Guinean authorities. The cross-border issues are expected to be addresses at the government level.

4.2 Liberian Environmental Administrative Framework

4.2.1 Government Organisations

National Government

Liberia's government comprises popularly-elected executive and legislative branches, the latter being a bicameral National Assembly consisting of the Senate (30 seats with members elected by popular vote to serve nine-year terms) and the House of Representatives (64 seats; members elected by popular vote to serve six-year terms). The country operates a dual system of statutory law based on Anglo-American common law for the modern sector and customary law based on unwritten tribal practices for the indigenous sector.

Local Government

Liberia comprises 15 administrative political subdivisions called counties, each headed by a Superintendent and further divided into Districts, each under a District Commissioner. Each District is sub-divided into Chiefdoms headed by a Paramount Chief, and each Chiefdom is divided into Clans headed by Clan Chiefs and towns headed by Town Chiefs. The clan areas were originally related to tribal sub-groupings and whilst this still largely applies, increasing urbanization and civil war has disrupted this pattern and Clans are now defined as administrative units.

4.2.2 Environmental Institutional Framework

Environmental Protection Agency

The Environmental Protection Agency (EPA) is an autonomous statutory body, established under the Act creating the Environmental Protection Agency of the Republic of Liberia 2003 (GOL, 2003a), and hereafter

referred to as the EPA Act, to address the country's environmental problems. The EPA became a fully functioning entity in 2006, with the appointment of a board of directors and establishment of a Policy Council.

The EPA was established to "coordinate, monitor, supervise and consult with relevant stakeholders on all activities in the protection of the environment and sustainable use of natural resources" and as the lead national environmental agency is charged with executive authority for all environmental activities and programs relating to environmental management in Liberia. The EPA also has a key responsibility for matters relating to the issuing of an environmental impact assessment license and for compliance monitoring relating to environmental regulations and standards.

Ministry of Land, Mines and Energy

The Ministry of Lands, Mines and Energy has the statutory responsibility for the development of mineral, water and energy resources in Liberia; it is in charge of land surveys in all parts of the country and coordinates, administers and regulates the use of public and private lands in Liberia, including mineral resources through granting of operation licenses, and regulates beach sand mining. It works along with the Ministry of Agriculture and the University of Liberia to conduct training and research on land rehabilitation. Energy provision is administered through the same Ministry by the National Energy Committee, while water resources are the responsibility of the National Hydrological Service.

Ministry of Agriculture

The Ministry of Agriculture regulates the forestry as relate to plant quarantine, agro-forestry and food crop related plantations; fishery and agriculture sectors and has specific responsibilities for soil conservation. Some water resource matters used to be managed by the National Water Resources and Sanitation Board prior to the civil war, and proposals have recently been made for its re-establishment. It plans, executes, administers, manages and supervises agriculture programs and provides extension services, trains local farmers in improved cultural practices, and supplies farm inputs to enhance food security.

Forestry Development Authority

The Forestry Development Authority (FDA), established in 1976, was historically the government agency with primary responsibility for environmental management in Liberia. Now an autonomous body, and mandated by the National Forestry Reform Law of 2006, the FDA has responsibility for the protection, management and conservation of government-owned forests and wildlife on a sustainable basis. It manages commercial, conservation and community uses of Liberia's forests. It provides long- and middle-range planning in the forestry sector as well as preparing forestry policy, law and administration. It exercises control of the commercial use of state-owned forests through the granting of concessions, supervises adherence to forest legislation and concession agreements, calculates and determines forestry fees, evaluates investment proposals, executes reforestation and forest research and training and monitors activities of timber companies. The 2006 law revised the institutional framework of the FDA and created a Department of Conservation which is made up of the Division of National Parks and the Division of Wildlife with the responsibility for development and management of protected areas and wildlife respectively.

Ministry of Planning and Economic Affairs

The Ministry of Planning and Economic Affairs (MPEA) is responsible for inter-sectoral coordination for the development of policies, plans and programs for the economic, financial, social, cultural and physical development of Liberia. In fulfilling its various duties, it serves as the direct link between implementing Ministries/Agencies, NGOs, private voluntary organizations, and the international community. Coordination occurs at the national, sectoral and regional planning levels and also involves the implementation of crosscutting initiatives.

Rural and Renewable Energy Agency

The Rural and Renewable Energy Agency (RREA) was established in January 2010 to facilitate and accelerate the economic transformation of rural Liberia by promoting the commercial development and supply of modern energy products and services to rural areas through the private sector and community initiatives with an emphasis, but not necessarily exclusive reliance, on locally available renewable resources.

Liberia Electricity Corporation

The Liberia Electricity Corporation was created in 1973 to generate, transmit, distribute, and sell electricity throughout the country at economically reasonable rates. In July 2006, electricity was restored to parts of Monrovia for the first time in fifteen years.

Other governmental institutions with environment-related responsibilities include the Ministry of Education, Ministry of Public Works, Ministry of Health and Social Welfare, Ministry of Foreign Affairs, and the Liberia Water and Sewer Corporation.

County and District Environmental Committees

To decentralize environmental management, the Environmental Protection Agency Act authorizes the establishment of County and District Environmental Committees and directs the National Environmental Policy Council to provide guidelines for their establishment. Each County Committee is composed of county and district officials, traditional leaders, private citizens, and two local representatives to the national legislature. The Committee is staffed by a County Environment Officer, hired by the EPA, but responsible to the County Committee.

The District Environment Committees are to be established by and report to the relevant County Environment Committee. They are charged with promoting environmental awareness and mobilizing the public to manage and monitor activities within the district to ensure that they do not have any significant impact on the environment. The District Committees are composed of district officials, mayors, chiefs, and private citizens and are staffed by a District Environment Officer hired by the EPA.

In addition to assisting the County and District Committees in the fulfillment of their responsibilities, the County and District Environment Officers are responsible for compiling reports to the EPA, promoting environmental awareness, and conducting public hearings on environmental impact assessment in the County and the District.

At present, two County Environmental Committees have been established; One in Sinoe County and another in Nimba County. However, EPA has established outstation offices in eight counties. The offices are staffed by Environmental Inspectors. As the County Environment Committees are established, some of the Inspectors may be reassigned as County Environment Officers.

4.2.3 Environmental Inspectors and Courts

To provide for enforcement of environmental requirements and standards, the Environmental Protection Agency Act provides for the appointment of Environmental Inspectors and the establishment of an Environmental Court system.

Environmental Inspectors

The Act authorizes the EPA to “designate its officers and duly qualified public officers/civil servants ... to be environmental inspectors within such Counties and District limits.” Thus, Environmental Inspectors do not have to be EPA employees, but can also be designated officers or civil servants in other branches of the government. Environmental Inspectors are authorized to enter premises, inspect activities, take samples, and review records to ensure compliance with environmental rules and regulations. The exact nature of the inspector’s enforcement authority is not defined in the Act, but the Act does state that the EPA is to

“...establish the conditions, rules and regulations governing the qualifications, performance, powers and duties of the Environmental Inspectors.” The EPML confirms that Environmental Inspectors can write Restoration Orders to correct an activity deemed to be noncompliant with environmental rules and regulations.

Environmental Courts

The Environmental Protection Agency Act defines a two-tiered court system to hear and rule on compliance with environmental rules and regulations.

The first tier is the Environmental Administrative Court. This court is to hear and rule on complaints relating to the environment. The complaints may concern the actions or decisions of the EPA or an Environmental Inspector, or may be brought by a member of the public to stop activities they believe are damaging the environment.

The second tier is an Environmental Appeals Court, established at the Judicial Circuit level.

At present, the Environmental Court system has not been formally established. EPA’s five-year strategic plan (starting July 2011) provides for an administrative court to handle environmental issues for an intermediate period before the full establishment of an environmental court under the judicial system.

4.3 National Legislative Framework

Table 5 describes the main categories of legislation in Liberia and Table 6 and Table 7 provide a summary of relevant Liberian environmental legislation and international environmental conventions signed/ratified by the Government of Liberia.

Table 5: Categories of legislations in Liberia.

Law	Laws are passed by the National Legislature of Liberia comprising of the Senate and the House of Representatives. Any citizen or group of citizens, Cabinet Ministers, Managing Directors of public corporations or agencies can propose a bill to the National Legislature for enactment. The draft bill is first passed over to the appropriate Steering Committee of the Legislature. In case of environmental bill, this committee is generally the Committee on Natural Resources and the Environment. The Committee reviews, assesses and presents the bill to the Legislative Plenary with appropriate amendments for debate, public hearing and subsequent enactment by the Legislature.
Executive Order	The Executive Branch of government headed by the President can issue Executive Order without the approval of the National Legislature. The Executive orders have the power of a law provided that they do not contravene the existing law. The power of such orders has a limited time of existence.
Regulations	The national Legislature has empowered Cabinet Ministers and Managing Directors of public corporations and agencies to issue regulations for their respective functionaries without legislative approval or supervision, provided that such regulations are consistent with the statutory laws and the constitution of Liberia.

Table 6: Relevant environmental laws.

Title	Year	Description
Conservation of the Forests of the Republic of Liberia	1953	This Law provided the framework for the use of forest and wildlife resources and allowed for the creation of government reserves, native authority reserves, commercial forests, national parks and wildlife refuges.
Supplementary Act for the Conservation of Forests	1957	This Supplementary Law also provided the framework for the use of forest and wildlife resources and allowed for the creation of government reserves, native authority reserves, commercial forests, national parks and wildlife refuges.

Title	Year	Description
The Act that created the Forestry Development Authority (FDA)	1976	The Act established and defined the responsibilities of the FDA, outlined forest offences and penalties; made provision for an Advisory Conservation Committee and specified powers of forest officers with regard to trees in reserve areas.
Public Health Act	1976	It contains provision for the protection of drinking water resources and the inspection of potential sources of pollution.
The Natural Resources Law of Liberia	1979	This Law includes chapters on forests, fish, and wildlife, soil, water, and minerals.
Wildlife and National Parks Act	1988	The Act identifies a number of protected areas; specifies policies and objectives regarding wildlife and conservation in the country.
The Environment Protection Agency (EPA) Act	2002	The Act provides the Agency with the authority of government for the protection and management of the environment in Liberia. It provides for an Environmental Administrative Court to hear from aggrieved parties. It requires that an Environmental Impact Assessment (EIA) be carried out for all activities and projects likely to have an adverse impact on the environment.
The Environment Protection and Management Law	2002	The Act enables the Environment Protection Agency to protect the environment through the implementation of the Law. It arranges the rules, regulations, and procedures for the conduct of EIA. It establishes regulations for environmental quality standards, pollution control and licensing, among others.
The National Environmental Policy Act	2002	It defines policies, goals, objectives, and principles of sustainable development and improvement of the physical environment, quality of life of the people and ensures coordination between economic development and growth with sustainable management of natural resources.
National New Forestry Reform Law	2006	The administration of this Act provides for the Forestry Development Authority to exercise the power under the Law to assure sustainable management of the Republic's forestland, conservation of the forest resources, protection of the environment, sustainable economic development with the participation of and for the benefit of all Liberians and to contribute to poverty alleviation in the country.

Table 7: International environmental conventions signed/ratified.

Convention	Status	Year	Objectives
African Convention on Conservation of Nature and Natural Resources	Ratified	NA	To encourage individual and joint action for the conservation
Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Ratified	1981	To prevent trade of endangered or threatened species
Convention Concerning the Protection of the World Cultural and Natural Heritage	Signed	2002	To recognize and protect cultural and natural heritage for future generations
Framework Convention on Climate Change and the Kyoto Protocol	Signed	2002	<ul style="list-style-type: none"> To achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climatic system To strengthen the commitment of developed country parties with a view to reduce their overall emissions
Stockholm Convention on Persistent Organic Pollutants (POP)	Signed	2002	<ul style="list-style-type: none"> To strengthen National Capacity and to enhance knowledge and understanding Amongst decision makers, managers, industry and the public at large on POPs To develop a National implementation Plan (NIP) to manage the elimination of POPs.
Ramsar Convention on Wetlands of	Signed	2003	<ul style="list-style-type: none"> To manage wetland systems so that the human uses

<i>Convention</i>	<i>Status</i>	<i>Year</i>	<i>Objectives</i>
International Importance			<p>of these areas are undertaken in such a way as to retain their natural capital for future generations.</p> <ul style="list-style-type: none"> To encourage and support countries to develop and implement national policy and legislative frameworks, education and awareness raising programs, as well as inventory, research and training projects.
Convention on Biological Diversity (CBD)	Ratified	2000	<ul style="list-style-type: none"> Promote Conservation of Biological Diversity. Sustainable use of its components. Fair and equitable sharing arising out of the utilization of genetic resources.
Convention on the Conservation of Migratory Species of Wild Animals	Ratified	2004	Aims to conserve terrestrial, marine and avian migratory species throughout their range
The Cartagena Protocol on Biosafety	Ratified	2003	To contribute to ensuring an adequate protection in the field of living modified organisms resulting from modern biotechnology
Convention on Desertification	Signed	1998	To combat desertification and mitigates the effect of drought in countries experiencing serious droughts and/or desertification
International Tropical Timber Agreement	Ratified	2008	Requires sustainable management of timber resource base, simultaneously encouraging the timber trade and the improved management of the forests
Vienna Convention for the Protection of the Ozone Layer	Signed	1996	States agreed to cooperate in scientific research on the ozone problem, to exchange information, and to adopt "appropriate measures" to prevent activities that harm the ozone layer. The obligations are general and contain no specific limits on chemicals that deplete the ozone layer.
Montréal Protocol on Substances that Deplete the Ozone Layer	Signed	1996	A protocol to the Vienna Convention for the Protection of the Ozone Layer, it is designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion
International Convention on Oil Pollution Preparedness, Response, and Cooperation(OPRC), London, 1990	Signed	1995	To strengthen the legal framework for the control of environmental pollution by oil, in general, and marine pollution by oil in particular.
International Covenant on Economic, Social and Cultural Rights	Ratified	2004	ICESCR commits to work toward the granting of economic, social, and cultural rights to individuals, including labour rights and rights to health, education, and an adequate standard of living. ICESCR is part of the International Bill of Human Rights, along with the Universal Declaration of Human Rights (UDHR) and the International Covenant on Civil and Political Rights (ICCPR)

4.3.1 Constitution of Liberia

Article 7 of the 1986 Constitution of the Republic of Liberia sets the fundamental basis for the constitutional, legislative, and institutional frameworks for the protection and management of the environment. It also encourages public participation in the protection and management of the environment and the natural resources in Liberia.

With respect to acquisition of land, Article 24 gives the principles under which government can expropriate land as follows:

- that reasons for such expropriation are given;
- that there is prompt payment of just compensation;

- that such expropriation or the compensation offered may be challenged freely by the owner of the property in a court of law with no penalty for having brought such action; and
- that when property taken for public use ceases to be so used, the Republic shall accord the former owner or those entitled to the property through such owner, the right of first refusal to reacquire the property.

4.3.2 The Environmental Protection Agency Act

“An Act to establish a monitoring, coordinating and supervisory authority for the sustainable management of the environment in partnership with regulated Ministries and organizations and in a close and responsive relationship with the people of Liberia; and to provide high quality information and advice on the state of the environment and for matters connected therewith”.

Thus, the Environment Protection Agency of Liberia (EPA) was created by the Act creating the Environment Protection Agency of the Republic of Liberia, known as the Environment Protection Agency Act. The Act was approved on November 26, 2002 and published on April 30, 2003. The establishment of the EPA marked a significant step forward in the protection and management of the environment of Liberia.

Section 5 of the Act designates the EPA as the principal Liberian authority for environmental management which shall co-ordinate, monitor, supervise, and consult with relevant stakeholders on all the activities for environmental protection and the sustainable use of natural resources. Section 6 (b) of the Act stipulates that the EPA should propose environmental policies and strategies to the Policy Council and ensure the integration of environmental concerns in the overall national planning. Moreover, the EPA is empowered to carry out, among other things, the following aspects of environmental protection and management in Liberia:

- Establish environmental criteria, guidelines, specifications, and standards for production processes and the sustainable use of natural resources for the health and welfare of the present generation, and in order to prevent environmental degradation for the welfare of the future generations;
- Identify projects, activities, and programs for which environmental impact assessment must be conducted under this Law
- Review and approve environmental impact statements and environmental impact assessment submitted in accordance with this Act;
- Monitor and assess projects, programs, and policies including activities being carried out by relevant ministries and bodies to ensure that the environment is not degraded by such activities and that environmental management objectives are adhered to and adequate early warning and monitoring on impending environmental emergencies is given;
- Review sectoral environmental laws and regulations and recommend for amendments and to initiate proposals for the enactment of environmental legislations in accordance with this Act or any other Act;
- Encourage the use of appropriate environmentally sound technologies and renewable sources of energy and natural resources;
- Function as the national clearinghouse for all activities relating to regional and international environment-related conventions, treaties and agreements, and as national liaison with the secretariat for all such regional and international instruments.

4.3.3 Act Adopting the Environmental Protection and Management Law of the Republic of Liberia

“An Act to establish a legal framework for the sustainable development, management and protection of the environment by the Environment Protection Agency in partnership with regulated Ministries and organizations and in a close and responsive relationship with the people of Liberia; and to provide high quality information and advice on the state of the environment and for matters connected therewith”.

Section 15 of the EMPL states that business investors should present an environmental mitigation plan to the EPA, which should include the following sections:

- Objectives
- Description of activities to be carried out by the project to mitigate any adverse effects on the environment
- Period within which the mitigation measures shall be implemented
- Proven efficacy of the mitigation measures of indicating their experimental nature

Section 12 of the EPML requires environmental review for projects or activities that may have significant impact on the environment. The project proponent shall submit to the EPA their plans for improving environmental performance including:

- Identification of the major environmental effects; and
- A comprehensive mitigation plan in accordance with section 15 of this Law.

Section 6 of EPML requires an Environmental Impact Assessment license or permit for the commencement of such projects, and Section 13 requires the preparation of an environmental impact study for such a project.

Section 24 of the EPML requires that the EPA should ensure that projects comply with their environmental mitigation plan through monitoring of its operations. Where evidence of non-compliance occurs, the EPA shall impose remedial measures and may bring action before the Environmental Court or through the Ministry of Justice to enforce compliance.

Section 25 of the EPML gives responsibility to the EPA carrying out periodic environmental audit of activities or projects that are likely to have adverse effects on the environment

Section 58 of the EPML requires that a license must be obtained from the EPA for any type of effluent discharge into the sewage system, also in case of operation of a sewage system. This license is provided by the EPA for a period that does not exceed 1 year.

Section 61 of the EPML prohibits pollution of all Liberian Waters. In case of water pollution, a sentence and/or a fine is/are imposed on the polluting party. The latter is also responsible for the cost of the removal of the pollutant and the restoration, restitution or compensation as determined by a law court.

Section 62 of the EPML bans pollution by solid waste of any land, coastal zone or water surface, street, road or site in or on any place to which the public has access, except in a container or at a place which has been specially indicated, provided or set apart for such purpose. In case of such pollution, a fine or a prison term is imposed on the polluting party. The latter is also responsible for the clean-up of the solid waste pollution it caused.

Section 64 of the EPML requires the acquirement of a “Solid and Hazardous Waste Disposal License” in case of generation, storage, handling, transport or disposal of hazardous waste, or else ownership or operation of a waste disposal site. The EPA provides this license for a period of not more than one year. This license entails the party who is generating the waste to take up waste management measures such as treatment, determination or recycling and re-mediation.

Section 71 of the EPML requires the acquirement of a “Pollution Emission License” for any project or activity which is likely to pollute the environment in excess of any standards or guidelines issued under the EPML. This license is provided by the EPA for a period of not more than one year.

Section 75 of the EPML prohibits the below activities in relation with a river, lake or wetland that are declared as protected areas by the EPA. These activities include:

- Use, erect, construct, place, alter, extend, remove or demolish any structure in, on, under, or over the bed;
- Excavate, drill, tunnel or disturb the bed otherwise;
- Introduce or plant any part of a plant, plant specimen or organism whether alien or indigenous, dead or alive in a river, lake or wetland;
- Introduce any animal or micro-organism whether alien or indigenous, dead or alive in a river, lake or wetland;
- Deposit any substance in a river, lake, or wetland or in or under its bed, which is likely to have adverse environmental effects on the river, lake or wetland;
- Direct or block a river, lake or wetland from its natural and normal course; and
- Drain any river, lake or wetland.

Section 91 of the EPML, states that the EPA may impose on the party that has caused or is likely to cause harm to the environment an “Environmental Restoration Order” requiring it to remedy/prevent the harm within 21 days of the service of the order. Section 92 allows the party to request the Agency to reconsider that order by giving reasons in writing within the same period. Section 107 states that non-compliance with the restoration order convicts the responsible party to imprisonment and/or a fine.

4.3.4 National Energy Policy

In February 2007, the GOL, through the Ministry of Lands, Mines and Energy (MLME), with the support of the United States Agency for International Development (USAID) published the National Energy Policy (NEP). The principal objective of the NEP is to ensure universal access to modern energy services in an affordable, sustainable and environmentally-friendly manner in order to foster the economic, political, and social development of Liberia.

The NEP recognizes the fact that energy is essential towards GOL Poverty Reduction Strategy (PRS) and the achievement of the Millennium Development Goals (MDGs).

The NEP assumes the implementation of proposed energy sector reforms founded on three essential features: (1) demonstrating the Government’s resolve for good governance and ensuring financial transparency in all sector transactions; (2) overcoming the significant obstacles to private sector investment in energy supply; and (3) creating the requisite institutional and legal framework and an independent regulatory regime. In undertaking energy sector reform, the Government will also be addressing a key component of Liberia’s commitment to the World Bank and other donors for debt relief under the program for Highly Indebted Poor Countries.

The NEP addresses the following strategic issues that are implied in the principal policy objective – access, quality, cost, and institutional framework. These issues refer to the need for the various technologies and delivery options for energy products and services to be available, acceptable, affordable, and adequate.

4.3.5 The Land Rights Policy

The Land Rights Policy (2013) concerns four land rights categories (Public Land, Government Land, Customary Land, and Private Land), and a cross-cutting sub-category called Protected Areas, which must be conserved for the benefit of all Liberians.

For Public Land and Government Land, the Policy sets forth critical policy recommendations regarding: how the Government transfers such land, and how the Government acquires land, especially through the exercise of eminent domain (i.e. forced acquisition).

With respect to the new category of Customary Land, there are several significant recommendations: Customary Land and Private Land are equally protected; and communities will self-define, be issued a deed, establish a legal entity, and strengthen their governance arrangements to make them fully representative

and accountable. The Government also undertakes to support communities in implementing these recommendations.

Below are the policy recommendations designed to ensure the Government exercises eminent domain consistent with international best practices and in a manner that balances the Government's constitutional powers with the fundamental constitutional right of Private Land and Customary Land ownership.

- Owners of Private Land and Customary Land will be provided just and prompt compensation such that, as much as possible, they are put in the same position they were in before the decision to expropriate.
- Just compensation for the land will be calculated based on fair market value assuming a willing buyer and a willing seller. Any change in fair market value as a result of the decision to expropriate will not be considered.
- In the context of the Government's exercise of its eminent domain power, 'public purpose' means a purpose beneficial to the public but for which no private entity has been willing to use its resources.
- Before exercising its eminent domain power the Government must make a reasonable effort to acquire Private Land or Customary Land through mutual agreement that provides just compensation in accordance with fair market value and the principles and recommendations set forth in this section.
- The Government must issue a notice to individuals, private entities, and communities likely to be affected such that they are given a reasonable period of time to review the notice, and advertise the notice to the public for a reasonable period of time. The notice must include: the Government's reasons for expropriating; the exact location of the land including a survey plan; the landowner's right to negotiate the Government's access to the land for the purpose of evaluating fair market value; and the landowner's right to be present at all times when the Government enters the land. If the Government changes its reasons for expropriating then the Government must inform individuals, private entities, and communities likely to be affected and advertise the change to the public for a reasonable period of time. Under no circumstances will the above notice transfer ownership of the land or be used by any government employee or their agents to claim ownership of the land.
- During the notice period the Government must make a good faith effort to locate the landowner and reach an agreement regarding access to the land for the purpose of evaluating its fair market value. If at the conclusion of the notice period the landowner refuses to grant access, the Government may enter onto the land for the sole purpose of evaluating its fair market value without the landowner's consent. The landowner will have the right to be present at all times when the Government enters the land.
- The valuation of just compensation must be based on the land's fair market value assuming a willing buyer and a willing seller and excluding any changes in value as a result of the decision to expropriate. In addition, just compensation must include temporary costs reasonably incurred by the landowner as a direct result of the expropriation, including, but not limited to: legal fees; and relocation costs, such as transportation to new land and compensation and projects to restore the natural resources and economic base of those relocated.
- If only a portion of the land is expropriated and as a result, the landowner's remaining land loses value, the Government must either compensate the landowner for the loss in value or expropriate the remaining land, whichever the landowner prefers.
- Owners of Private Land or Customary Land must be given a minimum of six (6) months' notice before they are required to relocate.
- The Government must provide payment of just compensation to the owner of Private Land or Customary Land before they are required to surrender their land to the Government.
- If Private Land or Customary Land acquired through the exercise of eminent domain after a certain date is not used for a public purpose within five (5) year of its acquisition, then the previous owner

or their heir(s) will have the right of first refusal (i.e. the right to buy back the land from the Government before any other prospective buyers). The Government must make a good faith effort to locate the previous owner or their heir(s).

- If after a certain date the buildings, projects, or activities of the Government are located on Private Land or Customary Land, the Government must continue to either lease the land or purchase the land through mutual agreement or eminent domain.

4.3.6 National Environmental and Occupational Health Policy

The Ministry of Health and Social Welfare has a Division of Environmental and Occupation Health; however, the Division lacks standards and policies specific to industries and/or occupational hazards. The National Environmental and Occupational Health Policy (NEOHP) was developed in 2007 to provide a framework for identifying policy needs and actions to improve occupational health and safety. It supplements the National Health Policy (Table 8), which focuses on public health and health systems. The NEOHP identified the following key Environmental and occupational health needs:

1. Environmental sanitation
2. Food Safety Services
3. Water Quality and Safety
4. Vector Control & Chemical Safety
5. Waste Management
6. Disaster Management
7. Health Promotion
8. Occupational Health Services
9. Port Health
10. Pollution Control
11. Sanitary Engineering

Table 8: Additional safety, health and welfare laws.

Title	Year	Description
Public Health Law	1976	This Law provides a framework for the management of public health and health systems in Liberia. The 1976 Law is currently being updated in order to effectively govern the decentralized health sector and accommodate the changes that have taken place since its promulgation. For example, in 2010 a new chapter was added to the Law to manage HIV / AIDS.
National Health Policy and National Health Plan	2007	The document is a framework for health sector reforms in Liberia. The goal of the policy is to make health care delivery services throughout the country effective and efficient, thereby enhancing the quality of life of the population.

4.3.7 Additional Safety, Health and Welfare Laws

Other important safety, health and welfare legislation that may apply generally (not specifically to workers) to E&P activities in Liberia include the Public Health Law and the National Health Policy and National Health Plan. These are summarized in Table 8.

4.3.8 Liberia Land Commission Act

The objective of this act is to propose, advocate and coordinate reforms of land policy, laws and programs in Liberia. It does not have adjutory or implementation role. The goal of the commission is “to develop comprehensive national land tenure and land use system that will provide equitable access to land and security of tenure so as to facilitate inclusive sustained growth and development, ensure peace and security and provide sustainable management of the environment”.

4.4 Liberian Environmental Quality Standards

Several environmental quality standards are partly prepared by EPA. Some of these environmental quality standards are: 1) Air Quality Standards; 2) Water Quality Standards; 3) Noise Level Standards; and 4) Waste Management Standards.

Air quality standards are not complete for ambient air. Existing ambient air quality standards are given in Table 9.

Water quality standards are only completed for the marine waters. Drinking, domestic, industrial, agricultural and other types of water standards are still incomplete. However the Ministry of Health Water Testing Laboratory uses the drinking water standards presented in Table 10.

Noise level standards are complete for many environments. Relevant noise standards are presented in Table 11, Table 12 and Table 13. Other noise standards can be found in the Environment Protection and Management Law- Noise Pollution Control and Standards Regulations, 2009.

Table 9: Ambient air quality tolerance limits (Environment Protection and Management Law- Air Quality & Standards Regulations, 2009)

Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
Sulphur oxides (SOX)	Annual Average*	80 µg/m ³	60 µg/m ³	15 µg/m ³
	24 hours**	120 µg/m ³	80 µg/m ³	30 µg/m ³
	Annual Average		0.019 ppm/50 µg/m ³	
	Month Average			
	24 hours		0.048 ppm /125 µg/m ³	
	One hour			
	Instant Peak		500 µg/m ³	
Oxides of Nitrogen (NOX)	Instant Peak (10 min)		0.191 ppm	
	Annual Average*	80 µg/m ³	60 µg/m ³	15 µg/m ³
	24 hours**	120 µg/m ³	80 µg/m ³	30 µg/m ³
	8 hours			
	Annual Average		0.2 ppm	
	Month Average		0.3 ppm	
	24 hours		0.4 ppm	
Nitrogen Dioxide	One hour		0.8 ppm	
	Instant Peak		1.4 ppm	
	Annual Average		0.05 ppm	
	Month Average		0.08 ppm	
	24 hours		0.1 ppm	
Suspended particulate matter (SPM)	One hour		0.2 ppm	
	Instant Peak		0.5 ppm	
	Annual Average*	360 µg/m ³	140 µg/m ³	70 µg/m ³
	24 hours**	500 µg/m ³	200 µg/m ³	100 µg/m ³
Suspended particulate matter (SPM)	mg/kg			
	Annual Average****		100 µg/m ³	

Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
	24 hours***		180 µg/m ³	
Suspended Particulate matter (<10 µg/m ³) (RPM)	Annual Average*	120 µg/m ³	60 µg/m ³	50 µg/m ³
	24 hours**	150 µg/m ³	100 µg/m ³	75 µg/m ³
Lead (Pb)	Annual Average*	1.0 µg/m ³	0.75 µg/m ³	0.50 µg/m ³
	24 hours**	1.5 µg/m ³	1.00 µg/m ³	0.75 µg/m ³
	Month Average		2.5	
Carbon monoxide (CO)/ carbon dioxide (CO ₂)	8 hours**	5.0 mg/m ³	2.0 mg/m ³	1.0 mg/m ³
	1 hour	10.0 mg/m ³	4.0 mg/m ³	2.0 mg/m ³
Hydrocarbons (HC)	24 hours**			
VOC	24 hours**			
Ozone	1 hour		0.12 ppm	
	Instant Peak		1.25 ppm	

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days. The 24-hour limit may not be exceeded more than three times in one year.

*** Not to be exceeded more than once per year average concentration

Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.

Table 10: Liberian drinking water quality standards (Ministry of Health and Social Welfare).

Parameter	Unit	WHO	Class I	Class II	Class III
pH	-logH	-	6.5 - 8.0	6.0 - 9.0	5.5 - 9.0
Chloride	mg Cl/l	350	≤ 250.0	≤ 350.0	≤ 450.0
Sulphate	mg SO ₄ /l	250	≤ 150.0	≤ 200.0	≤ 250.0
Hardness	CaCO ₃ mg/l	100-500	≤ 190.0	≤ 300.0	≤ 600.0
Iron Total	Fe mg/l	0.1	≤ 0.1	≤ 1.5	≤ 2.0
Manganese	Mn mg/l	0.1	≤ 0.1	≤ 0.3	≤ 0.8
Zinc Total	Zn mg/l	5	≤ 1.0	≤ 2.0	≤ 5.0
Coliform Bacteria	n/ml	0	0	0	≤ 5
Bacteria Total	n/ml	0	0	≤ 10	≤ 50
Dissolved Substance	mg/l	500	≤ 500.0	≤ 1000.0	≤ 1200.0
Suspended Solids	mg/l	-	≤ 10.0	≤ 30.0	≤ 50.0
Ammonia	mg NH ₄ /l	0.5	≤ 1.0	≤ 3.0	≤ 6.0
Nitrate	mg NO ₃ /l	50	≤ 40.0	≤ 60.0	≤ 80.0
Nitrite	mg NO ₂ /l	-	≤ 0.1	≤ 0.5	≤ 1.0
Phosphate	mg PO ₄ /l	-	≤ 0.01	≤ 0.02	≤ 0.05
Phenols	mg/l	0.001	≤ 0.001	≤ 0.02	≤ 0.05
Detergents	mg/l	-	≤ 1.0	≤ 2.0	≤ 3.0
Fluoride	F mg/l	1.5	≤ 1.5	≤ 1.5	≤ 2.0
Cyanide	Cn mg/l	0.05	n.d.	≤ 0.02	≤ 0.05
Lead	Pb mg/l	0.1	≤ 0.1	≤ 0.1	≤ 0.1
Mercury	Hg mg/l	0.01	n.d.	≤ 0.005	≤ 0.01
Copper	Cu mg/l	0.05	≤ 0.01	≤ 0.01	≤ 0.2
Cadmium	Cd mg/l	0.01	n.d.	≤ 0.001	≤ 0.01
Chromium Trivalent	Cr mg/l	-	≤ 0.5	≤ 0.5	≤ 0.8
Chromium Hexavalent	Cr mg/l	0.05	≤ 0.05	≤ 0.1	≤ 0.1
Nickel	Ni mg/l	-	≤ 1.0	≤ 1.0	≤ 0.1
Silver	Ag mg/l	0.05	≤ 0.01	≤ 0.01	≤ 0.01
Vanadium	V mg/l	-	≤ 1.0	≤ 1.0	≤ 1.0

Parameter	Unit	WHO	Class I	Class II	Class III
Boron	B mg/l	-	≤ 1.0	≤ 1.0	≤ 1.0
Arsenic	As mg/l	0.05	≤ 0.05	≤ 0.05	≤ 0.2
KEY					
mg	milligram				
L	Liter				
ml	milliliter				
n	count				
n.d.	non detectable				
Water Classification	Water can be used as				
Class I	Drinking water for the population, Water Supply for industry requiring drinking water.				
Class II	For Fisheries, Cultivated fisheries, Organized public bath, Recreational water sports.				
Class III	Industry supply except for industry requiring drinking water, irrigation or agricultural land.				
<i>Prepared for the Government of Liberia by UN Department of Technical Cooperation for UNDP New York 1987</i>					

Table 11: Maximum Permissible Noise Levels for General Environment (Environment Protection and Management Law - Noise Pollution Control & Standards Regulations, 2009).

Facility	Noise Limits B (A) (Leq)	
	DAY	NIGHT
Any building used as hospital, convalescence home, home for the aged, sanatorium and institutes of higher learning, conference rooms, public library, environmental or recreational sites.	45	35
Residential buildings	50	35
Mixed residential (with some commercial and entertainment)	55	45
Residential + industry or small-scale production + commerce	60	50
Industrial	70	60
Time Frame: use duration Day : 6.00 a.m. 10.00 p.m. Night : 10.00 p.m. 6.00 a.m. The time frame takes into consideration human activity		

Table 12: Maximum Permissible Noise Levels (Continuous or intermittent noise) from a Factory or Workshop (Environment Protection and Management Law- Noise Pollution Control & Standards Regulations, 2009).

Leq dB (A)	Duration (Daily)	Duration (Weekly)
85	8 hours	40 hours
88	4 hours	20 hours
91	2 hours	10 hours
94	1 hour	5 hours
97	30 minutes	2.5 hours
100	15 minutes	1.25 hours
103	7.5 minutes	37.5 minutes
106	3.75 minutes	18.75 minutes
109	1.875 minutes	9.375 minutes

Noise Levels shall not exceed a Leq of -

(i) Factory/Workshops 85 dB (A)

(ii) Offices 50 dB (A)

(iii) Factory/Workshop Compound 75 dB (A).

Table 13: Maximum Permissible Noise Levels for Residential & Commercial Areas (Environment Protection and Management Law- Noise Pollution Control & Standards Regulations, 2009).

Facility	Limit Value in dB(C)
For any building used as a hospital, school, convalescent home, old age home or residential building.	109 dB (C)
For any building in an area used for residential and one or more of the following purposes: Commerce, small-scale production, entertainment, or any residential apartment in an area that is used for purposes of industry, commerce or small-scale production, or any building used for the purpose of industry, commerce or small-scale production.	114 dB (C)

4.5 Environmental Impact Assessment Process in Liberia

An EIA Process Flow Chart has been included as Figure 9. The main steps in the process are:

- Prepare Application for Environmental Impact License
- Prepare Notice of Intent (NOI)
- Submit Project Brief (allow 14 working days for EPA review and feedback)
- Conduct Scoping Process:
 1. Publish NOI in Media
 2. Prepare Terms of Reference (TOR)
 3. Conduct Meetings with EPA Environmental Committee and District Environmental Committees, as needed.
 4. Conduct Public Meetings with Potentially Affected Communities
 5. Submit Scoping Report to EPA
- Prepare Environmental Review
- Obtain EPA Approval of TOR and Environmental Review
- Prepare Environmental Impact Study and Report (included in EIA)
- Prepare Environmental Impact Statement (EIS) (included in EIA)
- Develop Comprehensive Environmental Mitigation Plan and Implementation Strategy (included in EIA)
- Agency Review of EIA (within 3 months)
- Public Consultation on EIA (within first 30 days of 3 months)
- Public Hearings (EPA to decide whether to hold these)
- Liberia Line Ministries Comment on EIA
- Review by EPA Environmental Assessment Committee
- Approval or Rejection by EPA (within 3 months of receiving EIA)

4.5.1 Public Consultation Requirements of the EIA Process

Involvement of the public in the EIA commences with the launch of the EIA process and continues throughout its course. Detailed below are the different requirements of the public involvement throughout the EIA process:

1. After the submission of an application for an environmental impact assessment permit, the project proponent should publish a “notice of intent” that states the information that may be necessary to allow the stakeholders or any interested party to identify their interest in the proposed project or activity. This information should include: the nature of the project, its related activities, its timeframe and its site of operation and the area that may be impacted.
2. Before preparing the EIA document, the project proponent should conduct public consultations with the potential affected stakeholders. This procedure is called the “scoping process” which aims

to: 1) inform the stakeholders about the project’s details, its potential impacts on the physical, biological and socio-economic environments, and the mitigation measures that can be taken in order to minimize these impacts, and 2) get the stakeholders’ input on the various related issues. By achieving this, the scoping process is also a guiding tool for the project proponent and its consultants. It helps them in identifying the project’s impacts, mitigation measures and alternatives, which will form the essential part of the EIA document. The scoping process consists of publishing the project’s details in the affected district’s media, holding public meetings to consult directly with the affected communities and stakeholders, and incorporating the views of these stakeholders in the scoping report which is submitted to the EPA.

3. On the completion of the EIA study report, the public is invited again to participate in the EIA review through public consultation meetings. The public’s views on the EIA are taken into consideration by the EPA when deciding about approving or rejecting the project.
4. In some cases, the EPA also decides to hold a public hearing about the project in order to fortify the public participation. These cases include but are not limited to: requests by the public for a public hearing, controversy about the project or expiry of the period stipulated for receipt of comments.

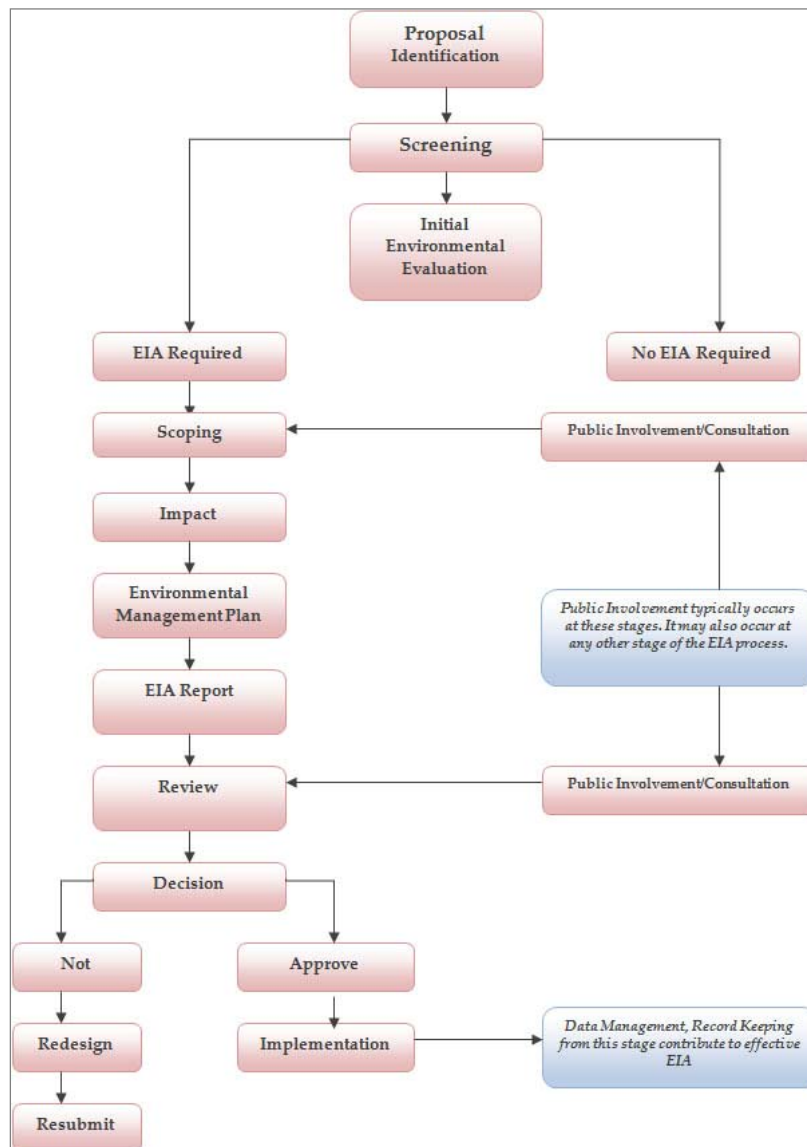


Figure 9: EIA process in Liberia.

4.6 Guinean Regulatory Framework on Land Administration

The Fundamental Law of the Second Republic of Guinea

The Constitution, known as the Fundamental Law of the Second Republic of Guinea (1990), guarantees its citizens the right to private property and the unalienable right to benefit from the country's natural resources. It also stipulates that private property in general can only be expropriated: (1) where a public interest has been established; (2) for purposes of urban or rural development; and (3) where the public interest is compelling enough to justify a restriction of property rights and just compensation is paid.

The Guinea Land Code

The 1992 Guinea Land Code (Code Foncier et Domanial) introduced an elaborate land privatisation and registration system. The Code affirms state ownership of vacant land and grants individuals the right to own land. Land ownership is established through land registration. The Land Code also includes provisions for the establishment of Land Commissions in each commune and in the capital city of Conakry. However, the Code is largely unenforced in rural areas.

The Land Code recognises private ownership of land, and the formal law grants owners rights to use and alienate land held in ownership. Land rights must be registered with the national land registry and be included within a local land tenure plan. Once established, land rights registered under formal law are enforceable against competing claims.

The Land Code recognises state-owned public land, which includes areas that provide public services or are used by the public. Such land cannot be alienated. Some state land is classified as within the private domain (such as land identified as vacant or unclaimed) and can be alienated.

The Land Code also provides that ownership rights under customary law may be registered and granted status under formal law provided that the landholder has occupied the holding for a statutory period of time and has made a sufficient level of investment in the land. The Land Commissions determine the requisite level of investment, which can include creation of structures and infrastructure or the development of plantations, irrigation, and cultivation. Registration requires a public process to confirm the occupant's rights and the lack of competing claims to the land. Few rural people have the knowledge and resources to register land, and the state has limited capacity to register land. The Land Code stipulates that unregistered land in rural areas (the vast majority of rural land) is owned by the state.

While this formal land tenure system with transferable ownership rights exists in some parts of the country, most of Guinea's tenure systems and types are based on informal and customary law. The customary tenure structures include a range of tenure forms, including individual and communal ownership, use rights, and pastoralist rights. Customary tenure systems vary by region, but are characterised by the following general attributes: (1) land and resources are inalienable, (2) access to land is secured by social identity and kin-group membership; and (3) different use-rights may be granted for the same land. As the population increases, customary rights have increasingly focused on families and individuals, rather than on lineage and tribe.

Private land rights are generally considered well-protected from state expropriation in Guinean law. Under the Land Code, land expropriations must be in the public interest. Expropriation requires just compensation, and Guinea's Land Commissions are charged with responsibility for helping parties negotiate the amount of compensation. According to the Constitution, expropriation may occur where public interest has been established and must adhere to a rigorous public process.

Rural Land Policy

The Government of Guinea passed a Rural Land Policy in 2001 (Déclaration de la Politique Foncière en Milieu Rural). The policy recognises certain customary land rights and calls for the development of

legislation to formalise such rights. The code analyses the existing land legislation and establishes new principles to guide future legislation and practices that: improve the effectiveness of existing land tenure legislation; clarify and secure land-tenure property rights; decentralise land tenure management and increase the participation of local actors; reinforce the land-tenure administration institutional framework; and seek to harmonise property rights across existing bodies of natural resource legislation. However the policy lacks application texts and so is not yet functioning.

The Forestry Code

The Forestry Code recognises the customary rights of communities living within or close to forests. Under customary law, communities with rights to forestland or land adjacent to forests generally have rights to use the land and forest products. The Code permits local communities to use wood products to meet domestic requirements and to graze livestock in classified forests. The Code does not recognise rights of local communities to engage in commercial logging. The Code specifies that forest areas should be protected against any form of degradation or destruction caused by factors such as overuse or overgrazing.

Institutional Framework

Both statutory and customary institutions strongly influence local patterns of control and access to land and natural resources. Faced with this plurality, Guinea has embarked on reforms that create administrative and institutional arrangements that seek to: (a) involve stakeholders more widely in providing more tenure security, in routine management, and even in setting new directions; (b) ensure greater cooperation and coordination among disparate land- and resource-related sectors; and (c) decentralize land tenure governance.

At the national level, land tenure and natural resources legislation, policies and plans have been implemented by ministries and agencies that continue to shift and reorganise. Current Ministries applicable to land tenure and natural resources include:

- The Ministry of Agriculture
- The Ministry of Construction and Public Land Management
- The Ministry of Decentralization and Local Development
- The Ministry of Environment and Sustainable Development
- The Ministry of Mines and Energy
- The Land Registry (Bureau de la Conservation Foncière) is responsible for maintaining the land registry and processing formal land transactions

The 1992 Land Code provides for the establishment of Land Commissions in each commune and the capital city of Conakry. The commissions are composed of seven members, of whom four are designated by the Ministries of Urbanism, Agriculture, Interior, and Mines; the three remaining members are to be designated by a prefect or governor. Land Commissions are charged with: 1) ensuring that land is actually being put to productive use; 2) facilitating agreements between parties when lands are expropriated in the public interest; 3) advising on the price that should be paid for buildings during pre-emptive acquisitions; and 4) opining on real estate transactions and any issues pertaining to the direction of the local government's land tenure policy. Guinea's Land Commissions are charged with responsibility for helping parties negotiate the amount of compensation. In practice however, few Land Commissions are active.

The Rural Land Policy of 2001 envisions the decentralisation of rural land management to local governments (collectivités locales) in the form of local-level land tenure and property rights administration institutions.

4.7 International Safeguard Policies

The Gbedin mini hydropower project is expected to be partly financed by African Development Bank (AfDB) and possibly other international financing institutions. There might also be private sector participation from

foreign companies. Thus, in order to ensure that the project becomes “bankable”, the project has been benchmarked against AfDB’s Integrated Safeguards System as well as the IFC Performance Standards.

4.7.1 AfDB Integrated Safeguards System

The Integrated Safeguards System (ISS) consists of an Integrated Safeguards Policy Statement, Operational Safeguards (OSs), a revised set of Environmental and Social Assessment Procedures, and Integrated Environmental and Social Impacts Assessment Guidance Notes.

The Bank’s Integrated Safeguards Policy Statement sets out the Bank’s own commitments to and responsibilities for delivering the ISS to (i) ensure the systematic assessment of environmental and social impacts and risks; (ii) apply the OSs to the entire portfolio of Bank operations; (iii) support clients and countries with technical guidance and practical support in meeting the requirements; (iv) implement an adaptive and proportionate approach to environmental and social management measures to be agreed with clients as a condition of project financing; (v) ensure that clients engage in meaningful consultations with affected groups; and (vi) respect and promote the protection of vulnerable groups, in a manner appropriate to the African context.

The Policy Statement also sets out the Bank’s commitment to harmonise environmental and social safeguards among multilateral financial institutions (MFIs) and to co-ordinate with co-financing partners. It highlights the importance of compliance monitoring and supervision to ensure that the safeguards are implemented. Finally, it includes a list of goods harmful to the environment for which Bank-provided funds may not be used in either public or private investments.

The Operation Safeguards (OSs) are a set of five safeguard requirements that Bank clients are expected to meet when addressing social and environmental impacts and risks. Bank staff use due diligence, review and supervision to ensure that clients comply with these requirements during project preparation and implementation. A summary of the OSs and their applicability to the Gbedin mini hydropower project is given on the next pages.

Operational Safeguard	Purpose / Objectives	Applicability to the Project
<p>OS 1: Environmental Assessment</p>	<p>This overarching safeguard governs the process of determining a project’s environmental and social category and the resulting environmental and social assessment requirements including climate change issues.</p> <p>OS 1 objectives include:</p> <ul style="list-style-type: none"> • Identify and assess the environmental and social impacts and risks including those related to gender, climate change and vulnerability of Bank lending and grant-financed operations in their areas of influence; • Avoid or, if avoidance is not possible, minimise, mitigate and compensate for adverse impacts on the environment and on affected communities; • Provide for stakeholders’ participation during the consultation process so that affected communities and stakeholders have timely access to information in suitable forms about Bank operations, and are consulted meaningfully about issues that may affect them; • Ensure the effective management of environmental and social risks in projects during and after implementation; <p>The environmental and social assessment covers, in an integrated way, all relevant direct and indirect environmental and social risks and impacts, throughout the project cycle triggered by all project components including associated facilities. Where relevant, the assessment also covers possible cumulative impacts: impacts on areas and resources that result from the proposed project in addition to impacts from other existing or planned developments.</p> <p>As needed, the assessment leads to the development of a comprehensive and implementable ESMP with a realistic timeframe, incorporating the necessary organisational capacity (including further training requirements) and financial resources to address and manage the environmental and social risks that may occur during the full project cycle.</p> <p>The borrower or client also establishes adequate emergency preparedness and response plans so that it is prepared to respond to accidental and emergency situations that may pose a threat to local communities, and to provide affected communities with appropriate information about emergency preparedness and response activities, resources, and responsibilities.</p>	<p>The Gbedin project has been classified as Category 1 (i.e. likely to cause significant environmental and social impacts) and therefore requires a full ESIA study (including ESMP). The process of preparing the ESIA and ESMP has followed a participatory approach. The final project details, including the ESIA report, will be made public and shared with the stakeholders.</p>
<p>OS 2: Involuntary resettlement: land acquisition, population displacement and compensation</p>	<p>This safeguard consolidates the policy commitments and requirements set out in the Bank’s policy on involuntary resettlement. In particular, it embraces comprehensive and forward-looking notions of livelihood and assets, accounting for their social, cultural, and economic dimensions. It also adopts a definition of community and common property that emphasises the need to maintain social cohesion, community structures, and the social interlinkages that common property provides.</p> <p>The safeguard retains the requirement to provide compensation at full replacement cost; reiterates the importance of a resettlement that improves standards of living, income earning capacity, and overall means of livelihood; and emphasises the need to ensure that social considerations, such as gender, age, and stakes in the project outcome, do not disenfranchise particular project-affected people.</p> <p>OS 2 ensures that borrowers:</p> <ul style="list-style-type: none"> • Avoid involuntary resettlement where feasible, or minimise resettlement impacts where involuntary resettlement is deemed unavoidable after all alternative project designs have been explored; • Ensure that displaced people are meaningfully consulted and given opportunities to participate in the planning and implementation of resettlement programmes; 	<p>The ESIA study has assessed the extent of involuntary resettlement through a separate Resettlement Action Plan (RAP). The project will cause economic displacement but no physical displacement.</p>

Operational Safeguard	Purpose / Objectives	Applicability to the Project
	<ul style="list-style-type: none"> Ensure that displaced people receive significant resettlement assistance under the project, so that their standards of living, income-earning capacity, production levels and overall means of livelihood are improved beyond pre-project levels; 	
<p>OS 3: Biodiversity and ecosystem services</p>	<p>This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources by reflecting the value of key ecosystems to the population, emphasising the need to “respect, conserve and maintain the knowledge, innovations and practices of indigenous and local communities and to protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements.</p> <p>OS 3 ensures that borrowers/Clients:</p> <ul style="list-style-type: none"> Conserve biological diversity and ecosystem integrity by avoiding or, if avoidance is not possible, reducing and minimising potentially harmful impacts on biodiversity Endeavour to reinstate or restore biodiversity, including, where some impacts are unavoidable, through implementing biodiversity offsets to achieve “not net loss but net gain” of biodiversity; Protect natural, modified, and critical habitats; Sustain the availability and productivity of priority ecosystem services to maintain benefits to the affected communities and sustain project performance; Identify and implement opportunities to conserve and sustainably use biodiversity and natural habitats; and Observe, implement, and respond to requirements for the conservation and sustainable management of priority ecosystem services. <p>The OS requires that as part of the environmental and social assessment, the borrower or client identifies and assesses the potential opportunities for, risks to, and impacts on biological diversity and ecosystem services, including direct, indirect, and cumulative and premitigation impacts. Special attention is given to the major threats to biodiversity and ecosystem services, such as pollution and contamination, land conversion, habitat fragmentation, natural habitat loss, deforestation, over-exploitation of natural areas and resources, invasive alien species, migration barriers, the capturing of wild animals, the harvesting of endemic species and indigenous ornamental flora and fauna, and wildlife poaching.</p> <p>The OS requires that for projects that affect water resources, the borrower or client shall avoid significant alteration of flow regimes in ways that prevent water resources from fulfilling their functions for important upstream and downstream ecosystems and their services to local communities.</p>	<p>The ESIA includes baseline studies of biodiversity and living natural resources in the project’s area of influence, including a description of affected habitats their conservation value. The predicted impacts have been rated according to significance/magnitude and the mitigation hierarchy has been applied as appropriate.</p>
<p>OS 4: Pollution prevention and control, hazardous materials and resource efficiency</p>	<p>This safeguard covers the range of impacts of pollution, waste, and hazardous materials for which there are agreed international conventions and comprehensive industry-specific standards that other multilateral development banks follow. It also introduces vulnerability analysis and monitoring of greenhouse gas emissions levels and provides a detailed analysis of the possible reduction or compensatory measures framework.</p> <p>The OS objectives are:</p>	<p>The ESIA has assessed the risk of environmental pollution and imposed prevention and control techniques consistent with national and international standards.</p>

Operational Safeguard	Purpose / Objectives	Applicability to the Project
	<ul style="list-style-type: none"> • Manage and reduce pollutants resulting from the project including hazardous and non-hazardous waste so that they do not pose harmful risks to human health and the environment; and • Set a framework for efficiently using all of a project’s raw materials and natural resources especially energy and water <p>The OS expects that the borrower will prevent the discharge of pollutants (hazardous and non-hazardous) into the air, surface water and groundwater, land and soil during planned activities as well as unplanned events or emergencies that may result in local, regional, and transboundary impacts. If total prevention is not feasible, the borrower or client takes specific actions to reduce or minimise the effluents or volume of discharges.</p> <p>If significant production, use or generation of hazardous materials or waste cannot be avoided, the borrower or client, in consultation with potentially affected workers and communities, prepares a management plan in the framework of a lifecycle assessment (transport, handling, storage, recycling and disposal), incorporating management and reporting practices and including preventive and contingency measures.</p> <p>The OS expects that if third parties are to be used for hazardous waste management and disposal, the borrower or client evaluates their legitimacy and legality for conducting hazardous waste management activities and obtains the chain-of-custody documentation.</p>	
OS 5: Labour conditions, health and safety	<p>This safeguard establishes the Bank’s requirements for its borrowers or clients concerning workers’ conditions, rights and protection from abuse or exploitation. It covers working conditions, workers’ organisations, occupational health and safety, and avoidance of child or forced labour.</p> <p>The OS objectives are:</p> <ul style="list-style-type: none"> • Protect workers’ rights; • Establish, maintain, and improve the employee - employer relationship; • Promote compliance with national legal requirements and provide supplemental due diligence requirements where national laws are silent or inconsistent with the OS; • Protect the workforce from inequality, social exclusion, child labour, and forced labour; and • Establish requirements to provide safe and healthy working conditions. 	<p>The project will require a large workforce during the construction phase. The ESIA has referred to the applicable laws and regulations on labour and working conditions, and specified relevant requirements in the ESMP.</p>

4.7.2 IFC Performance Standards

The International Finance Corporation (IFC), a division of the World Bank Group that lends to private sector, has developed the IFC Performance Standards as part of IFC's Sustainability Framework (2012 Edition). These standards are used to evaluate any project seeking funding through the IFC. It should be noted that even for projects that do not anticipate seeking financing from the IFC, the IFC Performance Standards are typically applied as a benchmark of international good practice.

The Performance Standards are directed towards providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of direct investments for the IFC (including project and corporate finance provided through financial intermediaries), the IFC requires that its clients apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced.

The Performance Standards require that projects are executed in accordance with Good International Industry Practice (GIIP) as outlined in the IFC Environmental, Health and Safety (EHS) Guidelines. The EHS Guidelines contain the performance levels and measures that are normally acceptable to the IFC, and that are generally considered to be achievable in new facilities at reasonable costs by existing technologies. When host country (Liberian) regulations differ from the levels and measures presented in the EHS Guidelines, projects will be expected to achieve whichever is more stringent.

The Performance Standards and their applicability to the Gbedin project are presented on the next pages.

Performance Standard	Purpose / Objectives	Applicability to the Project
<i>PS1: Assessment and Management of Environmental and Social Risks and Impacts</i>	Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client’s management of environmental and social performance throughout the life of the project.	The Gbedin project requires a full ESIA study (including ESMP) to identify environmental and social risks and impacts and to provide a basis for the management of environmental and social performance during detailed planning, construction and operation.
<i>PS2: Labour and Working Conditions</i>	The objective of the Performance Standard 2 is to: <ul style="list-style-type: none"> • Promote fair treatment, non-discrimination, and equal opportunity of workers • Establish, maintain, and improve the worker-management relationship • To promote compliance with national employment and labour laws • To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client’s supply chain. • To promote safe and healthy working conditions, and the health of workers. • To avoid the use of forced labour. 	The ESIA has referred to the applicable laws and regulations on labour and working conditions, and specified relevant requirements in the ESMP.
<i>PS3: Resource Efficiency and Pollution Prevention</i>	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. Its aims are: <ul style="list-style-type: none"> • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related GHG emissions. To provide guidance on how to achieve the objectives of Performance Standard 3, reference is made to the Environmental Health and Safety (EHS) Guidelines. The EHS Guidelines are technical reference documents with general and industry-specific examples of good international industry practice. When host country regulations differ from the EHS Guidelines, projects are expected to adhere to, and aim for, the most stringent requirements.	The ESIA has assessed the risk of environmental pollution and imposed prevention and control techniques consistent with national standards and the IFC Environmental, Health and Safety (EHS) Guidelines.
<i>PS4: Community Health, Safety and Security</i>	Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an 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.	The existing and project-induced risks to community health, safety and security have been assessed, and necessary mitigation measures have been specified in the ESMP.
<i>PS5: Land Acquisition and Involuntary Resettlement</i>	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	The ESIA study has assessed the extent of involuntary resettlement through a separate Resettlement Action

Performance Standard	Purpose / Objectives	Applicability to the Project
	<p>of livelihood (1) as a result of project-related land acquisition (2) and/or restrictions on land use. The objectives of the Performance Standard are:</p> <ul style="list-style-type: none"> • To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs. • To avoid forced eviction. • To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. • To improve, or restore, the livelihoods and standards of living of displaced persons. • To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites. 	<p>Plan (RAP). The project will cause economic displacement but no physical displacement.</p>
<p><i>PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources</i></p>	<p>Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. Habitats are classified into modified, natural and critical habitats. The client will not significantly convert or degrade natural habitats, unless all of the following are demonstrated:</p> <ul style="list-style-type: none"> • No other viable alternatives within the region exist for development of the project on modified habitat • Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation • Any conversion or degradation is mitigated according to the mitigation hierarchy <p>In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible.</p> <p>In areas of critical habitat, the client will not implement any project activities unless all of the following are demonstrated:</p> <ul style="list-style-type: none"> • No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical • The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values • The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time • A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program 	<p>The ESIA includes baseline studies of biodiversity and living natural resources in the project's area of influence, including a description of affected habitats their conservation value. The predicted impacts have been rated according to significance/magnitude and the mitigation hierarchy has been applied as appropriate.</p>
<p><i>PS7: Indigenous Peoples</i></p>	<p>Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized</p>	<p>The project's direct impact zone is inhabited by a mix of ethnic groups with Mano being the dominant. There</p>

Performance Standard	Purpose / Objectives	Applicability to the Project
	<p>and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. The objectives of this policy include:</p> <ul style="list-style-type: none"> • To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. • To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. • To promote sustainable development benefits and opportunities for Indigenous peoples in a culturally appropriate manner. • To establish and maintain an on-going relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. • To ensure the free, prior, and informed consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. • To respect and preserve the culture, knowledge, and practices of Indigenous Peoples. 	<p>is no indication that any of the ethnic groups identify themselves as indigenous, tribal or ethnic minority populations as defined in PS7.</p>
<p><i>PS8: Cultural Heritage</i></p>	<p>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.</p> <p>The client is responsible for siting and designing a project to avoid significant adverse impacts to cultural heritage. The environmental and social risks and impacts identification process should determine whether the proposed location of a project is in areas where cultural heritage is expected to be found, either during construction or operations. In such cases, the client will develop provisions for managing chance finds through a chance find procedure which will be applied in the event that cultural heritage is subsequently discovered.</p> <p>Where the client has encountered tangible cultural heritage that is replicable and not critical, the client will apply mitigation measures that favour avoidance. Where avoidance is not feasible, the client will apply the mitigation hierarchy.</p> <p>The client should not remove, significantly alter, or damage critical cultural heritage. In exceptional circumstances when impacts on critical cultural heritage are unavoidable, the client will use a process of Informed Consultation and Participation of the Affected Communities which uses a good faith negotiation process that results in a documented outcome.</p>	<p>Cultural heritage resources has been assessed through consultations with affected communities and other stakeholders.</p>

5 BASELINE CONDITIONS

5.1 Physical Environment

5.1.1 Topography and Landscape

The terrain surrounding the Gbedin Falls is characterised by undulating hills with thick vegetation consisting of both primary and secondary forest. The project site is located at an altitude of approx. 300 metres above sea level (masl.). Access is possible from the left bank only as the right bank of the river is very steep and forms the border with Guinea. There are no bridges nearby.

The waterfall is a conspicuous landscape element, although it is not visible from afar because of the thick vegetation cover. The falls are steep and ~20 m high. At the toe of the falls, there is a large pool (~170 m long) and the topography is relatively flat. The river flows from the pool into a narrow and meandering river channel in the downstream.

The proposed access road and transmission line are routed north of some hills (mountain range) that separate the Gbedin Falls and its environs from the main Ganta-Sanniquellie road. These hills reach up to an altitude of about 650 masl. The last section of the transmission line towards the grid connection point (near the main road) will traverse one of these hills (referred to as Kitoma hill). The slopes are very steep and covered with thick vegetation.

Selected landscape photographs are shown below and on the next pages.



Figure 10: Gbedin Falls viewed from the pool at the foot of the waterfall.

Conclusion: The aesthetic qualities of the project area are typical of the surrounding landscapes and not unique to the region at large. However, the Gbedin Falls is a conspicuous landscape element that adds value to the visual landscape. Overall, the value is rated as medium.

Value		
Low	Medium	High



Figure 11: River discharge at Gbedin Falls on 22 November 2018.



Figure 12: River discharge at Gbedin Falls on 1 March 2019.



Figure 13: Saint Paul River upstream of Gbedin Falls viewed towards the planned reservoir area.



Figure 14: The pool below Gbedin Falls viewed from the top of the waterfalls.



Figure 15: Saint John River at Gampa downstream of Gbedin Falls.



Figure 16: Landscape view from Kitoma hill towards the proposed transmission line area (left) and Gbalasonoh (right).

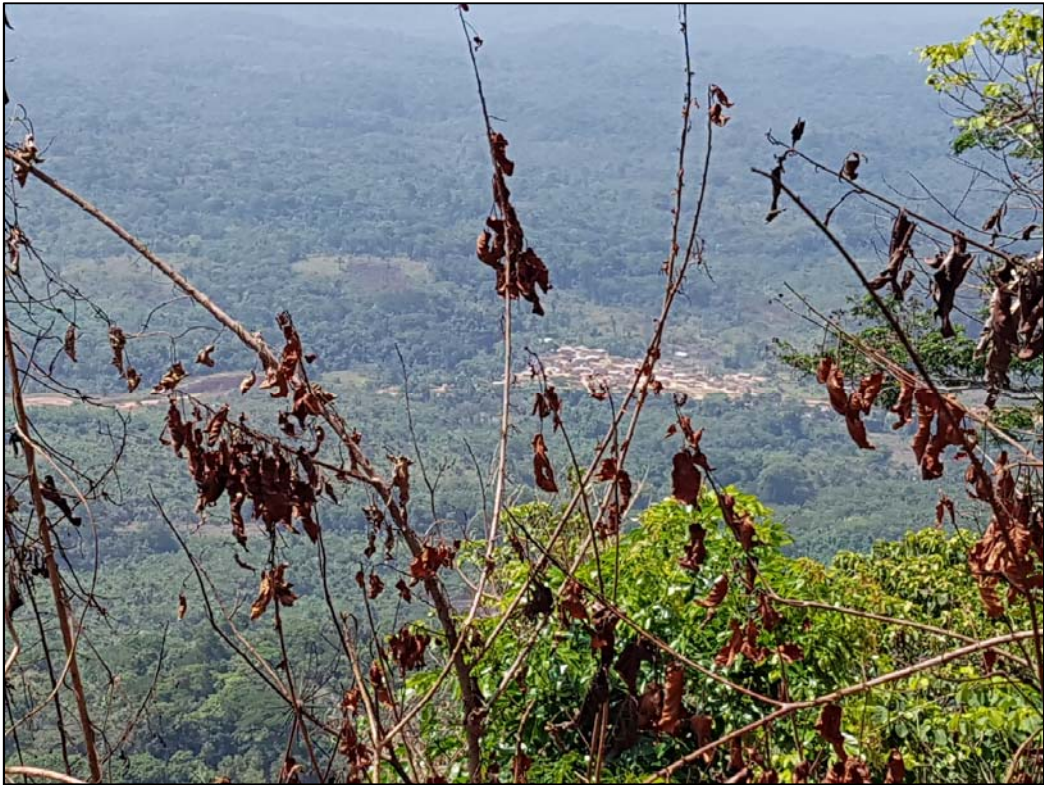


Figure 17: Kitoma town viewed from Kitoma hill.



Figure 18: The proposed substation site near Kitoma town along the Ganta-Sanniquellie road.

5.1.2 Geology and Soils

The project area belongs to the Liberian age province which can be dated back to 2700 million years ago (Tysdal and Thorman 1983). This Precambrian Liberian age province is generally structurally stable and characterised by a thick crust with a large proportion of gneissic rocks. The Gbedin Falls site is located in the leucocratic gneiss which is a fairly homogeneous quartzofelspathic gneiss. The only readily apparent inhomogenities are those of deformation fabric and those of amphibolite bodies that are probably metamorphosed dikes (Tractebel 2016). The leucocratic gneiss outcrops in rivers, as is the case at Gbedin Falls.

Liberia is far from the seismic zone along the Mid-Atlantic Range. The Precambrian basement rocks underlying much of Liberia's territory are part of the West African Craton which is noted for an absence of tectonic activity over the last 250 million years. Intra-plate zones of earthquake activity are not known to exist within Liberian territory.

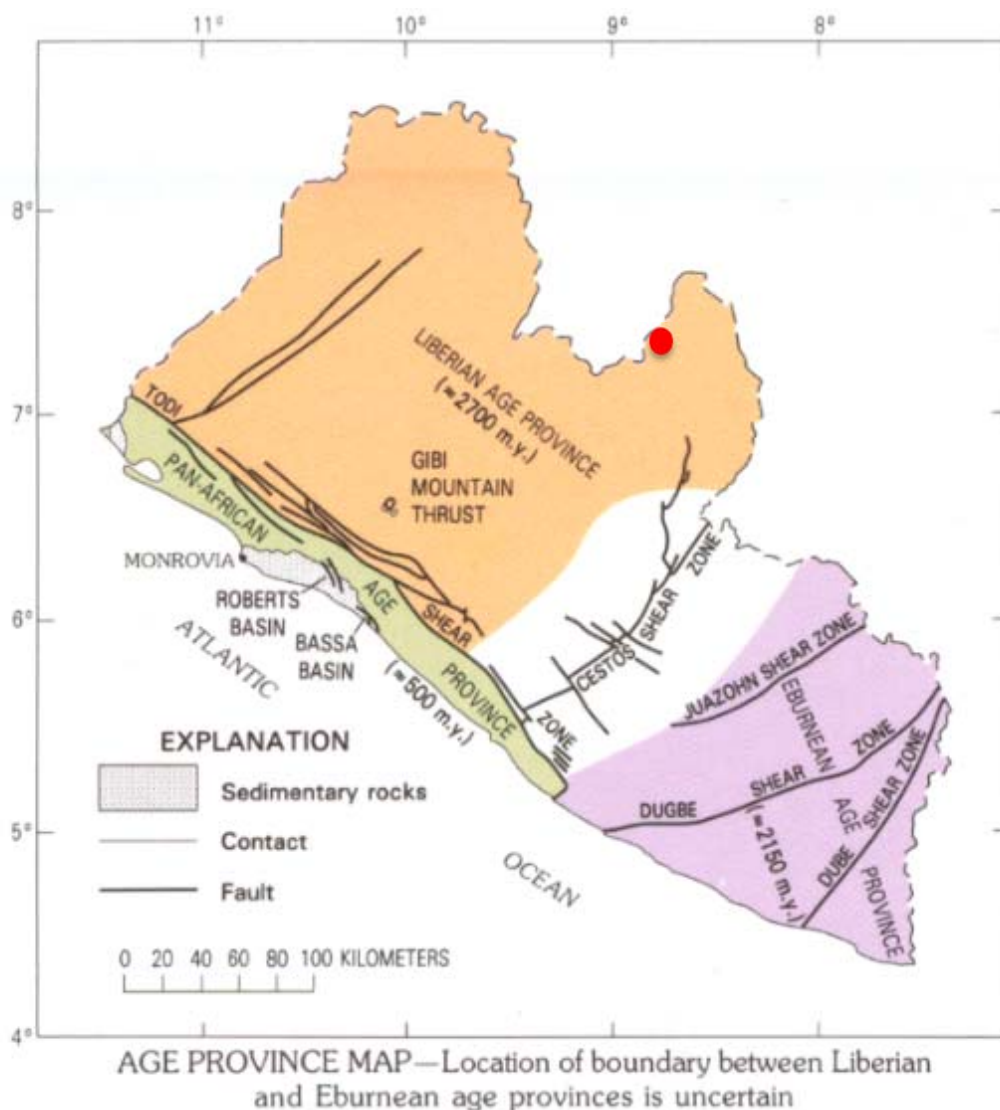


Figure 19: Gbedin Falls (red dot) located in Liberian age province.

Due to the tropical weathering caused by a combination of high temperature and rainfall, a thick laterite and saprolite soil cover has been formed covering most of the rocks in Liberia (Tysdal and Thorman 1983). The three major groups of soil in Liberia can be identified: latosols, lithosols and regosols. At Gbedin, the dominant soils are latosols. These are heavily leached, and silica, nutrients and humus are mostly washed out. Iron and aluminium minerals have accumulated as permanent residual materials, forming hardpans and cemented layers within the subsoil, while on the surface hard and rounded iron oxides can be observed. This process which is called laterization has a pronounced binding effect, making the soils impermeable and increasing the hazards of run-off and erosion. The prevalence of the iron oxides gives the laterites the characteristic brown and red colour.

The soil generally contains a thin but very fertile layer of topsoil formed by humus dropped from plants and animals in the forest above, followed by an infertile second layer due to rapid leaching in the high rainfall, and a third layer of weathered bedrock. The latosol is completely reliant on the rainforest to maintain fertility, as all nutrients leach away quickly when the forest is felled and the layer of humus is no longer being replaced.

Based on these available data and considering the limited land take and earthworks associated with the Gbedin mini hydro project, further soil investigations have been scoped out of the detailed study. The project will not have any significant impact on soil productivity or physical characteristics. It is expected that the engineering design may require additional soil data but that has no relevance in terms of the project's environmental and social feasibility.

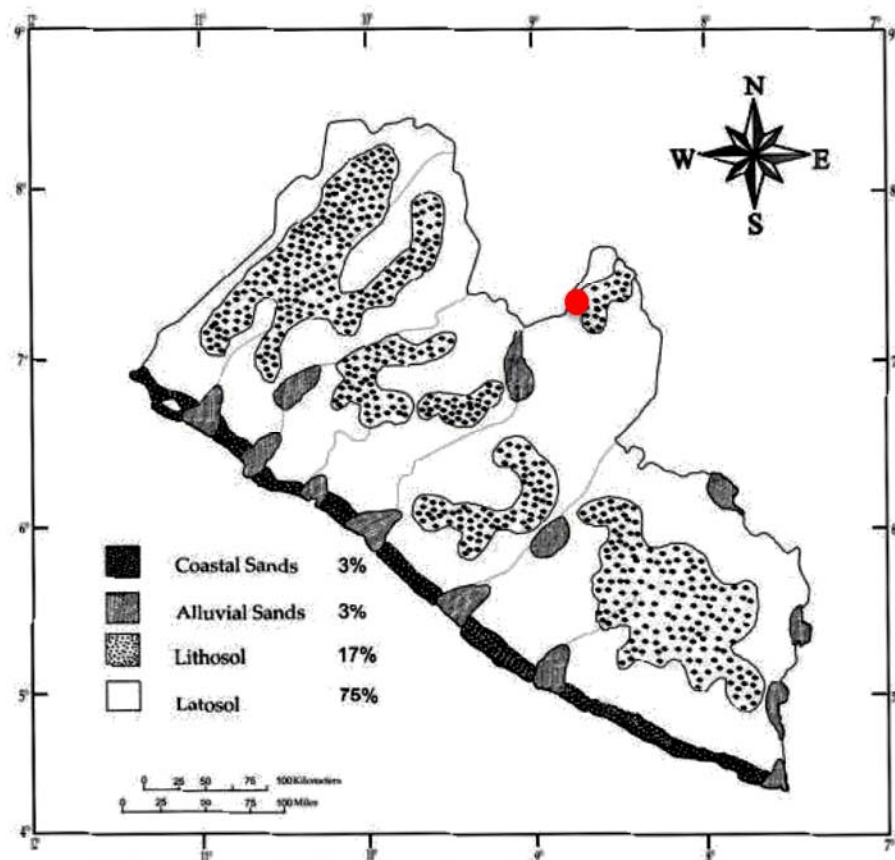


Figure 20: General soil map of Liberia with Gbedin Falls marked as red dot.

5.1.3 Climate and Air Quality

The climate of Liberia is determined by the equatorial position and the distribution of low and high-pressure belts along the African continent and the Atlantic Ocean. A fairly warm temperature throughout the year with very high humidity is common because of the moderating influence of the ocean and the equatorial position.

Generally, temperature remains warm throughout the country and there is little change between seasons. The temperature over the country ranges from 27°C to 32°C during the day and from 21°C to 24°C at night. The highest temperature occurs between January and March and the lowest is between August and September.

There is a very clear seasonal variation in rainfall with a typical unimodal distribution. The rainy season starts in April-May and lasts generally until November. The dry season then lasts from December to March, but the onset of the rainy season can vary from year to year. Dry years are identified not so much by the amount of rainfall but rather by the time of onset of the rainy season.

Meteorological records in Liberia are scarce, and currently there are no operating stations. The nearest station from where rainfall data have been obtained is Sanniquellie (450 masl.) about 14 km west of Gbedin Falls and 2 km west of the proposed access road. The Sanniquellie records are for 14 complete calendar years between 1953 and 1980 (URS/Scott Wilson 2010). The average annual rainfall over the 14 years was 2,276 mm.

The rainfall data reported by Tractebel (2016) show that mean monthly rainfall reaches 358 mm in September and exceeds 100 mm from March to October (Figure 21). The driest months are December and January with less than 20 mm per month. The overall catchment rainfall has been estimated at 2,011 mm/year.

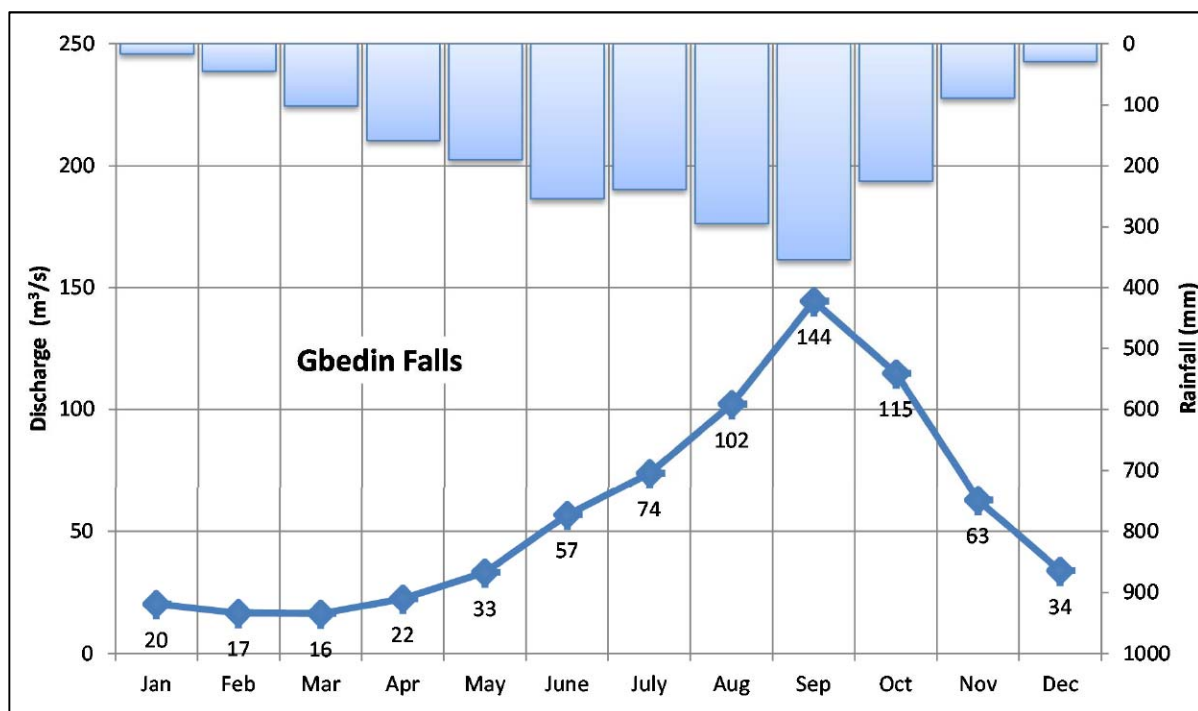
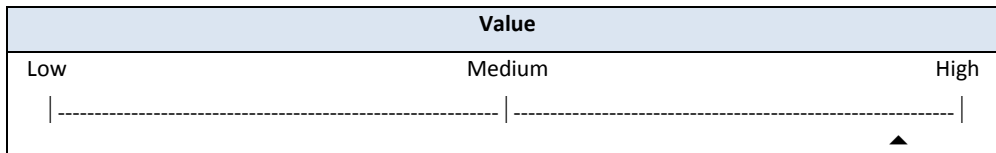


Figure 21: Mean monthly rainfall and discharge at Gbedin Falls. Source: Tractebel (2016).

Air quality measurements were not undertaken because the airshed over the project area is not considered to be degraded. The only sources of air pollution (and greenhouse gas emissions) are forest fires, mainly from slash-and-burn agriculture. However, any background concentrations would be extremely low.

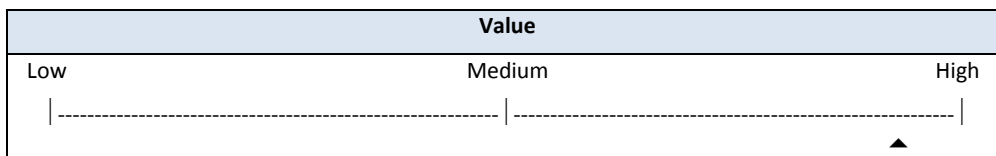
Conclusion

The climatic conditions in the project area is typical of the region at large, and the ambient air quality is considered as non-degraded. The value is thus rated as high with respect to climate and air quality.



5.1.4 Noise

No data exist on the present noise situation. However, due to the remoteness of Gbedin Falls, the very low traffic volumes on the local roads, and the absence of any major industrial activities, noise levels are considered insignificant and/or within the normal range of natural sounds. The baseline value is therefore high.



5.1.5 Hydrology

The Saint John River is one of the six main rivers of Liberia. The headwaters are in the Nimba Range of the Guinea Highlands in Guinea and flow south towards and along the border with Liberia. At Niatande, Liberia, it meets the Mani River where it enters Liberia.³ The river is of 360 km long with 30 km in Guinea, 50 km at the border and the remaining in Liberia. It flows generally southwest through Liberia and empties into the Atlantic Ocean at Bassa Cove near Edina in Grand Bassa County.

The catchment area at Gbedin Falls is 1,815 km² and the mean flow has been estimated to 58.1 m³/s (Tractebel 2016). The mean monthly flows (Figure 21) are highest in September (144 m³/s) and lowest in March (16 m³/s). The daily discharge series at Gbedin Falls is shown in Figure 22. Individual years are represented by thin grey lines and the daily discharge percentiles associated with exceedance frequencies of 5%, 50% and 95% are represented by red lines.

The flow duration curve is provided in Figure 23. Flood estimates range from 720 m³/s for the 10,000 years return period to 650 m³/s for the 1,000 years return period, 570 m³/s for the 100 years return period, and 480 m³/s for the 10 years return period (Tractebel 2016). According to local informants, the water level in the pool at the foot of Gbedin Falls can rise by as much as 4-5 m from the dry season to the wet season. The outlet of the pool into the downstream river channel forms an important hydraulic control point.

³ Most local people use the name Saint John River even to the Mani tributary.

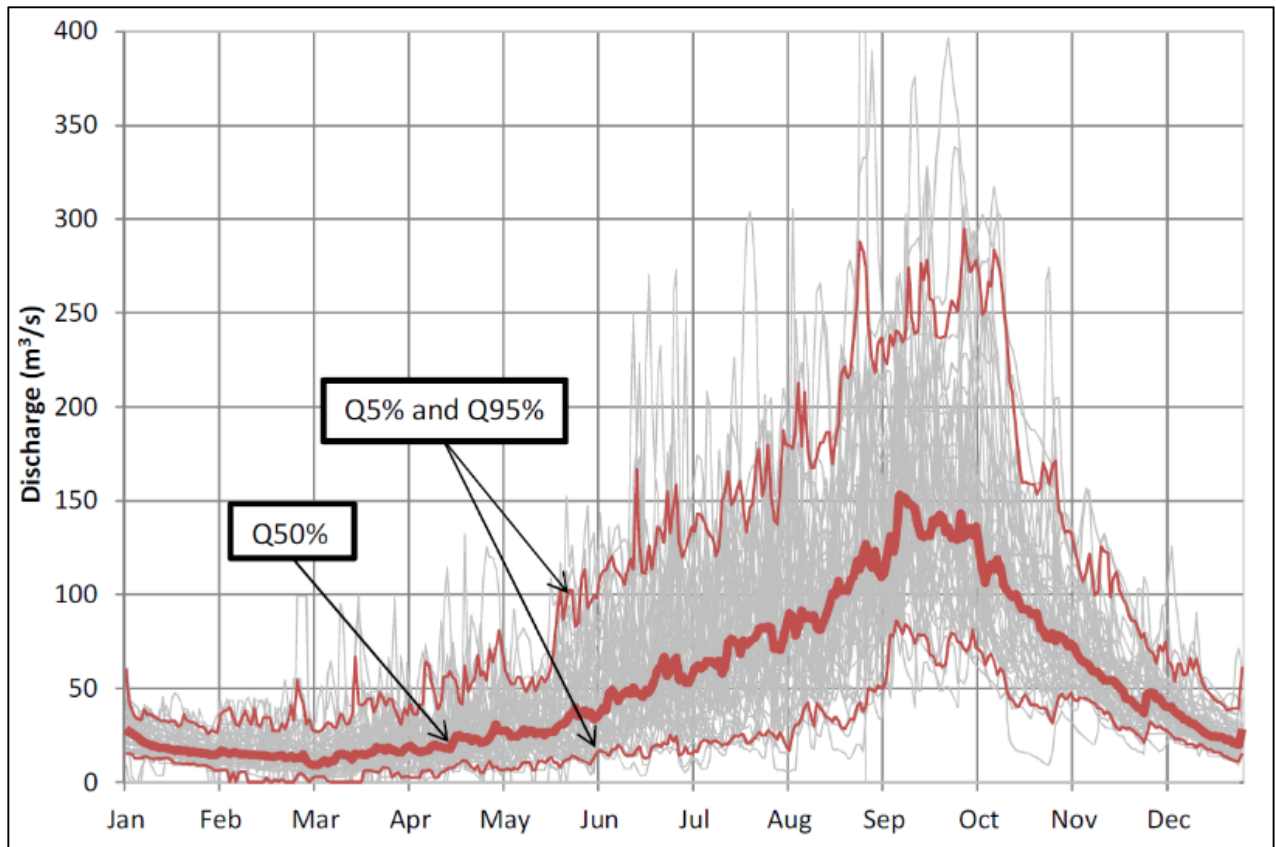


Figure 22: Daily discharge series at Gbedin Falls. Source: Tractebel (2016).

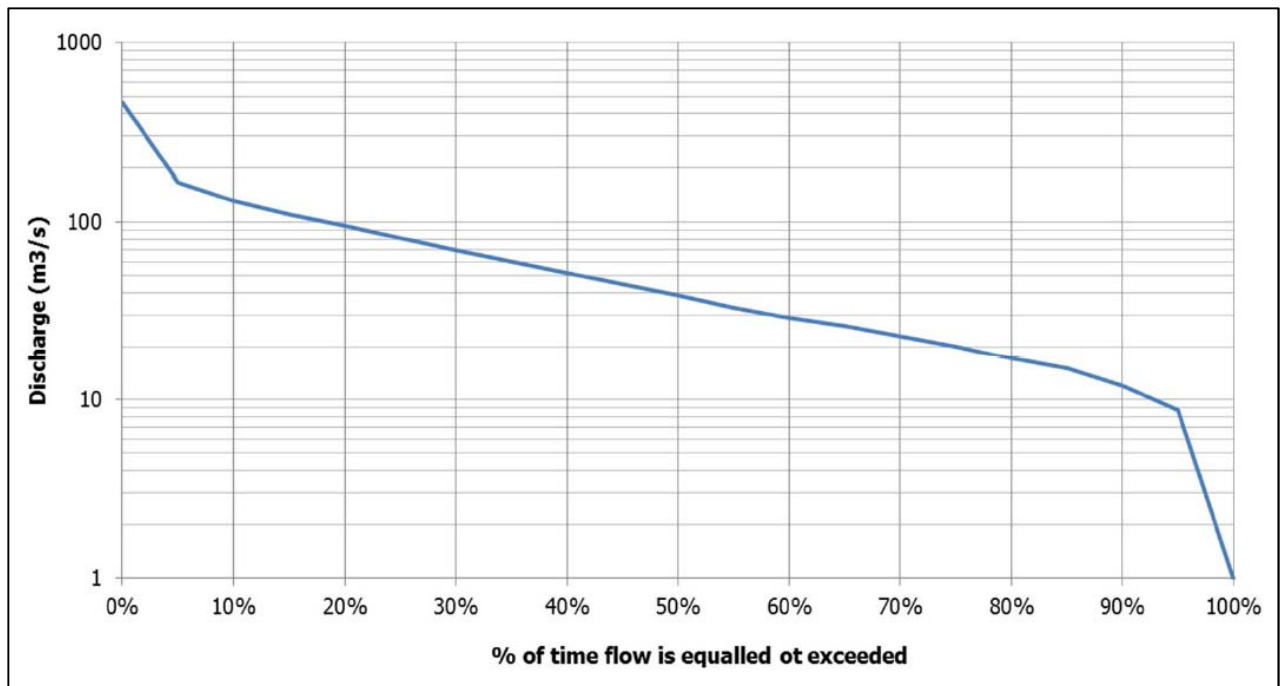


Figure 23: Flow duration curve at Gbedin Falls. Source: Tractebel (2016).

5.1.6 Water Quality

Water samples taken in the dry season at low flow (1st March 2019) showed that the water in Saint John River upstream and downstream of Gbedin Falls ranged from neutral to slightly alkaline with pH values between 6.0 and 7.7 (Table 14). Turbidity was generally low but with slightly elevated values in the pool at the foot of Gbedin Falls (where a lot of sediment is deposited) and in the far downstream reaches at Gampa (where water is probably more affected by sediment runoff from riverbank farming). It can be expected that turbidity and sediment content is much higher during the rainy season.

Conductivity levels were consistently low downstream of Gbedin Falls and well within the range that typically supports healthy freshwater ecosystems. Similarly, dissolved oxygen values were favourable and in line with the Canadian Water Quality Guidelines for the Protection of Aquatic Life (Table 15). The dissolved oxygen content below Gbedin Falls (in the pool) was higher than in the other reaches of the river which is a typical phenomenon near large waterfalls (where rapid aeration can contribute to supersaturation).

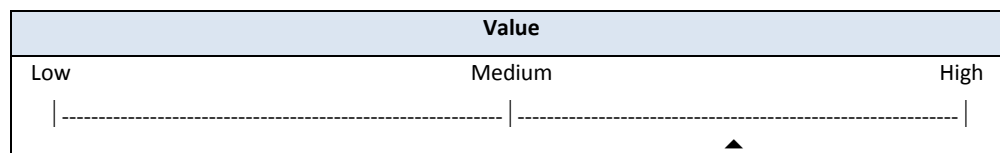
Table 14: Water quality data.

Location	Temperature (°C)	Turbidity (NTU)	pH	Dissolved Oxygen (mg/l)	Conductivity (µs/cm)
Upstream	22.5	2.82	6.0	8.36	
Pool	23.7	8.94	7.7	8.61	55.1
Downstream of pool	21.4	5.32	7.1	8.10	34.9
Gampa crossing point	22.0	10.96	7.5	8.22	53.7
<i>WHO Drinking Water Standard</i>		5	6.5 – 8.5		

Table 15: Canadian water quality guidelines for dissolved oxygen for the protection of aquatic life.

	Early Life Stages	Other life stages
Warm Water	6	5.5
Cold Water	9.5	6.5

In conclusion, the water quality in the Saint John River near Gbedin Falls is generally favourable in ecological terms although it does not meet drinking water quality standards. The value with respect to water quality is considered as medium-high.



5.2 Biological Environment

5.2.1 Protection Status

Gbedin Falls and the project’s area of influence is not located in a protected conservation area. The nearest legally protected area is Diécké (Classified Forest) in Guinea about 7 km northwest of Gbedin Falls (Figure 24). Diécké Forest Reserve is also an Important Bird Area (IBA). Other key biodiversity areas and protected areas within a distance of 30 km include (Figure 24, Figure 25):

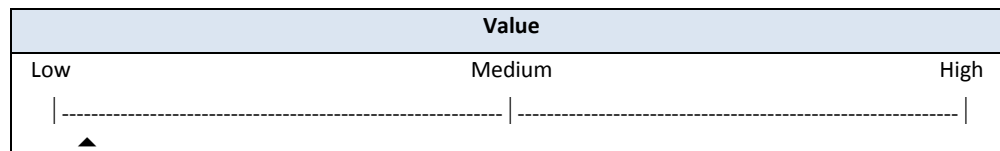
- Nimba West (Proposed) National Park in Liberia
- East Nimba Nature Reserve in Liberia (which also includes Nimba Mountains IBA and covers parts of the Mount Nimba Strict Nature Reserve, a UNESCO World Heritage Site)
- Banie (Classified Forest) in Guinea

In addition, there is a small RAMSAR site located about 8 km south of Gbedin Falls near Gbedin Camp 3 and Gbedin Rice Station. However, this Gbedin RAMSAR wetland (25 ha) is not fed by Saint John River but by other smaller streams than join the main river further downstream. The wetlands are highly modified by irrigation (rice) and other human activities (hunting and fishing).

The key biodiversity areas are considered as ‘critical habitat’ according to the criteria defined under the IFC Performance Standard 6 (Brauneder 2018). Figure 25 illustrates the spatial distribution of areas considered potential or likely critical habitats.⁴

Conclusion

The physical footprint of the Gbedin mini hydropower project does not overlap with protected areas and is not in conflict with any key biodiversity areas that in future may become legally protected. The value of the project’s impact zone in terms of protection status is low.



⁴ This spatial dataset is developed by the UNEP-WCMC (2017) based on 12 biodiversity datasets that align with at least one of the criteria defined by IFC PS6 for Critical Habitat, and is purposed for screening and scoping biodiversity baseline studies in compliance with the IFC PS6 guidelines.

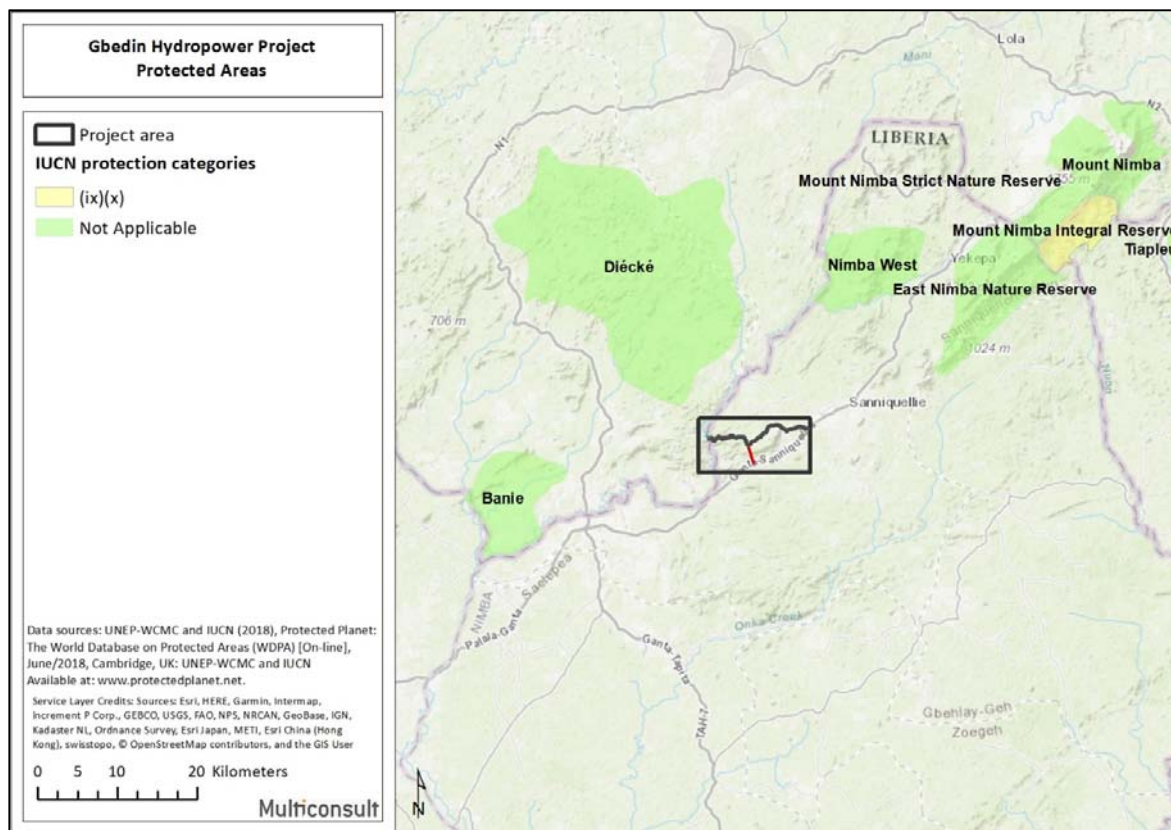


Figure 24: Location of Protected Areas and the proposed Gbedin mini hydropower project.

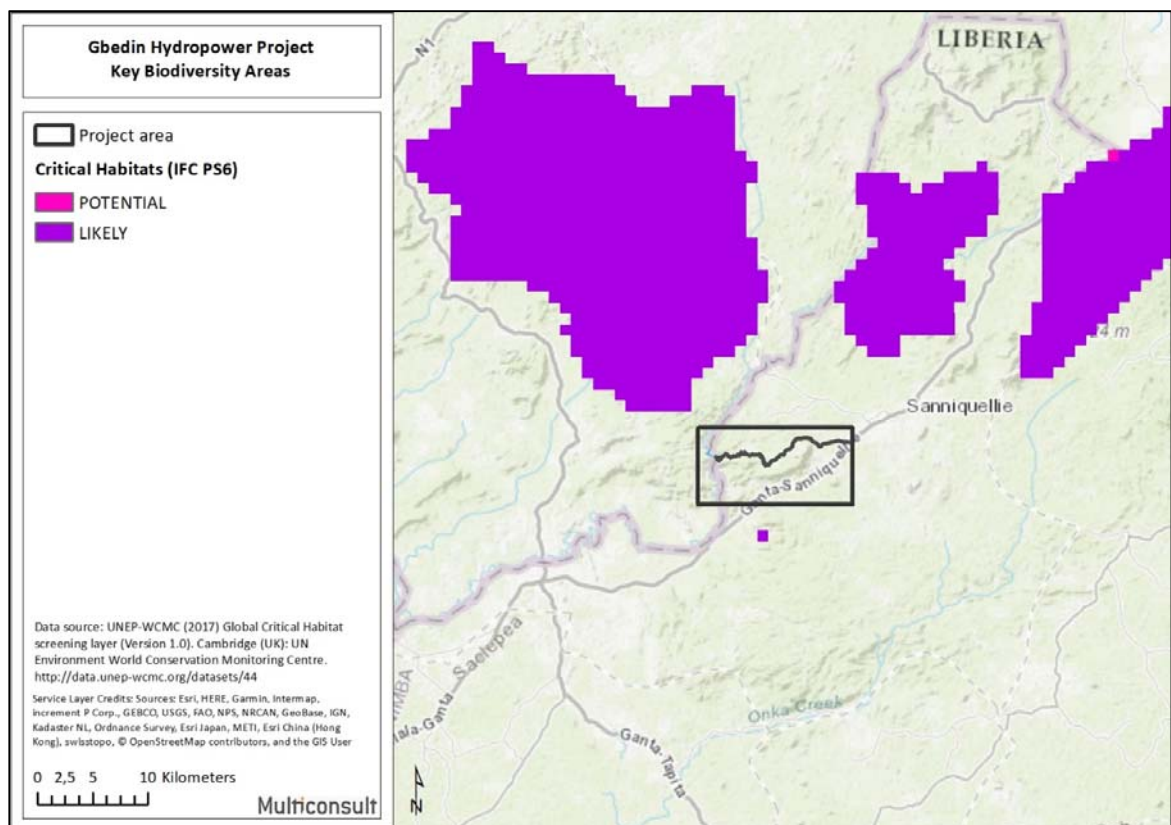


Figure 25: Gbedin project and the nearest key biodiversity areas (potential or likely critical habitats).

5.2.2 Terrestrial and Aquatic Biodiversity

Biogeographic Context

Liberia is located in West Africa with climate characterise by tropical conditions and historic vegetation dominated by closed moist forest. The country occupies a very significant portion of the Upper Guinea forest (UGF) zone, which is considered as a critical ecosystem by Conservation International (2011) and as an Endemic Bird Area (EBA 084) by Birdlife International (2019).

The UGF is the western extent of the Guinea-Congo forest biome, which is one of the most diverse biomes in Africa. The UGF has, however, experienced significant fragmentation over the last couple of centuries with much of the original closed canopy primary forest degraded through slash-and-burn shifting cultivation, timber exploitation and hunting (Gatter 1984). Although historic data show that the forest recovered during periods of disease outbreak, inter-tribal wars and civil conflict, the current state of vegetation has resulted from significant transformation due to urbanisation, traditional agriculture and the establishment of plantations of oil palm and rubber.

There is a strong legislation on wildlife through the establishment of the Forestry Development Authority by an act in 1976, and the subsequent enactment of the Wildlife and National Parks Act in 1988 and additional forestry legislations in the year 2000. In principal, these legislations are well-known and respected by the local communities, but the seemingly low presence of wildlife officers in these communities is one of the key reasons of the violations and encroachment on wildlife and their habitats in these localities. In almost all communities, farmers and hunters were openly handling shot guns which they use for hunting of wildlife.

Vegetation

Vegetation characteristics: Gbedin Falls and its environs is situated within the Guinea-Congo forest biome, which is the main forest ecosystem that runs across most of West Africa. The status of the forest in the vicinity of Gbedin Falls is generally good, and to a large extent may be considered primary with evergreen and semi-deciduous trees. This may be the result of the remoteness of the area from major human settlements and the hilliness of the terrain. This is also true for the forest in the areas that have been identified for the construction of the access road and transmission line. However, there is evidence of logging and old farming activities in a few areas.

The forest can be characterised as closed moist forest. The tree density in these areas is high and many of the trees have diameter at breast height far greater than 10 cm and heights greater than 30 m. There is clear stratification of the forest canopy trees into lower, medium and upper strata, with dominant emergents including species such as *Lophira alata*, *Amphimas pterocarpoides*, *Alstonia congensis*, *Amphimas pterocarpus*, *Dialum guinensis*, *Terminalia ivorensis*, *T. glaucescens* and *Heritiera utilis*. The emergents also includes species that were uncommon such as *Parinari excels*, *Ceiba pentandra* and *Bombax buonopozense*, among others. Also the forests have low density of undergrowth and the trees were observed to form three strata as expected in closed canopy forest ecosystems.

There is a narrow riparian zone along the river upstream and downstream of Gbedin Falls. The riparian zone includes all areas inundated by natural flooding cycles along the water course. It is affected by seasonality, precipitation levels and stream flow, and so its ecology is flood-dependent. Flooding cycles causes natural disturbance regimes in riparian ecology, thereby facilitating species diversity and dispersal of seeds and plant propagules.

Healthy riparian vegetation is found to occur on the southern flank and downstream of the waterfall, especially along the Liberian side of the river where the gallery forest occurs on a relatively gentle slope. Typical riparian plant species that were recorded includes *Annona muricata*, *Cleistopholis patens*, *Hexalobus crispiflorus*, *Gilbertiodendron limba*, *Manilkara obovata*, *Synsepalum afzelii* and *S. brevipes*.



Figure 26: Closed moist forest near Gbedin Falls.

Invasive plants: The invasion of agro-ecosystems by the weedy shrub *Chromolaena odorata* is slowly becoming an issue in areas close to human settlement as a consequence of the frequency of cultivation. *C. odorata* is a very prolific weed that invades fallow plots at early stages of succession. It is also known to cause decline in soil nutrient level and has some allelopathic properties that is injurious to native vegetation. One of the mitigating effect and control methods for this invasive species is to allow plots to fallow for longer periods, and for the areas that are closer to the waterfall, the longer fallow period is serving as a natural deterrent to the spread of the weed. In addition to *C. odorata*, the presence of *Scleria boivinii* (locally called 'bush blade') in areas just south of the waterfall, is an indication of some level of disturbance or degradation to forest environment.

Plant diversity: The Gbedin Falls and its environs has a rich botanic diversity, with a total of 298 species of vascular plants, belonging to 68 families and eight ferns belonging to eight different families (Appendix 10). The largest plant family recorded was Rutaceae with 29 species, followed by Euphobiaceae (24 species), Mimosaceae (22 species) and Gutiferae (16 species). The tree species *Terminalia ivorensis*, *T. glaucescens* and *Ceiba pentandra* were the most widely distributed species, whilst *Ananas comosus* was the most common herbaceous plant.

The distribution and diversity of vascular plant is similar on both the Liberia and Guinea sides of the waterfall, including the undergrowth vegetation. This also applies to the lower plants, including the ferns, and the small spray zone on the Guinea side of the waterfall. However, one species of ferns *Lycopodium cernuum* was only recorded on the Guinea side of the waterfall and in the Gbedin wetlands (outside of the project's area of influence). None of the plants growing in the moist spray zone are of global conservation concern.

Threatened species: Twenty-two (22) of the recorded plant species are listed as threatened by IUCN. Of these, 20 are 'vulnerable' (VU) and two are 'near threatened' (NT). The species are listed in Table 16 and they comprise 19 species of trees, two species of shrubs and one species of liana. Some of these species are endemic to the Upper Guinea forest and they include *Cryptosepalum tetraphyllum*, *Gilbertiodendron limba*, *Ccopaifera salikounda*, *Terminalia ivorensis*, *Amanoa bracteosa*, *Nauclea diderrichii* and *Heritiera utilis*.

Nine species (highlighted with asterisk) in Table 16 are threatened plants that were found to have limited distribution in the project's area of influence, with only a few stands recorded. However, all the threatened species are widely distributed within the sub-region, although restricted to forest reserves and unprotected mature forests, depicting the nature of fragmentation that characterise forest status distribution in West

Africa. The rest of the threatened species (without asterisk) are widely distributed both locally and within the sub-region.

Table 16: Threatened plant species recorded in the project's area of influence.

Botanical name	IUCN Status	Growth Form	Gbedin Falls	T-Line / New Road	Existing Road	T-Line South	Gbedin RAMSAR Wetland
<i>Azelia africana</i>	VU	Tree		x			
<i>Cryptosepalum tetraphyllum*</i>	VU	Shrub	x	x		x	
<i>Gilbertiodendron limba</i>	NT	Tree	x	x		x	
<i>Coccoloba salikounda*</i>	VU	Tree		x			
<i>Terminalia ivorensis</i>	VU	Tree	x	x	x	x	x
<i>Amanoa bracteosa</i>	VU	Tree	x	x		x	
<i>Garcinia afzelii</i>	VU	Tree	x	x			
<i>Garcinia cola</i>	VU	Tree	x	x			
<i>Irvingia gabonensis</i>	NT	Tree	x	x		x	
<i>Trichilia ornithothesa*</i>	VU	Tree	x	x			
<i>Turraenthus africanum</i>	VU	Tree	x	x	x	x	
<i>Entandrophragma candollei*</i>	VU	Tree	x	x		x	
<i>Albizia ferruginea*</i>	VU	Tree		x			
<i>Milicia regia</i>	VU	Tree	x	x			
<i>Lophira alata</i>	VU	Tree	x	x	x	x	
<i>Millettia warneckei</i>	VU	Liana	x	x			
<i>Hallea stipulosa*</i>	VU	Tree	x	x	x		
<i>Nauclea diderrichii</i>	VU	Tree	x	x			x
<i>Zanthoxylum atchoum</i>	VU	Tree	x	x			
<i>Placodiscus oblongifolius*</i>	VU	Shrub	x	x			
<i>Heritiera utilis*</i>	VU	Tree	x	x			
<i>Sterculia oblonga*</i>	VU	Tree	x	x			

Note: The shaded species are restricted to the Upper Guinea Forest

Mammals

A total of 22 species of mammals was recorded and/or known by local inhabitants to occur in the wider area around the proposed Gbedin hydropower plant (Table 17). This list includes eight species of primates, among which are the threatened Western chimpanzee *Pan troglodytes* ssp. *verus* and the near threatened Sooty mangabey *Cercocebus atys*.

The Western chimpanzee is one of the flagships for mammal conservation in Liberia and the Upper Guinea Forest biogeographic sub-region. It is listed as 'critically endangered' (CR) by IUCN and placed in CITES Appendix I. The main threats include habitat loss and fragmentation (from agriculture, logging, mining, etc.) and poaching (including bushmeat and live trade) (Humble et al. 2016).



Figure 27: Undisturbed (primary) moist forest near Gbedin Falls.

Nonetheless, from direct observations and anecdotal information from local respondents, chimpanzees use the area for foraging, but there were no evidences of nesting in the project’s area of influence. One hunter indicated that the animals nest in an area that is about a couple of miles into the interior of the forest. Throughout the range of the project’s area of influence, not a single chimpanzee nest faecal matter and footprints were observed, with the exception of remnants of feeding activity in one location along the joint transmission line and access road section of the project.

In the case of the ‘near threatened’ (NT) Sooty mangabey, which was once a very common and widespread species of monkey in Liberia and the wider sub-region, its population has declined considerably because of over-hunting. There was no trace of this species in the project’s area of influence, but the local informants claimed that it can occasionally be spotted in the less disturbed forest north of the project site. As true for all other species of monkey, this species is target candidate of the bushmeat trade and so its exposure to hunting has contracted its distribution to isolated patches of enclaves all over the country, but more frequently encountered in and around forest reserve areas.

This situation is consistent with the status of most of the primate species listed in Table 17 and so from information given by local inhabitants, almost all primate species are rarely encountered in the area. Nevertheless, with the exception of the two species mentioned, all other primate species are considered as ‘least concern’ (LC) by IUCN, but local populations are generally low in the project’s area of influence. Only one species of primate, Campbell’s monkey *Cercopithecus campbelli* (LC) was heard along the gallery forest around the pool of Gbedin Falls.

Table 17: Mammal species that occur in the project’s area of influence.

Scientific name	English name	IUCN Status	Abundance
PRIMATES			
<i>Pan troglodytes ssp. verus</i>	Western chimpanzee (*e)	CR	Very rare
<i>Cercopithecus sabaues</i>	Callithrix monkey (*)	LC	Rare
<i>Cercopithecus campbelli</i>	Campbell’s monkey (*h)	LC	Rare
<i>Cercocebus atys</i>	Sooty mangabey (*)	NT	Not common
<i>Perodictus potto potto</i>	Western potto (*)	LC	Uncommon
OTHER LARGE MAMMAL			

Scientific name	English name	IUCN Status	Abundance
<i>Syncerus cafer</i>	Forest buffalo (*e)	LC	Rare
<i>Sylvicapra grimmia</i>	Bush duiker (+)	LC	Rare
<i>Cephalophus niger</i>	Black duiker (*)	LC	Rare
<i>Cephalophus maxwelli</i>	Maxwell duiker (*)	LC	Rare
<i>Tregalaphus scriptus</i>	Bush buck (*)	LC	Very rare
<i>Potamochoerus porcus</i>	Red River hog (*)	LC	Very rare
<i>Neotragus pygmaeus</i>	Royal antelope (*)	LC	Very rare
<i>Potamochoerus larvatus</i>	Bush pig (*)	LC	Rare
<i>Civetticus civetta</i>	West African civet (*)	LC	Rare
SMALL MAMMALS			
<i>Euxerus erythropus</i>	Stripped ground squirrel (+)	LC	Common
<i>Funisciurus pyrropus</i>	Fire-footed rope squirrel (+)	LC	Common
<i>Herpestes sanguinea</i>	Slender mongoose (*)	LC	Rare
<i>Phataguinus tricuspis</i>	Tree pangolin (*)	LC	Rare
<i>Thryonomys swinderianus</i>	Marsh cane rats (+)	LC	Common
<i>Crecitomyis emini</i>	Pouched rat (+)	LC	Common
<i>Atherurus Africana</i>	Brush-tailed porcupine (*)	LC	Rare
<i>Mastomys natalensis</i>	Bush rat (+)	LC	Very Common

(*) Not seen, but evidence of presence from interviews; (+) Seen during survey; (*e) Not seen, but with evidence of presence such as footprints or faecal matter; (*h) Not seen, but calls heard.

Nine species of other large mammals were recorded, none of which are listed in IUCN threatened categories, but whose presence are considered to be rare or very rare locally. Species such the duikers and antelopes are particularly hunted or trapped for their meat and subsistence by many hunters and farmers all over the project area. The presence of forest buffalos in the area is not surprising, as the animal is known to have a large foraging range and can traverse a wide expanse of habitat. From observations on the vegetation status, the reduction in forest cover at lower altitude due to extensive sugarcane farming, is contracting the range and density of most of the primate and large mammal species in the project's area of influence, thereby exposing them to hunting and trapping by farming communities.

Eight species of small mammals were recorded through visual evidences and interviews (Table 17), all of which are considered 'least concern' (LC) by the IUCN. One of the most common is the Marsh cane rat *Thryonomys swinderianus* (locally called ground hog) which is usually found associated with farmlands and bush fallows and is trapped by local people mainly for meat. Both ground and tree squirrels are quite common, so are bush rats. The other small mammals listed are less common and are less known by most of the people in the local communities because of their low numbers and low encounter rates.

Birds

A total of 139 species of birds belonging to 34 avian families was recorded in the project's area of influence (Appendix 10). Among these were two species of conservation concern – Yellow-bearded Greenbul *Criniger olivaceus* (VU) and Rufous-winged Illadopsis *Illadopsis rufescens* (NT). These are both forest-dependent species and not closely associated with river habitats or waterfalls.

The Yellow-bearded Greenbul *Criniger olivaceus* is threatened mainly by habitat loss due to large-scale agriculture and logging (BirdLife International 2018a). The same threats are recorded for the Rufous-winged Illadopsis *Illadopsis rufescens* but the population decline is believed to be more moderate (BirdLife International 2018b).

The number of migratory species recorded includes five Intra-African migrants and two Palearctic migrants. The reason for the insignificant number of the latter species category could be a result of the season during which the field survey was conducted, which did not coincide with the migratory season of these birds. The Gbedin wetland (a RAMSAR site) situated across the main road south of Gbedin Falls had a large migratory assemblage of Cattle Egret *Bubulcus ibis* (LC) as well as a good number of roosting West African Pied Hornbill *Lophoceros semifasciatus* (LC) at the periphery of the wetland.

Except for this appreciable number of West African Pied Hornbill that are suspected to fly across the road to/from roosting sites on the Gbedin wetland, there is no strong evidence that crossings by large flocks occur, which would have exposed them to collision with or electrocution by transmission lines. Moreover, no waterbird species of particular interest was recorded at Gbedin Falls; however, two species of waterbirds were encountered in areas within reach of the waterfall, namely White-faced Tree Duck *Dendrocygna viduata* (LC) and White-spotted flufftail *Sarothrura pulchra* (LC), both of which are considered to be resident migrants.

Reptiles

A total of 12 reptile species belonging to six families were recorded while the semi-structured interviews with locals resulted in 19 additional species (Appendix 10). Among the 12 species recorded in the field, none is of IUCN conservation concern.

Though the interview result was resourceful, the present survey team did not confirm the occurrence of the additional species, as there were no signs of these species in the project's area of influence. However, due to the nature of the various habitats present within the surveyed area, there is indeed a potential for the occurrence of these species.

Of the 19 reptile species reported by locals, three are of IUCN conservation concern. These are the Home's Hinge-back Tortoise *Kinixys homeana* (VU), African Dwarf Crocodile *Osteolaemus tetraspis* (VU), and Senegal Flapshell Turtle *Cyclanorbis senegalensis* (VU). The latter two species (*Osteolaemus tetraspis* and *Cyclanorbis senegalensis*) are forest and stream/river environment dependent, while *Kinixys homeana* is a forest tortoise.

Dwarf crocodiles *Osteolaemus tetraspis* occur throughout West Africa though recent publications state that the distribution has changed due to local extirpations. They live from lowlands to mid-altitude in streams, small rivers, swamps, pools and mangrove, but generally avoid main sections of large rivers. Most of their range is within forested regions, but may extend into more open regions where the streams or river are well shaded. Unlike most crocodiles, dwarf crocodiles only rarely bask in the sun. At night, they may move some distance from water onto the land. Female dwarf crocodiles build their nest mounds at the beginning of the wet season (May and June). The nest is usually situated near the water, in a mound of wet, decaying vegetation that incubates the eggs due to the heat generated by the decomposition of the plant material. Small numbers of eggs are laid, usually about 10, though in extreme cases up to 20, and they incubate in 85 to 105 days. The female guards the nest during the incubation period, and after the eggs hatch, she watches over the young for an unknown period of time, as young can be eaten by a great range of predators (birds, fish, mammals and reptiles, including other crocodiles). The dwarf crocodile is considered 'vulnerable' (VU) by the IUCN, and it is listed under CITES Appendix I.

Notably, *Crocodylus niloticus* (now known as *C. suchus*), which was not sighted during the survey, but reported by locals, is larger than the dwarf crocodile. Though common and considered as 'least concern' (LC) by IUCN, it is classified under CITES Appendix I.

The Senegal Flapshell Turtle *Cyclanorbis senegalensis* is a widespread African species perceived to be declining across much of its range, especially in West Africa. Declines are due to a combination of exploitation for local consumption and fetish purposes plus some international pet trade with habitat

impacts and intensive use of water resources for agriculture. It is not thought to be in significant decline in the far eastern part of its range. Based on available literature, *Cyclanorbis senegalensis* appears to utilise nearly any freshwater body in its range, but with a strong emphasis on small, seasonal ponds, puddles and marshes with high productivity and amphibian aggregations. Adults can inhabit predominantly large permanent ponds as well as deeper, relatively calm parts in riverine forests within the savanna zone (but in shaded waters where they can be observed basking); whereas hatchlings and juveniles may be found far from these habitats in temporary savannah waters. Their diet is not well known, but amphibians, particularly tadpoles, and fish, are known to be a significant food source, while larger animals appear morphologically adapted for feeding on freshwater clams and snails (Diagne et al. 2016).

The Home's Hinge-back Tortoise *Kinixys homeana* is currently experiencing a very serious decline in much of its range, due mainly to habitat loss (through agricultural and industrial expansion and deforestation) and intensive harvesting for subsistence and traditional medicine ("ju-ju") by local people in desperately poor economic condition, as well as for the international pet trade (Luiselli et al. 2006).

Amphibians

Twenty (20) amphibians belonging to six families were documented among which are three species that are of IUCN conservation concern (Appendix 10). All three species are 'near threatened' (NT) and include Sierra Leone Reed Frog *Hyperolius chlorosteus*, Allen's River Frog *Phrynobatrachus alleni* and Liberia River Frog *Phrynobatrachus liberiensis*. Two of the three IUCN conservation concern species *P. alleni* and *H. chlorosteus*, were recorded within less than 200 m away from Gbedin Falls, while *P. liberiensis* was recorded around the proposed transmission line area.

None of the near threatened amphibian species recorded is known to be dependent upon large rivers such as the Saint John or fast flowing water for survival. In particular, none of the species are associated with the fast flow and moisture from waterfalls such as the small spray zone at Gbedin Falls. *H. chlorosteus* is arboreal and in normal situation occurs in primary rainforest, mostly by small streams. It breeds exclusively in flowing water, laying its eggs on leaves above water into which the larvae fall and develop (Rodel and Schiøtz 2004a). *P. alleni* and *P. liberiensis* depend on areas of undisturbed forest. *P. alleni* is widely distributed but its habitat is declining, thus making it close to qualifying for 'vulnerable'. It breeds in small temporary puddles and can survive in small forest fragments (Rodel and Schiøtz 2004b). *P. liberiensis* is confined to the Upper Guinea forest zone of West Africa (Sierra Leone, southern Guinea, Liberia, Cote d'Ivoire and southwest Ghana). It is usually associated with swampy areas, breeding in small forest streams (Rodel and Schiøtz 2004c).

Fish and Macro-Invertebrates

A total of 26 species belonging to 12 families were captured in the fish survey, of which 24 species were finfish and two were macro-invertebrates (shellfish species). The dominant fish species were *Enteromius (Barbus) ablabes*, *Micralestes occidentalis*, *Brycinus longipinnis* and *Hemichromis fasciatus* (Table 18). A detailed account of the species, including photos and catch records, is enclosed in Appendix 10.

Enteromius (Barbus) ablabes emerged as the most common fish species for this study with almost 1,500 individuals caught across all sites upstream and downstream of Gbedin Falls. This species inhabit the bottom, mid or surface waters of rivers where they feed on benthic as well as free swimming organisms, and are largely potamodromous (Fermon and Gsegner 2006, Paugy et al. 2003, 2004).

Other fish species of similar habitat preferences include *Labeobarbus sacratus*, *Hemichromis fasciatus*, *Hemichromis bimaculatus*, *Coptodon (Tilapia) guineensis*, *Oreochromis niloticus*, *Mastacembelus liberiensis*, *Epiplatys dageti* and *Rhexipanchax schioetzi*.

Micralestes occidentalis was also recorded in high quantity and belongs to the surface dwelling groups of species (pelagic), unlike the benthopelagic species that move in almost every depth of water column. The

pelagic fishes however sometimes move to the middle depths of water systems but are never associated with the bottom. These can move within streams and rivers and are thus said to be potamodromous (Fermon and Gsegner 2006). Unlike *Nannocharax fasciatus* and *Brycinus longipinnis* that feed on free floating microscopic organisms such as plankton, the species which belong to this category of habitat are cannibalistic and feed on fishes. These include the predatory tiger fish, *Hydrocynus forskalii* and *Micralestes occidentalis*.

Brycinus longipinnis constitutes the third most commonly recorded fish for this survey, and as with *Micralestes occidentalis* and *Enteromius ablabes* was recorded upstream, downstream and in the larger pool of Gbedin Falls.

None of the recorded species is of high conservation interest and they are all listed as 'least concern' (LC) in the IUCN Red List. Table 18 provides the list of fish and macro-invertebrate species and their abundance for this study in the Saint John River and its tributaries.

Table 18: Fish and macro-invertebrates recorded in the Saint John River.

Family	Species	IUCN Status	Up-stream	Gbedin Falls Pool	Down-stream	Total Abundance
FISH		LC				
Cichlidae	<i>Sarotherodon caudomarginatus</i>	LC		X	X	5
	<i>Hemichromis fasciatus</i>	LC		X	X	112
	<i>Hemichromis bimaculatus</i>	LC		X	X	2
	<i>Coptodon guineensis</i>	LC		X	X	5
	<i>Tilapia brevipinnis</i>	LC		X	X	4
	<i>Oreochromis niloticus</i>	LC		X	X	3
Cyprinidae	<i>Labeobarbus sacratus</i>	LC	X		X	7
	<i>Enteromius ablabes</i>	LC	X	X	X	1,455
	<i>Raiamas steindachneri</i>	LC	X	X	X	25
Mormyridae	<i>Marcusenius thomasi</i>	LC			X	1
	<i>Petrocephalus pellegrini</i>	LC			X	45
	<i>Brecimyrus (Pollimyrus) sp.</i>				X	3
Characidae	<i>Brycinus longipinnis</i>	LC	X	X	X	756
	<i>Hydrocynus forskalii</i>	LC			X	1
	<i>Micralestes occidentalis</i>	LC	X	X	X	1,225
Bagridae	<i>Chrysichthys maurus</i>	LC		X	X	18
Eleotridae	<i>Kribia kribensis</i>	LC			X	14
Mastacembelidae	<i>Mastecembelus liberiensis</i>	LC			X	2
Aplocheilidae	<i>Epiplatys dageti</i>	LC			X	2
Distichodontidae	<i>Nannocharax fasciatus</i>	LC			X	8
Claridae	<i>Heterobranchus isopterus</i>	LC	X	X	X	23
	<i>Heterobranchus longifilis</i>	LC	X	X	X	35
Poeciliidae	<i>Rhexipanchax schioetzi</i>	LC			X	2
Hepsetidae	<i>Hepsetus odoe</i>	LC	X	X	X	8
MACRO-INVERTEBRATES						
Crab	<i>Potamon sp.</i>			X	X	4
Shrimp	<i>Macrobrachium sp.</i>			X	X	3

All species recorded have been documented in other rivers of Liberia and in the sub-region (Fermon and Gsegner 2006, Paugy et al. 2003, 2004). Thus, they are not exclusive only to the Saint John River but are regarded as regional endemic.

In addition to the species caught in the fish survey, local fishers were also asked to identify fish species that occur in in the Saint John River and its tributaries using a photographic record of fish by Fermon and Gsegner (2006). In spite of some confusion on distinguishing species of same genus and of similar morphometric characteristics, 19 additional fish species were identified as potentially occurring in this part of the river (Appendix 10). This altogether gives a total of 43 fish species likely to occur in this part of the Saint John River.

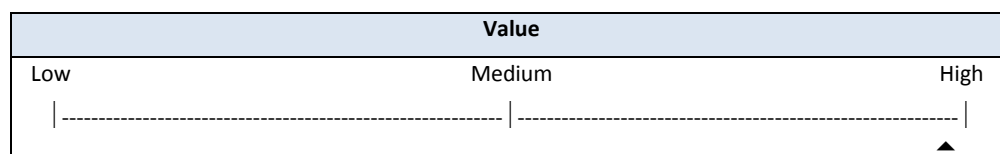
Five (5) of the additional fish species identified by the local fishers are of conservation concern. They are *Sarotherodon occidentalis* (NT), *Labeo curriei* (CR), *Rhexipanchax nimbaensis* (VU), *Enteromius (Barbus) eburneensis* (VU) and *Enteromius (Barbus) carcharhinoides* (CR). Records of these have previously been made by Fermon and Gsegner (2006) from the Saint John River except for the two ‘critically endangered’ (CR) species *Labeo curriei* and *Enteromius (Barbus) carcharhinoides*. It is possible that these two species occur in the river near Gbedin, but a further study is needed to confirm this. *Labeo curriei* is so far only known from Saint Paul River, but may also occur in Mano, Moa and Lofa rivers. *Enteromius (Barbus) carcharhinoides* is only known from the Via River in Saint Paul River system. It is likely that these species have been misidentified by the local fishermen.

As for the species caught in the fish survey, all of the fish species identified by local inhabitants occur in other rivers of Liberia and the sub-region, and are therefore not endemic to Liberia or the Saint John River.

The Gbedin waterfalls of height ~20 m constitutes a natural barrier for upstream migration of fish, despite the suctoral and mouth parts possessed by most fish (e.g. *Labeo* spp. and *Enteromius* spp.). None of the local inhabitants interviewed had knowledge of such display or ability by fishes in the area, and it is very likely that the waterfall acts as a complete barrier to upstream fish migrations. It should be noted that the pool below Gbedin Falls has higher diversity of fish than the upstream reaches because fish tend to aggregate at the foot of the migration barrier and because some fish are washed down along with the fall from upstream.

Conclusion

Gbedin Falls and the project’s area of influence is situated in a remote area of closed moist forest that is relatively little disturbed by farming, logging and other human activities. Although not located in a protected area or key biodiversity area, several globally threatened species of plants and animals have been recorded including 25 species categorised as ‘vulnerable’ and possibly three ‘critically endangered’ species. The project’s area of influence is unlikely to host a significant portion of the global populations, or a key habitat, for any of these species, but the value in terms of biodiversity is nonetheless considered as high.



5.3 Human Environment

5.3.1 Local Government and Administration

Administratively, the Nimba County is headed by the Superintendent, while the districts are headed by district commissioners. Each district is sub-divided into chiefdoms headed by a paramount chief, and each chiefdom is divided into clans headed by clan chiefs and sub-clan chiefs, with urban clans headed by town chiefs. Sanniquellie is defined as a city headed by city mayors. The clan areas were originally related to tribal sub-groupings and whilst this still largely applies, increasing urbanization and civil war has disrupted this pattern and clans are now defined as administrative units.

The proposed Gbedin mini hydropower scheme and all its associated facilities are situated within the territorial boundaries of Sanniquellie Mahn District. Gbedin Falls area belongs to Gbalasonnoh town about 5 km to the northeast while the hills immediately south of the waterfalls belong to Gampa town about 5 km south (downstream) of the waterfalls. Gampa has one settlement on the Liberian side (referred to as Gampa Phor) of the river and another one on the Guinean side (referred to as Gampa – Guinea or Gampa town centre). The planned access road and transmission line extends from Gbedin Falls through Gbalasonnoh, Gehwee and Kitoma (in Sanniquellie Mahn District). It should be noted that the downstream communities, including Gampa town, are located within the neighbouring Bain Garr District (hence, the town boundaries are not consistent with the district boundaries).

Table 19: Administrative divisions.

Project Component	District	Town/Village
Hydropower facility	Sanniquellie Mahn	Gbalasonnoh
Access road	Sanniquellie Mahn	Gbalasonnoh, Gehwee
Transmission line	Sanniquellie Mahn	Gbalasonnoh, Gehwee, Tonwee, Kitoma
Downstream communities	Bain Garr	Gampa Phor, Gampa town centre (Guinea), Gbedin, Gbedin Camp 3



Figure 28: Residential structures in Gehwee town.

5.3.2 Population

Demographic Data

Nimba County has the 2nd highest population among counties of Liberia after Montserrado County and among the counties with the highest population density (LISGIS 2009). The two largest towns are Ganta, a major market town, and Sanniquellie, the administrative centre and county capital. Gbedin Falls is located about half way between these two major towns.

Nimba County has a relatively high population density compared to other rural areas in Liberia due to better transport and communication facilities, fertile soil for agricultural activities, local alluvial mining activities, presence of international mining and agricultural companies, and opportunities for trade with neighbouring West African countries.

The population data for Nimba County and the respective districts are presented in Table 20 and for the towns in the project's area of influence are given in Table 15.

Table 20: Population in Nimba County and the respective districts in 2008.

County/District	Male	Female	Total	Household size	Population growth rate (%)	Population density (per square mile)
Nimba County	230,113	231,913	462,026	5.6	2.5	100
Sanniquellie Mahn District	12,336	13,034	25,370			
Garr Bain District	29,813	31,412	61,225			

Source: LISGIS (2009)

Table 21: Population by town.

District	Town	Male	Female	Total	Number of Households
Sanniquellie	Gehwee	268	289	557	144
Sanniquellie	Kitoma	286	266	552	630
Sanniquellie	Gbalasonnoh	716	872	1,588	
Sanniquellie	Tonwee	26	32	58	
Garr- Bain	Gbedin Camp 3	1,494	1,505	2,999	219
Garr- Bain	Gbedin	225	213	438	
Garr- Bain	Gampa Phor	223	235	458	83
Nzékoré	Gampa - Guinea				~500*

Source: Adapted from LISGIS (2009) and data from town chiefs.

* Including satellite camp

Ethnic Composition

The major ethnic groups in Nimba County are Gio (Dan), Mano (Mah), Krahn (Kruan), Mandingo, and Gbei. Consultations with the town chiefs confirmed that the population in all the directly affected towns belong to the Mano ethnic group, and the two major clans are Gboa and Barr. The Gboa territory includes Gbedin Falls and the towns of Gbalasonnoh and Gehwee (i.e. east of Saint Paul River and north of the mountain range), while the Barr territory is located immediately south of the waterfalls and hills including the towns of Gampa, Gbedin, Tonwee and Kitoma.

The Mano people are one of the two most dominant groups in Nimba County. Historically, it is recorded that the Mano originated from the Mali Empire and travelled to what is present day Liberia through the Republic of Guinea at the turn of the 16th and 17th centuries. In Liberia, the Mano settled close to the Guinea border in the present day Nimba County. The Mano belongs to the Mende speaking group. There is

no indication that the Mano identify themselves as an ethnic minority population or are defined as Indigenous Peoples.

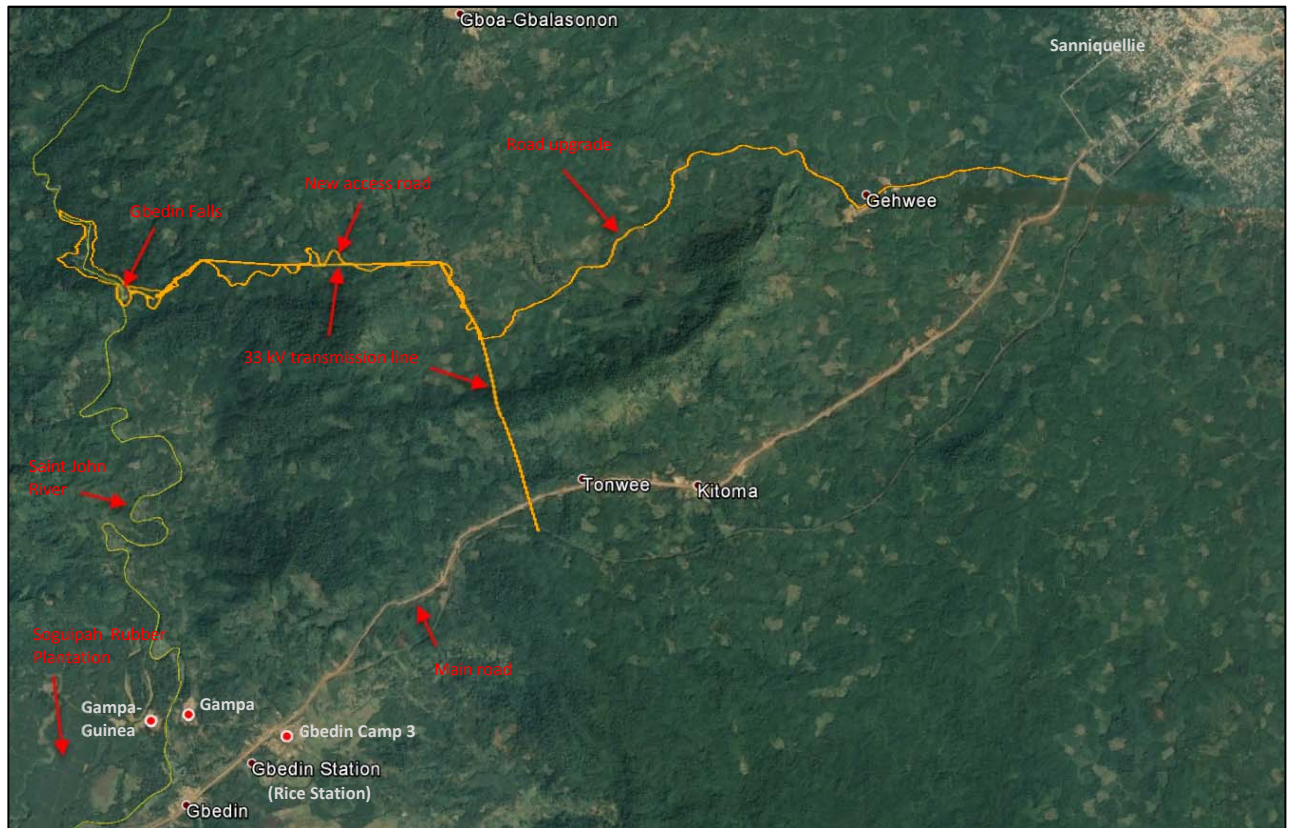


Figure 29: Location of Gbedin mini hydropower project and nearby towns. (Source: Google Earth).

Literacy and Education

A high proportion of people in Nimba has no education and the educational attainment is even lower among women. According to LISGRIS (2013), 44.7% (females) and 33.7% (males) of the population aged 6 years and above has never attended school, while 2.9% (females) and 1.7% (males) completed primary school, 2.2% (females) and 8.2% (males) completed secondary school, and only 0.1% (females) and 1.5% (males) attained higher education beyond secondary school. In terms of literacy, only 39.7% of women in Nimba are literate compared to 63.9% of males.

Consultations with the directly impacted communities revealed the low education attainment among the female youth was attributed to early marriages, long distances to school and the low prioritisation of education for girls. Low school attendance for children below 10 years was attributed to the long distances to schools and the security threats that the children were exposed too on their way to school.

Irrespective of the low education attainment, the communities reported to have the necessary skills and knowledge to take on semi-skilled and unskilled labour should the project proceed to the construction phase. The males said that they could work as drivers (for light duty vehicles), mechanics, electricians, chainsaw operators, masons, carpenters, security guards, community facilitators, health assistants among others. The women reported that they can prepare food for project workers and work traffic controllers, casual labourers and cleaners.

5.3.3 Land Tenure/Ownership and Land Use

Land Tenure and Ownership Issues in Liberia

The four exclusive categories of land ownership in Liberia are (1) Public Land, (2) Government Land, (3) Customary Land, and (4) Private Land. Subsisting with the four categories of land ownership is a unique land category to be called Protected Area, which cuts across and may exist or be created within each of the four land ownership categories.

LISGIS (2009) reports that in Nimba County, 48% of the population have personal plots with deed, 46% of personal or community land is without deeds, 2% is leased, and 5% are squatters on land. Discussions with the District Commissioner for Sanniquellie Mahn confirmed that the land in the Gbedin project area is owned under customary land arrangements without deeds. Customary Land is land acquired and owned by a community in accordance with customary practices and norms based on long period of occupancy and/or use and which include, but is not limited to wetlands, communal forestlands, and fallow lands.

The land rights under the customary land arrangement include:

- The rights to exclude all others;
- The right to possess and use the land along with all non-mineral resources thereon;
- The right to manage and improve the land including planting crops, harvesting forest products, etc., directly or through third parties by way of management contracts or similar agreements/arrangements; and
- The right to transfer some of the land or the use and possession thereof through lease or other lawful means consistent within the provisions of the Land Act and any regulations promulgated hereunder.

In Liberia, Customary Land and Private Land are equally protected. With respect to Customary Land, communities will self-define, be issued a deed, establish a legal entity, and strengthen their governance arrangements to make them fully representative and accountable.

Where a tribal certificate has been issued in respect of a piece of land that still remains a Customary Land, the holder of the tribal certificate may apply and be granted a lease for the acres stated in the certificate for a period of up to fifty (50) years to enable the holder to continue his or her present occupancy or use of the land. This applies if the holder took possession of some portion of the land in or before the year 2010, and began some appreciable improvements on the land with at least some crops planted and/or a house built thereon.

Furthermore, where a tribal certificate was issued in respect of a piece of land that still remains a Customary Land, the holder of the certificate is entitled to purchase of up to twenty-five (25) acres of the land if:

- a) the holder (i) took possession of the land and (ii) paid all taxes on the land; or
- b) the holder (i) took all requisite steps and obtained all approvals for obtaining the requisite Public Land Sale Deed except obtaining signature of the said public land certificate by the President; and (ii) the holder has made substantial developments/improvements having a permanent nature on the land.

A deed obtained under such circumstances is issued in the name of the community owning the Customary Land as the grantor and signed by the duly authorised representatives of the community.

Within the proposed footprint of the project, some communities/households hold tribal certificates and title deeds, but the majority are undocumented customary users. According to the Land Administration Commissioner of Nimba County, the government (Liberia Land Authority) is yet to commence on the process of confirmatory boundary survey for community land and issuing of title deeds to communities. The process of land registration is described as cumbersome, lengthy and unaffordable to most households and communities.

Land Tenure and Ownership Issues in Guinea

Land tenure in Guinea can be classified into statutory and customary and falls along a rural-urban divide. The Land Code recognises state-owned public land, which includes areas that provide public services or are used by the public. Such land cannot be alienated. However, some state land is classified as within the private domain (such as land identified as vacant or unclaimed) and can be alienated.

The Land Code recognises private ownership of land, and the formal law grants owners rights to use and alienate land held in ownership. Land rights must be registered with the national land registry and be included within a local land tenure plan. Once established, land rights registered under formal law are enforceable against competing claims.

The Land Code also provides that ownership rights under customary law may be registered and granted status under formal law provided that the landholder has occupied the holding for a statutory period of time and has made a sufficient level of investment in the land. Registration requires a public process to confirm the occupant's rights and the lack of competing claims to the land. The Land Code stipulates that unregistered land in rural areas (the vast majority of rural land) is owned by the state.

Consultations with the stakeholders in Guinea confirmed that the land within the project footprint (i.e. the right bank of the reservoir area) is unregistered and therefore considered state land.

To secure formal rights, land must be registered with the national land registry. Registration of land upon formal sale in Guinea is accomplished in the following six steps: 1) obtain a map indicating the extent and boundaries of the property; 2) confirm identity of landowner and a clear title at the Land Registry (Bureau de la Conservation Foncière); 3) obtain tax clearance from authorities; 4) sign the sale contract as written and witnessed by the notary; 5) register the sale contract with the National Tax Authorities (Service des Impôts); and 6) transfer the final ownership with the Land Registry (Bureau de la Conservation Foncière). Registration requires 104 days and 14% of the property value.

Customary rights are secured by the person who initially cleared the piece of land (known as the land's founder). Use rights are allocated on the basis of social customs and kinship relations. However, the right to use the land is not considered ownership. As stated above, unregistered rural land (terres vacantes et sans maître) – nearly all of the land that exists in rural areas – legally remains the property of the state.

Gender Issues

In Liberia, gender issues are critical in the customary systems of land tenure, especially in the areas of land ownership and inheritance. While women generally have access to land, their participation in decision making in land management and control over the use of land, as well as their ability to own land, is virtually non-existent, especially in the customary systems where land relations are largely informed by a patriarchal orientation where women are usually excluded in land management and inheritance. Women's rights to land are usually secondary and related to rights obtained through primary rights holders such as brothers, husband, or sons.

Consultations with women in the town nearby Gbedin Falls indicated that it is common for a woman to lose her land use rights if she leaves her husband's household, as in the case of divorce, although the woman's male children usually retain their inheritance rights. In case of a spousal death in a childless marriage, the woman is exposed to a high risk of landlessness and homelessness.

The primary effect of the existing gender inequality in relation to land is that it weakens women's position, entrenches inequality between men and women, affects food production and food security and ultimately the sustainable use of land.

In Guinea, the law guarantees women and men the right to own property and prohibits discrimination on the basis of sex. The Land Code makes no distinction between men and women, and the Family Code permits spouses to enter marriage contracts in which they may mutually agree to specify the mode of property ownership as joint, separate, or shared in proportions.

Although Guinean formal law supports gender equality in land rights, women nonetheless tend to be highly marginalised under customary law and traditional practice. Only 14% of adult women are literate (compared to 46% of men) and early marriage and polygamy are common. In most areas, women rarely assert ownership rights to land, but rather depend on use rights to land owned by male relatives. As in Liberia, it is common for a woman to lose her use rights to land if she leaves her husband's household (e.g. after divorce), although the woman's male children usually retain their inheritance rights. A woman's right to land upon the death of her husband is less clear cut, but in many areas she may retain use rights if she has male children who will inherit the land in the future.

Inheritance rights for widows frequently do not reflect the principles of equal property ownership acquired during marriage. For example, a childless widow's inheritance, if there are child heirs or other widows with children of the deceased, is calculated on the basis of every five years of a marriage based on dignity and devotion. Islamic law provides for inheritance of property by girls and women, at a percentage of the share taken by boys and men. However, in some areas customary law trumps Islamic law to deny women their share.

Land Use

The land cover at Gbedin Falls and the surrounding hills is predominantly rainforest. Land use is mostly restricted to shifting cultivation (slash and burn farming) which involves the cutting and burning of forest plots to create temporary farms for seasonal or annual crops such as upland rice and cassava (intercropped with vegetables, e.g. okra, bitter ball, pepper, eggplant, potato leaf). The fields are usually cultivated for two or three years until the soil nutrients have become depleted and the forest is left to regenerate. The fallow period is typically five to six years or longer because of the abundance of land compared to the relatively low human population in these areas.



Figure 30: Slash and burn cultivation on Kitoma hill.

Perennial tree crops such as rubber, oil palm and cocoa are also grown, mainly in the vicinity of settlements and along the roads (including the access road near Gehwee), yet plantations can also be found scattered within the forest. In addition, wild trees (e.g. oil palms) are harvested by communities even if they have not been planted or belong to individual farmers. Other perennial crops include plantain, pineapple, sugarcane and fruit trees (e.g. mango, avocado, papaya). There is a large commercial rubber plantation at Gampa on the Guinean side of the border (outside the direct impact zone). This farm is operated by Soguipah Agricultural Company.

In the low-lying areas, there is extensive cultivation of sugarcane as well as some maize (corn). This applies particularly to the riverbanks and to the valley along the hills east of Gbedin Falls where the transmission line will be passing. Sugarcane farming is a major source of income for the local community and the sugar is used for the production of cane juice (liquor made from the fermentation of cane sugar), and so the landscape in the low-lying zones and floodplains is covered with sugarcane farms.

At Gbedin Rice Station (near Gbedin town and Gbedin Camp 3), rice irrigation has been practiced for several decades. The area has much swamp land that is suitable for paddy rice cultivation. The water sources for the swamps and rice scheme are some streams that join the Saint John River downstream of Gbedin.

The settlement pattern is clustered into small villages (towns). As mentioned above, the towns in the project's area of influence include Gbalasonnoh, Gampa Phor, Gampa town centre (Guinea), Gbedin, Gbedin Camp 3, Gehwee, Tonwee and Kitoma (see Figure 29). However, as the farms are usually located a long distance from the towns where the farmers have their homesteads, temporary farm shelters (sometimes referred to as 'farm kitchens') are often erected and used as on a seasonal basis. A few such farm shelters are found in the vicinity of Gbedin Falls and the proposed transmission line and access road. In addition, two structures (and one farm kitchen) made of more durable materials are located about 400 m east of the waterfalls within the area that is likely to be affected by the construction of powerhouse, switchyard, transmission line and access road. Like for the farm shelters, these two structures are also used only on a seasonal basis (during planting and harvesting).

In terms of future land use, the whole project footprint is situated within a mineral exploration license held by the privately owned, junior iron ore company Cavalla Resources (Figure 35). The former license holder BHP Billiton performed exploration drilling on Kitoma hill (where the transmission line is planned to cross from Gbedin Falls to the existing power grid). In October 2015, Cavalla Resources acquired all of BHP Billiton's iron ore interests in Liberia including the exclusive rights granted over the Kitoma exploration area.

Consultations with Cavalla Resources have confirmed that Kitoma hill is a promising iron ore resource that is likely to be developed. In that case, it will become a bulk mining operation suggesting that the space for infrastructure may be more widespread than just over the actual mining areas on Kitoma hill. Blasting and location of infrastructure will probably extend north of the mountain range, i.e. in the vicinity of the proposed transmission line and access road. Thus, while the transmission line across Kitoma hill may not interfere with the exploration drilling at this stage, future mining operations are likely to require that the transmission line is relocated. To this end, Cavalla Resources suggested that the electricity from Gbedin hydropower plant rather be evacuated through a power line running along the river (via Gampa) to avoid any future conflicts with mining.



Figure 31: Oil palm plantation.



Figure 32: Cocoa trees.



Figure 33: Sugarcane farm.



Figure 34: A typical farm shelter (farm kitchen) in the project area.

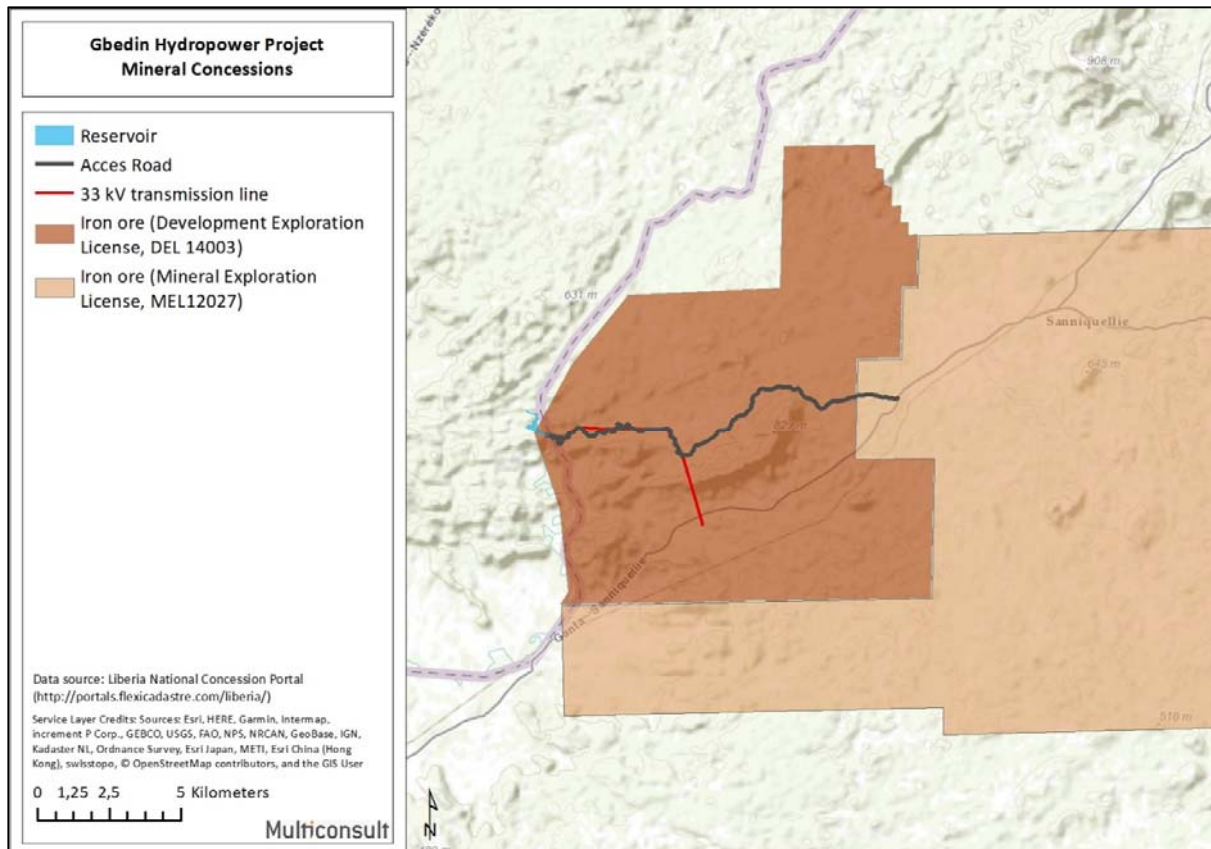


Figure 35: Mineral exploration concessions in the project's area of influence.

5.3.4 River Use

There are no water abstraction schemes for irrigation or water supply upstream or downstream of Gbedin Falls. The river is used mainly for domestic purposes like washing and bathing. Women also collect dietary supplements including vegetables commonly known as water green and a few herbs along the river bank. The use of river water for drinking is limited due to the high sediment load and the leech infestation. None of the project affected households rely on the river as a source of drinking water. The towns are served by a few boreholes and hand pumps, and many people also collect water from the nearby streams/creeks.

There is a crossing point on the river at Gampa about 5 km downstream from Gbedin Falls. This cross-border transport is by use of a simple raft pulled by a rope and operated by one person. Observations confirmed the passenger flow between Liberia and Guinea communities for purposes of trade, accessing of basic social services and access to farmland. It was reported as the most time efficient (<5 min) and cost effective (50 LD) way of border crossing for the communities in comparison to the alternative road transport through Sanniquellie or Ganta. This method of crossing was reported to be safe by the communities. Consultations with the elders revealed that there has been no accidents in their life time despite the crudeness of the raft and the spontaneous increase in river flow (volume and speed during the rainy season). The major limitation was that transportation of bulky items is restricted by the raft's load limits.



Figure 36: Cross-border river crossing at Gampa.

Fishing is practiced mostly on a subsistence basis and mainly in the rainy season (particularly in the months of July-August) at which period catch is much higher. During this period, the fishers fish daily, both morning and evening and spend about six hours on a fishing trip. The catch is most times as large as 100 individual fish of about 35 kg altogether per trip.

The most common fishing craft is the locally made Kru-canoe that is usually designed to accommodate only two crews per boat. According to local fishermen, fishing seasons and inefficient fishing gears are key challenges limiting the quantity of fish catch. The youths in the various communities comprise the main age group actively engaged in fishing.

The locals prefer to fish in the main river downstream of Gbedin Falls during both rainy and dry seasons, probably because of the distance between the settlement and the waterfall. Fishing in the pool at the foot of Gbedin Falls is practiced mainly in the peak wet season when the river flow is sometimes too high in the downstream. The fishermen mainly use hook and line for this fishing but they also set nets near the right bank (Guinea side) where the water current is calmer as opposed to the left bank of the pool (Liberia side).

5.3.5 Livelihoods and Economic Activities

Agriculture

The Gbedin project area falls within the rice with cassava and market gardening livelihood zone (Figure 37). The main crops grown are cassava, rice and vegetables. Commercial rice and cassava production in this livelihood zone is mainly undertaken by the rich households while the poorer mainly grow vegetables for commercial purposes and rice and cassava for home consumption. Although rice is traded, it is never produced in sufficient amounts to satisfy the household's food supply needs throughout the year. Even wealthier farmers tend to begin buying rice on the market around June, well before the harvest starting from November. Poorer farmers are buying already by March, and rely increasingly on cassava in the ensuing months, whilst in October they also consume green rice (matured rice but still moist grain) which they parboil, dry and then pound for threshing. Lowland rice, i.e. paddy rice in swampland, is cultivated in scattered areas, as it requires considerably more investment of labour than the rain fed practices.

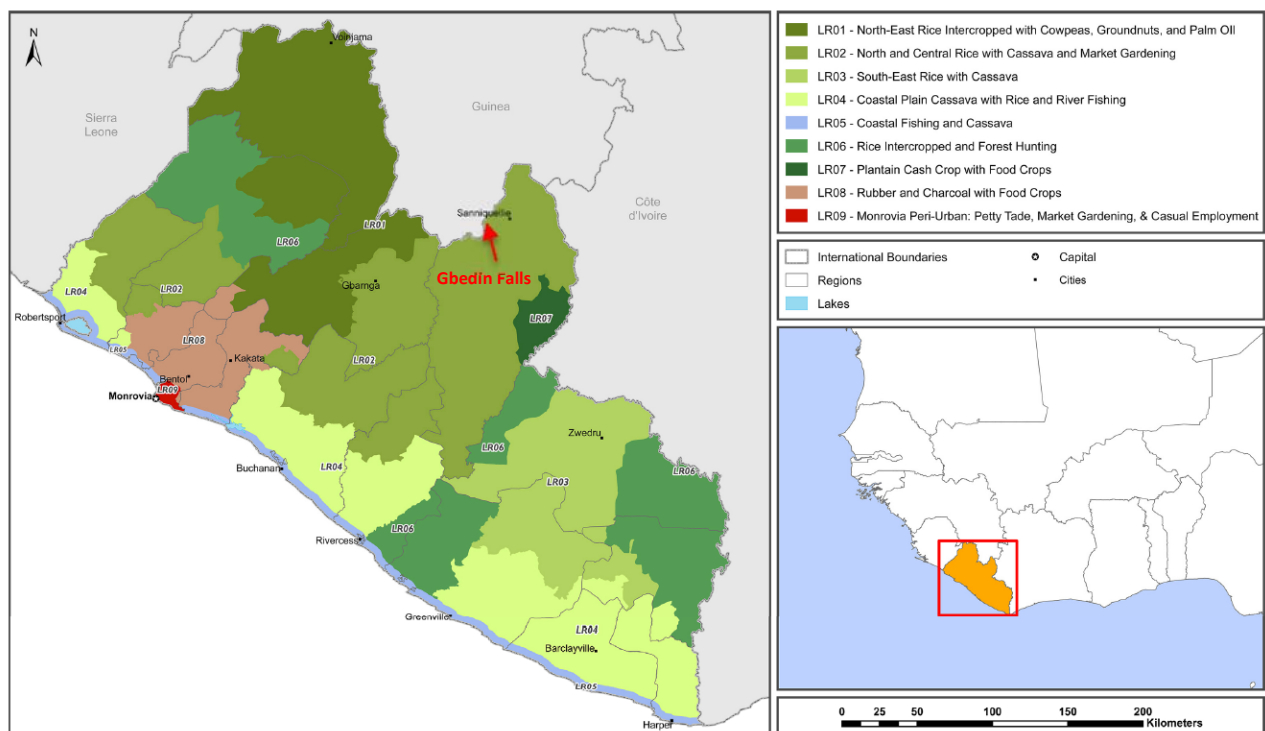


Figure 37: Livelihood zones in Liberia. Source: FEWS NET (2011).

The typical agricultural calendar in this part of Liberia is illustrated Figure 38. According to local farmers, the agricultural calendar is not reliable anymore as rains tend to come late and in unexpected quantities. This results in poor farmer planning, low yields and food crisis later in the year (June to September).

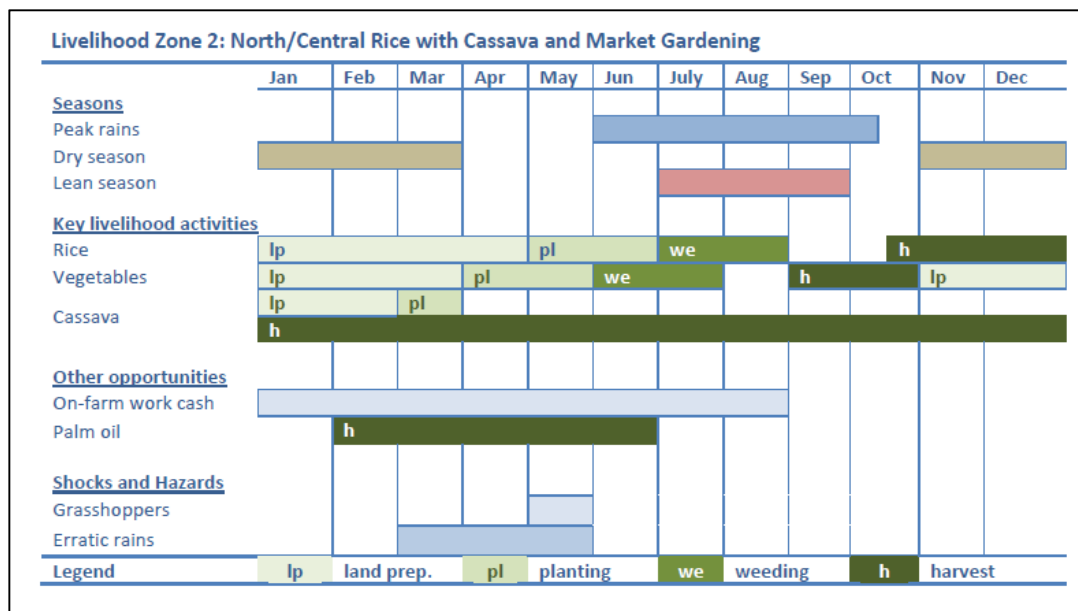


Figure 38: Agricultural calendar in the project area. Source: FEWS NET (2011).

The households in the project’s area of influence are mainly poor households relying on subsistence agriculture characterised by small traditional household farms using primitive production techniques with extremely limited use of modern inputs. Household farms are based on family labour with an estimated average size of 1.5 ha and with little hired hand permanently or even on a causal basis. The interviewed women attributed the low productivity to the lack of basic agricultural tools for land clearing and preparation such as hoes, shovels, pangas and labour. To manage the labour shortfalls, it is common practice for communities to work in groups to support each other during the peak agricultural seasons of bush clearing, sowing and harvesting.

In addition to cassava and rice mentioned above, the main crops grown include sugarcane, plantain, maize (corn) and vegetables (okra, pepper, bitter ball, potato, and potato green). Rice and vegetables serve as both cash and food crop. Several key informants emphasised that rice production greatly suffers from erratic rainfall, especially in the first planting season when the timing of land clearing, preparation and sowing is critical, and this creates shortfalls in rice later on in the year (June to September) forcing households to rely on the market for rice.

Among some of the households, farming is supplemented with fishing, charcoal burning and sale of food products harvested in the forest (palm oil and rubber from wild trees). Charcoal is mostly produced from trees that have been cut for land clearing (slash and burn). Poorer people make an important part of their cash income from paid agricultural labouring or casual off-farm work. For example, the Soguipah Agricultural Company (SAC) is a major source of employment for communities on both the Guinea and Liberia side of the river.

It terms of gender, it should be noted that there are certain discrepancies between male and female households in Nimba when it comes to crops grown and other sources of food (Table 22).

Table 22: Crops grown and other sources of food by gender.

Crop cultivated	Male	Female
Rice farming	75	25
Cassava	75	25
Plantain	78	22
Rubber	81	19
Palm Oil	81	19
Coffee	82	18
Cocoa	81	19
Coconut	80	20
Sugar cane	80	20
Livestock	78	22
Poultry	77	23
Fishery	80	20

Fisheries

As mentioned in Section 5.3.5, fishing is practiced mostly on a subsistence basis and mainly in the rainy season (particularly in the months of July and August) at which period the catch is much higher. During this period, the fishers fish daily, both morning and evening and spend about six hours on a fishing trip. The catch is most times as large as 100 individual fish of about 35 kg altogether per trip.

The most common fishing craft is the locally made Kru-canoe that is usually designed to accommodate only two crews per boat. According to local fishermen, fishing seasons and inefficient fishing gears are key challenges limiting the quantity of fish catch. The youths in the various communities comprise the main age group actively engaged in fishing.

Consultations with the communities revealed that both men and women are engaged in fishing activities, but the women tend to fish in creeks and wetlands close to the settlements while men fish in the main river. For this reason, women usually fish small fish while men fish the bigger species.

Hunting and Gathering

The households in the project's area of influence supplement their food needs with hunting and gathering of forest products. Women were reported to be the most active in terms of gathering, while men were mostly involved in hunting. Species such as the duikers, forest buffalos, monkeys, ground hog, ground and tree squirrels, bush rats and antelopes are particularly hunted or trapped for their meat and subsistence by many hunters and farmers all over the project area. Typical forest products harvested (mostly by women) include wild palm oil and rubber, different types of spices, and 'monkey apple'.

Household Incomes

Household incomes have been computed using an indirect method based on market prices, productivity and percentage of produce sold of the key cash crops. Within the project's area of influence, the main source of income is through the sale of agricultural produce for the majority of the households and casual labour for the few households employed in the SAC agricultural company on the Guinean side of the Saint John River. Major cash crops and produce reported include rubber, palm oil, palm wine, cocoa, sugarcane juice and plantain. Livestock rearing is common in a few towns but this was not mentioned as a major source of income.

Table 23: Household annual incomes.

Crop	Yield (kg/ha/year)	Price (kg/litre)	Estimated Income (USD)
Rubber	127	2.22	282
Cocoa	100	1.4	140
Palm oil (litres)	20	1.1	22
Coffee	50	1.2	60
Sugarcane juice	48	1.1	53
Plantain	15	1.2	18
Total annual income			575
Computed monthly income			48

Source: Key informant interviews

Household Assets

Asset ownership is a good indicator of the household welfare. Based on the socio-economic profiles of the project affected households, the assets owned are very few and simple. Most households reported having only furniture, a radio and mobile phone while very few own farm tools and nobody had a refrigerator or television (because of no electricity supply). None of the project affected households have access to their own means of transportation (bicycle, motorcycle or vehicle).

Expenditure

According to MoA (2007), 65.5% of total spending among Liberian households is on food (including the equivalent market value of home production) and 34.5% on non-food items (including estimated rent for those that own their homes and the estimated use value of household assets). The share of food spending is higher in rural areas (73.2%) compared to urban areas (60.2%). This is consistent with rural areas being generally poorer than urban areas, therefore devoting a larger share of the budget to food spending, and to the larger number of necessary non-food expenditure in urban areas, including rent and transportation.

The pattern of spending among the households in the project's area of influence is similar to that of Nimba County in general where 71.4% of the household income has been estimated to be used for food purchase and only 28.6% is used for non-food items such as education, health, energy and clothing (MoA 2007). Focus group discussions with women in the communities confirmed this share of spending on food and non-food items is roughly consistent with their own experience. The expenses on food purchase mostly occur during the dry season.

Food Security

In Liberia as a whole, 41% or about 1.2 million people have an unacceptable food consumption, i.e. they consume limited or insufficient nutritious foods to maintain an active and healthy life (MoA 2010). Of those, 13% have an extremely one-sided consumption pattern, mainly consisting of rice, roots and tubers only.

Food insecurity is more prevalent in rural areas with rural residents at least three times more likely to be food insecure. That is, 57% of rural households have unacceptable food consumption compared with 18% of urban households (MoA 2010).

In Nimba County, 32.4% of the households are classified as food insecure (LISGIS 2013). Stunting, wasting, and being underweight are common scenarios among children while a significant proportion of adults are below the normal body mass index (see Section 5.3.8). The major cause of the observed malnourishment include insufficient food intake and nutrition over long periods of time.

The project affected households reported eating only two meals per day (no lunch or mid-day meal). The staple food consists of cassava, rice and plantain combined with vegetables (e.g. eddo). So-called ‘soft’ rice is eaten as a last resort.

Networks and Support Systems

Networks and social support systems are necessary especially in communities where the public welfare systems are constrained or non-existent.

People in the project’s area of influence rely on the self-help groups, family and friends during times of need. Consultations revealed that different segments of the population are organised into self-help groups. For example, women, men and youth in all the towns are organised into groups of 15 to 25 members depending on the town population.

The group system was an initiative of the Danish Refugee Council and the intention was to empower communities’ access and manage resources collectively. Discussions with the women groups in Gampa, Tonwee and Gehwee revealed that the group members work together in several ways such as sale of labour, setting up food banks, farming and sale of farm products to generate an income for the group. The proceeds from the group effort are used to set up saving and credit schemes, to which the group members will be entitled to credit at a low interest rate, or receive financial support during the times of need.

The group income is used to address community needs like repair of a water wells among others. Other benefits to the group members are mainly in form of counselling, advisory services, collective marketing and acquisition of farm inputs.

According to the locals, social support networks for the sick, the disabled, the elderly, widows and infant orphans are limited to family and friends.

In addition to the social networks, a few non-governmental organisations (NGOs) are supporting communities to access basic social services and improve their livelihoods. Table 24 shows the active NGOs and their thematic and geographical focus areas.

Table 24: List of NGOs supporting communities in the project area.

NGO	Thematic Area
Partners for Community Health Services (PCHS)	Health, livelihoods
Living Waters	Water supply, livelihoods
Rural Integrated Centre for Community Empowerment (RICCE)	Livelihoods, agriculture, health

5.3.6 Infrastructure and Services

Transport and Communication

The main access to the Gbedin Falls currently consists of:

- Paved road from Monrovia to Ganta
- Unpaved road from Ganta to Sanniquellie via Gbedin town (good quality)
- Unpaved road ~7 km length from Gbedin town to a car stop point (from good to poor quality)
- Foot track of ~1.5 km length to Gbedin Falls

The proposed access road to the mini hydropower station will follow the existing road which branches off from Mr Kona town (near Sanniquellie) through Gehwee town. The road section from the junction on the main road to Gehwee town is unpaved but in good condition for low traffic volumes. Beyond Gehwee, the unpaved road continues for about 2 km before it becomes a track/footpath and eventually disappears. A

new road alignment (7.8 km length) will therefore be needed to reach Gbedin Falls following the north side of the small mountain range (Kitoma hill).

It should be noted that the main road between Ganta and Sanniquellie is currently being upgraded from gravel to asphalt road.

With respect to mobile communication networks, MTN and Orange are available in the project area although with varying network connectivity. The network was particularly poor on the Guinean side. Internet is also accessible through the mobile phone service providers. According to LISGIS (2013), only 1.1% of the rural population in Nimba own a mobile phone, while the majority of the households in the project's area of influence reported owning a mobile phone (probably because of the short distance to Ganta, Sanniquellie and the main road).

Market Access

The communities in the project's area of influence are well connected to the markets in the nearby towns of Ganta and Sanniquellie. Trade in this zone also benefits from the paved road between Ganta and Gbarnga and further to Monrovia, and this opportunity particularly favours the perishable vegetables such as bitter ball and fresh chilies but also potatoes and okra which are the first source of income for wealthier and poorer farmers alike. Apart from vegetables, the wealthier farmers sell rice, notably at the Gbarnga market, whilst poorer farmers sell cassava and sugarcane juice.

Key hindrances to market access include the poor road network to the smaller towns, lack of access to bulk buyers and to updated market information (including information communication services), poor post-harvest handling methods, lack of storage facilities, and low value addition.

Table 25: Markets used by communities in the project's area of influence.

Market	Town	Distance to market
Sanniquellie weekly market	Gehwee	10 km
	Kitoma	20 km
	Gbalasonnoh	20 km
	Tonwee	20 km
	Gbedin Camp 3	25 km
	Gampa Phor	25 km
Ganta market	Gbedin Camp 3	20 km
	Gbedin	20 km
	Gampa Phor	25 km
	Gampa Guinea	25 km
Nampa market	Gampa Guinea	7 km
Gbarnga markets	All towns	>70 km
Monrovia markets	All towns	>250 km

Health Facilities and Services

The communities within the project's area of influence (both Guinea and Liberia) rely on two main hospitals. That is, the County Referral Hospital (George Way Harley Hospital) in Sanniquellie and the E and J Hospital in Ganta run by the Methodist Church. Both hospitals are about 15 km away from Gbedin town.

Transport services are limited and ambulance services are also challenging to secure. Consultations with the women of Gampa indicated that ambulance services from E and J Hospital in Ganta are available on call in case of child birth or pregnancy-related complications and emergencies. For communities closer to Sanniquellie, ambulance services were not available at all. One of the traditional birth attendants in Kitoma

said that women with pregnancy complications had to walk the long journey to the hospital since there is no public transport between Kitoma and Sanniquellie.

According to LISGRIS (2013), the factors contributing to adult and maternal mortality in Liberia include acute shortage of skilled health workers, inadequate emergency obstetric care facilities, inefficient and limited referral systems, poor nutritional status among pregnant women, high fertility rate, and overwhelming numbers of teenage pregnancies coupled with poor access to family planning services.

Community based health structures in the form of Community Health Assistants (CHA) are available in all the towns. The CHA provide preventive health services targeting environmental health areas like hygiene and sanitation, nutrition, immunisation, child care and advisory services and monitoring for the sick. The CHA services are supported by the NGO Partners for Community Health Services (PCHS).

Outreach services run by Ganta and Sanniquellie Hospitals are also available to the communities, although the scope is limited to vaccination, antenatal, HIV and child care.

Water and Sanitation Facilities

Consultations with the communities indicated that each community has access to safe water supply within 2 km from their homes. The most common water supply facilities are hand pumps and protected wells. However, at the time of this ESIA study most of the hand pumps were reported to have broken down while the few functional ones dry up during the dry season. Communities cope by resorting to other surface water sources like wells, streams and creeks. Saint John River was not reported as a source of drinking water for the communities. The poor water supply situation increases the community's risk of being exposed to water borne and water related diseases.

Table 26: Water supply facilities.

Town	Number and type of water supply facility
Gehwee	4 broken down hand pumps
Kitoma	1 hand pump for the school
Gbalasonoh	Hand pump, surface water sources
Tonwee	Surface water source, hand pump at the school
Gbedin / Gbedin Camp 3	3 hand pumps, 9 protected wells, 1 broken down hand pump
Gampa Phor	1 hand pump
Gampa Guinea	2 hand pumps (only one functional)

Source: Consultations with communities

Regarding sanitation, the Community Health Assistants reported that 90% of the population do not have toilets at household level except for the residents of Gampa Camp 3. The low latrine coverage explains the high prevalence of sanitation related diseases such as diarrhoea and human myiasis in the project area (see Section 5.2.8).

The reason given for the low latrine coverage was high costs of construction which made them unaffordable for most households. It is also suspected that cultural beliefs might contribute to the low prioritisation attributed to improved sanitation facilities at household level.

Sanitation related interventions at household level are restricted to awareness creation and community mobilisation by the County Health Team (CHT). At institutional level, the CHT has ongoing projects focussing on the construction sanitation facilities at public institutions like schools and health centres. NGOs such as Partners for Community Health Services (PCHS) are also mobilising communities towards improved water, sanitation and hygiene services but their achievements are restricted by limited resources.

Table 27: Sanitation facilities.

Town	Number and Type of Sanitation facility	Status in relation to the SDG goals
Gehwee	14 communal pit latrines (only 6 useable)	Sanitation status is way below the international standard of 1 toilet per 20 people
Kitoma	Bush (90%), 10% pit latrines	Sanitation status is way below the international standard of 1 toilet per 20 people
Gbalasonnoh	75% latrines, 25% bush	Sanitation status is way below the international standard of 1 toilet per 20 people
Tonwee	Bush (90%), 10% pit latrines	Sanitation status is way below the international standard of 1 toilet per 20 people
Gbedin / Gbedin Camp 3	15 pit latrines, 24 latrines under construction	This is the only community that meets the international standard of 1 toilet per 20 people
Gampa Phor	Bush (100%)	Sanitation status is way below the international standard of 1 toilet per 20 people
Gampa Guinea	Bush (90%), 1 school pit latrines	Sanitation status is way below the international standard of 1 toilet per 20 people

Source: Consultations with communities and Community Health Assistants

Education Facilities

According to LISGIS (2009), Nimba County has 334 schools of which four are technical vocational training institutes. There is no college or higher institute of learning in Nimba. The total number of schools in Sannequielle Mahn and Garr Bain is 36 and 34, respectively.

The number of educational facilities in the respective towns is shown in Table 28.

Table 28: Educational facilities per town.

Town	Number and type of school	Access/Distance
Gehwee	1 primary school	1 km
Gbalasonnoh	1 primary school	1 km
Kitoma	1 primary school	1 km
Tonwee	Shared school with Kitoma	1 km
Gbedin Camp 3	2 primary schools	1 km
Gbedin	1 primary school	1 km
Gampa	None	1 km
Gampa Guinea	1 primary school	1 km

Source: Data from Nimba County Education Office

Energy Access

None of the towns neighbouring Gbedin Falls are connected to the grid. In the absence of electricity access, people are completely dependent on kerosene lamps, small generators, dry cell or rechargeable batteries for lighting. Within the project's area of influence, communities use firewood for cooking and kerosene and flashlights for lighting.

According to UNIDO (2011), kerosene consumption is around 4-5 litres per household per month. Households and business centres using small generators (e.g. tiger generator) in the bigger towns and in Ganta and Sanniquellie consume about 1-2 litres of diesel per hour of use depending on the generator capacity. Average hours of use by the households was found at about 4-5 hours daily, indicating use of 4-6 litres diesel every day, costing USD 4-5. UNIDO (2011) also found that people in Ganta are paying about USD1/amp for of power connection for 10 hours of supply from local diesel generator operators (i.e. approx. 45 US cents/kWh). They are also paying (approx. 25 US cents) for charging the cell phones in shops running on diesel electricity.

There are few existing enterprises like hotels, fish cold storage, carpentry shops, gasoline pump stations, and cellular service providers in Ganta and Sanniquellie. All these enterprises are currently depended on diesel generators with capacity such as ~ 1.2 kVA, 3.5 kVA, 15 kVA, 30 kVA, 45 kVA, 55 kVA. The Gbedin Rice Station uses wood for parboiling of the paddy and diesel generators for running the small rice mills. These commercial enterprises could be potential beneficiaries of electricity apart from the thousands of households in the districts. ArcelorMittal and BHP Billiton (now Cavalla Resources) are also involved in iron ore mining in Nimba County and are currently dependent on large diesel generators.

Housing Structures

According to LISGIS (2013), 47% of the Liberian households have earthen floors and 40% use one room for sleeping, with separate shelters for cooking and sanitation facilities. The situation in the project's area of influence is similar to that of the country as a whole. Most households have structures made of temporary materials with limited protection against bad weather and hazards like fire and flooding. The walls and floors are usually of earth material, the roofs are either of corrugated iron or grass, and the size of the rooms was not more than 15 m². Most of the of the households do not have more than one dedicated sleeping room and a living room that doubles as a storage as well sleeping room in the night depending on the size of the household and the age of the dependants.

5.3.7 Health, Safety and Security

Public Health

According to the County Health Team (CHT), the health status of the communities in the project's area of influence is mainly affected by environmental factors like food security, hygiene and sanitation, and vector related diseases. The CHT closely monitors the four priority diseases of malaria, diarrhoea, acute respiratory infections (ARIs) and sexually transmitted infections (STI). These diseases have proved to be the most prevalent in this part of Nimba.

Malaria, diarrhoea, dysentery and cholera outbreaks are common. This is not surprising given the general lack of access to safe water supply and the practice of open defecation.

According to the CHT, ARIs tend to have a seasonal prevalence, with different strains (viral and bacterial) for the dry season and wet season. The most vulnerable groups to ARIs included the elderly, children and pregnant women.

In Nimba County, 39.4% of the females and 16.4% of the men are reported to be victims of sexually transmitted diseases. Statistics at town level are not readily available, so the situation in the project's area of influence could not be verified. HIV prevalence in Nimba County has been estimated at 0.7%. There is no consistent pattern by age and gender but peak prevalence is among women aged 25-29 and men aged 40-44. HIV was also reported to be common among polygamous families and the urban poor who engage in risky behaviour for survival.

The CHT cautioned that there are many other health threats within the communities that might not be captured by the official data (Health Management Information Systems). This applies especially to malnourishment which affects both adults and children and is becoming a major health threat as a result of the long dry spells experienced in the region. According to LISGIS (2013), observed malnourishment within the population is as a result of insufficient food intake and nutrition over long periods of time. Stunting, wasting, and being underweight are common scenarios among children while a significant proportion of adults are below the normal body mass index (BMI) as shown in the table below.

Table 29: Nutrition status among children and adults in Nimba County.

Nutrition Parameter	Percentage of Children Under 5 Years	
Severely stunted	18.9	
Chronically stunted	36.4	
Severely wasted	0.5	
Wasted	3.9	
Severely underweight	6.9	
Underweight	20.7	
Adult BMI Status	Female (%)	Male (%)
Normal	75.6	80.3
Undernutrition (thin)	14.2	29.4
Over nutrition (overweight)	17.4	6.4

Source: LISGIS (2013)

Other health conditions reported by the communities include myiasis which is transmitted by the “mango fly” (scientifically known as *Cordylobia anthropophaga*). Mango fly related infections were in both livestock and humans. It lays its eggs on the ground often contaminated with faeces. The larvae, known generally as “cayor worms”, crawl over the contaminated soil until they come in contact with a mammal, penetrate the skin and lie in the subcutaneous tissue, causing the formation of tumours. On reaching full growth, the larvae leave the host, fall to the ground, bury themselves and then pupate. This fly is said to be the most common cause of human or animal myiasis in tropical Africa.

Local informants also revealed that Saint John River is infested with leeches, and women and children are susceptible to leech attacks while undertaking their daily chores of washing, riverbank farming and bathing. Leech bites are generally not alarming, although infestations on some body parts can lead to fatal conditions like persistent bleeding, severe anaemia, dizziness and loss of breath.

The women reported that the communities also struggle with animal attacks. This is confirmed by WHO (2017) which reports human exposure to animal bites as a main health threat exposing communities to the risk of contracting rabies. The main vectors are sick dogs, bats and monkeys which are common in the Gbedin area.

Furthermore, according to WHO (2017), schistosomiasis is endemic in all 15 counties of Liberia. However consultations with the County Health Team and the communities did not report schistosomiasis as health threat in the project’s area of influence.

WHO (2017) also reports other diseases with potential of resulting in emergency outbreaks in Nimba County including the Lassa fever which is transmitted by consuming food and water contaminated by rats excreta and spread through contact with people who are sick with the disease or their body fluids. A recent outbreak of Lassa fever was reported early 2019. In addition, cholera and acute diarrhoea are attributed to consuming water from contaminated sources due to the widespread practice of open defecation. Among infants, measles and tetanus nutrition are monitored among the major causes of neonatal deaths.

Community and Occupational Safety

The major safety threats are related to traffic (road and train). Consultations with the traffic inspector at Sanniquellie Police Station indicated that the road safety challenges are attributed to incompetent drivers, cars in poor mechanical conditions, overloading of public transport, and the poor state of the Ganta-Sanniquellie road. He further indicated that train accidents are also common and these are usually fatal. The most common railway accidents include train-animal collision and train derailling of its tracks.

At Gbedin Falls, the county authorities reported that drowning accidents have occurred. Two people were reported to have drowned at Gbedin Falls in 2017/2018. Both cases involved visitors from Ganta who tried to swim in the turbulent waters.

With respect to occupational safety, it is known that safety standards on civil engineering projects in Liberia tend to be below best international standards, resulting in avoidable accidents and injuries to workers. Observations from the ongoing road construction on the Ganta-Sanniquellie road revealed very poor occupational health and safety standards exposing both workers and neighbouring communities to hazards in form of traffic accidents, compromised air and water quality. No sanitation facility was seen at any of the construction sites along the road, implying open defecation by workers exposing communities to sanitation related diseases and potential cholera outbreaks in the rainy season. Furthermore, the road workers confirm that the local labourers do not yet comprehend the notion of workplace safety and do not necessarily undertake risk assessments in their day to day activities.

Security

Ethnic conflicts: Nimba County is one of the political subdivisions that was most affected by the war. Nimba was the prime theatre for combat operations during the 14 year civil war and as a consequence has the highest number of ex-combatants especially from the National Patriotic Front of Liberia (NPFL) and the Independent National Patriotic Front of Liberia (INPFL). Nimba has been plagued by perennial problems of inter-ethnic tensions and conflicts, land and property disputes, and inter-generational discord among others.

Ethnic tensions increased during the post-war period as factions and allegiances began to emerge on the basis of ethnicity, and communities have been left with scars and memories that are still fresh. Even though many of these issues reflect post-war challenges, the relationship between these communities began to deteriorate long before the war.

Land conflicts: According to UNOPS (2008), conflict can be found across all districts of Nimba County, and is present in both urban and rural communities. The causes of conflict are varied; most are about land, but there are other important sources such as inter-ethnic disputes, poor governance practices, and apprehension over the relationship between modernisation and traditional practices.

UNOPS (2008) reports that two categories of land disputes are rampant in Nimba County. The first category relates to property disputes over privately-owned 'urban' plots of land. Land disputes in urban areas stem from the pre-war period and were worsened by the civil war resulting in inter-ethnic conflicts. An example is the recent conflict in Ganta between the Mano people and the Mandingo. The tensions that were reported resulted from the refusal of Mano and Gio individuals to turn over the property of Mandingos returning from exile which had been occupied during the war years.

The second category has no ethnic or political overtones and is not so clearly related to the history of the civil war. It is largely prevalent in the 'rural' environments, and concerns encroachment on agricultural land (including forests) for economic reasons. Its scope is variable; from conflicts between families around specific plots of small dimension in a given town, to issues of communal land demarcation that refer to large swaths of agricultural land. These can be categorized into the following types:

- Disputes over communal boundaries between two or more communities, or between individuals
- Disputes over property between different groups within the same community

Discussions with the Sanniquellie District Commissioner confirmed that communal boundary conflicts are common in the project area and there are unresolved boundary conflicts between Gampa and Gbalasonnho communities (i.e. the two closest communities to Gbedin Falls) as well as between Tonwee, Gampa Phor and Kitoma communities (near the proposed transmission line). These conflicts are triggered by individuals using borrowed land and claiming ownership rights thereafter. The underlying cause is usually the

perceived economic benefits attached to land particularly income from agriculture and other land-related activities.

Land disputes and conflicts on the Guinean side are of varying scales and can be classified as conflicts between individuals and families, conflicts between pastoralists and sedentary farmers, and conflicts resulting from larger regional conflicts that have had sub-regional consequences. Intra-family conflict over inheritance rights to outer fields and family concession land is common in Guinea, and inter-family conflicts may arise between land users and landowners, such as in cases where individuals using borrowed land claim ownership rights. Disputes also occur when landholders migrate out of the area and others use the land and ultimately claim primary rights to the land (Fischer 1995).

Sexual and Gender Based Violence (SGBV): The most common forms of SGBV in the project area include rape, sexual exploitation and abuse, domestic violence, early and forced marriage, and human trafficking. Discussions with the Women and Child Protection Unit in Sanniquellie indicated that they receive an average of 24 cases per month and with a significant number of cases unreported. The most common forms of SGBV include sexual assault (rape and sex without consent in married couples), physical assault, domestic violence, Female Genital Mutilation (FGM), spousal murder, family abandonment, wife and child neglect, and widow mistreatment.

The causes of SGBV were summarised as poverty, cultural traditions that consider women as secondary citizens, women's lack of awareness of their legal rights, vulnerability of women that makes them dependent on men, male ignorance, misuse of alcohol, the poor exploiting the rich among others. In most cases, the triggers stem from trivial incidences like women expressing their opinion in public, women demanding clarifications related to household expenses, women attempting joint planning for the household economy, women questioning the husband's use of resources, etc.

Women's vulnerability is worsened by the fact that women obtain use rights to agricultural land through their husbands and sons, and they are usually dependent on those relationships to maintain their rights of access to land. A woman loses her use rights to land if she leaves her husband's household, as in the case of divorce, although the woman's male children usually retain their inheritance rights. A woman's right to land upon the death of her husband is less clear cut, but in many areas she may retain use rights if she has male children who will inherit the land in the future, while the situation is even worse for a widow from a childless marriage, who gets exposed to a higher risk of being both homeless and landless, particularly if the marriage was polygamous.

Child abuse: Child abuse is manifested in several ways including child neglect, forced child labour, sexual abuse and assault, child trafficking for domestic work in urban areas, early marriages, and FGM. The Women and Child Protection Unit in Sanniquellie handle an average of four rape cases per month, with highest recorded incidence being nine cases a month. The victims of sexual assault were mainly young boys and young girls insulted by their step fathers or family friends.

Forced child labour was reported to be most rampant in schools, where teachers force students to work on their farms during the planting and harvesting seasons.

Early marriages were evident among the communities in the project area. Pregnant teenagers and child mothers made up almost 60% of the female participants in the community meetings. This has contributed to the high levels of illiteracy among women in the project area. According to the women, poverty is the main cause of the early marriages. Due to the lack of school fees, girls and boys are forced to drop out of school at an early age and girls are then prepared for marriage while boys can be trafficked to the city to search for work.

Regarding Female Genital Mutilation (FGM), all the key informants perceive FGM not as a human right abuse but rather a necessary rite of passage. It was acknowledged that FGM is a widespread practice which

only becomes illegal if it is undertaken during the school semester, without parental consent and without the child’s consent.

Discussions also revealed that fighting child abuse is the most challenging task because usually the parent is the offender and it is considered abomination to petition a parents for exercising his/her perceived parental obligations.

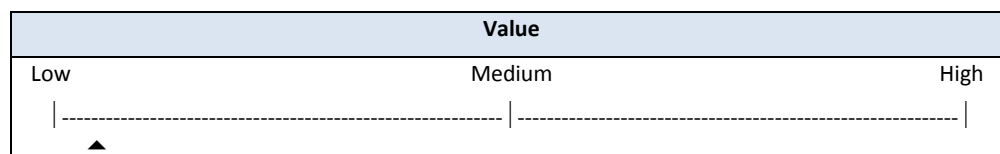
Crime: Other common crimes reported by the communities include livestock theft, petty theft and child kidnapping. The cases of child kidnapping could not be quantified but women reported that child kidnapping is on the increase in the project area.

Illegal immigration: There is a border crossing at Gampa town. The border posts on both the Liberian and the Guinean sides of the river are controlled by a few staff, and they were not well equipped with patrolling equipment (e.g. vehicles, cameras and walkie talkies). The free entry and exist policy for Liberia and Guinea nationals might facilitate the movement of illegal immigrants from other neighbouring countries under the disguise of search for employment.

5.3.8 Cultural Heritage

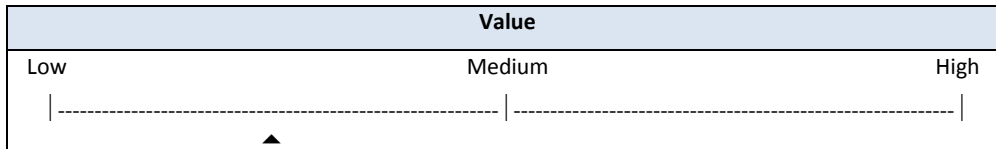
There is no indication that there are any cultural sites or objects within the proposed project footprint or direct impact zone. Gbedin Falls has an aesthetic value to the local communities, but they do not refer to it as a sacred site or a place where they conduct cultural/religious ceremonies. However, all ethnic groups in Liberia participate in religious secret societies associated with the supernatural world of ancestral and bush spirits. These are referred to as “bush societies”. The exact location of the cultural/religious sites in the bush are secret and cannot be revealed to outsiders/non-members. It should be noted that female genital mutilation (FGM) mentioned above is usually implemented through the women’s secret bush society known as the Sande society (bush schools for girls). Girls are taken to the bush where they are taught local customs, sex education, feminine hygiene and housekeeping skills. It is in these bush schools that girls undergo FGM. Because of the secretive nature of the bush society and the sensitivity of the topic, indirect approaches were used to investigating the topic by only assessing membership to a bush society and levels of awareness. In Nimba County, 92.9% of the women have heard about a bush society, and 62.6% are reported to be members of a bush society.

The local communities did not raise cultural heritage as an important issue in the context of the Gbedin mini hydropower project and there is no indication that there are any cultural sites or objects within the proposed project footprint. Thus, although cultural/religious traditions and practices are important in everyday life in all rural communities in Liberia, cultural heritage is rated as low value in the project’s area of influence.



5.3.9 Tourism

There are no commercial tourist operations in the project's area of influence. However, Gbedin Falls do attract local visitors mainly from Ganta and Sanniquellie during the festive seasons (Valentine's Day, Easter, Christmas and New Year's Day). The number of visitors is not known due to lack of records, but the county authorities confirmed that Gbedin Falls is a well-known attraction in Nimba. The waterfalls are accessed free of charge and the neighbouring communities have the responsibility to maintain the footpath from Gampa to Gbedin Falls. Despite this local tourism and recreation activity, the overall value in terms of tourism is relatively low (i.e. low-medium).



6 PUBLIC CONSULTATIONS AND STAKEHOLDER ENGAGEMENT

6.1 Introduction

This chapter describes the process of stakeholder engagement and public consultations that was conducted during the execution of the Environmental and Social Impact Assessment (ESIA) and the Resettlement Action Plan (RAP) for the Gbedin mini hydropower project. Views from stakeholders were sought through interviews, group discussions and public meetings. Feedback from these consultations has been taken into account when preparing the baseline, impact and mitigation sections of the ESIA. A summary of issues discussed is given in Section 6.5.

6.2 Consultation Objectives

Stakeholder consultations to support the ESIA process were specifically aimed to achieve the following objectives:

- to provide information about the project and its potential impacts to those interested in or affected by the project, and solicit their opinion in this regard;
- to identify additional impacts/issues and possible mitigation measures;
- to verify the significance of the identified environmental, social and health impacts;
- to provide opportunities for stakeholders to discuss their opinions and concerns;
- to better understand the people’s practices, perceptions and conditions in the project area;
- to manage expectations and misconceptions regarding the project;
- to inform the process of developing appropriate mitigation measures;
- to provide stakeholders an opportunity to contribute towards identification of mitigation measures and the Environmental and Social Management Plan (ESMP); and
- to analyse gaps identified from the issues

6.3 Stakeholder Identification

The stakeholder identification process was based on the following principles:

- Stakeholders (individuals, groups, communities) directly affected by the project components
- Stakeholders likely to be indirectly affected either by virtue of their proximity to the project site or disrupted access to communal property within the project footprint
- Stakeholders with an influence on project development
- Stakeholders with the capacity to be partners in development

Based on the above criteria, stakeholders to be engaged during the detailed ESIA and RAP studies were identified as shown in Table 30. The stakeholder list will be updated as more stakeholders are identified throughout the consultation process.

Table 30: List of stakeholders.

Category	Stakeholder
Project developer	Rural and Renewable Energy Agency
Financier	African Development Bank
Regulators	Environmental Protection Agency
	Ministry of Lands, Mines and Energy
	Ministry of Agriculture
County and district authorities	Nimba County Commission
	Sanniquellie Mahn District
	Bain Garr District
Directly impacted communities (hydropower plant)	Gbalasonnoh, Gampa (Guinea)

Category	Stakeholder
Directly impacted communities (transmission line)	Gbalasonnoh, Tonwee, Kitoma
Directly impacted communities (access road)	Gbalasonnoh, Gehwee
Downstream communities	Gampa Phor (Liberia), Gampa (Guinea), Gbedin, Gbedin Camp 3,
Indirectly impacted communities	Gampa Phor, Kitoma, Tonwee, Gbalasonnoh, Zolowee, Guededou District (Guinea)
Vulnerable groups	Women, elderly, very poor households, the sick and the disabled, and households to be physical displaced
Other developers in the area	Soguipah Agricultural Company
Potential partners (ESMP)	Nimba County Health Team (outreach programs)
	Nimba County Department of Agriculture (livelihood restoration)
	Department of Water
	Department of Community Development
	Local Police (traffic and security officers)
	NGOs (partners for community health services)
	Sanniquellie Hospital
	Ganta United Mentalist Hospital
	Nimba County Education Team (vocational training)

6.4 Consultation Approach

6.4.1 Mobilisation Strategies

Prior to the field visits, a mobilisation letter was sent from the projects proponent (RREA) to the Superintendent of Nimba County (Honourable D Dorr Cooper) to inform him of the planned project development, ongoing studies and to introduce the consultants. In return, the County Superintendent informed the relevant District Commissioners, who consequently informed the respective Town Chiefs.

Mobilisation for community meetings was through direct contact with the Town Chiefs. The consultant engaged the services of a resident coordinator, who was charged with the responsibility of liaising with the chiefs and disseminating project information. The chiefs in turn mobilised the residents of the town for the meetings. Arrangements for follow up meetings with special groups (women, fishermen, and hunters) were agreed upon in the general community meetings with a clear specification of date, time, venue and participants.

Mobilisation for resettlement planning (socio-economic surveys, asset inventory and land surveys) was undertaken through media publications and community mobilisation meetings. A Notice of Intent was printed in national newspapers for a period of three days (see Appendix 5). The print media was supplemented by radio announcements on local radio in Ganta and Sanniquellie. Public notices were also placed at town halls in the directly impacted towns and at main noticeboards in Ganta and Sanniquellie.

6.4.2 Information Disclosed

The following information was disclosed to the public and stakeholders during the ESIA and RAP process:

- The project purpose
- Details of project proponent
- Technical details, including project components and activities
- Project's area of influence
- Potential impacts (positive and negative) during construction and operation phase
- Procedures to be followed during the census surveys, compensation, and grievance handling
- Roles and responsibilities of the parties involved
- Timelines for project implementation

6.4.3 Methodologies Adopted

A combination of qualitative and quantitative methods were adopted for information disclosure and consultation. The choice of methodology was based on the nature of the information to be shared and the audience targeted. The strategies for this project included the following:

- *Information dissemination:* Information was disseminated through formal meetings, community meetings, focus group discussions and media publications. Tools included information brochures (see Appendix 6), media announcements (see Appendix 5), maps and illustrations among others.
- *Brainstorming sessions:* This method was adopted especially when dealing with institutional stakeholders with interests in the same project area. This applied to Nimba County authorities and relevant departments, NGOs, Cavalla Resources, among others.
- *Formal meetings:* These took the form of teleconferences and physical meetings. Formal meetings were held with the Environmental Protection Agency (EPA), the project proponent (RREA) and the client/financier (AfDB) to share progress updates and brainstorm on outstanding issues.
- *Case studies and household surveys:* The directly affected households were consulted on a case-by-case basis particularly during the baseline census surveys (socio-economic and asset inventories), property valuation and grievance management.
- *Key informant interviews:* In-depth interviews with key informants were the main strategy adopted for consultations with institutions that are expected to have a role during the implementation and monitoring of the environmental mitigation and livelihood restoration activities.
- *Focus group discussions:* Focus group discussions were adopted when consulting with special groups like the vulnerable households (women groups, the disabled, the elderly, the youth, very poor households, fishermen, hunters, herbalists, among others).

6.4.4 Consultation Schedule

The consultations schedule is given in Table 31 and details of the participants are enclosed in Appendix 4.

Table 31: Schedule of the consultation activities.

Date	Stakeholder Meeting	Venue
<i>Scoping Phase</i>		
19 Nov 2018	Kick-off meeting with RREA	RREA Office, Monrovia
20 Nov 2018	Courtesy call Nimba County Superintendent	County Headquarters, Sanniquellie
20 Nov 2018	Consultation meeting Bain Garr District Commissioner	Zuluyee Town
20 Nov 2018	Focus group discussion Nimba County Education Team	County Headquarters, Sanniquellie
20 Nov 2018	Focus group discussion Nimba County Health Team	County Headquarters, Sanniquellie
20 Nov 2018	Mobilisation meeting Town Chiefs of Gampa and Gbedin Town	Gampa and Gbedin Town Halls
21 Nov 2018	Community meeting Gampa Phor	Gampa Town Hall
21 Nov 2018	Group discussion Gampa women	Gampa Town Hall
21 Nov 2018	Mobilisation meeting Kitoma	Kitoma Chief's Office
21 Nov 2018	LISGIS key informant consultation and data collection	Nimba County LISGIS Office
22 Nov 2018	Community meeting Gbedin Camp 3	Gbedin Camp 3 Town Hall
22 Nov 2018	Consultation meeting Gehwee	Gehwee Town Church
22 Nov 2018	Consultation meeting Gampa Town Centre – Guinea	Gampa Town Centre (Chief's Residence)
22 Nov 2018	Consultation meeting District Commissioner Sanniquellie Mahn	Sanniquellie Mahn, Sangleapea
23 Nov 2018	Community meeting Kitoma	Kitoma Town Hall
<i>Mobilisation for Census Surveys</i>		
26 Feb 2019	Tonwee mobilisation meeting	Chief's Residence
26 Feb 2019	Nimba County mobilisation meeting	Superintendent Office
27 Feb 2019	Nimba County Development Committee	County Headquarters, Sanniquellie

Date	Stakeholder Meeting	Venue
27 Feb 2019	Nimba County Lands Administrator	County Headquarters, Sanniquellie
27 Feb 2019	Community meeting Gbalasonnoh (landlord, chiefs and directly impacted households)	Town Hall
28 Feb 2019	Community meeting Gampa Town Centre - Guinea (landlord, chiefs and directly impacted households)	Gampa Town Centre (Chief's Residence)
28 Feb 2019	Community meeting Tonwee (landlord, chiefs and directly impacted households)	Town Hall
28 Feb 2019	Community meeting Gampa Phor - Liberia (landlord, chiefs and directly impacted households)	Town Hall
2 March 2019	Community meeting Gehwee (landlord, chiefs and directly impacted households)	Town Hall
<i>Key Informant Interviews and Focus Group Discussions</i>		
1 March 2019	Sannequielle Police (Traffic Inspection Unit)	Police Office
1 March 2019	Sannequielle Police (Women and Child Protection Department)	Police Office
1 March 2019	Ministry Of Gender, Children and Social Protection, Nimba County	Nimba County Headquarters
1 March 2019	Key informant interview fishermen and Gampa town chief	Gbedin Falls
2 March 2019	Key informant interview Tonwee (landlord, chiefs and directly impacted households)	Town Hall
2 March 2019	Tonwee (women meeting)	Town Hall
4 March 2019	Consultations RREA	RREA Office, Monrovia
19 March 2019	Cavalla Resources	Cavalla Office, Monrovia
<i>Asset Inventory and Socio-economic Surveys</i>		
11–25 March 2019	Tonwee (directly impacted individuals, households, communities)	On site
11–25 March 2019	Gbalasonnoh (directly impacted individuals, households, communities)	On site
11–25 March 2019	Gampa Phor - Liberia (directly impacted individuals, households, communities)	On site
11–25 March 2019	Gampa - Guinea (directly impacted individuals, households, communities)	On site
11–25 March 2019	Gehwee (directly impacted individuals, households, communities)	On site
11–25 March 2019	Mr. Kona Town (directly impacted individuals, households, communities)	On site
11–25 March 2019	Kitoma (directly impacted individuals, households, communities)	On site

6.5 Summary of Issues Raised

The main issues raised during the consultation meetings are presented in Table 32. Details of the participants and stakeholders consulted are enclosed in Appendix 4 while the minutes of meetings are enclosed in Appendix 3.

In general, the main reaction of the stakeholders was positive. They expressed their appreciation and support for the project and the development prospects associated with the project. They also pledged their continued support to ensure the project gets implemented.

Table 32: Main issues raised during the consultation meetings.

Stakeholder Concerns and Questions	Summary of Discussion
Compensation procedures	What procedures will be followed to minimise affecting assets? Answer: <ul style="list-style-type: none"> • The transmission line route will be selected carefully to avoid crossing structures.
Compensation packages	Question: Will the government decide for us the compensation package for the losses to be incurred? Answer: <ul style="list-style-type: none"> • If the transmission line crosses seasonal crops, the towns will be notified ahead of time and the project will wait for the harvest of the crops before using the land. • Discussions and agreements with the communities will take place to provide a fair compensation in cases where the transmission line crosses plantations with permanent crops.
Employment opportunities	Question: Will the local population be eligible for employment? Answer: <ul style="list-style-type: none"> • Skilled and semi-skilled workers from the local community will be hired where and when possible during construction phase. Gender equality will be promoted as much as possible if the skills required are available. Suggestions from participants: <ul style="list-style-type: none"> • Suggestions were raised for the project to offer apprenticeship opportunities for the students in the Technical and Vocational Training Institutes through employment on the project during construction and operation. • Another suggestion was raised to the local authorities to start a capacity building program for students from the communities to orient them towards the expertise that will be needed during project implementation which will lead to local employment during operation as well. • Priority for employment should be given to the local communities.
Community benefits	Question: How will the communities benefit from this project? Answer: Possible community benefits include: <ul style="list-style-type: none"> • Rural electrification • Training opportunities for students and the general local population • Improvement of health facilities • Improved water supply and sanitation facilities • Entrepreneurial opportunities for women • Employment opportunities • Improved lighting for communal facilities (schools, town halls, health centres and public offices)
Downstream water quality	Question: Will the water quality downstream be compromised during the operation phase? Answer: <ul style="list-style-type: none"> • No major water quality changes are expected during the operation phase downstream of the power station, except for the periods that would be scheduled for sediment flushing.
Electricity costs	Question: What is the cost of the current and who will pay for it? Answer: <ul style="list-style-type: none"> • The current will not be supplied for free and the receivers will be paying for the electricity they will use. • The cost of the current is not determined yet but will be lower than the cost of electricity from diesel generators.

Stakeholder Concerns and Questions	Summary of Discussion
Project timeline	<p>Question: When will be the construction start and for how long will it last?</p> <p>Answer:</p> <ul style="list-style-type: none"> • The feasibility study is complete and the environmental assessment is currently being conducted and will need approximately three months to be concluded. • Once completed, the project proponent will be looking for financing. A few financiers have expressed interest in funding the project and there is a good chance they will proceed with the project. • Once funding is secured, the project will start and the construction phase will take two or three years. During this period, current will not be available but other benefits like employment opportunities will be available. • After the construction phase is completed, the operation phase will start and current will be generated. • The operation phase does not have a specific timeline and the hydropower plant will be operating for as long as it is maintained properly.
Access road route	<p>Question: What was the justification for siting the access road and transmission line through Gehwee town and not Gampa town?</p> <p>Answer: The main reason is that the access through Gampa is prone to flooding because of the low-lying terrain along the river.</p>
Land use after the cut-off date	<p>Question: The participants inquired on the permissible land uses within the project footprint after the cut-off date.</p> <p>Answer: Growing of seasonal crops can continue until such a date when RREA provides notification of land takeover. It was clearly communicated that seasonal crops will not be compensated for and farmers will be allowed to harvest them prior to land takeover. Participants were further cautioned against using the land for perennial crops after the asset inventory/cut-off date. They were informed that any perennial crops planted after the cut-off date will not be eligible for compensation.</p>
Land use after construction of the transmission line	<p>Question: Participants inquired if they can use the land after the construction of the transmission line.</p> <p>Answer: They were informed that yes the land can be used for cultivation of crops that do not grow above 12 feet at maturity. Permanent structures like houses will not be permitted and trees that grow beyond a certain height will also be prohibited.</p>
Compensation for undeveloped land	<p>Question: Will bare land be compensated?</p> <p>Answer: Participants were informed that all land to be permanently acquired (developed or undeveloped) will be compensated. On this note, it was clarified that since land is owned communally, households will only be compensated for assets on land, while land compensation will be paid to the entire community.</p>
Safety issues	<p>Please be informed that there has been cases of drowning at the Gbedin Falls. At least two cases were reported in 2017 and 2018.</p> <p>Other safety threats are posed by traffic and train accidents. Traffic accidents result from the poor road condition, overloading, incompetent drivers and vehicles in poor mechanical conditions.</p>
Local authority involvement	<p>Stakeholders advocated for the local authority involvement during the resettlement planning and grievance management process.</p>
Involvement of Guinea authorities	<p>Participants advised that the contact with the Guinea should be approached through two parallel routes. That is through the Ministry of Foreign Affairs and through the focal security forum coordinated by Nimba County.</p>
Sexual and Gender Based Violence	<p>Stakeholders advised that the project includes a component of sensitisation to minimise incidences of gender-based violence.</p>

Stakeholder Concerns and Questions	Summary of Discussion
Power line and safety	<p>Question: Participants inquired if they will be safe using the land adjacent to the transmission line.</p> <p>Answer: It was confirmed that it was ok as long they keep within the safe height limitations and outside the wayleave. They were also informed that RREA will conduct safety awareness sessions prior to the electrifying of the transmission line.</p>
Compensation for communal facilities	<p>Question: Participants inquired what would happen in case the transmission line affected a water well.</p> <p>Answer: The project would replace the water facility to ensure that the community continues to have access to water.</p>
Information dissemination in Guinea	<p>The participants advised that project information to the communities on the Guinean side has to be shared with the local administration in Guinea prior to dissemination in the communities.</p>
Information sharing after the ESIA/RAP	<p>Question: Communities inquired whether there will be continuous project updates after the ESIA and RAP studies.</p> <p>Answer: They were informed that RREA will set up a community liaison unit that will be responsible for information disclosure and consultations throughout the project planning and implementation.</p>
Land allocation	<p>Land is mainly allocated by the landlords. All affected households will be allocated replacement land from the landlords at no cost.</p>
Potential conflict with mining operations	<p>Cavalla Resources holds a mining exploration license covering the areas between Gbedin Falls and Sanniquellie. There are promising iron ore deposits on Kitoma hill where the proposed transmission line will cross. Bulk mining operations may also affect the northern side of Kitoma hill. Cavalla Resources therefore advised that the transmission line be re-routed to avoid future interference with mining operations.</p>

7 IMPACT ASSESSMENT AND MITIGATION MEASURES

7.1 Introduction

This chapter describes the potential environmental and social impacts of the proposed Gbedin mini hydropower project together with the proposed mitigation and enhancement measures. The significance/magnitude of the impacts on each baseline theme is evaluated without and with mitigation/enhancement measures, respectively.

Potential impacts have been identified for the construction phase and operation phase, respectively. In addition, future impacts that could arise from decommissioning of the hydropower facility as well as potential cumulative (and trans-boundary) impacts have been described in separate sections at the end of this chapter.

The implementation and monitoring of the mitigation/enhancement measures are described in greater detail in the Environmental and Social Management Plan (Chapter 9) and the Environmental and Social Monitoring Plan (Chapter 10).

7.2 Physical Environment

7.2.1 Topography and Landscape

Construction and operation phase

Visual impact: Visual impacts relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity. For hydropower facilities, visual impacts typically concern the appearance of the power station and associated transmission infrastructure and their interference with the character of the surrounding landscape, particularly to nearby communities.

In the case of Gbedin mini hydropower project, the major visual impact will occur at the waterfalls where the power station will become a dominant physical feature combined with a much reduced water volume in the reach between the intake and the outlet. The diversion of the river flow through the penstocks and turbines will essentially convert the Gbedin Falls to a rocky outcrop in the dry season except for the small minimum flow that should be released from the weir to maintain a portion of the waterfall (Figure 39). This impact will be less in the wet season when the inflow is significantly higher than the turbine discharge causing significant spilling/overflow into Gbedin Falls.

The release of a minimum flow into Gbedin Falls will not prevent the landscape from being highly degraded compared to the present situation. However, as environmental flow is widely considered as a standard requirement in modern hydropower development, it is recommended to install a pipe or culvert through the weir (or at the sediment flushing arrangement) to ensure a constant release of at least 10% of the mean annual flow (i.e. 5.8 m³/s).

Despite the environmental flow release, people who visit the waterfalls will notice changes in the sense of place of the area as the landscape will change from a largely undisturbed environment into a man-made landscape. However, it should be recognised that aesthetic impacts are largely a subjective matter determined by individual preferences. The hydropower facility and associated infrastructure might be considered as a symbol of development, or as an intrusion in the natural landscape. The attitudes and perceptions will change with cultural background and over time.

The other major change to the landscape will be caused by the clearing of forest to make way for the new access road and transmission line (Figure 40). These linear features will not be visible from afar due to the thick forest cover and height of the tree canopy compared to the narrow width of the corridors and the low height of the transmission line poles. The visual impacts will mainly occur on the hills where familiar

landscape profiles and scenic views might be disturbed. Also, a deforested right of way is more visible when running along an exposed hillside such as the hill near the main road where the transmission line will cross.

Mitigation measures:

- An environmental flow of at least 5.8 m³/s shall be released into Gbedin Falls at all times
- All disturbed surfaces shall be subject to landscaping, including revegetation using local topsoil and native plant species
- Temporary construction facilities shall be demolished and the sites be restored to pre-construction state
- Excess material shall either be disposed of in the reservoir area, or as spoil tips in specially designated spoil disposal areas subject to landscaping
- Vegetation clearance and maintenance along the transmission line and access road shall be restricted to the right of way



Figure 39: Visualisation of Gbedin Falls after commissioning of the power plant.

Conclusion

The magnitude of the impact on topography and landscape without mitigation (▲) is rated as **medium negative** during both construction and operation phase. The impact is reduced to **low negative** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	----- ----- ----- -----				
Operation		▲	▲		



Figure 40: Visualisation of the 33 kV transmission line.

7.2.2 Geology and Soils

Construction phase

Soil erosion: During the construction phase, soils will be impacted by activities like vegetation stripping, grading, soil removal, backfilling, compacting, excavation and disposal of surplus soil, etc. Exposure of the ground and removal of vegetation cover will make the soil liable to erosion by wind and running water. Parts of the project area, especially along the transmission line, are situated on slopes which are particularly prone to erosion. Failure to re-vegetate temporary used land may accelerate soil erosion.

Mitigation measures:

- Except where vegetation clearing is required for permanent works or excavation operations, all trees and vegetation shall be preserved
- Erosion control practices shall be implemented prior to any major soil disturbance and be maintained until permanent protection is established
- All exposed surfaces and spoil areas shall be covered with topsoil and replanted or re-seeded

Land contamination: Construction activities may pose the potential for release of petroleum-based products, such as lubricants, hydraulic fluids and fuels during their storage, transfer or use in equipment. Other hazardous components include paint and other chemicals used in the building process. If such hazardous materials are not contained and handled properly, there is a risk that they can cause soil contamination as well as water pollution (see below).

Mitigation measures:

- Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills

- Diesel shall be stored in a standard skid tank with secondary containment proving 110% volume of the total capacity of the skid
- Maintenance of machinery and trucks shall be done in workshop servicing and repair areas with impervious concrete platforms and oil traps
- All storage areas and major construction sites shall have spill kits, sand, dust, and other appropriate absorbent materials

Operation phase

Soil erosion: Soil erosion is expected to be less severe during the operation phase due to a paucity of earthwork activities and re-vegetation of exposed soils. However, erosion and gully formation may occur, especially along the access road, during heavy rains.

Mitigation measures:

- Drainage arrangements shall be installed along the access road (culverts, ditches)

Land contamination: During operation, soil could be impacted due to spillage of hazardous wastes and materials, including hydrocarbons. Failure or lack of spill prevention systems and inadequate handling of hazardous waste may cause accidental soil contamination.

Mitigation measures:

- All permanent facilities where fuel and hazardous materials are used or stored shall be equipped with secondary containment, oil traps, spill kits and absorbent materials

Conclusion

The magnitude of the impact on soil and geology during the construction phase is **medium negative** without mitigation (▲) and **low negative** with mitigation (▲). During the operation, it is **low-medium negative** without mitigation (▲) and **low negative** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction		▲	▲		
Operation			▲	▲	

7.2.3 Climate and Air Quality

Construction phase

GHG emissions: During the construction phase, greenhouse gas (GHG) emissions will be generated from increased traffic and from diesel generators used to supply the construction machinery. In addition, vegetation clearing in the small reservoir area, along the transmission line and in the road reserve will cause emissions from deforestation. However, the emissions are assumed to be insignificant in terms of climate change impact.

Mitigation measures:

- N/A

Air pollution: The main impact to air quality during construction will be from increased dust levels arising from construction machinery, excavations, rock blasting, cement mixing and road construction. Emissions of small particles from diesel trucks as well as road dust are difficult to quantify but the impacts will be

intermittent and short term. In addition to emissions of particles, there will be minor emissions of NO_x and SO₂ from construction machinery, vehicles and diesel generators.

Mitigation measures:

- Water shall be sprayed on the access road to minimise dust dispersion when necessary
- Trucks transporting loose/friable materials shall be tarped to reduce wind entrainment of dust
- Stockpiles of excavated soils located near residential areas shall be subject to water spraying

Operation phase

GHG emissions: The Gbedin mini hydropower project is planned to supply renewable energy using a technology which is not generally considered to cause greenhouse gas (GHG) emissions. Assuming that the power generation will replace fossil fuel based electricity generation, it will instead contribute to avoidance of GHG emissions from those other sources.

Under certain conditions, however, hydroelectric projects can turn into a significant source of GHG emissions. This mostly applies to hydroelectric reservoirs in tropical areas with low energy production / flooded area ratio (i.e. power density). The power density of Gbedin mini hydropower plant is 9.34 MW / 0.06 km² = 156 and the reservoir is so small that the GHG emissions can be assumed to be zero (IPCC 2006).

The avoided emissions can be calculated by assuming that the equivalent amount of energy is produced from diesel (similar to distillate oil no. 2 in Table 33) or other fossil fuels as shown in Table 33. The estimated CO₂ emissions from a diesel power plant are 0.76 kg CO₂ / kWh (EIA 2015), corresponding to 42,864 tonnes CO₂ per year to achieve the same energy generation as the Gbedin mini hydropower plant.

Table 33: Estimated CO₂ emissions produced by a steam-electric generator for different fuels.

Fuel	kg CO ₂ / kWh*	tonnes CO ₂ / 56.4 GWh
Coal (Bituminous)	0.94	53,016
Coal (Sub-bituminous)	0.98	55,272
Coal (Lignite)	0.99	55,836
Natural gas	0.55	31,020
Distillate oil (No. 2)	0.76	42,864
Residual oil (No. 6)	0.82	46,248

* Source: EIA (US Energy Information Administration), March 30, 2015.

Mitigation measures:

- Conduct pre-impoundment clearing of trees in the reservoir in order to reduce emissions from decay of organic matter in the reservoir

Air pollution: Air pollution during the operation phase is expected to be very limited. The main source of air pollution will be from vehicle emissions and dust from traffic on unpaved roads. In addition, there might be some dust from construction sites before they are properly re-vegetated.

Mitigation measures:

- N/A

Conclusion

The magnitude of the impact on climate and air quality during the construction phase is **low negative** without mitigation (▲) and **insignificant** with mitigation (▲). During the operation phase, it is **medium-large positive**.

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction			▲	▲	
Operation					▲

7.2.4 Noise

Construction phase

Construction noise: Noise will be generated from vehicular movements, quarrying, sand and aggregate processing, concrete mixing, excavation machinery, blasting operations, etc. Also, the presence of personnel will serve as a continuous source of low-level noise emissions.

During the construction phase, noise will be generated from vehicular movements, quarrying, sand and aggregate processing, concrete mixing, excavation machinery, blasting operations, etc. The presence of personnel will serve as a continuous source of low-level noise emissions during the entire construction period. Compliance with Liberian and international standards for day time and night time noise shall be verified by regular measurements of noise level (Leq, dBA) at the nearest sensitive receptors.

Mitigation measures:

- Noisy installations shall be located in adequate distance to residential areas to meet noise limit values
- Noisy activities shall be scheduled to daytime hours when possible
- Noise control devices shall be installed in construction equipment if noise levels exceed the applicable guidelines
- The workforce shall be instructed to avoid unnecessary noise

Operation phase

Operation noise: The only significant source of noise during the operation phase is the traffic to and from the power station. The impact will be intermittent and short-term. The noise level from the operation of turbines and generators is expected to be insignificant (except occupation noise).

Mitigation measures:

- N/A

Conclusion

The magnitude of the impact on noise levels during the construction phase is **low-medium negative** without mitigation (▲) and **low negative** with mitigation (▲), while it is insignificant during the operation phase.

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction			▲	▲	
Operation					▲

7.2.5 Hydrology

Construction phase

Flow bypass: During the main construction phase, water flow in the Saint John River will be as it was before. Cofferdams will be constructed to intercept the construction pit from the river flow, thus providing a bypass for the water. In later stages of the dam construction, the river flow will pass through the flushing gate.

Mitigation measures:

- N/A

Reservoir filling: The small reservoir will be filled at the very end of the construction phase, causing a reduction in downstream flow for a short period. However, as the impoundment is likely to occur during the rainy season, the filling period will only last for a few hours even if the flushing gate is kept open. The impoundment will create a narrow reservoir extending upstream of the dam for a distance of approx. 1 km.

Mitigation measures:

- During the initial filling of the reservoir, a minimum flow shall be release through the flushing gate equal to at least 50% of the inflow at the time of impoundment

Operation phase

Flow alterations: The proposed hydropower scheme involves diverting the river flow through two penstocks for a total distance of approx. 90 m from the intake weir to the powerhouse outlet. Thus, the river flow will be significantly reduced in the Gbedin Falls (diversion/bypassed reach) to the extent that the waterfall will be totally dry except in the rainy season. On average, however, there will be spilling of water from the dam during the entire rainy season, as the typical wet season flow is much higher than the design discharge of the power plant (52 m³/s). The downstream flow (below the tailrace) will be uninterrupted during both the wet and dry seasons, as it has been assumed that the power plant will be operated as a run-of-river scheme.

Mitigation measures:

- An environmental flow of at least 5.8 m³/s shall be released into Gbedin Falls at all times

River impoundment: The other main impact on the river hydrology will be the actual impoundment. The dam is proposed to be approx. 5.4 m high, resulting in a reservoir with surface area of approx. 6 ha extending upstream of the dam for a distance of about 1 km. The current riverbanks and lower hill slopes will be submerged and converted into an artificial lake, or more precisely a slow-flowing river due to the run-of-river operation mode of the power plant.

Mitigation measures:

- N/A

Conclusion

The magnitude of the impact on hydrology during the construction phase is **low-medium negative** without mitigation (▲) and **low negative** with mitigation (▲). In the operation phase, it is **medium negative** without mitigation (▲) and **low negative** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	-----		▲	▲	
Operation		▲	▲		

7.2.6 Water Quality

Construction phase

Water pollution: During the construction phase, soil erosion from earthworks, including construction and removal of cofferdams, and runoff of crushed and ground rock material from drilling, blasting, stone crushing, etc. are expected to cause increased sediment load, and hence increased turbidity and reduced dissolved oxygen in the river and possible siltation in slower flowing river reaches further downstream. To some extent, however, this impact will be reduced due to deposition of sediments in the pool below Gbedin Falls which will reduce the amount of sediments entering the main river channel downstream of the pool.

In addition, accidental fuel and oil spills from construction machinery, and leaching of ammonia and nitrogen from the blasting and soil rock deposits, may cause pollution of the river and other water sources. Another source of water pollution is represented by the batching plants and particularly by the effluent from concrete truck cleaning which consist of wastewater with high pH and contaminants from the concrete additives.

The workers' camp will generate sanitary effluents which are potential sources for microbiological and organic pollution of surface and ground water. The workers' camp will also produce domestic waste amounting to an estimated 0.5 kg/capita/day. Unless the waste and wastewater from domestic or construction origin (e.g. scrap metal, wood, plastic, cement bags, used tires and batteries, etc.) is adequately managed, it may result in pollution of water as well as soils.

Mitigation measures:

- Erosion control practices shall be implemented prior to any major soil disturbance on the riverbanks
- Sedimentation controls shall be implemented in the form of silt trap fences, sedimentation ponds and drainage channels where appropriate
- Cofferdams shall be constructed such as to minimise releases of sediments and pollutants to the downstream environment (e.g. avoiding low flow periods and rock material with high content of fine particles)
- All the water draining down from batching plants, crusher plants, etc. shall be led to sedimentation and neutralisation ponds and has to be treated before releasing it to the recipient water body
- Storage and handling of fuel and hazardous materials shall be kept away from the river
- Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills
- Diesel shall be stored in a standard skid tank with secondary containment proving 110% volume of the total capacity of the skid
- All storage areas and major construction sites shall have spill kits, sand, dust, and other appropriate absorbent materials
- Sanitary water treatment facilities shall be installed in the workers' camp

Operation phase

River impoundment: As the Saint John River upstream of the dam will be converted into a slow flowing reservoir, water quality characteristics will also change. The impacts on water quality generally depend on the retention (turnover) time of the reservoir – its storage capacity in relation to the amount of water flowing into it – and the pre-impoundment conditions, especially the amount of submerged biomass. Water in small reservoirs behind a run-of-river dam will undergo very little deterioration, while that stored for many months or years behind a major dam where vegetation is left decomposing may be lethal to most life in the reservoir and in the river downstream.

In order to evaluate the risk of water quality deterioration in the Gbedin reservoir, the following items should be considered:

- The Gbedin mini hydropower plant will be operated as a run-of-river scheme. The average retention (turnover) time of the reservoir is only 40 min in the wet season and 6 hours in the dry season, assuming a reservoir volume of 350,000 m³.
- The maximum depth of the reservoir is approx. 5 m at the dam and significantly less towards the tail end of the reservoir.
- The vegetation along the riverbanks within the reservoir area will be cleared prior to impoundment.
- The amount of organic matter and nutrients entering the reservoir is assumed to be low and is not expected to create eutrophic conditions.

Taking the combined effect of these points into consideration, it is highly unlikely that the Gbedin reservoir will be subject to significant water quality deterioration (including oxygen depletion).

Mitigation measures:

- Conduct pre-impoundment clearing of trees in the reservoir in order to minimise the risk of water quality deterioration

Sediment trapping: The Gbedin mini dam will create a physical barrier in the river continuum and hence obstruct the flow of sediments from the upstream to the downstream. The sediments will be transported into the reservoir by the inflow, mainly during the rainy season. Course sediments will be deposited in the head and tail reach of the reservoir before progressively filling up the pool closer to the dam. This will reduce the life of the reservoir and eventually increase the amount of course sediments entering the power intake, while fine sediments (clay, silt and fine sand) and associated nutrients will mostly pass over the spillway or through the turbines. A sediment flushing system has been proposed consisting of a manually actuated gate located at the downstream end of the offtake and a 2 x 2 m culvert of structural concrete (Tractebel 2016).

Mitigation measures:

- Reservoir sedimentation shall be reduced using the flushing gate and/or by drawing down the water level and using excavators
- Sediment flushing should be confined to flood periods to reduce the sediment concentration and allow spillage of surface water after the flushing period in order to wash away the silt deposited in the downstream reaches

Water pollution: During the operation phase, the risk of water pollution will be reduced as compared to the construction phase. However, accidental spills could still occur with inadequate handling of waste and wastewater combined with failure of spill prevention systems.

Mitigation measures:

- Storage and handling of fuel and hazardous materials shall be kept away from the river
- Sanitary water treatment facilities shall be maintained
- All permanent facilities where fuel and hazardous materials are used or stored shall be equipped with secondary containment, oil traps, spill kits and absorbent materials

Conclusion

The magnitude of the impact on water quality, during both construction and operation phase, is **low-medium negative** without mitigation (▲) and **low negative** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction			▲	▲	
Operation			▲	▲	

7.3 Biological Environment

7.3.1 Protection Status

Construction and operation phase

Proximity to protected areas: The physical footprint of the Gbedin mini hydropower project does not overlap with protected areas and is not in conflict with any key biodiversity areas that in future may become legally protected. This also applies to the Gbedin RAMSAR site which is outside the project’s area of influence.

Mitigation measures:

- N/A

Conclusion

The magnitude of the impact on protected areas during the construction and operation phase is **insignificant**.

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction			▲		
Operation			▲		

7.3.2 Terrestrial and Aquatic Biodiversity

Construction phase

Vegetation clearing and degradation of terrestrial habitats: The construction of Gbedin mini hydropower project will require forest clearing at the dam/weir (including reservoir area), penstocks, powerhouse, access road, transmission lines, and substation areas. The total area affected is estimated to be approx. 30 ha. This includes a mosaic of primary and secondary forest as well as farmland with tree cover (natural and cultivated). Despite the limited project footprint, there is a risk that valuable flora and fauna will be adversely affected by the vegetation clearing, including felling of some trees belonging to the ‘vulnerable’ and ‘near threatened’ species.

Vegetation clearance will also cause degradation of animal habitats. The total habitat loss will be rather limited in comparison to the total land available, though some of the impacted areas contain rich resources for wildlife including large trees on the riverbanks acting as perching sites for birds. The filling of the reservoir at the end of the construction period will destroy terrestrial habitats and trigger animals to escape. Animals which are not able to escape (or to swim) might get drowned.

Overall, the loss of terrestrial habitats in the project footprint is not expected to affect the viability of populations of any of the recorded plant and animal species. This also applies to the species of conservation concern because they are all widely distributed both locally and within the sub-region and/or they do not depend strictly on the affected habitats for their life cycle requirements. Due to the limited project footprint and the thick vegetation cover in all surrounding areas, there is little scope or need for off-site restoration of the lost vegetation through tree planting or natural revegetation.

Mitigation measures:

- Except where vegetation clearing is required for permanent works or excavation operations, all trees and vegetation shall be preserved
- All disturbed areas that are not required for permanent works shall be restored and replanted with native trees
- Vegetation clearance along the transmission line and new access road shall be restricted to the right of way

Disturbance from construction activity: In addition to the conversion of terrestrial habitats during construction, the project's area of influence will be subject to increased noise from vehicular movements, sand and aggregate processing, concrete mixing, excavation machinery, blasting of rocks, etc. Also, the presence of personnel will serve as a continuous disturbance throughout the construction phase. The disturbance is likely to affect wildlife in general and trigger animals to avoid or escape the project area. This is also likely to apply to the Sooty mangabey and indeed to the chimpanzees that have their core home range and nests in the less disturbed forest north of the project footprint. The overall impact on the populations from such temporary disturbance is likely to be negligible (Table 34).

Mitigation measures:

- Schedule noisy activities to daytime hours and instruct the workforce to avoid unnecessary noise
- Conduct detailed survey of chimpanzees prior to construction in order to ascertain that the project's area of influence is not used as a nesting habitat
- Strictly prohibit all hunting, firewood collection, charcoal production, and purchase of bush meat by the workforce

Sedimentation and pollution of downstream aquatic habitats: Site preparation including vegetation clearing and earthworks, drilling, blasting, etc. combined with in-stream works (e.g. construction and removal of cofferdams) will contribute to releasing sediment material into the water. Increased water turbidity is a known threat to most of the biota (e.g. clogging of fish gills) and may also affect the dissolved oxygen of the water downstream from the construction works. It should be noted, however, that the river already carries high sediment loads in the rainy season, and the fish species are expected to be relatively tolerant of suspended matter.

In addition to sediment releases, water pollution might happen from accidental fuel and oil spills, leaching of ammonia and nitrogen from blasting operations and rock spoil, etc. Any pollution event would cause negative impact on the aquatic biota in the immediate downstream and even at further distance depending on the type and amount of spill.

Mitigation measures:

- Erosion control practices shall be implemented prior to any major soil disturbance on the riverbanks
- Sedimentation controls shall be implemented in the form of silt trap fences, sedimentation ponds and drainage channels where appropriate
- Cofferdams shall be constructed such as to minimise releases of sediments and pollutants to the downstream environment (e.g. avoiding low flow periods and rock material with high content of fine particles)

- Storage and handling of fuel and hazardous materials shall be kept away from the river
- All storage areas and major construction sites shall have spill kits, sand, dust, and other appropriate absorbent materials

Operation phase

Habitat conversion in the inundation zone: The impoundment of the small Gbedin reservoir will convert the current riverbanks into an aquatic environment creating a narrow reservoir extending about 1 km upstream. The habitat loss from the construction phase will thus be translated into a permanent condition, at least until the hydropower scheme is decommissioned. The water level rise will reduce the abundance of terrestrial animals (of which most species will adjust their range to adapt to the habitats created along the shores of the reservoir) and create a small lake ecosystem, or more precisely a slow-flowing river. While some aquatic species can adapt easily to this type of habitat, others cannot and will therefore diminish in numbers or disappear altogether from the reservoir.

In the small Gbedin reservoir, it is expected that the fish biomass will increase in the initial phase of operation. Due to decomposition of the remaining organic materials (after reservoir clearing), phytoplankton and zooplankton populations will be growing rapidly after impoundment. This 'trophic upsurge' may cause a temporary boom in fish production, mainly consisting of plankton-feeders and predators. Afterwards, as it has been observed in many man-made lakes with small surfaces, the water will become poorer in its natural feeds, to reach a productivity level equal to, or lower than, before the construction of the dam. Overall, the impact on aquatic biodiversity and fish productivity in the inundation zone is expected to be minor in the long term due to the small size of the impoundment.

Mitigation measures:

- N/A

Fish entrainment: With the diversion of water to the power intake, there is a risk that fish in the Gbedin reservoir will become entrained in the turbines with subsequent injury or mortality. The potential for fish entrainment and turbine-induced mortality is mainly related to fish size, i.e. smaller fish and juveniles are more likely to survive turbine passage than larger fish. Survival rates also depend on turbine technology; Kaplan turbines (which are proposed for the Gbedin mini hydropower plant) are relatively 'fish-friendly' with lower mortality rates than other turbine alternatives.

There is also a risk that fish are flushed over the spillway and become injured or killed down the Gbedin Falls. However, this impact is not significantly higher than in the no-project scenario because the waterfalls already represent a risk to downstream movement of fish. Moreover, since Gbedin Falls is a complete barrier to upstream fish migrations, any downstream movement of fish is not connected to critical life-cycle requirements. Mitigation measures should therefore aim at reducing excessive fish mortality through the turbines as a means to sustain fisheries in the pool below Gbedin Falls (rather than as a means to create upstream/downstream river connectivity).

Mitigation measures:

- Consider installation of a fish screen (or reductions in trash rack openings) at the intake to reduce fish entrainment and mortality

Degradation of aquatic and riparian habitats in the downstream: River diversion for hydropower production will cause periodic desiccation of the waterfalls (Gbedin Falls) in the bypassed river section between the intake and the powerhouse outlet. This will happen mainly in the dry season, when all the inflow will be diverted to the turbines. The periodic dewatering of Gbedin Falls will result in degradation of aquatic habitats in a relatively short river section (approx. 90 m). However, the aquatic ecology in the Saint John River as a whole will not be significantly affected because of the run-of-river operation mode of the

power plant combined with the fact that upstream fish migration is already obstructed by the steep waterfall.

There is a small spray zone at the foot of Gbedin Falls. The spray zone is confined mainly to the right riverbank (i.e. Guinea side of Saint John River) but extends across the river during the rainy season when the flow is high. This moist environment at the foot of Gbedin Falls will be significantly reduced or eliminated during the dry season. However, as the flora and fauna survey did not record any species of conservation importance in the spray zone, the reduced moisture content is not considered to have significant impacts on biodiversity.

Thus, while the release of a minimum/environmental flow into Gbedin Falls is not strictly warranted for ecological purposes (due to the absence of critical habitat in the spray zone and because the waterfall acts as a complete barrier to upstream fish migration), an environmental flow release should nonetheless be included in the project design as a standard condition mainly for aesthetic reasons (see Section 7.2.1).

As explained above, the downstream flow regime in the Saint John River will not change as the inflow will be equal to the outflow at all times (i.e. run-of-river). The possibility of operating the power plant in peaking mode has not been elaborated in the feasibility design (Tractebel 2016) and has also not been raised as an issue by the project proponent (RREA). However, if daily peaking becomes a feasible option during the detailed design, it should be recognised that such operation can be harmful to downstream ecosystems (e.g. causing fish stranding at high ramping rates) as well as creating additional impacts in the reservoir drawdown/regulation zone. Further studies will then be required in order to determine the hydrological and hydraulic conditions in the downstream reaches and how the regulated flow regime will affect aquatic and riparian habitats and species. As a rule of thumb, peaking flow ratio (i.e. ratio between maximum and minimum flow during peaking operation) less than 10 is generally considered to have none or very small impacts on ecosystem properties, at least in North American and European rivers (Bain 2007), yet the exact threshold for acceptable peaking needs to be verified on a case-by-case basis.

Another risk in terms of downstream flow can arise if the turbine flow comes to a full stop as a result of planned or unplanned outages of the power station, especially during periods when there is no spilling over the dam. In such a case, the critical factor to prevent downstream flow alteration would be the time lag from the outage event until a compensation flow can be released over the spillway (or from the flushing gate). A typical mitigation approach is the installation of a turbine bypass valve, but this has been found not to be necessary for the Gbedin power station due to (i) the short distance between the dam and the powerhouse tailrace, (ii) the short time period (a few minutes) until water will start spilling over the dam, and (iii) the opportunity to open the flushing gate for immediate release of a compensation flow.

Overall, the impact on aquatic biodiversity in the downstream is minimal provided that the power plant is operated strictly as a run-of-river scheme. This also applies to the river-dependent species of conservation concern, including the African Dwarf Crocodile ('vulnerable') and the five threatened species of fish that potentially occur in the Saint John River (as suggested by local fishermen but not recorded in the fish survey) (Table 34).

Mitigation measures:

- An environmental flow of at least 5.8 m³/s shall be released into Gbedin Falls at all times
- In case of power station outage during periods when there is no spilling over the dam, a compensation flow shall be released by immediately opening the flushing gate
- If daily peaking is considered in the detailed design, then conduct an environmental flows (EFlows) assessment to determine the acceptable peaking pattern

Electrocution and wire collision: The planned transmission line will become a danger for birds and other flying or climbing animals. Accidental kills can occur as a result of collision between the flying animal and a power cable, or it can occur if a climbing or resting animal happens to short circuit the conductors.

In general, collision risk increases with voltage level, and the risk is relatively low for 33 kV lines. At Gbedin, the risk is further reduced by the fact that the transmission line poles and conductors will be at lower height than the surrounding tree canopy. For this reason, it is not considered necessary to install visibility enhancement objects such as marker balls, bird deterrents or diverters.

In addition to the physical risk of injury from collision with electric lines, birds and climbing animals run a risk of electrocution injury should they complete an electric circuit by touching two energised components or an energised and a ground component. Risk of electrocution is higher for large animals, including birds such as vultures and hornbills (e.g. West African Pied Hornbill which occurs in the project's area of influence). However, there is no indication that electrocution is a major cause of bird mortality along the existing 33 kV grid (to which the power from Gbedin power station will be evacuated). Furthermore, the use of wooden poles instead of steel lattice towers are likely to prevent large mammals (such as monkeys) from climbing and being exposed to electrocution risk.

Mitigation measures:

- N/A

Establishment of invasive plant species: One of the effects of disturbance of vegetation and soils (during construction) is the subsequent upsurge of invasive plants (during operation). These have a high potential to suppress the native flora and change the structure and composition of the vegetation as they spread. Exotic and invasive plants may also be introduced to the project area for ornamental reasons.

Similarly, in the power line right of way, excessive vegetation maintenance may remove unnecessary amounts of vegetation resulting in the continual replacement of successional species and an increased likelihood of the establishment of invasive species.

At least one non-native plant species has already been introduced to the project area, the invasive shrub *Chromolaena odorata*. It is difficult to get rid of this species once it has become established, and further introductions of exotic species may cause the spread of more invasive plant species. However, the relatively short duration and limited extent of the construction works is likely to reduce this risk in comparison to most other infrastructure projects.

Mitigation measures:

- Disturbed areas shall be restored immediately after the construction and maintenance works
- All invasive plant species shall be removed during routine vegetation maintenance
- Importation of exotic trees and soil from other places (e.g. for restoration or as ornamentals) shall be prohibited

Table 34: Assessment of the most endangered (EN or CR) and important species.

Species	IUCN Status	Presence in Area of Influence	Critical Habitat Qualification*	Likelihood of Impact
<i>Pan troglodytes ssp. verus</i>	CR	Recorded (but no nests)	Unlikely	Negligible
<i>Labeo curriei</i>	CR	Potential	Unlikely	Negligible
<i>Enteromius (Barbus) carcharhinoides</i>	CR	Potential	Unlikely	Negligible

* Ref. IFC PS6 Guidance Note on threshold for EN and CR species (>0.5% of the global population and >5 reproductive units)

Conclusion

The magnitude of the impact on terrestrial and aquatic biodiversity during the construction phase is **medium negative** without mitigation (▲) and **low negative** with mitigation (▲). In the operation phase, it is **low-medium negative** without mitigation (▲) and **low negative** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction		▲	▲		
Operation			▲	▲	

7.4 Human Environment

7.4.1 Population

Construction phase

Population influx: During construction, there will be a temporary increase in population due to in-migration of workers, job seekers, camp followers, traders, service providers, etc. The exact number of workers to be employed is not known at the current stage, but it may reach more than 300 people in peak periods. While many of the unskilled and semi-skilled workers will be recruited from the local/neighbouring communities, others will come from outside and be resident in the project area for the duration of the construction period (2-3 years).

Population influx, even though temporary, will put considerable pressure on the local infrastructure, services and utilities, especially on health and sanitation. An increase in population is usually also associated with a breakdown in social fabrics, norms and practices. This could potentially result into an increased risk of exposure to HIV/AIDS and other STIs as well as tensions between the resident population and the in-migrants. Women are particularly vulnerable as they can be exploited as sex workers.

In general terms, regions with a significant rural population practising and reliant upon agricultural subsistence-based livelihoods, high unemployment and under-employment, highly concentrated development, and a low per capita income are likely to experience high levels of internal migration toward economic opportunities (IFC 2009). This is certainly the case in the Gbedin project's impact zone. The local capacity to meet the additional requirements for infrastructure, services and utilities is highly limited, which together with the high demand for labour during the construction phase serves as an indication that population influx will become a major issue that must be given due attention.

Mitigation measures:

- Establish transparent recruitment procedures to avoid camp followers in form of job-seekers
- Establish a recruitment policy that gives priority to local residents for less specialised services
- Share recruitment procedures with the local authorities for further dissemination
- Provide opportunities for sub-suppliers and sub-contractors by engaging local firms which in turn employ local labour
- Consider engaging local women groups for the award of sub-contracts like vegetation clearing, traffic control, catering services among others
- Conduct public health campaigns addressing issues of behavioural change, SGBV (sexual and gender based violence), malaria, HIV/AIDS, traffic management, etc.
- Support communities to construct communal water supply and sanitation facilities in preparation for the population influx

- Provide access to safe water supply and sanitation facilities for all project workers to prevent additional pressure on the existing facilities.
- Establish a workers’ housing camp and a site clinic to reduce pressure on local infrastructure, services and utilities
- Provide training and awareness to workers on health risks and prevention, and establish a code of conduct on worker-community relations including SGBV

Operation phase

Population growth: The provision of affordable electricity is likely to cause population growth triggered by economic development. This could be through the return of previously displaced people or those who voluntarily migrated to Monrovia or other urban centres in search of better opportunities, business entrepreneurs, large scale agricultural projects and probably more industries (e.g. mining). While such influx will put pressure on local resources and social services over the longer term (ref. construction phase), it must be considered as an overall positive development for Nimba County at large.

Mitigation measures:

- N/A

Conclusion

The magnitude of the impact on population during the construction phase is **medium negative** without mitigation (▲) and **low negative** with mitigation (▲), while it is **medium positive** during the operation phase.

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	----- -----		▲	----- -----	
Operation				▲	

7.4.2 Land Tenure/Ownership and Land Use

Construction phase

Land acquisition: The project land take will involve the dam and reservoir above Gbedin Falls; the power station area with all auxiliary facilities (switchyard, storage areas, offices, etc.) at the foot of the waterfalls; the 15 m wide right of way (RoW) for the transmission line including the section which will be shared with the new access road; and the 50 feet (15 m) wide road reserve required for the upgrade of the existing road/track.

The total land take is considered relatively small for a hydropower project of this size and capacity. However, it should be noted that changes may occur during detailed design related to those facilities that have not yet been planned (e.g. Kitoma substation, workers’ camp, quarry) as well as to the routing of the transmission line and new access road. Such changes need to be addressed at a later stage and will require the involvement of an engineering consultant. Special attention should be given to the potential conflict with future mining activities at Kitoma hill, which might justify an entirely new alignment of the access road and transmission line, possibly following the existing access to Gbedin Falls via Gampa (i.e. along the river).

Mitigation measures:

- Appoint an engineering consultant to prepare the detailed design and make the necessary adjustments to the project layout and land requirements
- Carry out cadastral survey and follow the legal steps to obtain the land titles

Table 35: Project land requirements.

Project Component	Land (ha)
Dam and reservoir	6
Power station area	13
Access road (upgrade)	14
Transmission line (incl. new road)	11
Total	44

Operation Phase

Restricted land use: No land use by communities will be permitted within the project boundaries (e.g. power station area, dam site and reservoir). Households along the transmission line wayleave will be subjected to restricted land use permitting only land uses compatible with the transmission line safety requirements, i.e. no permanent structures and only cultivation of low-growing seasonal crops as opposed to high tree crops. With this approach, the severity of the project land take to the communities will be less severe and it could also save RREA the cost of vegetation maintenance/clearing during the operation phase.

Mitigation measures:

- Sensitise communities about the prohibited and permissible activities within the transmission line wayleaves
- Award contracts for vegetation clearing/maintenance to the women groups and/or other community members

Potential conflict with mining operations: As explained in the baseline section, the proposed routing of the transmission line (and partly the access road) is in conflict with a planned mining operation on Kitoma hill. The licence holder Cavalla Resources has advised that the transmission line should be re-routed to avoid the iron ore deposits on the hill as well as the surrounding areas (that will be required for bulk mining and associated infrastructure). The two main alternatives would be to change the line route during detailed design or to take the risk that mining operations will not materialise and then to relocate the transmission line in case there is future interference from mining. From an environmental and social safeguard perspective, this risk is more of a technical/economic feasibility issue though it should be noted that a change in the project layout will require an update of the ESIA and RAP at a later stage.

Mitigation measures:

- Appoint an engineering consultant to assess alternative routing of the transmission line (and access road) to avoid crossing Kitoma hill

Conclusion

The magnitude of the impact on land tenure/ownership and land use during the construction phase is **medium negative** without mitigation (▲) and **low negative** with mitigation (▲). In the operation phase, the magnitude of impact is **low negative** without mitigation (▲) and **insignificant** with mitigation (▲) provided that the RAP has been successfully implemented.

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	-----		▲	-----	
Operation	-----		▲	▲	-----

7.4.3 River Use

Construction phase

River contamination: Construction activities in the rivers are usually associated with risk of compromised water quality due to increase in sediment load and contamination through oil spills from construction equipment (see Section 7.2.6). The potential impacts will be felt by the downstream river users including fishermen and the communities of Gampa Phor, Gampa town centre (Guinea) and Gbedin Camp 3 which rely on the riverbanks for farming.

Mitigation measures:

- Comply with best industry practice to prevent river pollution during construction activities
- Notify the downstream communities about construction activities in the rivers and provide early warning in case of pollution events

Increased river transport: Downstream river flow will not be altered during construction (or operation). However, there will be an increase of passengers crossing from the Guinea to the Liberia side of the river in search for jobs and business opportunities during the construction phase. The current raft used for river crossing is not suitable to carry a large number of people and may represent a safety risk to the passengers. Any disruption of river transport will especially affect the women who are involved in cross-border trade for their agricultural produce, as well as the Guinean communities who access health services from Liberia.

Mitigation measures:

- Support the Gampa community to procure a more mechanically sound and safe boat/raft to be used for river crossing
- Ensure that there are no sudden changes in river flow that might disrupt river transport downstream

Disruption of fishing at Gbedin Falls: The pool below Gbedin Falls is used for artisanal fishing by the local community, mainly in the wet season. Although there are many other fishing grounds downstream of the waterfalls, the construction activities will cause disturbance at the pool and probably prevent the fishermen from accessing this fishing ground. It should be noted, however, that the local fishermen had no strong objections to the project especially since the fisheries in the pool is not as significant as in the downstream reaches. The best site to set the fishing nets in the pool seems to be on the opposite side of the proposed tailrace, hence it might be possible to continue some fishing activity in this area.

Mitigation measures:

- Ensure continued access to the pool for fishermen during safe periods of the construction phase
- Prioritise the fishermen for employment as an alternative source of livelihood during the construction phase
- Support fishing households (including wives) with credit and/or agricultural starter packages (tools, seeds, fertilisers) to promote alternative sources of livelihoods

Operation Phase

Restricted access to fishing at Gbedin Falls: For safety reasons, there will be restricted access to the area around the power station and tailrace at the foot of Gbedin Falls. The disruption of fishing grounds in the pool noted above for the construction phase is therefore likely to continue into (and throughout) the operation phase. This impact can potentially be mitigated by improved access to the river/reservoir upstream of the waterfalls and by the expected increase in fish biomass in the reservoir.

Mitigation measures:

- Ensure access to the reservoir area for local fishermen in order to provide alternative fishing grounds

Conclusion

The magnitude of the impact on river use during the construction phase is **low-medium negative** without mitigation (▲) and **low negative** with mitigation (▲). In the operation phase, the magnitude of impact is **low negative** without mitigation (▲) and **low positive** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	-----		▲	▲	
Operation			▲	▲	

7.4.4 Livelihoods and Economic Activities

Construction phase

Economic displacement: While the existing project design will not cause physical displacement (i.e. relocation or loss of shelter), the land take will trigger economic displacement (i.e. loss of assets or access to assets that leads to loss of income sources or means of livelihood). Local farmers rely on shifting cultivation combined with growing of permanent (cash) crops such as sugarcane, rubber, oil palm and cocoa. A total of 148 households will be directly affected by the land clearing to make way for the construction and safe operation of the project infrastructure. In addition, some valuable trees growing in the wild within the RoW of the transmission line and access road will be lost.

The table below shows the total land loss per project component the number of households economically displaced. The magnitude of economic displacement is significant in the sense that a large number of households will be affected. However, as physical displacement is fully avoided and an alternative design/routing is unlikely to achieve significantly less economic displacement, the overall impact can be considered acceptable for a project of this size and importance. Indeed, only small portions of farms will be affected in most places within the RoW of the transmission line and access road. Provided that the Resettlement Action Plan (RAP) is successfully implemented, the affected livelihoods are expected to be restored to pre-project levels.

Table 36: Magnitude of economic displacement.

Project component	Number of economically displaced households	Total land acquired (ha)
Dam and reservoir	0	6
Power station area	9	13
Access road (upgrade)	97	14
Transmission line (incl. new road)	42	11
Total	148	44

Mitigation measures:

- Give prior notice to farmers and allow them to harvest seasonal crops before the start of construction
- Allow the farmers to collect the wood from the vegetation clearing (e.g. in reservoir area and RoW of transmission line)

- Compensate for the loss of crops and land use rights to all affected households and communities as per the Resettlement Action Plan (RAP)
- Provide support for livelihood restoration and community development projects as per the RAP
- Facilitate the process of regularising of tenure for all the economically displaced households that could be exposed to the risk of future evictions
- Provide documented evidence of replacement land allocation to all economically displaced households
- Ensure that residual tribal certificates are provided to all affected landowners with registered land (title deeds/tribal certificates)

Risk of food insecurity: Due to economic displacement (loss of farmland and crops), the poor and vulnerable households will be exposed to the risk of food insecurity because the farming activities will be disrupted affecting the annual production of essential food crops (and cash crops). As noted from the baseline section, farmers are already faced with a number of challenges that require proper planning if they are to meet their food and income requirements.

Mitigation measures:

- Ensure timely allocation of replacement land to all affected households
- Provide agricultural starter packages (tools, seed and fertilisers) to all affected households as support towards land clearing and replacement of farms
- If affected households are not given sufficient notice to harvest their mature food crops prior to land takeover, provide food/food allowances to all economically displaced households during the transition period to secure them from the risk of food insecurity for a period of at least one year
- Align the project land takeover with the agricultural calendar to allow farmers sufficient planning time for the new season

Employment and business opportunities: A relatively high number of workers are expected to be employed during the peak construction period (see above). However, given the local population's educational backgrounds and skills, most of the local residents will only be in position to take on unskilled labour. The project is also expected to create local business opportunities for the resident population. Local entrepreneurs will be encouraged to offer services as suppliers and sub-contractors. In addition, the improved cash flow among the local population will increase their purchasing power resulting into good business for those already engaged in trade. Construction and upgrade of roads will further contribute to more efficient transportation services and better access to markets. Overall, the employment and business opportunities can offset the adverse impacts of economic displacement but only if targeted efforts are made to maximise the local content (i.e. prioritising recruitment of local people and especially project affected persons) while also ensuring that the livelihoods of PAPs are restored through RAP implementation.

Mitigation measures:

- Priority for recruitment to be given to local residents for less specialised and labour-intensive services
- Provide opportunities for sub-suppliers and sub-contractors by engaging local firms which in turn employ local labour
- Consider engaging local women groups for the award of sub-contracts like vegetation clearing, traffic control, catering services among others
- Create equal opportunities for employment of women in both management and casual placements
- Prevent child labour by not employing minors of less than 15 years of age

Operation phase

Employment opportunities: The project will create direct employment of few permanent employees for the operation of the power plant and several on temporary basis under maintenance contracts. The number of workers is low compared to the available job seekers but it will result into job security and improved cash flow for those permanent employees.

Mitigation measures:

- N/A

Local economic development: The objective of the project is to provide affordable electricity supply to rural and urban communities connected to the cross-border network between Liberia and Côte d’Ivoire. The power supply will allow grid expansion to isolated communities and remote areas, and encourage the connection of a larger amount of households, businesses and industries to the grid. Households will have reduced energy costs, creating more disposable incomes and opportunities to better their livelihoods. In particular, the provision of electricity supply is expected to reduce the domestic workload especially on women and children.

Mitigation measures:

- N/A

Conclusion

The magnitude of the impact on livelihood and economic activities during the construction phase is **medium negative** without mitigation (▲) and **low positive** with mitigation (▲). In the operation phase, the magnitude of impact is **low positive** without mitigation (▲) and **low-medium positive** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	▲		▲		
Operation			▲	▲	

7.4.5 Infrastructure and Services

Construction phase

Disturbance from construction traffic: During the construction phase, traffic volumes will increase on the main roads, creating public health risks including traffic accidents, dust and noise. This will negatively affect other road users such as cyclists, motorists and particularly school children.

Mitigation measures:

- Collaborate with the traffic police to raise awareness about road safety in schools, communities and among project drivers
- Disseminate traffic management plans in the project area, through campaigns in schools and communities
- Ensure that all project vehicle drivers are well trained and have a full and up to date license to operate their vehicles
- Institute speed limits and traffic controls for project vehicles and equipment in recognition that the main access road is a shared road with the public
- Implement dust control measures (e.g. water sprinkling) especially in sections close to schools and health centres

Pressure on public sanitation facilities and waste management: The project workforce and population influx will cause an increased demand for sanitation and waste management services. Currently, there are no communal/public toilets in the project area, and people practice open defecation. Waste management services are also lacking. The construction contractors must be required to handle the waste and wastewater from their operations in accordance with the applicable standards, but the project also needs to mitigate the public sanitation and waste management risks caused by the in-migration of job seekers, camp followers, traders, etc.

Mitigation measures:

- Provide sufficient sanitary facilities and safe water supply for workers at all work sites
- Prior to construction, establish possibilities for local disposal of non-hazardous wastes and make all necessary arrangements for handling of hazardous waste
- Construct communal sanitation and water supply facilities in targeted locations (Gbalasonnoh, Gehwee, Tonwee and Gampa Phor) and set up sustainable operation and maintenance systems (including water guards)
- Conduct hygiene improvement campaigns at community level and create awareness in regard to sustainable waste disposal practices

Pressure on health facilities: The project workforce and population influx will also cause an increased demand for health services. Currently, there are only two health facilities/hospitals serving all the communities while systems for handling of health emergencies are non-existent, ambulance services are unreliable, and diagnostic services at the hospitals are limited. The hospitals' capacity to handle complicated cases is limited.

Mitigation measures:

- Provide adequate health care to project workers and their families to avoid exerting additional pressure on the existing health facilities
- Conduct preventive health campaigns for the communities with particular focus on water and sanitation related diseases
- Institute all possible measures to ensure that communities are not exposed to the risk of construction accidents in any form (e.g. water pollution, traffic accidents, collapsing structures)

Operation phase

Improved road infrastructure: The construction and upgrade of roads will contribute to improved public transport services and better access to markets. This will mainly benefit Gehwee town (or Gampa if the access road to Gbedin Falls is shifted following detailed design).

Mitigation measures:

- N/A

Promotion of rural electrification: Provided that the above-mentioned mitigation measures are successfully implemented, the standard of public infrastructure and services is likely to have improved by the time the power station is put into operation. However, unless rural electrification becomes part of the project objectives, the local villages will remain without reliable electricity supply as the power is fed into the cross-border network. In the long term, all the communities may be connected to the grid, but in the meantime RREA should explore possibilities of subsidising connection costs to a level that the directly impacted communities can afford.

Mitigation measures:

- Give priority to the project-affected communities for provision of rural electrification

Conclusion

The magnitude of the impact on infrastructure and services during the construction phase is **medium negative** without mitigation (▲) and **low negative** with mitigation (▲). In the operation phase, the magnitude of impact is **low positive** without mitigation (▲) and **medium positive** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	▲		▲		
Operation			▲	▲	

7.4.6 Health, Safety and Security

Construction phase

Health and safety risks: The construction activities will require a considerable amount of local labour, mainly unskilled and semi-skilled workers with little experience from large-scale construction projects. It is likely that the limited exposure will cause increased risk of occupational accidents. When considering safety of the employees, there is a risk of hearing damage from increased noise, risk of accidents (including risk of falls from elevated positions during construction and installation of the electricity poles), and an increased risk of electrocution should activities not follow operation guidelines and safety measures.

Positive impacts on health and safety will occur due to the provision of health care for employees in the form an on-site first aid facility, as well as due to the employment of a safety specialist to prepare, implement and maintain a comprehensive safety program.

In addition, community exposure to health and safety risks will also increase, especially due to transportation of equipment and personnel through the towns, and should non-employees enter to unauthorised access areas at construction sites.

Mitigation measures:

- Include best practice health and safety provisions in the construction contracts and ensure strict compliance with national legislation and the World Bank EHS guidelines
- Ensure that the workers' camp standards in regard to quality, management and provision of basic social services are compliant with the IFC/EBRD guidance on workers' accommodation
- Ensure project sites are secured against unauthorised access
- Collaborate with the traffic police to raise awareness about road safety in schools, communities and among project drivers
- Disseminate traffic management plans in the project area, through campaigns in schools and communities
- Ensure all project vehicle drivers are well trained and have a full and up to date license to operate their vehicles
- Institute speed limits and traffic controls for project vehicles and equipment in recognition that the main access road is a shared road with the public

Public health risks: The project can potentially increase the prevalence of some public diseases due to population influx (e.g. HIV/AIDS, water and sanitation related diseases) and creation of new water bodies (malaria, schistosomiasis). Table 37 gives an overview of the known and potential diseases and how the risks can be mitigated.

Table 37: Potential diseases and mitigation.

Public Health Diseases	Baseline	Project Impact	Mitigation
Malaria	Common	Yes (creation of water pools)	Spraying, draining pools, mosquito nets, repellents, treatment
Diarrhoea, dysentery, cholera	Common	Yes (influx, pressure on water and sanitation facilities)	Sanitation and hygiene campaigns, improved sanitation and water supply facilities
Sexually transmitted diseases	Common	Yes (influx, behavioural change)	Awareness creation, condoms, counselling, treatment
Myiasis	Occurring	No impact	N/A
Schistosomiasis	Not reported	Potential (reservoir as potential breeding ground for snails)	Awareness creation, surveillance, drug supply, treatment
Lassa fever	Rare	No impact	N/A
Onchocerciasis	Not reported	Insignificant (reservoir will submerge potential breeding sites)	Monitoring/recording cases of river blindness

Given the situation in the project area, the focus should be on malaria, HIV/AIDS (and other sexually transmitted infections) and water and sanitation related diseases. In addition, there is a risk that schistosomiasis may occur (although not reported at present, even not from the nearby rice irrigation scheme). The approach to mitigation should involve a combination of prevention and treatment, while there is little scope for achieving health benefits from technical design modifications (e.g. options for sluice gate management to control vector borne diseases are limited since the power station will be operated as a run-of-river scheme and at a constant reservoir level).

Mitigation measures:

- Eliminate small pools of water acting as breeding grounds for mosquitos
- Conduct public health campaigns on malaria, HIV/AIDS, schistosomiasis and sanitation/hygiene
- Ensure that the local health facilities have access to drugs for treatment
- Provide funding to construct communal sanitation facilities and to rehabilitate non-functional water supply facilities in towns affected by population influx

Security threats: Construction projects in settings with high unemployment rates tend to attract many job seekers, some of whom can pose security threats by involving in criminal activities (e.g. thefts). The short distance to the international border (Guinea) is expected to aggravate the situation further. The security threat is a risk to both the local residents and to the project (e.g. stealing and selling of project equipment and materials).

Mitigation measures:

- Support local security systems to strengthen community policing and crime-handling measures
- Institute strict control measures for project property, including fencing as required
- Ensure that the conduct of security personnel complies with good international practice
- Establish a grievance mechanism for addressing security-related grievances

Risk of Sexual and Gender Based Violence: Population influx during the construction phase has the potential to result in an increased incidence of SGBV (sexual and gender based violence) particularly in the form of sexual assault, physical assault, domestic violence and sexual child abuse triggered by alcoholism, prostitution, polygamy and the inferior role of women in traditional households. These incidents are already rampant in the communities and with the introduction of a cash economy, alcoholism and other vices will potentially increase.

Much as it a good idea for the project to ensure equal opportunities for both men and women, women participation should be handled cautiously to avoid any misperceptions that could trigger domestic violence. Consultations with the communities revealed that the most of the domestic violence cases are triggered by misunderstandings/misperceptions between men and women, women expressing themselves, women demanding accountability for household resources, women taking decisions without consulting the husbands, women's hesitation to hand over the proceeds of their labour to their husbands, etc.

Mitigation measures:

- Raise awareness related to SGBV among men, women, girls and boys through community campaigns, school campaigns and workers campaigns
- Employ women in groups instead of individuals and assign them female supervisors wherever possible
- Allocate tasks to women that allow them sufficient time to attend to their household needs
- Establish a code of conduct on worker-community relations and inform all workers on the rules and regulations governing the host communities
- Institute a grievance mechanism that also captures community concerns related to workers behaviour and SGBV
- Enact and enforce human resource policies against sexual harassment and abuse in the workplace

Risk of child labour and abuse: Due to the high levels of poverty, the school drop-out rate among boys and girls is high in the project area. This has resulted in early marriages for girls and joining of the workforce at an early age for boys. It is likely that the project will attract young job seekers (both boys and girls) and that many teenage girls will perceive the project as an opportunity to secure themselves potential husbands, thereby worsening the rate of teenage pregnancies and school drop-outs.

Mitigation measures:

- Raise awareness related to child labour and abuse through community campaigns, school campaigns and workers campaigns
- Limit the eligibility age for employment to not below 15 years of age for all contractors and sub-contractors
- Incorporate opportunities for apprenticeship for the youth in the community and internships for the young ones with a certificate in vocational training during construction phase

Operation phase

Health and safety risks: The operation and maintenance personnel are likely to be exposed to physical hazards in the power stations, electrical and fire hazards especially during repair of live power lines, risk of drowning, etc.

Similarly, the neighbouring villagers will also be exposed to certain health and safety risks, although less so than during the construction phase. Limiting access to the project site helps reduce risks of accidents occurring due to project activities.

There has been much public concern related to suspicion that the radiation of the electromagnetic field (EMF) created by power lines and substations might cause serious health impacts on people living or working close to such structures. The focus has in particular been on the alleged excess frequency of leukaemia with children living near power lines.

The IFC Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution provides insights and guidelines for EMF exposure to the general public due to electrical transmission lines. The document reinforces that "there is no empirical data demonstrating adverse health effects from

exposure to typical EMF levels from power transmissions lines and equipment. However, while the evidence of adverse health risks is weak, it is still sufficient to warrant limited concern.”

The IFC guidelines present limits for the general public of 5000 V/m (electric field) and 100 μT (magnetic field). Maintaining average and peak exposure levels below these limits is recommended, otherwise additional measures should be considered to minimize exposure. The expected exposure due to the 33 kV transmission line are assumed to be well below the established limits.

The risk of dam failure will be extremely low, as the dam will be designed, constructed and operated in accordance with international best practises.

Mitigation measures:

- Ensure compliance to strict occupational health and safety procedures and exposure limits
- Ensure institution and compliance of fire safety plan and procedures
- Increase safety awareness amongst public regarding risk from electrocution
- Ensure safe operation of the dam, and develop a flood warning system

Conclusion

The magnitude of the impact on health, safety and security during the construction phase is **medium negative** without mitigation (▲) and **low negative** with mitigation (▲). During the operation phase, it is **low negative** without mitigation (▲) and **insignificant** with mitigation (▲).

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	▲		▲		
Operation			▲ ▲		

7.4.7 Cultural Heritage

Construction phase

Loss of physical cultural resources: There is no evidence that cultural heritage resources will be affected by the Gbedin mini hydropower project. However, since there is much secrecy attached to cultural/religious issues, there is a risk that such issues might be raised when the bush clearing starts. It is also necessary for the construction contractor(s) to have a chance finds procedures in case they discovered cultural heritage objects or sites during construction.

Mitigation measures:

- Conduct further consultations with chiefs during vegetation clearing and land preparation to avoid interference with any non-documented cultural/religious sites
- In case of chance finds, the construction activity shall be stopped, the site be secured and the responsible authority be notified

Conclusion

The magnitude of the impact on cultural heritage during the construction phase is **low negative** without mitigation (▲) and **insignificant** with mitigation (▲), while it is **insignificant** during the operation phase.

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	-----		▲		
Operation			▲		

7.4.8 Tourism

Construction and operation phase

Impacts on tourism: The recreational trips to Gbedin Falls by local people are mainly motivated by the aesthetic value of the waterfalls. This value will obviously diminish with the construction of the power station. On the other hand, the accessibility will improve with the construction of the new access road, and many people would probably be attracted to visit the place not because of its natural environment but to witness a modern hydropower station and a symbol of development. This will particularly apply to government officials, engineers and students who may come on study tours. However, since there is no tourism industry involved in such sightseeing, the overall impact on the tourism sector is negligible.

Mitigation measures:

- N/A

Conclusion

The magnitude of the impact on tourism is **insignificant** during both the construction phase and operation phase.

Phase	Magnitude				
	Large Negative	Medium Negative	Low/Insignificant	Medium Positive	Large Positive
Construction	-----		▲		
Operation			▲		

7.5 Overall Impact Assessment

Table 38 summarises the potential impacts of the planned Gbedin mini hydropower project without and with the proposed mitigation/enhancement measures. The overall impact scores are given for the construction phase and the operation phase, respectively.

Table 38: Summary of impact assessment without and with mitigation/enhancement measures.

Theme	Baseline Value	Impact Magnitude		Overall Impact	
		Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
CONSTRUCTION PHASE					
Physical Environment					
Topography and landscape	Medium	Medium negative	Low negative	--	-
Geology and soils	N/A	Medium negative	Low negative	--	-
Climate and air quality	High	Low negative	Insignificant	-	0
Noise	High	Low-Medium negative	Low negative	--	-
Hydrology	N/A	Low-Medium negative	Low negative	--	-
Water quality	Medium-High	Low-Medium negative	Low negative	--	-
Biological Environment					
Protection status	Low	Insignificant	Insignificant	0	0
Terrestrial and aquatic biodiversity	High	Medium negative	Low negative	--	-
Human Environment					
Population	N/A	Medium negative	Low negative	--	-
Land tenure/ownership and land use	N/A	Medium negative	Low negative	--	-
River use	N/A	Low-Medium negative	Low negative	--	-
Livelihoods and economic activities	N/A	Medium negative	Low positive	--	+
Infrastructure and services	N/A	Medium negative	Low negative	--	-
Health, safety and security	N/A	Medium negative	Low negative	--	-
Cultural heritage	Low	Low negative	Insignificant	-	0
Tourism	Low-Medium	Insignificant	Insignificant	0	0
OPERATION PHASE					
Physical Environment					
Topography and landscape	Medium	Medium negative	Low negative	--	-
Geology and soils	N/A	Low-Medium negative	Low negative	--	-
Climate and air quality	High	Medium-Large positive	Medium-Large positive	+++	+++
Noise	High	Insignificant	Insignificant	0	0
Hydrology	N/A	Medium negative	Low negative	--	-
Water quality	Medium-High	Low-Medium negative	Low negative	--	-
Biological Environment					
Protection status	Low	Insignificant	Insignificant	0	0
Terrestrial and aquatic biodiversity	High	Low-Medium negative	Low negative	--	-
Human Environment					
Population	N/A	Medium positive	Medium positive	++	++

Theme	Baseline Value	Impact Magnitude		Overall Impact	
		Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Land tenure/ownership and land use	N/A	Low negative	Insignificant	–	0
River use	N/A	Low negative	Low positive	–	+
Livelihoods and economic activities	N/A	Low positive	Low-Medium positive	+	++
Infrastructure and services	N/A	Low positive	Medium positive	+	++
Health, safety and security	N/A	Low negative	Insignificant	–	0
Cultural heritage	Low	Insignificant	Insignificant	0	0
Tourism	Low-Medium	Insignificant	Insignificant	0	0

Very large negative ----, Large negative ---, Medium negative --, Small negative -, Minimal/no 0, Small positive +, Medium positive ++, Large positive +++, Very large positive ++++.

7.6 Decommissioning Phase

7.6.1 Introduction

It is anticipated that the lifespan of the Gbedin mini hydropower plant will be at least 30 years (economic life) and probably a much longer technical lifespan. It is recognised that particularly the civil infrastructure can last up to 100 years and will be a long-term asset for the country. Indeed, very few hydropower schemes have so far been decommissioned due to old age. However, once hydropower production has ceased and the project is no longer required, it will be necessary to decommission the dam/weir, waterway structures, generating facilities and transmission line, and to return the affected area to a natural environment similar to that which existed prior to the construction.

A decommissioning plan will be prepared before the start of the decommission operations, taking the applicable legislation and environmental/social conditions prevailing at that time into account. Due to the obvious uncertainties related to the future scenario, the potential impacts and mitigation measures described below should only be considered as a preliminary analysis.

7.6.2 Potential Impacts

The environmental and social impacts of decommissioning include among others:

Ecological and landscape restoration: Removing dams involves significant risks as well as opportunities for restoration of the affected river environment. A decommissioning of the Gbedin mini hydropower plant and removal of the dam will re-establish the free flowing conditions at Gbedin Falls, hence restoring the river continuum. This is likely to have a positive impact on the local ecology and habitats associated with the waterfall. It will also bring back Gbedin Falls as a natural landscape feature with natural flow conditions.

Sediment transport: The removal of the Gbedin mini dam will expose the deposited sediments in the reservoir to the strong currents of the free-flowing river. Sediments which have been trapped upstream of the dam during the operating life will then be progressively transported downstream by the flow of the river. The increase in suspended sediments can affect aquatic life in a number of ways. Macroinvertebrates would be affected as their digestion slows down, leading to unfavourable conditions for reproduction. Suspended sediments may also cause respiratory problems for fish species, and under extreme conditions fish tend to stop feeding until conditions improve. Eggs and larvae of fish are generally more susceptible to physical damage from increased levels of suspended sediments. In the short term after decommissioning, much of the sediments will be deposited in the pool below Gbedin Falls.

Pollution: Decommissioning of the dam will involve blasting and other activities which will lead to temporary increase in noise and vibration as well as air pollution due to dust emissions. The deconstruction of buildings and dismantling of electromechanical equipment will also result in the creation of both hazardous and non-hazardous waste. Much of the waste will be inert building waste that could be reused in building works, and the disposal of the inert waste in suitable spoil areas is not expected to be of environmental concern.

Loss of employment: There will be loss of jobs as the hydropower plant is envisaged to provide a number of long-term employment opportunities during the operation phase. This adverse impact will only partly be compensated by the short-term jobs created by the decommissioning works.

Occupational health and safety risks: The decommissioning works will involve occupational health and safety risks similar to those of the construction phase.

7.6.3 Mitigation Measures

The following mitigation measures should serve as a basis upon which a detailed decommissioning plan can be devised at the appropriate time:

- The decommissioning works shall be undertaken in liaison with the relevant regulatory authorities and adhere to applicable safety guidelines to ensure that the decommissioned facilities do not become a hazard to the public or the environment.
- Complete or partial removal of sediments behind the dam, combined with stabilising the sediments by engineering measures or vegetation cover.
- Restoration of all disturbed sites to pre-construction conditions through landscaping and bio-engineering measures.
- Safe disposal of hazardous waste, concrete and similar non-recyclable construction materials, and recycling of scrap metal.
- Provide personal protective equipment and training to all workers, and ensure that all sub-contractors abide by the applicable health and safety procedures.

7.7 Cumulative Impacts

7.7.1 Introduction

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. The magnitude of the cumulative impacts can be equal to the sum of the individual effects (additive effect), or can be an increased effect (synergistic effect) or a decreased effect (antagonistic effect).

The cumulative impact includes two components:

- The anticipated future condition arising from the cumulative impacts
- The contribution of the development under evaluation to the cumulative impacts

The other existing and planned developments that have been selected for analysis (see below) include those identified by stakeholders to be of critical concern and that have a high relative importance. The cumulative impacts may translate into a wide range of changes in the physical, biological and human environment, but only the most significant issues are dealt with here.

7.7.2 Existing Projects

The only notable project currently being implemented in the project's area of influence is the upgrade of the Ganta – Sanniquellie road. This section has until now been a gravel road but is being asphalted. It is not known how long this work will take (depending on the performance of the contractors); however, there is a risk that it will not be completed before the commencement of construction at Gbedin Falls. In that case,

there might be interruption of construction traffic especially affecting the transportation of equipment and personnel to Gbedin Falls. It might also aggravate the community health and safety risks in the towns along the main road (i.e. Gbedin, Gbedin Camp 3, Tonwee and Kitoma). However, as the financing, detailed design and tendering for the Gbedin mini hydropower project is expected to take at least one more year, it is more likely that the road upgrade has been completed by the time the contractors are ready to mobilise at Gbedin Falls. In that case, the project will benefit greatly from the ongoing road project in terms of reduced transportation time and costs as well as improved road safety.

7.7.3 Other Planned Developments

As described in the baseline section, there is a mineral exploration license covering the area between Gbedin Falls and Sanniquellie. The license is held by Cavalla Resources, a company that is targeting Kitoma hill for future iron ore mining. In that case, it will become a bulk mining operation that will require large space for mining and infrastructure.

There seems to be two main alternatives to address this cumulative impact. One would be to change the line route during detailed design while the other is to take the risk that mining operations will not materialise and then to relocate the transmission line in case there is future interference from mining. Consultations with Cavalla Resources have confirmed that they prefer the transmission line to be re-routed prior to construction.

The cumulative impact of the Gbedin hydropower project together with the future mining operation is that the local environment and livelihoods will be significantly affected by increased loss of natural habitat and farmland as well as other associated risks. However, since the construction of the hydropower facility is likely to be completed before commencement of bulk mining operations, many of the potentially synergistic effects will not occur. It should also be noted that mining development will strengthen the overall need and justification for increased power generation since the mining company can be a major off-taker or buyer of the electricity.

7.7.4 Climate Change

Climate change can also be considered to contribute to cumulative impacts, or should at least be taken into account in future scenarios that can affect project sustainability and performance. This was not addressed in the feasibility design by Tractebel (2016), but the following points can serve as a summary of the predicted changes to weather patterns in Liberia due to global warming:

1. The 15 Regional Climate Models of the CORDEX-Africa ensemble predict a slight increase (5-10%) in precipitation and runoff in Liberia. ECOWAS (2017) predicts similar long-term increases based on the median results from 30 climate change models. These predictions are encouraging for future hydropower developments in Liberia.
2. The UNDB climate change profile states for Liberia that the recent climate trends are:
 - Increase of temperature of 0.8°C from 1960 to 2006; average rate is 0.18 °C per decade;
 - Increase in number of hot nights per year (average number increased by 57 nights);
 - Decrease of number of cold days per night (average decrease of 2.7 per month);
 - No significant increase or decrease of hot or cold days per year;
 - Mean annual rainfall has decreased since 1960, though it is difficult to determine if this part of a long-term trend or related to the variability of rainfall in the region. Rainfall between the 1960s and 70s were particularly wet, between the 1970s and 80s dry, and in 2005 and 2006 very dry (McSweeney et al. 2010).

Based on the above, it is not possible to predict in detail how the environmental and social impacts of the Gbedin project might be affected by climate change. The hydropower scheme is likely to remain technically feasible and economically viable, but local livelihoods can be expected to be faced with more unpredictable

weather. While this can contribute to increased vulnerability of project affected households in the long term, it also needs to be recognised that the project's impacts on livelihoods (without climate change) are relatively small and that people will benefit from electricity supply which in itself can make them more resilient to climate change. Overall, the environmental and social risks associated with climate change in the context of the Gbedin hydropower project are considered to be relatively minor.

7.7.5 Trans-Boundary Impacts

The World Bank Operation Policy (OP) 7.50 requires that international aspects of a project on an international waterway are dealt with at the earliest possible opportunity. As the Saint John River is a shared water resource between Liberia and Guinea and forms the international border at Gbedin Falls, the neighbouring country (Guinea) should be notified about the Gbedin mini hydropower project in order to ensure compliance with OP 7.50.

The notification was issued by the Ministry of Foreign Affairs in a letter to the Embassy of the Republic of Guinea in Monrovia dated 19th September 2018 (see Appendix 8). Furthermore, during consultations with Gampa town on the Guinea side, it was agreed that RREA would follow up with Nimba County to make sure that proper protocol is followed in communication between the Liberian and Guinean side. RREA consider the Gbedin project as a purely Liberian undertaking and does not expect that the cross-boundary context represents a major risk to project implementation.

Regarding the physical impacts on Guinea territory, they are limited to riverbank inundation in the Guinean part of the reservoir area. From consultations with Gampa-Guinea, there is no land use in this area and no farms to be affected. This was also confirmed by field observations. Hence, even if the Gbedin project touches on Guinean territory, the actual impacts are very few and minor. Indeed, there will be no permanent access or operation components on the right abutment of the dam/weir (i.e. on the Guinean side) and no change in downstream river flow (along the international border) due to the run-of-river operation.

The main reason for notifying the neighbouring country is to promote improved river basin management across international boundaries, and hence to lay the basis for addressing long-term cumulative impacts arising from increased water abstraction along the Saint John River and its catchment.

8 ANALYSIS OF ALTERNATIVES

8.1 Introduction

This chapter describes and examines the alternatives to the proposed hydropower project. While only one project alternative was examined in detail in Chapter 7, different technical alternatives have been considered in the early planning stage, as presented below.

Generally, a comparison of alternatives can help to determine the best method of achieving project objectives while minimising environmental and social impacts. Alternatives should be evaluated and compared on the basis of their potential environmental and social impacts, costs and feasibility.

It should be noted that the present ESIA has been carried out under a constrained project scenario, i.e. the project identification has largely been completed prior to the ESIA process. This chapter will therefore mainly deal with project-specific alternatives and not try to retroactively revisit the whole range of land use alternatives and power generation options in Liberia (e.g. thermal, wind, solar, biomass).

8.2 Alternative Sources for Electricity Supply

According to Tractebel (2016), the Gbedin mini hydropower project should be evaluated against two other alternatives:

- Supply from heavy fuel oil (HFO) units (selected as the most suitable technical alternative in Fichtner 2014)
- Imported electricity supply from the CLSG (Côte d'Ivoire – Liberia – Sierra Leone – Guinea) interconnector

Tractebel (2016) concluded that Gbedin mini hydropower project is both technically and economically preferable compared to these two other alternatives. This also applies to the project's environmental and social sustainability because:

- small run-of-river schemes are more climate-friendly than electricity produced from fossil fuels (see Section 7.2.3), especially when risks and impacts can be mitigated as in this project; and
- continued reliance on electricity imports will require other sources of power generation in the grid that are likely to be less sustainable than the Gbedin project (although this would need to be verified).

Compared to the risks and impacts associated with some of the other hydropower projects being planned in Liberia and as part of the CLSG network, such as those on the Saint Paul River which will involve extensive flooding of large tracts of forest and farmland, the Gbedin mini hydropower project can be classified as an environmentally sustainable and low-impact facility. Indeed, there are no environmental or social 'red flags' that would challenge the overall feasibility of this proposed hydropower scheme compared to other realistic alternatives.

8.3 Project-Specific Alternatives

8.3.1 Transmission Line

The electricity generated at Gbedin Falls will be evacuated to the existing 33 kV cross-border network through a 7.8 km long 33 kV transmission line to a new substation close to Kitoma town. The cross-border network is considered an off-grid network (not connected to the national grid) connecting Gbeunta in Côte d'Ivoire to Logouato, Duoplay, Karnplay, Sanniquellie and Ganta on one hand and Sanniquellie to Yekepa on the other hand. It is a conventional three-phase 33 kV line and is energized from Danane 90/33 kV substation in Côte d'Ivoire. Tractebel (2016) confirmed that there is sufficient future electricity demand within a 6 km buffer zone of the 33 kV cross-border network for the connection of the Gbedin mini

hydropower plant. Assuming that the network continues to operate off-grid in the short to medium-term, any surplus electricity produced can be sold to Côte d'Ivoire.

The future alternative is to connect the Gbedin power station to a proposed 66 kV transmission line from Yekepa to Ganta and Gbanga (passing near Gbedin). This transmission line has been proposed as an extension of the CLSG corridor but will not be constructed in the near future. However, Tractebel (2016) recommended that the design of the Gbedin substation takes this alternative into account.

From an environmental and social perspective, it is unlikely that such future option would have very different impacts than those described for the proposed 33 kV line. However, the alternative routing of a 66 kV line will need to be studied in detail to determine its environmental and social impacts before it can be evaluated against the currently proposed 33 kV line.

8.3.2 Access Road

The proposed access route is from a junction on the main Ganta-Sanniquellie road at Mr Kona town near Sanniquellie and through Gehwee town following the hills on the northern side towards Gbedin Falls. This involves upgrade of 9.5 km of existing road and a new road alignment of 7.8 km.

The alternative access would be from Gampa town where there is already a dirt road connection from the main road and a footpath towards to Gbedin Falls. However, even if this is the preferred option by the Gbedin and Gampa community, it is technically not feasible because of the low terrain which causes flooding during the rainy season. In order to have reliable access to the project site during the construction period and over the lifetime of the scheme, an access road alignment is required which is outside of the flood inundation zone and connects the left bank of Gbedin Falls to the main Ganta-Sanniquellie road to the east (Tractebel 2016).

Hence, although the alternative access from Gampa would benefit the community with better road infrastructure close to where the majority of people live while also avoiding forest clearing in the more remote areas east of Gbedin Falls (as currently proposed), it is not technically feasible and therefore not a preferred option. The only issues that can change this conclusion is the potential conflict with future mining at Kitoma hill which might require re-routing of the transmission line (and thus also a new road alignment).

8.3.3 Environmental Flow

The feasibility design by Tractebel (2016) did not provide for release of environmental flow into Gbedin Falls. However, as environmental flow is widely considered as a standard requirement in modern hydropower development (i.e. dams should not dry out even a small part of the river, especially an area with waterfall) and because it would help to maintain some of the natural characteristics of Gbedin Falls, it is our opinion that a minimum flow should be released from the weir into the waterfalls. A typical environmental flow release is 10% of the mean annual flow, which in this case is equal to 5.8 m³/s. Considering the large width of vertical rock at Gbedin Falls, a lower residual flow release would probably mean that the aesthetic benefits will diminish to a level where it is no longer warranted.

The implications of imposing an environmental flow requirement should be assessed in terms of lost power production. Obviously, the economic loss would mainly be caused by lower production in the dry season while there will be no impact in the wet season (when there is significant spilling of water from the dam).

8.4 No Project Alternative

Under the "no project" alternative, the proposed Gbedin mini hydropower project would not be constructed and operated, and hence, the identified environmental and social impacts would not occur. However, choosing the no project alternative does not necessarily correspond to maintaining baseline conditions or status quo, as changes may result from other actions.

Continued growth in power demand in the region and country as a whole – and in Nimba County in particular – is likely to trigger other power generation options, especially fossil fuel-based thermal power plants, which are associated with high recurrent costs and air emissions. Assuming, on the other hand, that the proposed project would not be replaced by alternative power generation, the no project alternative will have foregone costs in terms of suppressed economic growth.

The environmental impacts of the no project alternative would be positive in terms of biodiversity, at least on the local scale and in the short term until other hydropower projects are possibly developed on the Saint Paul River or other nearby rivers. Similarly, the no project alternative would not involve any economic displacement (e.g. loss of farmland) and would allow the communities to continue their current land use practices.

However, given that most of the adverse environmental and social impacts can be successfully mitigated, the no project alternative is not considered to be a preferred option when taking all technical, economic, social and environmental aspects into account. Indeed, if the regulators and/or financiers opt for the no project scenario, an alternative solution with other renewable energy sources should be explored in order to meet the growing demand for electricity in Nimba County.

9 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1 Introduction

One of the objectives of the ESIA process is to develop an Environmental and Social Management Plan (ESMP) which outlines the costs, timeframes and responsibilities to implement the mitigation and enhancement measures.

This chapter presents the preliminary ESMP for the Gbedin mini hydropower project based on the information available at the current stage of project development. It is expected that the ESMP will be refined during the detailed design phase and once the construction contractors have been identified. Thus, the ESMP will need continuous revision and updating.

In order to facilitate the next project phase, the mitigation measures that were listed as bullet points in Chapter 7 have been organised into a series of “sub-ESMPs” and elaborated in further detail here. The construction-related requirements are presented as specifications that can be inserted into the tender documents (Section 9.3).

The sole responsibility for the implementation and outcome of the ESMP rests with the Rural and Renewable Energy Agency (RREA) as the project proponent. RREA shall be committed to manage all the environmental, health, safety and social risks and impacts identified in this ESIA study as elaborated below.

9.2 Institutional Arrangements

The institutional arrangements for the Gbedin mini hydropower project have not yet been decided. However, for the purpose of this preliminary ESMP, it is assumed that all the project components will be owned and operated by a single entity, hereinafter called the ‘Company’, either under RREA management or as a separate utility. Other institutions are likely to include an Owner’s Engineer, construction contractors, financiers/lenders and the relevant government agencies including the local administration, as outlined below.

Regulatory Authorities

For purposes of this project, the regulating body will include all those government institutions responsible for enforcing compliance with national standards in the different areas of specialisation. These will include but not be limited to those represented in the Rural Energy Working Group:

- Ministry of Lands, Mines and Energy
- Ministry of Health and Social Welfare
- Ministry of Education
- Ministry of Planning and Economic Affairs
- Ministry of Justice
- Ministry of Internal Affairs
- Ministry of Gender and Development
- Ministry of Public Works
- Liberia Electricity Corporation
- Liberia Water and Sewer Corporation

The Environmental Protection Agency (EPA) will be responsible for issuing the environmental impact assessment licence and for compliance monitoring relating to environmental regulations and standards.

The Ministry of Agriculture will provide technical support during the compilation of compensation rates for agricultural products and contribute to livelihood restoration activities as/when relevant.

The local administration at county and district level will be involved in the land acquisition process and serve as the link between the company and the communities. The chiefs at the various levels together will assist in mobilising the people, addressing grievances, and overseeing project implementation.

Company

The Company will have the primary overall responsibility for the implementation of the ESMP and for ensuring compliance with national legislation and international lenders' guidelines for environmental and social performance.

For the purpose of ESMP implementation, the Company (or the Owner's Engineer) will be expected to establish an Environmental and Social Management Unit and designate at least two appropriately experienced and qualified persons in charge of the environmental and social management. The two staff shall be assigned as Environmental Officer and Community Liaison Officer, respectively, and be supported by local assistants especially during the land acquisition and compensation process. In addition, the Company (or the Owner's Engineer) shall be staffed with an appropriate number of health and safety inspectors.

The Environmental and Social Management Unit will implement the Company's ESMP (see Section 9.4), either directly or in partnership with professional service providers such as non-governmental organisations (NGOs) or consultants. It should be noted that there is already an Environmental and Social Unit in RREA which is expected to facilitate ESMP implementation and provide technical guidance and backstopping to the project staff.

Owner's Engineer

The Company will possibly appoint an Owner's Engineer to supervise and manage the overall implementation of the Gbedin mini hydropower project. The Owner's Engineer will act as a construction manager during the construction phase and possibly as an operator of the power station during the initial stages of the operation phase. The Owner's Engineer will typically be responsible for health and safety management, but could also be delegated with the responsibility to implement other parts of the Company's ESMP.

Contractors

The Contractors will be responsible for avoiding or minimising environmental impacts caused by construction activities. It is expected that the construction works will be managed by an EPC Contractor which will be required to have an Environmental, Health and Safety (EHS) Unit. The EPC Contractor will be responsible for managing and monitoring the environmental and social mitigation measures in accordance with the contractual obligations. The EPC Contractor will also be responsible for ensuring that all sub-contractors are in compliance.

Consultants and NGOs

The Company is likely to delegate certain environmental and social management tasks to external consultants and/or non-governmental organisations (NGOs). Consultants will be needed for some of the specialised monitoring and evaluation activities, while NGOs might be assigned to deliver community health and safety services, among others. NGOs can also serve as witness to land acquisition and grievance management.

Financiers/Lenders

The Gbedin mini hydropower project is likely to be backed by grants and loans from international financial institutions, including the African Development Bank (AfDB). However, until the financing structure has been agreed, the roles and responsibilities of financiers and lenders are unknown.

A requirement of lender policies is usually that the project proponent engages a Panel of Experts to provide regular oversight of compliance with the relevant safeguard policies and performance standards. The financiers will normally also request for quarterly progress reports.

9.3 Construction Contractors' ESMP

9.3.1 Introduction

As explained above, the detailed contractual arrangements for the construction of the Gbedin mini hydropower project have not yet been decided. The Construction Contractors' ESMP therefore applies equally to all the Contractors (and sub-contractors). Each Contractor will be expected to comply with the relevant requirements within their scope of work.

Based on the requirements in the present Construction Contractors' ESMP, each Contractor shall develop a detailed Environmental, Health and Safety (EHS) Plan in accordance with their own policy framework and management systems to ensure that the organisation can fulfil all tasks required to achieve the objectives. The EHS Plan shall indicate how and when the Contractor expects to put the mitigation measures listed in the ESMP into practice, as well as how to monitor and report compliance. The overriding principle of the construction management will be to comply with the requirements of ISO 14001:2004 and OHSAS 18001:2007 as well as the environmental and social standards of the financiers and lenders (e.g. AfDB's Operation Safeguards, IFC's Performance Standards and EHS Guidelines).

In order to ensure compliance, the requirements in this Construction Contractors' ESMP should be incorporated into bidding and contract documents, either by placing environmental and social clauses directly into the documents or by attaching the ESMP as a legal condition. Moreover, when evaluating the tender bids, an environmental and social specialist should be assigned to review how each bid has addressed the environmental and social clauses and conditions. The environmental and social criteria should be included as part of the basis for selecting the Contractors.

It should be noted that the costs associated with the Construction Contractors' ESMP have not been estimated, as the environmental and social criteria will be included in the tender package upon which the tenderers will develop their base rates. Hence, the costs of the construction-related environmental and social management will be within the contract price. It is recommended that the environmental and social costs, as well as the occupational health and safety costs, are specified in the tenders and that payments to the Contractors are made conditional on performance.

9.3.2 General Requirements

Contractor's EHS Plan: Following the award of the construction contract and before the Contractor mobilises, the Contractor shall prepare a detailed and project-specific EHS Plan to show how the Contractor will meet the conditions of the Employer's EHS requirements.⁵

Risk management: The Contractors shall ensure that critical operations within their respective scope of work are systematically identified, analysed, evaluated and documented at the planning stage and by use of a recognised risk assessment method and that adequate control measures are taken. At a minimum, the Contractor's risk management should comprise of Job Safety Analysis/Job Hazard Analysis (JSA/JHA) and toolbox talks.

EHS induction and training: The Contractors shall establish an EHS induction program for all their personnel that are going to work at the project site, including sub-contractor personnel. The Contractors shall establish and operate a register of all personnel and visitors that have passed this induction.

⁵ In this section, the terms 'Employer' and 'Engineer' have been used instead of 'Company' and 'Owner's Engineer', respectively, to comply with standard FIDIC terminology.

EHS monitoring and inspection: The Contractors shall establish an EHS monitoring and inspection plan in accordance with the Contractor's EHS Plan and in compliance with applicable rules and regulations. The Company/Employer (and Owner's Engineer) has the right to participate in the site inspections. EHS topics to be monitored and inspection findings shall be documented. Proper follow-up of inspection findings shall be ensured.

EHS meetings: The Contractor shall participate in regular EHS meetings with the Company/Employer (and Owner's Engineer). The meetings shall be used to review the effectiveness of the Contractor's EHS efforts, to resolve EHS problems relating to current operations, and to provide a forum for planning future construction activities and EHS tasks. The EHS meetings can be held as part of the weekly construction meetings where EHS items shall be included on the agenda.

Incident reporting and investigations: The Contractors shall have a documented procedure for reporting and handling of incidents occurring during and outside work hours. All medium and major incidents, including near misses with a potential of major or medium consequences, shall be reported without delay to the Company/Employer (and Owner's Engineer).

Monthly EHS reports: The Contractors shall provide monthly reports to the Company/Employer regarding EHS performance and compliance.

9.3.3 Landscape and Land Cover Management

General Landscape Management

The Contractor shall exercise care to preserve the natural landscape and shall conduct the construction operations so as to prevent any unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. Except where clearing is required for permanent works, approved construction roads, or excavation operations, all trees and vegetation shall be preserved and shall be protected from damage by the Contractor's construction operations and equipment. Movement of labour and equipment within the right of way and over routes provided for access to the work shall be performed in a manner to minimise damage to crops and property.

In general, re-vegetation of damaged or final slopes will be required; however, on completion of the work, all work areas not re-vegetated shall be scarified and left in a condition which will facilitate natural re-vegetation, provide for proper drainage, and prevent erosion. All unnecessary destruction, scarring, damage, or defacing of the landscape resulting from the Contractor's operations shall be repaired, replanted, re-seeded or otherwise corrected as directed by the Engineer, and at the Contractor's expense. The species used for replanting shall as far as possible be local species and must not be listed as a noxious weed. The seed blends used must not contain seeds from such.

Spoil Disposal and Management

Spoil material shall not be disposed or used of outside of approved spoil areas without approval from the Engineer. The spoil areas shall be constructed as shown on the typical drawings, and shall include drainage facilities as well as facilities to prevent spoil to seep or erode out of the spoil area.

Spoil shall be compacted as described elsewhere in this specification. Wherever possible, the spoil areas shall be shaped or reshaped and treated such that farming is possible after completion of the works.

When they are no longer required, areas used for the disposal (spoil areas) or storage of surplus materials shall be reinstated by landscaping, including the replacement and spreading of topsoil to the satisfaction of the Engineer. Steep spoil walls shall be fenced to prevent accidents.

Vegetation Clearance in Right of Way

Vegetation clearing will be required in the right of way during construction and operation of the transmission line. Clearing vegetation outside the approved right of way may be required in areas that have vegetation capable of growing and potentially interfering with the operation of the transmission line.

The Contractor shall ensure that the following general rules are adhered to during clearing:

- The Contractor shall obtain approval from the Engineer prior to clearing the right of way and any adjacent areas that may require clearing
- The Contractor shall ensure that vegetation clearing procedures are developed and communicated to the workers directly involved in the clearing activities prior to the commencement of clearing work.
- Vegetation clearing shall be limited to the approved right of way, except where the potential exist for vegetation outside the approved right of way to interfere with the transmission lines.

The Vegetation Clearing Procedures or Method Statement, at a minimum, should address the following: a) limit of vegetation clearance b) vegetation clearing methods and c) environmental safeguards for erosion, sedimentation and pollution.

Where vegetation removal is required in, or around environmentally-sensitive areas such as riparian zones and wetlands, the Contractor shall take special precautions to minimise potential impacts. Around riparian areas, for example, the Contractor shall, to the extent practicable, maintain desirable streamside vegetation in order to maintain habitat, shading, and bank stability and to minimise the potential for sedimentation. In wetlands, the Contractor shall take special precaution to minimise rutting. Where practicable, only low-impact equipment (low ground pressure equipment) shall be used in wetlands.

Pre-Impoundment Biomass Clearing

The Contractor shall be responsible for pre-impoundment clearing of trees in the reservoir. The objectives of the biomass clearing includes:

- Reducing the amount of biomass, thereby reducing the risk of poor water quality and greenhouse gas (GHG) emissions from decay of organic matter in the reservoir
- Reducing the amount of wood debris floating on the reservoir and/or getting into the trash racks
- Reducing the number of dead trees standing in the water which would become an aesthetic nuisance and an obstacles for potential boat transport and fishing in the reservoir

The reservoir clearing shall start from the riverbanks towards the future reservoir banks so that the animals can escape into the right direction. In addition, animal rescue operations shall be done as part of the clearing (and during initial filling of the reservoir) in order to reduce the number of animals drowning during impoundment.

It is important that the pre-impoundment vegetation clearing is confined to below the Full Supply Level (FSL), such that existing vegetation along the shores of the reservoir is protected.

Local people should be employed to carry out this work and be equipped with personal protective equipment (PPE) and safety training by the Contractor. Local people should also be allowed to make use of the wood.

Site Restoration

On abandonment, all temporary buildings not selected to remain, including concrete footings and slabs, and all construction materials and debris shall be removed from the site before the final handing over. The area shall be re-graded, re-vegetated and maintained for the duration of the Defects Liability Period, so

that all surfaces drain naturally, blend with the natural terrain, provide for proper drainage, and prevent erosion.

9.3.4 Soil Erosion and Sedimentation Control

Sites within the project area not disturbed by construction activities shall be maintained in their existing condition. Only approved areas due for construction activity shall be cleared for vegetation and topsoil. The area disturbed shall be minimised in order to limit the opportunity to provide a source of erodible material. All exposed surfaces shall be covered with topsoil and replanted or re-seeded, at the Contractor's expense and as directed by the Engineer, at the earliest possible opportunity.

Soil erosion and sediment control practices shall be implemented prior to any major soil disturbance and be maintained until permanent protection is established. The effectiveness of the soil erosion and sediment control measures shall be regularly inspected.

All the water draining down from quarry sites needs to be lead to sedimentation and neutralisation ponds and has to be treated before releasing it to the recipient water body. Similarly, all the waters from the batching plants, the concrete mixer washing facilities and the crusher plants needs to be collected and treated before releasing to the environment.

Sedimentation controls shall be implemented in the form of silt trap fences, sedimentation ponds and drainage channels where appropriate. These shall be built prior to the start of the activity and shall be maintained until the completion of that activity. All structures including silt fences, bunds and sediment basins need regular maintenance to remove silt.

The siting of temporary facilities and design of storm water drainage facilities shall be carefully planned so that these do not create flows at erosive velocities to previously safe discharge points.

Along the access road, provisions shall be made for suitable and adequate permanent drainage facilities. Installed culverts shall have enough capacity for strong rains. Drainage pipes and channels shall be of an adequate size and should be equipped with screens at entrance and exit points to reduce the risk of clogging.

Vehicle washing facilities or rumble strips shall be sited at exits to construction sites to remove mud from vehicles and machinery before leaving the site. Wash down bays must discharge to a sediment collection basin and only after that to a watercourse.

For in-stream works, isolation techniques such as berming or diversion shall be used during construction to limit the exposure of disturbed sediments to moving water. The duration and timing of in-stream activities shall be restricted to periods that are not critical to biological cycles of valued flora and fauna (e.g., migration, spawning, etc.). During in-stream construction periods, water turbidity immediately downstream shall be monitored.

Coffer dams shall be constructed such as to minimise releases of sediments and pollutants to the downstream environment (e.g. avoiding low flow periods and rock material with high content of fine particles).

The Contractor shall carry out regular water quality measurements in the Saint John River, downstream of the construction sites, to demonstrate compliance with applicable water quality standards. The water quality monitoring shall focus on pollution parameters including turbidity, hydrocarbons and coliforms.

The Contractor shall notify the downstream communities about construction activities and schedules in the Saint John River.

9.3.5 Waste and Wastewater Management

General Waste Management

Waste management planning:

- The Contractor shall identify all waste streams and characterise the waste according to its source, composition, generation rates, and treatment or disposal method.
- Waste management shall be based on a hierarchy that considers prevention, recycling and reuse, treatment and disposal.

Waste prevention:

- The Contractor shall institute good housekeeping and operating practices, including inventory control to reduce the amount of waste.
- The Contractor shall institute procurement measures that recognise opportunities to return usable materials and which prevents the over-ordering of materials.

Recycling and reuse:

- The Contractor shall identify potentially recyclable materials (e.g. scrap metals).
- The Contractor shall investigate external markets for recycling and reuse.

Treatment and disposal:

- The Contractor shall consider opportunities for biological, chemical, or physical treatment of the waste material prior to final disposal.
- Disposal could include composting for organic non-hazardous wastes and properly planned and operated landfills or incinerators designed for the respective type of waste.
- Any fees or charges required to be paid for dumping of materials shall be paid by the Contractor and shall be included in the bid.

Site clean-up:

- A full clean-up of the site shall be carried out after construction. All wastes accumulated during construction and all demolition wastes from temporary structures have to be disposed properly.

Solid Waste / Household Waste

The different types of solid waste shall be separated and disposed of separately. Solid waste generated during construction and at campsites shall be properly treated and safely disposed of only in demarcated waste disposal sites.

A sufficient number of garbage bins and containers shall be made available at the main work sites and camps. The containers shall be marked with clear labels for 'organic', 'paper' and 'other waste' for sorting waste collection.

Garbage and other waste shall be regularly collected and be transported to a designated waste disposal site located at a distance from the nearest village and from watercourses or wells. Only materials approved by the Engineer may be buried.

The waste disposal site shall be protected from contaminating groundwater by an impermeable membrane or clay. When parts or the waste disposal area are full, they shall be sealed and covered by a minimum of 1.5 m of soil, and then re-vegetated.

Suitable sanitary and solid waste collection and disposal facilities or systems shall be provided at all camps, workshops, stores, offices, and long-term main work sites.

Domestic Wastewater

The Contractor shall supply and install wastewater treatment facilities for processing and disposal of sewage from the Contractors' housing, camp accommodation, camp amenities, workshops, stores, offices, and other buildings and facilities. The facilities shall be complete with adequate closets, urinals and hand-basins, septic tanks, absorption trenches or other sewerage disposal installations.

The septic tank and/or temporary holding tank(s) shall be kept pumped out at such intervals that the tank(s) will not overflow and contaminate the ground, flowing streams or surface drainage. On completion of the works, sanitary facilities shall be properly disinfected and all evidence of same including temporary buried tanks and foundations removed from the site.

The Contractor shall install, operate and maintain temporary toilet facilities at all work sites. Toilets (male and female separate) shall be installed at each short-term work site employing 5 workers or more. At least one toilet shall be installed per 20 workers. A distance of at least 15 m to the river has to be kept.

All water discharged from the works and living areas into natural waterways from the wastewater treatment facilities shall be chemically tested. The water quality shall comply with the sanitary sewage discharge standards according to World Bank Group EHS Guidelines.

Hazardous Materials and Hazardous Waste Management

All refuelling of heavy equipment and machinery shall be undertaken by a service vehicle, with appropriate safeguards and protection measures to prevent any spillage or contamination by chemical wastes or maintenance oils, lubricants, etc.

All the fuel and hazardous material shall be stored in special designated facilities away from the river. The storage shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills. Storage areas shall be designed such that they will contain 110% of the largest container/vessel stored in the storage area; suitable clean-up equipment and material needs to be on site.

Each storage container should be marked visibly with the necessary precaution signs and the Material Safety Data Sheet needs to be readily accessible to the workers.

The diesel shall be stored in a standard skid tank with secondary containment proving 110% volume of the total capacity of the skid. The skid tank shall be located at least 100 m away from any watercourse. The skid tank shall be inspected at regular intervals to ensure that the diesel is handled in accordance with the specification and that no spillage occurs.

Maintenance of machinery and trucks shall be done in workshop servicing and repair areas away from the river. Storm water runoff from open workshop servicing and repairs areas and banded storage areas shall be collected and treated in hydrocarbon separation pits/tanks before discharge into drains or waterways.

Spent solvents and oily rags, empty paint cans, used lubricating oils, used batteries, lighting equipment, etc. shall be categorised as a scheduled waste. This scheduled waste is to be stored in containers, with proper bunds, which are able to prevent spillage or leakage of the scheduled wastes into the environment. The containers of the scheduled wastes shall be clearly labelled for identification and warning purposes.

The Contractor shall engage a certified contractor to collect, transport and dispose of all the scheduled waste generated at the project site. Alternatively, this responsibility can be given to the supplier. The Contractor shall verify that each supply/disposal sub-contractor has adequate arrangements or facilities for proper transport, disposal, treatment or recycling of these wastes.

All employees working with hazardous materials should be trained in hazard identification, safe operating procedures, appropriate materials handling procedures, safe work practices, basic emergency procedures, and (if applicable) special hazards unique to their jobs.

Transportation procedures for hazardous materials should be prepared to be consistent with internationally accepted standards and should cover, at a minimum, the following: (i) ensuring that the nature, integrity and protection provided by packaging and containers used for transport are appropriate for the kind and quantity of hazardous material involved; (ii) ensuring adequate transport vehicle specifications; (iii) routes used; (iv) loading and unloading procedures; (v) informing employees involved in the transportation and training them as appropriate to handle normal operations and emergencies; (vi) using labelling and placarding (external signs in transport vehicles) as required; and (vii) providing the necessary means for emergency response; and (viii) compliance audit procedures.

9.3.6 Pollution Spill Contingency Plan

The Contractor shall prepare procedures for handling accidental spills of hazardous materials. The procedures shall include:

- Procedures for immediate actions specified for all relevant hazardous materials used in the construction processes.
- Complete list of equipment available for use in emergency situations.
- Procedures for neighbours and downstream warning in cases of accidental release of hazardous substances.
- Procedures for immediate information to the Engineer in case of discharges and standards for reporting irregular events.
- Program for training of key staff in emergency responses. The training shall be based on various emergency scenarios.

The following principles must be included in the procedures: (a) the source of the leak or spill must be stopped immediately once discovered; (b) the alarm must be raised throughout the site; (c) work on the site must be stopped and all available resources directed into resolving the problem; (d) emergency measures must be taken to contain all remaining material; (e) where appropriate, measures must be taken to neutralise hazardous substances; (e) the Engineer shall be informed immediately; and (f) site-specific and material-specific details will be given for the disposal of contaminated soil and water, and mitigation of the damage caused.

At a minimum, the Contractor must ensure that storage areas have spill kit, sand, dust, and other appropriate absorbent materials, and a spill containment plan displayed. Staff members in charge of storage area must have appropriate training.

The Contractor shall ensure that all site supervision staff is aware of the procedures and capable of implementing them. In the event of a leak or spillage, the Contractor shall bear all liability whether the plan is implemented or not.

9.3.7 Air Pollution Control

The Contractor shall use only adequate and well maintained construction and transportation equipment including diesel fuel of good quality. Equipment and vehicles that show excessive emissions of exhaust gases due to poor engine adjustments, or other inefficient operating conditions, shall not be operated until corrective repairs or adjustments are made.

The Contractor shall organise the sequence of construction activities in a way that the use of construction equipment powered by diesel fuel is optimised and the duration of use is minimised.

The Contractor shall take appropriate measures for dust suppression; this includes among other good housekeeping and water sprinkling especially on unpaved access roads. The Contractor is required to maintain a record of dust control spraying which shows the date and location when water has been sprayed. The dust spraying activities is to be included within the Contractor's monthly report.

Trucks which transport construction material for longer distances should be covered by a tarpaulin.

Burning of materials resulting from clearing of trees and bush, combustible construction materials, and rubbish will be permitted only when atmospheric conditions for burning are considered favourable and when authorised by the Engineer. In lieu of burning, such combustible materials may be disposed of by other methods as provided in this specification. Where open burning is permitted, the burn piles shall be properly constructed to minimise smoke, and in no case shall unapproved materials, such as tires, plastics, rubber products, asphalt products, or other materials that create heavy black smoke or nuisance odours, be burned. Burning of hazardous combustible material is not permitted.

The Contractor shall carry out regular Particulate Matter (PM₁₀) measurements, using standard air sampling equipment, to demonstrate compliance with WHO Air Quality Guidelines, or the applicable Liberian guidelines, whichever is strictest.

9.3.8 Noise Management

The Contractor shall carry out regular noise level measurements (Leq, dBA), using standard sound level meter, to demonstrate compliance with IFC Noise Level Guidelines which are also consistent with the Liberian standards for noise pollution. In case of non-compliance, mufflers and other noise control devices shall be installed in construction equipment and vehicles, while construction workers shall be provided with adequate hearing protection.

Other requirements:

- Installation areas, for example mechanical workshops etc., shall be separate from areas that are used by people for temporary housing and recreation.
- The crushing plant must be located in a sufficient distance to any populated area.
- Avoid any noise-intensive works such as piling, demolition, metalworking and blasting etc. during night time.
- Avoid transporting of material (rock, concrete, steel, machinery) during night time.
- Instruct the workforce to avoid unnecessary noise.

9.3.9 Chance Finds Procedure

The Contractor shall educate the construction workforce of the need to be vigilant in the detection and reporting of, and the prevention of disturbance and damage to, objects and sites of physical and cultural resources.

The Contractor shall prepare a detailed chance finds procedure based on the following guidelines:

If any person discovers a physical cultural resource, such as (but not limited to) archaeological sites, historical sites, remains and objects, or a cemetery and/or individual graves during excavation or construction, the Contractor shall:

- Stop the construction activities in the area of the chance find.
- Delineate the discovered site or area.
- Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities take over.

- Notify the Supervising Engineer who in turn will notify the Ministry of Information, Cultural Affairs and Tourism and the responsible local authorities immediately (within 24 hours or less).

The Ministry of Information, Cultural Affairs and Tourism is in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by archaeologists. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage.

Decisions on how to handle the finding shall be taken by the Ministry of Information, Cultural Affairs and Tourism. This could include changes in the layout (such as when finding an irremovable remain of cultural or archaeological importance) conservation, preservation, restoration and salvage.

Implementation for the authority decision concerning the management of the finding shall be communicated in writing by relevant local authorities, and construction works could resume only after permission is granted from the Ministry of Information, Cultural Affairs and Tourism.

9.3.10 Occupational Health and Safety

Occupational Health and Safety Planning

The Contractor is required to submit an Occupation Health and Safety (OHS) Plan as part of the Contractor's EHS Plan. As a minimum, the plan must:

- Describe the overall OHS policy of the organisation
- Describe hazards and risks to workers' safety and health arising from the working environment
- Identify which sources of injury and harm that can be eliminated, and identify preventive and/or protective measures that can be implemented in order to avoid those hazards and risks that cannot be eliminated
- Based on this analysis, formulate the company's OHS objectives for the Gbedin mini hydropower project, a plan for achieving each objective, and suitable measurement criteria for confirming that each objective has been achieved

Awareness and Training

In order to achieve the objectives defined in the OHS management plan, the Contractor should ensure that personnel on all levels in the organisation are aware of and participate in OHS activities.

The Contractor shall establish and maintain the necessary arrangements to ensure that all persons with OHS responsibilities at all levels are competent to perform their duties and responsibilities. The Contractor shall provide initial and refresher OHS training for all members of the organisation. This training course shall also include education on Sexually Transmitted Infections (STIs) and their prevention.

Incidents Reporting and Investigations

The Contractor is required to identify, investigate, record and report all incidents including accidents, near misses, diseases, and environmental incidents. The findings and conclusions of every investigation shall be reported to the Engineer without delay. The Contractor shall notify the Engineer immediately when any accident occurs whether on site or off site in which the Contractor is directly involved which results in any injury to any person whether directly concerned with the site or whether a third party. Such initial notification may be verbal and shall be followed by a written comprehensive report within 24 hours of the accident.

Emergency Preparedness and Response

The Contractor shall establish and maintain emergency preparedness and response measures, including first-aid stations, fire-fighting equipment, trained personnel and an evacuation plan in case of emergencies and serious accidents.

The emergency preparedness and response plan shall describe how to provide rapid and effective countermeasures to contain and control incidents and to prevent or limit undesired consequences. The emergency preparedness and response plan shall outline the following:

- Notification and warning procedures, including coordination with Engineer
- Evacuation procedures
- First aid facilities and equipment
- Procedures for rescue of people and treatment of the injured
- System for registration of personnel

Training drills should include rescue, evacuation, first aid, firefighting (use of different extinguishing agents and fire truck), communicating and use of communication equipment.

The Contractor shall produce accessible consultation sheets for review in case of emergency situations. These should have phone numbers for police, fire-fighters, hospital, site manager, etc.

Medical Screening

In order to facilitate placement decisions and early detection of occupational diseases, pre-placement and periodic medical screening of all workers is required. Qualified medical personnel, with the help of an approved checklist, should do this. The Contractor shall keep health records of all the Contractor's personnel.

Health Services

The Contractor shall provide first-line free qualified medical assistance for the benefit of the Contractor's personnel and their families. In addition, the Contractor shall ensure that there is an ambulance service available.

The Contractor shall provide first aid equipment at each construction site. The Contractor shall ensure that at least two people amongst the site staff and this for each of the different working areas/working groups, during site working hours are trained in first aid.

Malaria and HIV/AIDS Prevention

Special precautions shall be taken by the Contractor at his own expense to keep the incidence of malaria and other diseases as low as possible. The Contractor shall spray with approved insecticide the interiors of buildings which he occupies within one week of their occupation under the Contract and at two monthly intervals thereafter. Further, the Contractor shall have sufficient number of ultraviolet electronic lamps (at least one per building).

All pools of water and other likely mosquito breeding places within and adjacent to the works area shall either be eliminated or sprayed in an approved manner.

The Contractor shall provide mosquito nets to workers and prophylactic treatment for malaria.

The Contractor should ensure that his workforce is made fully aware of the causes and dangers of HIV/AIDS and ensure that a supply of condoms is available at all times at his camp facilities.

The Contractor shall provide support and not stigmatise their HIV positive employees.

Safety Equipment and Regulations

The Contractor shall provide proper safety equipment and draw up emergency regulations, including fire and electric shock prevention, stretchers and first aid boxes, together with rescue facilities, as well as properly trained personnel to administer these.

Lifesaving vests and lifesaving rings shall be available at construction sites bordering the Saint John River.

The Contractor shall provide adequate training regarding justification for and use of safety equipment to all workers. The Contractor shall make basic safety equipment available, and enforce use of such equipment during all working operations, which may expose workers to occupational health hazards.

Minimum requirement to Personal Protective Equipment (PPE) for all personnel at site (does not apply to indoor offices and in vehicles) are:

- Protective helmet / hardhat
- Protective footwear/safety boots
- Working clothing with strong colours and wide reflecting bands (similar vests shall be used by visitors)
- Safety glasses or over specs

Additional PPE such as ear, eye and respiratory protection or fall protection shall be provided when required to avoid occupational health incidents or illnesses as stipulated in regulatory requirements, material safety data sheets or Job Hazard Analysis.

The Contractor shall provide hearing protection for all workers working around equipment or at locations with a noise level of 80 dB(A) or more (e.g. heavy equipment and drills, blasting activities). The Contractor shall provide an appropriate instrument at site to measure noise levels.

All employees working with hazardous materials shall be trained and provided with suitable personal protection equipment (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, sanitary facilities, pre-employment and scheduled periodic medical examinations.

All restricted plant facilities shall be labelled with caution signs, especially those with potential risk for workers. Moreover, all construction areas shall be marked and fenced to avoid accident from unauthorised people.

The Contractor shall provide PPE for all own personnel. The EPC Contractor shall, in addition, provide PPE to the Employer's staff and representatives and any authorised visitors to the site.

Illumination

All working sites in the open, transit areas, excavation sites, etc., shall be adequately illuminated during night work by electrical lights.

Explosives Storage and Handling

The management of explosives shall take into account the procedures established by the responsible authorities of Liberia and/or such international standards as USBR Safety Handbook (or equal).

Explosives shall be transported to the storage magazines in appropriate containers and with appropriate vehicles and accompanied by trained personnel. Designated closed containers with insulation shall be used for the transport. Separate containers shall be used for the detonators.

The storage needs to have an area open surrounding of at least 10 m and no other combustible material is allowed to be stored in a distance less than 20 meter.

All magazines used for the storage of explosives shall be kept locked at all times except when opened by the designated person, under the supervision of the blaster. Locking systems installed in magazines shall comply with the safety requirements. All tools, as well as electrical and mechanical equipment used in

connection with blasting, shall be separately stored in a compartment devoted exclusively to such purpose at all times except when in use. Detonators should be stored in a different storage. Blasting agents should be stored separate from explosives, safety fuses and detonating cords.

No person, unless duly authorised by the responsible person, shall have access to or enter any magazine or explosives storage enclosure. Detonators or other explosives when removed from magazines shall not be left unguarded where unauthorised persons may have access to them.

Each magazine containing explosives shall be inspected regularly. All explosives and detonators shall be recorded in a log-book. Such inspection shall include the magazine exterior and interior with special attention to door and locking mechanisms. Any evidence of unauthorised entry or attempted unauthorised entry or missing explosives shall be reported immediately to the relevant person/authority.

The Contractor shall maintain a record of storage and withdrawal of all explosives. This record shall be made available to the Engineer on request. The Engineer shall be promptly notified of any loss or theft of explosives.

No person shall smoke or carry open flames, lighted objects or other spark-producing devices such as radio, walkie-talkie, hand phone, or mobile phone within 30 m of any magazine containing explosives nor within 30 m of any other explosives.

Explosives which have deteriorated or have been damaged so as to be unfit for use or are unwanted shall be destroyed in a safe manner only by a certified blaster.

Blasting

All blasting shall be carried out in a workmanlike and safe manner by a competent and experienced blaster and no blast shall be fired without his approval.

Blasting will be permitted only after adequate provisions have been made for the protection of persons, the works, and public or private property. The Engineer's approval of any of the Contractor's blasting operations shall not relieve the Contractor of his sole responsibility for the safety of persons and property. Any damage done to the works or property by blasting shall be repaired by the Contractor.

Blasting in the open air shall be carried out only at certain hours of the day agreed upon by the Contractor and the Engineer. Barriers shall be erected and a signal warning shall be given to the workers at the site and to the public immediately before blasting, so that no person will enter the danger zone until blasting is finished.

Upon completion of blasting, an "all clear" signal shall be given by the responsible blasting engineer after he has satisfied himself that all charges loaded have detonated and that no delay-explosions or misfiring are to be expected.

Such methods of blasting shall be employed that shock and vibration are minimised.

No charging and firing will be permitted during thunderstorms and other electrical disturbances.

Mats or rubber tires tied together with rope shall be used as protection from flying debris to cover the charges where blasting may expose persons or property to injury or damage.

Hazardous Chemicals and Materials

The Contractor shall ensure that risks related to normal and accidental personnel exposures to hazardous chemicals and materials are adequately controlled.

The Contractor shall comply with any statutory restrictions on procurement, transportation, use and disposal of chemicals and materials. For chemicals and materials categorised as below, the Contractor shall avoid procurement and systematically work to phase out or substitute with less harmful alternatives:

- Carcinogens, mutagens or toxic for reproduction (CMR); cf. EU directives 67/548/EEC and 1999/45/EC (as amended)
- Substances that deplete the ozone layer; cf. The Montreal Protocol (as amended)

Material Safety Data Sheets shall be organised and kept on site for all chemicals and materials in use.

The following hazardous substances shall not be used in field activities:

- Asbestos and asbestos-containing materials
- Polychlorinated biphenyl (PCB) and PCB containing materials
- Carbontetrachloride (CAS no. 56 23 5)
- CFC type chemicals
- Halon
- Mercury compounds

9.3.11 Traffic and Transportation Safety

The Contractor is required to submit a traffic and transportation safety plan as part of the EHS Plan. As a minimum, the plan must comply with the following requirements:

The Contractor and Sub-contractor shall make sure that their vehicles will not be operated unless:

- Vehicle is fit for purpose, inspected and confirmed to be in safe working order.
- System for annual inspection and control of all vehicles is in place. Tag or similar identification of last annual inspection dated to be fitted on individual vehicle.
- Number of passengers does not exceed manufacturer's specification for the vehicle.
- Loads are secure and do not exceed manufacturer's design specification or legal limits for the vehicle.
- Seat belts are installed and worn by all occupants.

The Contractor and Sub-contractor shall make sure that drivers are not authorised to operate the vehicle unless:

- They are trained, certified and medically fit to operate the class of vehicle.
- They are not under the influence of alcohol or drugs, and are not suffering from fatigue.
- They do not use hand-held cell phones and radios while driving.

The Contractor shall take every possible precaution to prevent its operations from damaging public roads in the vicinity of the project area. Moreover, the Contractor shall implement a maintenance program for access roads carried out before rainy season (cleaning gutters, improvement of the road if necessary, etc.)

The Contractor shall develop procedures for parking and on-site traffic movement. At no time shall construction vehicles be parked in a manner which may restrict movement of traffic on public roads.

The Contractor shall be responsible for adequate signing, warnings and controls, including speed limits. Machinery shall be equipped with warning alarms while reversing.

The Contractor shall ensure that all vehicles, equipment and materials that are required to pass through urban areas and villages are operated and loads transported safely without endangering these communities. Special caution has to be taken in front of schools where children suddenly cross the street. In the villages, animals and pedestrians have the right of way.

All loads are to be secured and all loads with fugitive dust producing materials (e.g. excavated soil and sand) are covered with tarpaulins.

The Contractor shall ensure that drivers have reasonably timed delivery schedules so as to allow them to operate within government mandated speed limits.

The Contractor shall develop specific procedures for moving special loads, such as hazardous material, or heavy loads. Maximum load restrictions shall be developed and enforced.

The Contractor when entering into any sub-contract for the execution of any part of the construction works or the supply or transport of heavy loads, materials or spoil shall incorporate in any such sub-contract provisions requiring the Sub-contractor or supplier to comply with the traffic and transportation safety requirements.

9.3.12 Security Arrangements

The Contractor shall be overall responsible for security at the site.

The tasks shall comprise but not be limited to necessary watchmen and other security staff for access control, site guarding and traffic regulations.

The security measures and operation shall be in accordance with the Voluntary Principles on Security and Human Rights.

The site shall be restricted by fencing or otherwise secured to prevent illegal or unauthorised access. Access control to the site shall be arranged to ensure that all personnel can be accounted for.

The Contractor shall be fully responsible for all Contractor's personnel, and also responsible for preventative measures against crime for workers after working hours.

9.3.13 Labour Management

The Contractor shall, at the minimum, comply with the national labour and employment law. In circumstances where the national law is not explicit, international practices will take precedence.

The Contractor shall hire local labourers and ensure that local workforce content is as high as possible. The Contractor is required to develop a local employment program to ensure that preference of employment is given to people from the project's area of influence including project-affected persons (PAPs), provided adequate qualifications. The Contractor shall also develop procedures for equitable selection of the local labour. Preference will be given to Contractors who employ local villagers.

The Contractor shall provide on the job-training in order to upgrade the skills of the local workforce.

The Contractor shall maintain accurate records in relation to each worker's employment covering issues such as payment of wages and social security, and working hours. The recruitment process shall be transparent and all employees shall be given written contracts. Employees shall be provided with information regarding their rights under national labour and employment law, including their rights related to wages and benefits in a clear and understandable language to the employees at the time of recruitment.

The employment relationship shall be based on the principle of equal opportunity and fair treatment, and not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline.

The Contractor shall provide opportunities for employment of women in both management and casual placements.

The Contractor shall provide a grievance mechanism for workers to raise reasonable workplace concerns and ensure that all workers are informed about the grievance mechanism and that it is accessible.

Child labour is not allowed. If the national law has no provision for employment of minors, the international standards will supersede this.

The workers' camp standards in regard to quality, management and provision of basic social services should comply with the IFC/EBRD guidance on workers' accommodation.

9.3.14 Drug and Alcohol Policy

The use of alcohol and illegal drugs may affect a person's ability to exercise judgment, coordination and motor control, concentration, and alertness, leading to an increased risk of injury, to himself and co-workers. Besides causing injuries, the use of alcohol and illegal substances may lead to damage to plant or equipment as well as negative publicity for the project. Cognisant of this fact, the possession, use, distribution or dispensation of alcohol and illegal drugs, as defined by Liberian Laws, is prohibited on project sites and premises.

The Contractor is expected to include a robust drugs and alcohol policy in its EHS Plan. The policy should include, at a minimum, regular drugs and alcohol monitoring and testing requirements, and disciplinary procedures. Alcohol testing should include, but not limited to, a mandatory post-accident testing requirement.

9.3.15 Community Relations

The Contractor shall interact with local communities and their representatives in a manner that maintains and promotes a good relationship. Special attention should be given to land, labour and cultural issues, including local norms and values.

A Code of Conduct shall be prepared covering the main rules of interaction with local communities and the rules of conduct in case of conflict situations.

The Contractor shall participate in the Employer's grievance mechanism, which will allow the affected communities to express concerns about the conduct of personnel and other EHS issues. The grievance mechanism will include a mechanism for assessing the credibility of allegations, investigation of credible allegations of unlawful behaviour, corrective actions and documentation and (where appropriate) reporting of such incidents.

The Contractor shall review and adhere to the relevant regulations and policies regarding compensation for land acquisition and damage to local property. No clearance or construction activities will be allowed before affected landowners and farmers have been duly compensated.

The Contractor shall be responsible for any damage to structures, crops and public infrastructure (including water pipeline along the access road) arising from the execution of the works, including unauthorised work and personnel's activities outside the approved project area. Damaged crops shall be immediately compensated using approved government rates.

The Contractor shall have a manager available for community and land related issues when so required by the Employer.

The Contractor shall prohibit hunting, fishing and collection of firewood for all Contractor's personnel.

9.4 Company's ESMP

9.4.1 Introduction

The Company's ESMP describes the environmental and social mitigation programme which the project proponent (RREA) is responsible for implementing during the construction and operation phase. It consists of several sub-plans, which will be implemented by the Environmental and Social Management Unit, or be outsourced to service providers, e.g. non-governmental organisations (NGOs).

Each ESMP sub-plan sets out the obligatory mitigation measures based on the available information at the current stage of project preparation. It is expected that they will be elaborated further by the Environmental and Social Management Unit, or be translated into Terms of Reference upon which NGOs or other service providers can develop their project proposals. The detailed mitigation programme should be formulated into in a Company's Environmental and Social Action Plan.

In addition to the sub-plans described in the present Company's ESMP, the Company (or the Owner's Engineer) will develop additional operation-phase management plans as required. For example, the Company will be expected to develop an emergency response plan, a waste management plan, an occupational health and safety plan, an employment and human resource management plan, etc. prior to the commissioning of the Gbedin mini hydropower station. The Company (or Owner's Engineer) must also prepare an impoundment plan before the initial filling of the reservoir. The details of such sub-plans will be developed at a later stage and be based on the relevant sections in the Construction Contractors' EHS Plan.

As for the Construction Contractors' ESMP, the overriding principle of the Company's ESMP is to comply with the requirements of ISO 14001:2004 and OHSAS 18001:2007 as well as the environmental and social standards of the financiers and lenders (e.g. AfDB's Operation Safeguards, IFC's Performance Standards and EHS Guidelines). The Company will be expected to formulate an environmental policy and to develop an environmental and social management system in compliance with AfDB's Operational Safeguards and IFC's Performance Standard 1.

9.4.2 Construction Supervision

The Company (or Owner's Engineer) is responsible to implement an EHS management system for the construction works, ensuring that all Contractors comply with the EHS requirements and international safeguard policies and best practices. The Company shall ensure that the environmental and social mitigation programmes are aligned with the construction schedule and the EHS requirements for the construction works.

The Company shall insert EHS clauses in tender documents which serve as a basis for selecting Contractors and as a benchmark for checking EHS performance during the construction phase. Based on the EHS specifications in the contracts, the Company shall develop a comprehensive system for compliance monitoring of contractors, including checklists and reporting formats for site inspections and audits (see Chapter 10).

9.4.3 Environmental Flow Release

The design of the Gbedin mini hydropower plant shall provide for the release of at least 5.8 m³/s as environmental flow into the bypassed reach. This can be achieved by installing a pipe or culvert through the weir (or at the sediment flushing arrangement). The facility can be dimensioned to release the prescribed flow at all times, or be installed with a valve or gate to adjust the flow.

The Company shall be responsible for continuous monitoring of the environmental flow in order to ensure compliance. A flow sensor can be installed and be connected to a data recording unit or directly to the control-system at the power station. The cost of these facilities shall be included in the tender bids and be

part of the contract price. The loss of power production and revenues from releasing environmental flow should be considered in the updated economic analysis to be conducted in the detailed design phase.

9.4.4 Biodiversity Action Plan

Introduction

As described in Section 5.2.2, the project's area of influence has a high value in terms of terrestrial and aquatic biodiversity. Gbedin Falls is situated in a remote area of closed moist forest that is relatively little disturbed by farming, logging and other human activities. Although not located in a protected area or key biodiversity area, several globally threatened species of plants and animals have been recorded (or reported by locals), including 25 species categorised as 'vulnerable' (20 plant, one bird, three reptile and one fish species) and possibly three 'critically endangered' species (two fish species and one mammal). The project's area of influence is unlikely to host a significant portion of the global populations or a key habitat for any of these species, but the value in terms of biodiversity is nonetheless considered as high.

The project impact on biodiversity has been rated as medium negative in the construction phase and low-medium negative in the operation phase (without mitigation). This is mainly because the power plant will be operated as a run-of-river scheme and the project footprint is relatively small. In addition, the dam will not create an obstacle to upstream fish migrations (Gbedin Falls already acts as a natural barrier). However, in order to achieve no net loss in biodiversity, the construction works need to comply with best industry practice and environmental flow should be released into the diversion reach (i.e. waterfalls). These are standard requirements for sustainable hydropower development.

Apart from the above mentioned requirements that need to be addressed during detailed design and tendering, the risk associated with the possible occurrence of the Western chimpanzee *Pan troglodytes ssp. verus* needs to be confirmed prior to construction. There is no indication that the chimpanzees use the project's area of influence for nesting, and it should be recognised that the proposed project footprint is already disturbed by human presence and farming. Nonetheless, given that the construction of Gbedin mini hydropower project might not commence for a long time to come, it is strongly recommended that another field survey is carried out during the detailed design phase when the project is closer to implementation. For this purpose, a team of experienced biologists should be appointed with the objective to conduct a detailed survey of chimpanzees in order to ascertain that the project's area of influence is not used as a nesting habitat (and does not qualify as critical habitat). Biodiversity monitoring will be carried out during construction and early operation phases (see below).

Mitigation Measures

Provided that the mitigation measures outlined in this ESIA/ESMP are successfully implemented, the residual impact on biodiversity is considered minor/insignificant and acceptable. The mitigation measures can be organised as follows:

Design and operation related mitigation measures:

- Consider installation of a fish screen (or reductions in trash rack openings) at the intake to reduce fish entrainment and mortality
- An environmental flow of at least 5.8 m³/s shall be released into Gbedin Falls at all times
- In case of power station outage during periods when there is no spilling over the dam, a compensation flow shall be released by immediately opening the flushing gate
- If daily peaking is considered in the detailed design, then conduct an environmental flows (EFlows) assessment to determine the acceptable peaking pattern

Additional field studies:

- Conduct detailed survey of chimpanzees prior to construction in order to ascertain that the project's area of influence is not used as a nesting habitat and does not qualify as a critical habitat

Requirements related to construction activities:

- Except where vegetation clearing is required for permanent works or excavation operations, all trees and vegetation shall be preserved
- All disturbed areas that are not required for permanent works shall be restored and replanted with native trees
- Vegetation clearance and maintenance along the transmission line and new access road shall be restricted to the right of way
- Schedule noisy activities to daytime hours and instruct the workforce to avoid unnecessary noise
- Strictly prohibit all hunting, firewood collection, charcoal production, and purchase of bush meat by the workforce
- Erosion control practices shall be implemented prior to any major soil disturbance on the riverbanks
- Sedimentation controls shall be implemented in the form of silt trap fences, sedimentation ponds and drainage channels where appropriate
- Cofferdams shall be constructed such as to minimise releases of sediments and pollutants to the downstream environment (e.g. avoiding low flow periods and rock material with high content of fine particles)
- Storage and handling of fuel and hazardous materials shall be kept away from the river
- All storage areas and major construction sites shall have spill kits, sand, dust, and other appropriate absorbent materials
- Disturbed areas shall be restored immediately after the construction and maintenance works
- All invasive plant species shall be removed during routine vegetation maintenance
- Importation of exotic trees and soil from other places (e.g. for restoration or as ornamentals) shall be prohibited

Compliance with AfDB OS 3 (Biodiversity and Ecosystem Services)

Background: The overarching objective of this safeguard is to conserve biological diversity and promote the sustainable use of natural resources. The specific objectives of OS 3 are to: (i) Conserve biological diversity and ecosystem integrity by avoiding or, if avoidance is not possible, reducing and minimising potentially harmful impacts on biodiversity; (ii) Endeavour to reinstate or restore biodiversity, including, where some impacts are unavoidable, through implementing biodiversity offsets to achieve "not net loss but net gain" of biodiversity; (iii) Protect natural, modified, and critical habitats; and (iv) Sustain the availability and productivity of priority ecosystem services to maintain benefits to the affected communities and sustain project performance.

In the context of the Gbedin project, the presence of closed moist forest and several species of conservation concern is evidence that the project's area of influence qualifies as natural habitat and possibly critical habitat (but see below). Critical habitat includes natural (or modified) habitats that have a high biodiversity value, including:

- Habitats important to critically endangered and footprint impacted species;
- Habitats of significant importance to endemic and/ or restricted-range species and subspecies;
- Habitats of significant importance to globally significant concentrations of migratory species and/or congregatory species;
- Regionally significant and/or highly threatened or unique ecosystems;
- Areas that are associated with key evolutionary processes;
- Areas that are important to species that are vital to ecosystems, such as keystone species; and
- Areas that supply ecological networks.

The safeguard requirements are different for natural and critical habitats. Projects in natural habitats must not cause significant modification of the affected (natural) habitats, except when:

- There are no technically and cost-effective viable alternatives to implementing the project in the natural habitat;
- The biodiversity mitigation hierarchy has been properly implemented and appropriate mitigation measures have been designed; and
- The opinions and concerns of affected communities, as identified through the consultation process, have been addressed in the design of the mitigation measures.

If projects are to be developed in natural habitats, or are to have potential adverse downstream impacts on natural habitats, they must include mitigation measures to achieve either net benefit or no net loss of biodiversity—for example, ecological restoration of habitats, measures to reduce fragmentation, and restoration of ecosystem functioning. As a last resort, this can be done by the development of a biodiversity offset programme, in accordance with the biodiversity offset principles established by the Business and Biodiversity Offsets Programme or comparable organisations and programs. When considering biodiversity offsets, the borrower/client uses a landscape/seascape-scale planning process to identify the most environmentally sound approach.

In critical habitats, AfDB may agree to finance a project only if it can be demonstrated, using appropriate measurement and monitoring methods, that:

- The mitigation hierarchy has been implemented;
- The project provides clear benefits and positive outcome for biodiversity and ecosystem services;
- The project-related activities will not have adverse effects (direct, indirect, or cumulative) on the criteria for which the critical habitat was designated;
- The project will not have any negative effects on critically endangered or endangered species;
- The project will achieve the previous two points without offsets or a “net gain” analysis; and
- A robust, appropriately designed and funded, long-term biodiversity monitoring and evaluation programme is integrated into (i.e., provides feedback into) the client’s management programme.

Assessment: The key OS 3 issues related to the Gbedin project are as follows: (1) Will the project affect critical habitat? (2) What is the residual impact (after adopting the mitigation hierarchy)? (3) Is there a need for biodiversity offsets?

As explained in Section 5.2.2 and Section 7.3.2, the occurrence of critically endangered (CR) species (ref. first criterion for critical habitat) is either unlikely or involves a very low percentage of their global populations. The two fish species classified as CR and reported only by local informants are very likely to be based on misidentification since they have never before been recorded in the Saint John River, while the potentially affected population of Western chimpanzees is certainly less than the IFC PS6 threshold of 0.5% of the total global population of 18,000 – 65,000 individuals (and there are no reproductive units in the project’s area of influence). The affected habitat is thus not considered as ‘important’ for any of the CR species. However, for precautionary reasons and because of the potentially long lag time, another chimpanzee survey should be carried out prior to construction (as explained above).

Irrespective of whether the project’s area of influence qualifies as critical habitat, the residual impact on biodiversity has been rated as ‘low’ and the likelihood of impact on the three CR species is considered as ‘negligible’ (see Section 7.3.2). It is inevitable that vegetation clearing and disturbance from construction works will affect terrestrial biodiversity at the local scale, but the limited project footprint combined with the environmental design and mitigation measures outlined above imply that none of the important species will be adversely affected at the population level. This also applies to the aquatic species due to the run-of-river operation of the power plant. The prescribed mitigation measures (see above) are therefore considered adequate and have been based on the ‘mitigation hierarchy’ approach, i.e.:

- *Avoidance*: Environmentally-friendly design, including run-of-river operation (instead of seasonal or daily flow regulation), environmental flow release, installation of fish screen, no night time construction ('temporal avoidance') and restricted vegetation clearance (reduced project footprint).
- *Reduction/minimisation*: Revegetation of disturbed surfaces, strict controls on construction practices (erosion, pollution), and a no-hunting/fishing/bushmeat policy.

The last step in the mitigation hierarchy, i.e. 'compensation', is only warranted if there is significant residual impact and should only be pursued as a last resort (Figure 41). As explained above, the residual impact after avoidance/minimisation is *not* significant and thus not required for compliance with OS 3 (or IFC PS6).

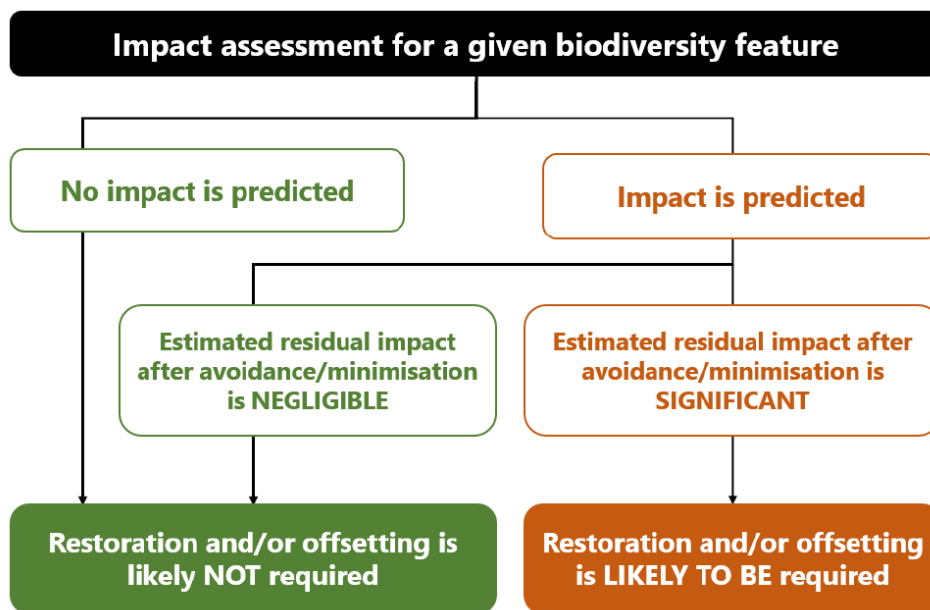


Figure 41: Identifying when offsets are likely to be required.

Biodiversity Monitoring

Performance Indicators:

- Number of trees cut outside the project boundary and RoW
- Presence of invasive plant species in the project area
- Number of animals (including birds and bats) killed by electrocution and wire collision
- Number of IUCN red-listed animal species observed in the project area

Means of Verification:

- Visual observations by project staff and local people
- Monitoring reports by professional biologists
- Interviews with hunters and fishermen

Monitoring Frequency:

The Environmental and Social Management Unit will record biodiversity observations on a continuous basis during their daily inspections. Professional biologists will be hired to produce biodiversity monitoring reports (on terrestrial and aquatic ecology) at least twice; during the early stages of construction (prior to dam construction) and during the initial filling of the reservoir (prior to commissioning). In addition, biodiversity monitoring should be conducted in the early phase of project operation.

Roles and Responsibilities

The Company's Environmental and Social Management Unit will be responsible to hire the services of professional biologists while also recording all biodiversity observations during their daily inspections. Expert reports shall be submitted to the company's management and the findings shall be included in the regular monthly reports.

Budget

- Pre-construction phase: USD 15,000 (one survey)
- Construction phase: USD 30,000 (two surveys)
- Operation phase: USD 15,000 (one survey)
- Total: USD 60,000

9.4.5 Community Health, Safety and Security Plan

Public Health Campaigns

Malaria: During the construction phase, the Company shall carry out malaria mitigation campaigns using the following strategies:

- Awareness raising and malaria education: Targeted campaigns (school children and mothers), distribution of IEC/BCC supported education including mass media, and event organization.
- Distribute malaria home packs and educate masses on prompt malaria handling measures.

HIV/AIDS: Prior to and during the construction phase, the Company shall adopt a comprehensive approach to prevent HIV/AIDS and other sexually transmitted diseases. The approach shall target both workers and the community since human interaction will not only be confined to the project boundaries. The Contractors are expected to make arrangements for the workforce through their occupational health and safety programme (Section 9.3.10), while the community health and safety measures should include the following:

- Awareness raising and peer education: Targeted campaigns, small group counselling, IEC/BCC along with event organisation, and the use of mass media
- Condom promotion: Free and effective distribution, and education on appropriate use

Water and sanitation: In order to mitigate the risks and impacts from in-migration during the construction phase, the Company shall carry out the following activities:

- Together with local health workers, the Company shall conduct sanitation and hygiene improvement campaigns aimed at awareness raising to ensure sustainable waste disposal practices
- Provide funding to construct communal sanitation facilities in towns affected by population influx
- Provide funding to rehabilitate non-functional water supply facilities in towns affected by population influx

For sustainability purposes, training shall be provided and community-based operation and maintenance arrangements shall be instituted for the water supply and sanitation facilities.

Schistosomiasis: Even if the probability of occurrence is unknown, the following mitigation measures are being proposed:

- Conduct awareness-raising among the communities about the transmission and prevention of schistosomiasis
- Coordinate with the Ministry of Health to ensure that surveillance and control of schistosomiasis is extended to the project's area of influence
- Throughout the life cycle of the project, liaise with the Ministry of Health to carry out monitoring and preventive services among the communities

If patients become diagnosed with schistosomiasis, the following mitigation measures shall be implemented:

- In collaboration with the Ministry of Health, ensure that the local health workers are well equipped with resources and human capacity to offer prompt and adequate treatment to those infected
- Ensure that the local health facilities have access to drugs for treatment of schistosomiasis
- Consider school-based deworming campaigns if the need arises
- In the worst case scenario, consider selective chemical control (molluscicides) or biological control (e.g. introduction of species that feed on the intermediate snails hosts)

Traffic Safety Campaigns

In addition to the traffic and transportation safety plan to be developed by the Contractors (see Section 9.3.11), the following activities shall be carried out by the Company:

- Collaborate with the local traffic police to ensure that traffic rules are enforced on shared public roads
- Share project-specific traffic management plans with the local administration and communities through school campaigns and meetings with the town chiefs

Security Arrangements

In addition to the requirements imposed on the Contractors (see Section 9.3.12), The Company shall carry out the following activities related to the project's security arrangements:

- Support local security systems to strengthen community policing and crime-handling measures.
- Share relevant information with the communities to ensure that all are aware of the rules and regulations.
- Ensure that Contractors issue clear instructions to security personnel about permissible actions, boundaries of their authority, and relations with community members.
- Establish a grievance mechanism for addressing security-related grievances with the aim of aiding communities to forward their complaints and receive feedbacks.

Sexual and Gender Based Violence

The Company shall carry out the following activities related to prevention of sexual and gender based violence (SGBV):

- Conduct gender sensitisation and public awareness campaigns on SGBV targeting the entire society, including men, women, youth, boys and girls, and educational institutions
- Enact and enforce human resource policies against sexual harassment and abuse at the workplace
- Establish comprehensive shelters for SGBV survivors and provide psychosocial support facilities and programs, including economic empowerment programs for women and girls as a community development or benefit sharing initiative
- Take a lead role in establishing partnerships among the public and private sectors, civil society, local communities, those in leadership positions, and other institutions such as the media to implement integrated SGBV programs that include counselling, legal advice, medical treatment, and protection

9.4.6 Resettlement Action Plan

Introduction

A Resettlement Action Plan (RAP) for the Gbedin project has been prepared as a stand-alone report. The below is a summary of the main findings and recommendation from the RAP.

Resettlement Impacts

Land use at Gbedin Falls and the areas along the planned transmission line and access road is dominated by slash and burn agriculture, sugarcane farming and tree crop plantations (oil palm and cocoa). Farms are found scattered inside the forest while the settlements are confined to the neighbouring towns at some distance from the proposed project footprint.

Permanent land acquisition will impact farmers from the towns of Gbalasonnoh, Gehwee, and Kitoma in Sanniquellie-Mahn District. A total of 145 farmers will lose parts of their farmland and crops at Gbedin Falls and within the right of way (RoW) of the transmission line and access road. No farmers will be affected by the reservoir as there is no active land use on the riverbanks upstream of the waterfalls.

The resettlement impacts are thus restricted to economic displacement of small-scale subsistence farms. Impacted crops include important cash crops like rubber, oil palm, cocoa and sugarcane as well as food crop like cassava and fruit trees like avocado. The average size of affected farmland per household within the project footprint is about 0.22 ha.

There is no expected physical displacement though two structures (used on a seasonal basis) will potentially be at a risk of being affected during the construction phase due to compromised safety and exposure to construction nuisances. Four farm kitchens and one oil pit will also be directly impacted.

No communal facilities, public infrastructure, cultural property or businesses will be displaced by the project activities.

In addition to the economic displacement of households caused by the land acquisition, there will also be disruption of fishing in the pool below Gbedin Falls. Measures have been proposed to ensure that fishing households will have access to the river and reservoir as alternative fishing grounds during both construction and operation phase. Other livelihood impacts include loss of access to communal land as well as loss of wild trees and fruits that are harvested by the local people.

Valuation, Compensation and Livelihood Restoration

The affected properties and assets have been recorded and valued. All persons affected by the project will be compensated in accordance with the applicable national legislation and the AfDB requirements. In addition to the compensation, displaced households will be supported to restore and improve their livelihoods. Livelihood restoration will include creating opportunities for alternative livelihoods through employment and apprenticeship, credit support for development of small to medium scale businesses, measures for community development and agricultural support through provision of starter packages. Livelihood restoration support will target all the economically displaced households and vulnerable groups.

Costs and Budgets

The total compensation cost amounts to USD 198,126 while the livelihood restoration budget has been estimated at USD 245,750. The RAP budget also includes provisions for administrative costs (e.g. staffing and consultants), stakeholder engagement and grievance management, and monitoring and evaluation. The total RAP budget is USD 972,872.

9.4.7 Capacity Building Plan

At the institutional level, RREA as the project proponent has so far implemented the Yandohun micro hydropower project and is currently preparing for construction of the Kaiha 2 hydropower plant. Both these projects have exposed RREA staff to the importance of environmental and social safeguards and meaningful community involvement.

With respect to staffing, RREA has an Environmental and Social Unit and a full-time environmental safeguard specialist. Consultations with RREA indicate that if funds were available it would be suitable for RREA to engage the services of a social safeguards specialist to complement the environmental safeguard specialist on projects with significant social risks. For the Kaiha 2 project, RREA recruited a Community Liaison Officer to undertake the day to day stakeholder engagement activities. A similar approach should be adopted for the Gbedin mini hydropower project.

In addition, RREA indicated that as an institution they have capacity gaps in relation to monitoring and evaluation (M&E) of their interventions. It was therefore proposed that resources should be provided to engage the services of an M&E specialist to support them especially during the resettlement implementation.

Regarding coordination with other ministries, ESMP and RAP implementation requires close collaboration with the Ministry of Agriculture, Ministry of Finance (Liberia Revenue Authority), Environmental Protection Agency (EPA) and the Nimba County authorities. For RAP, officials are delegated from each ministry to form a committee that reviews and verifies the contents of the RAP report prior to compensation payments. However, all the participating institutions would require orientation to the lenders' requirements on land acquisition and involuntary resettlement.

The primary business case of RREA is rural electrification and not the implementation of environmental management and livelihoods/community development programmes. Looking at RREA's current staffing levels, they do not have the resources necessary for the implementation and supervision of the ESMP. It is therefore proposed that AfDB together with RREA agree on the financing and staffing arrangements for the implementation of this ESMP.

The main components of the capacity building programme should include:

- *Staffing:* Strengthen RREA's capacity by ensuring that they have access to an Environmental Officer, a Social Safeguards Specialist (or Community Liaison Officer) and a Monitoring and Evaluation Specialist
- *Training:* Provide training to RREA staff on contract management especially related to the Construction Contractors' ESMP
- *Capacity building of stakeholders:* Provide training to local government institutions, especially related to RAP implementation. Relevant stakeholders include the Land Commission, Agricultural Officer, Assistant County Surveyor, Rural Estate Tax Officers, Paramount Chiefs, Town Chiefs and Township Commissioners.

9.4.8 Stakeholder Engagement Plan

Introduction

This section presents the proposed public consultation and stakeholder engagement strategy for the Gbedin mini hydropower project. It outlines the processes and procedures to be used during the execution of the proposed project to ensure that all stakeholders are meaningfully involved and informed about the project activities, stakeholder opinions are received, incorporated and feedback is given promptly.

Objectives of the stakeholder engagement plan are as follows:

- To offer opportunities for stakeholders to raise their concerns and submit their opinions
- To create avenues for complaints handling and grievance management
- To create opportunities for information sharing and disclosure
- To create a mechanism for giving feedback to the stakeholders
- To create an avenue for participatory project impacts monitoring
- To foster strong project community relationships
- To promote social acceptability of the project

Project Stakeholders

The key stakeholders for this project were identified during the preparation of the ESIA. The stakeholders are as listed in Section 4.2 (national stakeholders) and Section 6.3 (local level stakeholders).

Stakeholder Engagement Strategies

Regular reporting: The Company will submit periodic reports to the relevant government agencies at central and local level. The reporting schedule will be defined by the regulatory bodies.

Public consultations: In addition to the consultation meetings conducted as part of the ESIA process, the Company will carry out another round of public consultations when the project has been approved and ready for implementation. The purpose of these meetings will mainly be information sharing and participatory planning.

Community mobilisation: Communities will be mobilised prior to commencement of construction activities for purposes of preparing them for the construction phase and its associated impacts. Communities will also be mobilised prior to commissioning for purposes of creating awareness about the safety precautions particularly for those in close proximity to the project infrastructure.

Targeted consultations: The Company's Environmental and Social Management Unit will organise in-depth interviews, focus group discussions with key informants, socio-economic surveys and planning meetings with the relevant stakeholders. The frequency of the consultations will depend on the demand for stakeholder input or on regulated feedback schedules.

Feedback: As and when found necessary, all stakeholders including the affected communities will be given feedback directly by the Company's Environmental and Social Management Unit. Such circumstances will include complaints handling and mitigation management planning.

Incorporation of proceedings into management decisions: The results from the consultation and information sharing meetings will be used as input into management decisions. The views of the target groups will be used as basis upon which interventions will be designed and implemented. The views and opinions expressed by women and other special interest groups will be incorporated in the design of intervention strategies targeting them.

The detailed schedule of the stakeholder engagement activities shall be developed by the Company's Environmental and Social Management Unit when the project has been approved and the organisation has been staffed and equipped with resources.

Grievance Redress Mechanism

Introduction: The project induced risks and impacts need to be carefully managed to avoid unnecessary tensions and conflicts. A grievance mechanism will therefore be established to ensure that complaints are recorded and resolved. The scope of the grievance mechanism is limited to project-related issues affecting the community and other external stakeholders, while cases only involving workers and occupational health and safety will be handled through the internal procedures of the Contractors. It will be the responsibility of the Company to ensure that the grievance mechanism functions properly and is respected by all parties including Contractors and any other project service providers.

The objectives of the grievance redress mechanism is:

- To create a mechanism through which PAPs can communicate their dissatisfaction or grievances
- To create a mechanism through which the project will be able to follow up on all the complaints
- To create a mechanism through which the project will systematically and exhaustively respond to peoples' complaints

- To create an avenue through which the PAPs and the project can together solve problems and handle issues arising
- To create a mechanism in which the project will ensure that all complaints are promptly and adequately attended
- To create a mechanism where the project will receive feedback on what is not going as planned

Grievance Redress and Appeal System: Consultations with the affected communities confirmed that they have existing community based systems for grievance redress based in the Traditional Authority. This is further confirmed in the Land Rights Bill 2014, which recognises the role of Traditional Authority to solve matters of grievance/dispute resolution, land acquisition and community mobilisation. It is recommended that the project developer should collaborate and empower the existing grievance committees through training on project specific procedures.

The current membership of the grievance committees at the community level include two PAP representatives (male and female), the Town Chief, a respected elder, youth and women representatives. The existing committees will be strengthened by the inclusion of two PAP representatives and a representative of RREA.

The role of the community grievance committees will be to

- Receive and register complaints
- Forward complaints to the project representatives
- Together with the project representatives and the complainant, verify the validity of the complaint
- Together with the project representatives and the complainant, agree on the best way forward to resolve the grievance
- Monitor grievance resolution process
- Give feedback to the complainant

To ensure appropriate handling of project matters, the committee members will be trained on relevant project issues and the principles that should be followed when resolving the grievances. This includes principles of fairness, equality, transparency, honesty, respect of human rights, and compliance with national regulations. In addition, RREA will at any one time be represented in the grievance resolution sessions at all levels for purposes of guidance and quality assurance.

The grievance redress mechanism (GRM) will also offer opportunities for appeal and mediation at higher authorities within the community based hierarchy of authority. The judicial system will be used as a last resort. Figure 42 illustrates the proposed appeal procedure.

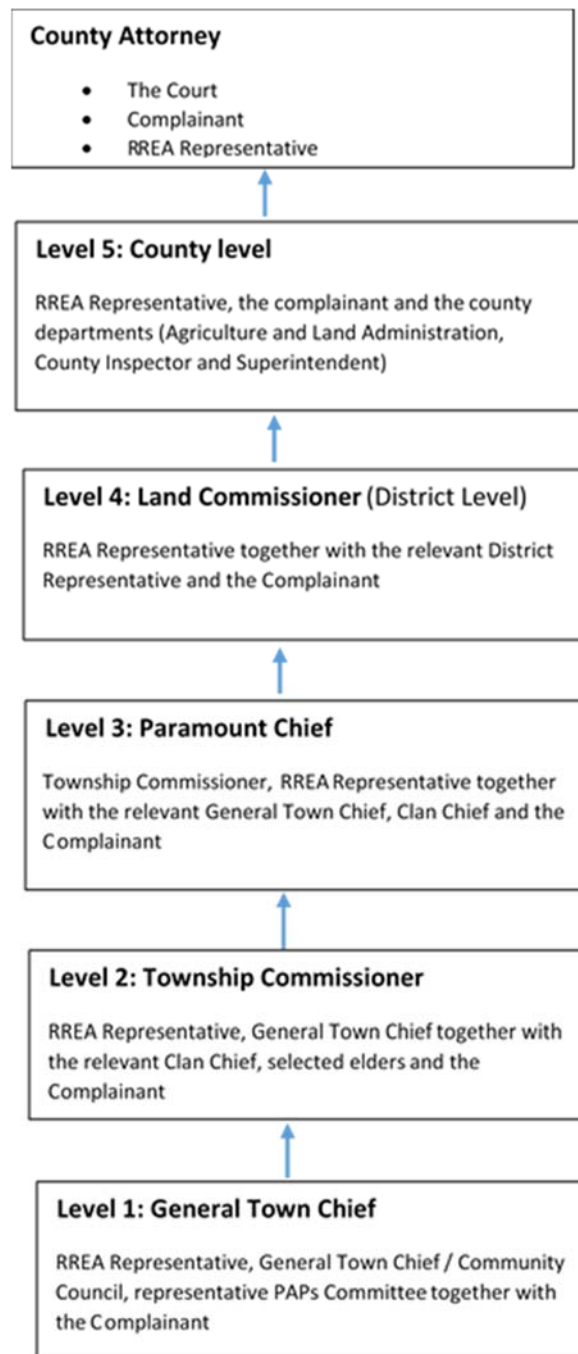


Figure 42: Grievance redress and appeal process.

Level 1: Village Level - PAPs will be expected to submit their complaints in writing on standard forms to the Community Liaison Unit directly or through their village leader (General Town Chief) or their representative on the grievance committee. At this level, received complaints will be registered, investigated and resolved by the project team, together with the village council and the complainant. A final decision on the way forward will be communicated to the complainant directly. In situations where both parties agree, the case will be closed at this level.

Level 2: Township Level – All cases that cannot be resolved at the first level will be referred to the Township level, to be handled by the Township Commissioner. The case will be handled in the presence of the relevant

village leader, the complainant, the Chairperson of the PAPs grievance committee and the project representatives. In situations where both parties agree, the case will be closed at this level, otherwise it will be forwarded to the Paramount Chief for resolution.

Level 3: Paramount Chief – At this level, the case will be handled in the presence of the Township Commissioner, the complainant, chairperson of the PAPs committee, and the relevant Community Chief and Clan Chief if necessary.

Level 4: District Level (Land Commission) – In situations where the customary authorities are not able to resolve the dispute, the case will be forwarded to the land commission⁶ prior to resorting to the judicial/federal system. The Land Commission will resolve all cases involving customary land disputes between entire communities.

Level 5: County Superintendent – RREA should always organise information sharing sessions with the County Superintendent in regard to all cases that have not been resolved through the community based systems ad prior to referral to the judicial system.

Level 6: County Attorney – All cases that will not be satisfactorily resolved by the District Land and Housing Tribunal will be referred to the High Court.

Guinea Grievance Redress Process: In Guinea, there are five distinct levels to resolve disputes: (1) within the family; (2) by the council of village elders; (3) by the sector and district representatives; (4) by the district office; and (5) by the sub-prefect. Difficult disputes, such as those between clans, are mediated by the Ligue Islamique Préfectorale.

Gbedin Project’s Grievance Redress Committees: Community level grievance committees have been set up and trained for the directly affected communities of Gehwee and Gbalassonoh. The formation and training of the grievance committtees was witnessed by the local authorities (town chiefs and the representative of the Ministry of Public Works).

Impacted Community	Grievance Committee Members
Gbalassonoh	Victor Suah - Chairman Alberto Flomo - Secretary Jefferson Konah - Elder Nyan F Tokpah - Elder Alfred Weanquoi - Committe Member Saye Yekezee - Female PAP representative Bill Lamah - Male PAP representative Oretha Dolo - Women representative Melvin Martor - Youth representative Oforee Ganawala - Committee member
Gehwee	Paul Nyonomie - Chairman Edward P Y Walkie - Secretary Gabriel S M Giagiae - Elder Mark Luamba - Elder Kou Dolo - Women Representative Paye W Nyonomie - Youth Representative Janet Zuah - Female PAP representative Austin Garteh - Male PAP representative Oliver N Wonkemie - Committeee member

⁶ Land Rights Act (2013), Article 37, Section 9: “A dispute involving Customary Land, which is not resolved at the Community level shall first be brought before the Commission before the commencement of any judicial proceeding”.

Grievance committees above the community level will be formed and trained once the decision to proceed with the investment has been concluded and as part of the mobilisation activities prior to the commencement of the compensation payments.

Complaints Handling Process: All affected stakeholders will be expected to submit their complaints in writing to either of the following collection points (corresponding to level 1 above):

- Town Chief
- Project Community Liaison Office (RREA)

All received written grievances will be registered in the project developer's database. After registration, a fact-finding mission will be conducted together with the complainant and the Town Chief. Proposals on how the grievance can be resolved will be discussed and the complainant will be advised accordingly. The grievance shall be addressed (at Level 1) within two weeks of receiving the written complaint.

Upon acceptance by the complainant and the actual implementation of the remedy actions, the complaint will be signed off as resolved. In situations where it will be difficult to reach a consensus the case will be forwarded to higher authorities for further mediation. Figure 43 illustrates the process of complaints handling.

SGBV Related Grievances: It is important that the project grievance mechanism ensures safe, confidential, non-judgmental and ethical reporting systems especially related to sexual and gender based violence (SGBV) and exploitation of child labour. The Company shall also provide service referral to survivors to alert cases of prevalence and assure them to access adequate response.

Planned Future Consultations

Table 39 outlines the future consultation plan.

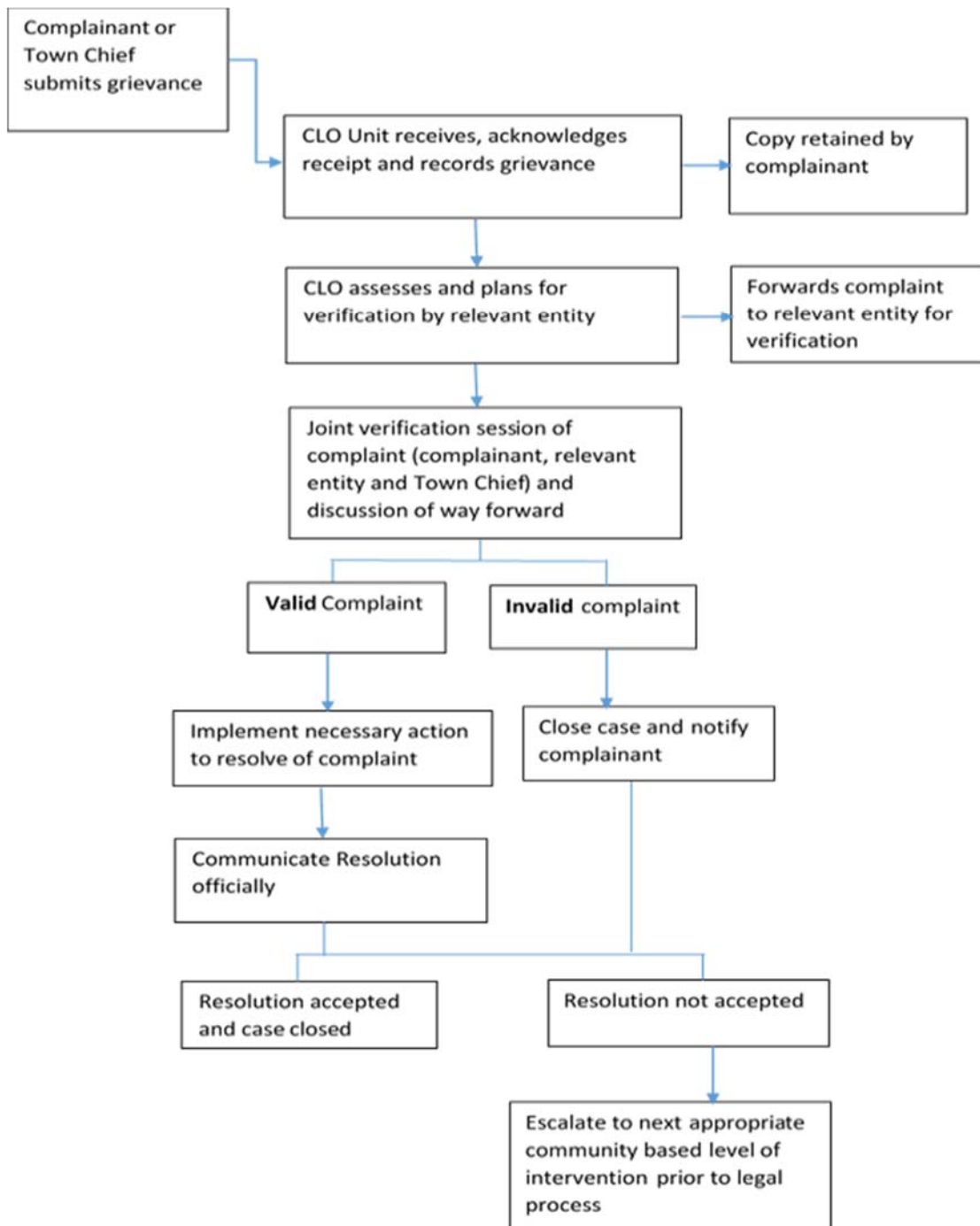


Figure 43: Process of complaints handling.

Table 39: Planned future consultation activities.

No.	Activity	Project Phase	Timing	Responsible Entity
1.	Mobilisation for the disclosure of the asset inventory	Planning	July 2019	RREA compensation committee
2.	Disclosure of the asset inventory results to the PAPs	Planning	July 2019	RREA and implementing partners
3.	Confirmatory consultations on the options for compensation for communal land	Planning	July 2019	RREA and implementing partners
4.	Confirmatory consultations on the options for compensation for the physically displaced households	Planning	July 2019	RREA and implementing partners
5.	Formation and training of project grievance committees above the community level	Planning	July 2019	RREA Community Liaison Officer
6.	Refresher training and facilitation of the project grievance committees at the community level	Planning	July 2019	RREA Community Liaison Officer
7.	Grievance registration and handling	Planning	Continuous	RREA Community Liaison Officer
8.	Financial training of the directly affected households for the land acquisition process	Planning	August 2019	RREA + Implementing partner
9.	In depth discussion with the physically displaced households with reference to relocation planning	Planning	August 2019	RREA + Implementing partner
10.	In depth discussion with physically displaced households and vulnerable households in relation to livelihood restoration	Planning	August 2019	RREA + Implementing partner for livelihood restoration
11.	Media notifications for compensation payments	Planning	Sept 2019	RREA
12.	Distribution of the notification to vacate	Planning	Sept 2019	RREA Community Liaison Officer
13.	Publication and dissemination of the notice to vacate to all directly impacted households	Planning	Sept 2019	RREA
14.	Delivery of in kind entitlements (replacement land and housing)	Planning	April 2020	RREA
15.	Handover of tenure documents for replacement land and housing	Planning	April 2020	RREA and County Authorities
16.	Notifications for land take over	Construction mobilisation	April 2020	RREA Community Liaison Officer
17.	Mobilisation for construction commencement	Construction	April 2020	RREA Community Liaison Officer
18.	Disclosure of the Environmental and Social Action Plan to the communities and County authorities	Construction	April 2020	RREA
19.	Periodic grievance handling (monthly during peak construction periods)	Construction	2020-2022	RREA Community Liaison Officer

20.	Quarterly monitoring of the Implementation of agreed upon strategies	Construction	2020-2022	RREA
21.	Internal monitoring and periodic progress reporting	Construction	2020-2022	RREA
22.	Compliance monitoring	Operation	2022	AfDB and other financiers
23.	Completion audit	Operation	2023	Independent third party
24.	Safety sensitisation in preparation for commissioning of the project	Operation	2023	RREA
25.	Dissemination of the operation phase emergency preparedness procedures	Operation	2023	RREA

9.4.9 Decommissioning Plan

Introduction

It is anticipated that the lifespan of the Gbedin mini hydropower plant will be at least 30 years (economic life) and probably a much longer technical lifespan. It is recognised that particularly the civil infrastructure can last up to 100 years and will be a long-term asset for the country. Indeed, very few hydropower schemes have so far been decommissioned due to old age. However, once hydropower production has ceased and the project is no longer required, it will be necessary to decommission the dam/weir, waterway structures, generating facilities and transmission line, and to return the affected area to a natural environment similar to that which existed prior to the construction.

A decommissioning plan will be prepared before the start of the decommission operations, taking the applicable legislation and environmental/social conditions prevailing at that time into account. Due to the obvious uncertainties related to the future scenario, the potential impacts and mitigation measures described below should only be considered as a preliminary analysis.

Potential Impacts

The environmental and social impacts of decommissioning include among others:

Ecological and landscape restoration: Removing dams involves significant risks as well as opportunities for restoration of the affected river environment. A decommissioning of the Gbedin mini hydropower plant and removal of the dam will re-establish the free flowing conditions at Gbedin Falls, hence restoring the river continuum. This is likely to have a positive impact on the local ecology and habitats associated with the waterfall. It will also bring back Gbedin Falls as a natural landscape feature with natural flow conditions.

Sediment transport: The removal of the Gbedin mini dam will expose the deposited sediments in the reservoir to the strong currents of the free-flowing river. Sediments which have been trapped upstream of the dam during the operating life will then be progressively transported downstream by the flow of the river. The increase in suspended sediments can affect aquatic life in a number of ways. Macroinvertebrates would be affected as their digestion slows down, leading to unfavourable conditions for reproduction. Suspended sediments may also cause respiratory problems for fish species, and under extreme conditions fish tend to stop feeding until conditions improve. Eggs and larvae of fish are generally more susceptible to physical damage from increased levels of suspended sediments. In the short term after decommissioning, much of the sediments will be deposited in the pool below Gbedin Falls.

Pollution: Decommissioning of the dam will involve blasting and other activities which will lead to temporary increase in noise and vibration as well as air pollution due to dust emissions. The deconstruction of buildings and dismantling of electromechanical equipment will also result in the creation of both hazardous and non-hazardous waste. Much of the waste will be inert building waste that could be reused in building works, and the disposal of the inert waste in suitable spoil areas is not expected to be of environmental concern.

Loss of employment: There will be loss of jobs as the hydropower plant is envisaged to provide a number of long-term employment opportunities during the operation phase. This adverse impact will only partly be compensated by the short-term jobs created by the decommissioning works.

Occupational health and safety risks: The decommissioning works will involve occupational health and safety risks similar to those of the construction phase.

Mitigation Measures

The following mitigation measures should serve as a basis upon which a detailed decommissioning plan can be devised at the appropriate time:

- The decommissioning works shall be undertaken in liaison with the relevant regulatory authorities and adhere to applicable safety guidelines to ensure that the decommissioned facilities do not become a hazard to the public or the environment.
- Complete or partial removal of sediments behind the dam, combined with stabilising the sediments by engineering measures or vegetation cover.
- Restoration of all disturbed sites to pre-construction conditions through landscaping and bio-engineering measures.
- Safe disposal of hazardous waste, concrete and similar non-recyclable construction materials, and recycling of scrap metal.
- Provide personal protective equipment and training to all workers, and ensure that all sub-contractors abide by the applicable health and safety procedures.

9.5 Cost Estimate

Budget Item	Cost (USD)
Construction Contractors' ESMP¹	
Company's ESMP	
Construction Supervision ²	
Environmental Flow Release ³	
Biodiversity Action Plan	60,000
Community Health, Safety and Security Plan	100,000
Resettlement Action Plan	972,872
Capacity Building Plan	30,000
Stakeholder Engagement Plan	15,000
Construction Contractors' Monitoring^{1, 4}	
Company's Monitoring⁴	50,000
Environmental and Social Management Unit⁵	
Contingency (10%)	122,787
TOTAL	1,350,659

¹ The costs associated with the construction contractors' ESMP and monitoring have not been estimated, as the environmental and social criteria will be included in the tender package upon which the tenderers will develop their base rates. The costs of the construction-related environmental and social management and monitoring will thus be within the contract price.

² Construction supervision, to be undertaken by the company's Environmental and Social Management Unit, is assumed to be covered under the existing budget item "construction supervision" in the project cost estimate (Tractebel 2016).

³ The installation of the facility and flow sensor for environmental flow release shall be included in the tender documents and be part of the contract price. The cost is assumed to be covered in the existing budget item "hydro-mechanical equipment" in the project cost estimate (Tractebel 2016). The loss of power production and revenues from releasing environmental flow should be considered in the updated economic analysis to be conducted in the detailed design phase.

⁴ The monitoring plan, including auditing and evaluation, is presented in Chapter 10. The costs are included as part of the respective management plans (Biodiversity Action Plan and RAP) and the costs of the Environmental and Social Management Unit (see next footnote), but a contingency budget has been added here.

⁵ The costs of the Environmental and Social Management Unit is assumed to be covered under the existing budget items "construction supervision" and "environmental and social cost" in the project cost estimate (Tractebel 2016).

9.6 Summary of ESMP

The predicted impacts, proposed mitigation measures, responsible institutions and estimated costs are summarised and outlined in the below table. Note that the cost estimates refer to the detailed budget given in Section 9.5.

Table 40: ESMP summary.

Impact Source	Mitigation Measures	Responsibility	Estimated Cost
CONSTRUCTION PHASE			
Physical Environment			
Visual impact	<ul style="list-style-type: none"> All disturbed surfaces shall be subject to landscaping, including revegetation using local topsoil and native plant species Temporary construction facilities shall be demolished and the sites be restored to pre-construction state Excess material shall either be disposed of in the reservoir area, or as spoil tips in specially designated spoil disposal areas subject to landscaping Vegetation clearance along the transmission line and access road shall be restricted to the right of way 	Contractors	Included in construction cost
Soil erosion	<ul style="list-style-type: none"> Except where vegetation clearing is required for permanent works or excavation operations, all trees and vegetation shall be preserved Erosion control practices shall be implemented prior to any major soil disturbance and be maintained until permanent protection is established All exposed surfaces and spoil areas shall be covered with topsoil and replanted or re-seeded 	Contractors	Included in construction cost
Land contamination	<ul style="list-style-type: none"> Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills Diesel shall be stored in a standard skid tank with secondary containment proving 110% volume of the total capacity of the skid Maintenance of machinery and trucks shall be done in workshop servicing and repair areas with impervious concrete platforms and oil traps All storage areas and major construction sites shall have spill kits, sand, dust, and other appropriate absorbent materials 	Contractors	Included in construction cost
Air pollution	<ul style="list-style-type: none"> Water shall be sprayed on the access road to minimise dust dispersion when necessary Trucks transporting loose friable materials shall be tarped to reduce wind entrainment of dust Stockpiles of excavated soils located near residential areas shall be subject to water spraying 	Contractors	Included in construction cost
Construction noise	<ul style="list-style-type: none"> Noisy installations shall be located in adequate distance to residential areas to meet noise limit values Noisy activities shall be scheduled to daytime hours when possible Noise control devices shall be installed in construction equipment if noise levels exceed the applicable guidelines The workforce shall be instructed to avoid unnecessary noise 	Contractors	Included in construction cost
Reservoir filling	<ul style="list-style-type: none"> During the initial filling of the reservoir, a minimum flow shall be release through the flushing gate equal to at least 50% of the inflow at the time of impoundment 	Company	No cost
Water pollution	<ul style="list-style-type: none"> Erosion control practices shall be implemented prior to any major soil disturbance on the riverbanks Sedimentation controls shall be implemented in the form of silt trap fences, sedimentation ponds and drainage channels where appropriate Coffer dams shall be constructed such as to minimise releases of sediments and pollutants to the downstream environment (e.g. avoiding low flow periods and rock material with high content of fine particles) All the water draining down from batching plants, crusher plants, etc. shall be led to sedimentation and neutralisation ponds and has to be treated before releasing it to the recipient water body 	Contractors	Included in construction cost

Impact Source	Mitigation Measures	Responsibility	Estimated Cost
	<ul style="list-style-type: none"> Storage and handling of fuel and hazardous materials shall be kept away from the river Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills Diesel shall be stored in a standard skid tank with secondary containment proving 110% volume of the total capacity of the skid All storage areas and major construction sites shall have spill kits, sand, dust, and other appropriate absorbent materials Sanitary water treatment facilities shall be installed in the workers' camp 		
Biological Environment			
Vegetation clearing	<ul style="list-style-type: none"> Except where vegetation clearing is required for permanent works or excavation operations, all trees and vegetation shall be preserved All disturbed areas that are not required for permanent works shall be restored and replanted with native trees Vegetation clearance along the transmission line and new access road shall be restricted to the right of way 	Contractors	Included in construction cost
Disturbance from construction activity	<ul style="list-style-type: none"> Schedule noisy activities to daytime hours and instruct the workforce to avoid unnecessary noise Conduct detailed survey of chimpanzees prior to construction in order to ascertain that the project's area of influence is not used as a nesting habitat Strictly prohibit all hunting, firewood collection, charcoal production, and purchase of bush meat by the workforce 	Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in monitoring cost (USD 60,000)
Sedimentation and pollution of downstream habitats	<ul style="list-style-type: none"> Erosion control practices shall be implemented prior to any major soil disturbance on the riverbanks Sedimentation controls shall be implemented in the form of silt trap fences, sedimentation ponds and drainage channels where appropriate Coffer dams shall be constructed such as to minimise releases of sediments and pollutants to the downstream environment (e.g. avoiding low flow periods and rock material with high content of fine particles) Storage and handling of fuel and hazardous materials shall be kept away from the river All storage areas and major construction sites shall have spill kits, sand, dust, and other appropriate absorbent materials 	Contractors	Included in construction cost
Human Environment			
Population influx	<ul style="list-style-type: none"> Establish transparent recruitment procedures to avoid camp followers in form of job-seekers Establish a recruitment policy that gives priority to local residents for less specialised services Share recruitment procedures with the local authorities for further dissemination Provide opportunities for sub-suppliers and sub-contractors by engaging local firms which in turn employ local labour Consider engaging local women groups for the award of sub-contracts like vegetation clearing, traffic control, catering services among others Conduct public health campaigns addressing issues of behavioural change, SGBV (sexual and gender based violence), malaria, HIV/AIDS, traffic management, etc. Support communities to construct communal water supply and sanitation facilities in preparation for the population influx 	Company/ Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)

Impact Source	Mitigation Measures	Responsibility	Estimated Cost
	<ul style="list-style-type: none"> Provide access to safe water supply and sanitation facilities for all project workers to prevent additional pressure on the existing facilities. Establish a workers' housing camp and a site clinic to reduce pressure on local infrastructure, services and utilities Provide training and awareness to workers on health risks and prevention, and establish a code of conduct on worker-community relations including SGBV 		
Land acquisition	<ul style="list-style-type: none"> Appoint an engineering consultant to prepare the detailed design and make the necessary adjustments to the project layout and land requirements Carry out cadastral survey and follow the legal steps to obtain the land titles 	Company	Included in project planning and design cost
River contamination	<ul style="list-style-type: none"> Comply with best industry practice to prevent river pollution during construction activities Notify the downstream communities about construction activities in the rivers and provide early warning in case of pollution events 	Company/ Contractors	Included in construction cost
Increased river transport	<ul style="list-style-type: none"> Support the Gampa community to procure a more mechanically sound and safe boat/raft to be used for river crossing Ensure that there are no sudden changes in river flow that might disrupt river transport downstream 	Company	Included in RAP cost (USD 400,000)
Disruption of fishing at Gbedin Falls	<ul style="list-style-type: none"> Ensure continued access to the pool for fishermen during safe periods of the construction phase Prioritise the fishermen for employment as an alternative source of livelihood during the construction phase Support fishing households (including wives) with credit and/or agricultural starter packages (tools, seeds, fertilisers) to promote alternative sources of livelihoods 	Company	Included in RAP cost (USD 400,000)
Economic displacement	<ul style="list-style-type: none"> Give prior notice to farmers and allow them to harvest seasonal crops before the start of construction Allow the farmers to collect the wood from the vegetation clearing (e.g. in reservoir area and RoW of transmission line) Compensate for the loss of crops and land use rights to all affected households and communities as per the Resettlement Action Plan (RAP) Provide support for livelihood restoration and community development projects as per the RAP Facilitate the process of regularising of tenure for all the economically displaced households that could be exposed to the risk of future evictions Provide documented evidence of replacement land allocation to all economically displaced households Ensure that residual tribal certificates are provided to all affected landowners with registered land (title deeds/tribal certificates) 	Company	Included in RAP cost (USD 400,000)
Risk of food insecurity	<ul style="list-style-type: none"> Ensure timely allocation of replacement land to all affected households Provide agricultural starter packages (tools, seed and fertilisers) to all affected households as support towards land clearing and replacement of farms If affected households are not given sufficient notice to harvest their mature food crops prior to land takeover, provide food/food allowances to all economically displaced households during the transition period to secure them from the risk of food insecurity for a period of at least one year Align the project land takeover with the agricultural calendar to allow farmers sufficient planning time for the new season 	Company	Included in RAP cost (USD 400,000)
Employment and business opportunities	<ul style="list-style-type: none"> Priority for recruitment to be given to local residents for less specialised and labour-intensive services 	Company/ Contractors	Included in construction cost

Impact Source	Mitigation Measures	Responsibility	Estimated Cost
	<ul style="list-style-type: none"> Provide opportunities for sub-suppliers and sub-contractors by engaging local firms which in turn employ local labour Consider engaging local women groups for the award of sub-contracts like vegetation clearing, traffic control, catering services among others Create equal opportunities for employment of women in both management and casual placements Prevent child labour by not employing minors of less than 15 years of age 		
Disturbance from construction traffic	<ul style="list-style-type: none"> Collaborate with the traffic police to raise awareness about road safety in schools, communities and among project drivers Disseminate traffic management plans in the project area, through campaigns in schools and communities Ensure that all project vehicle drivers are well trained and have a full and up to date license to operate their vehicles Institute speed limits and traffic controls for project vehicles and equipment in recognition that the main access road is a shared road with the public Implement dust control measures (e.g. water sprinkling) especially in sections close to schools and health centres 	Company/ Contractor	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Pressure on public sanitation facilities and waste management	<ul style="list-style-type: none"> Provide sufficient sanitary facilities and safe water supply for workers at all work sites Prior to construction, establish possibilities for local disposal of non-hazardous wastes and make all necessary arrangements for handling of hazardous waste Construct communal sanitation and water supply facilities in targeted locations (Gbalasonnoh, Gehwee, Tonwee and Gampa Phor) and set up sustainable operation and maintenance systems (including water guards) Conduct hygiene improvement campaigns at community level and create awareness in regard to sustainable waste disposal practices 	Company/ Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Pressure on health facilities	<ul style="list-style-type: none"> Provide adequate health care to project workers and their families to avoid exerting additional pressure on the existing health facilities Conduct preventive health campaigns for the communities with particular focus on water and sanitation related diseases Institute all possible measures to ensure that communities are not exposed to the risk of construction accidents in any form (e.g. water pollution, traffic accidents, collapsing structures) 	Company/ Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Health and safety risks	<ul style="list-style-type: none"> Include best practice health and safety provisions in the construction contracts and ensure strict compliance with national legislation and the World Bank EHS guidelines Ensure that the workers' camp standards in regard to quality, management and provision of basic social services are compliant with the IFC/EBRD guidance on workers' accommodation Ensure project sites are secured against unauthorised access Collaborate with the traffic police to raise awareness about road safety in schools, communities and among project drivers Disseminate traffic management plans in the project area, through campaigns in schools and communities Ensure all project vehicle drivers are well trained and have a full and up to date license to operate their vehicles Institute speed limits and traffic controls for project vehicles and equipment in recognition that the main access road is a shared road with the public 	Company/ Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Public health risks	<ul style="list-style-type: none"> Eliminate small pools of water acting as breeding ground for mosquitos Conduct public health campaigns on malaria, HIV/AIDS, schistosomiasis and sanitation/hygiene 	Company/ Contractors	<u>Contractor</u> : Included in construction cost

Impact Source	Mitigation Measures	Responsibility	Estimated Cost
	<ul style="list-style-type: none"> Ensure that the local health facilities have access to drugs for treatment Provide funding to construct communal sanitation facilities and to rehabilitate non-functional water supply facilities in towns affected by population influx 		<u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Security threats	<ul style="list-style-type: none"> Support local security systems to strengthen community policing and crime-handling measures Institute strict control measures for project property, including fencing as required Ensure that the conduct of security personnel complies with good international practice Establish a grievance mechanism for addressing security-related grievances 	Company/ Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Risk of Sexual and Gender Based Violence	<ul style="list-style-type: none"> Raise awareness related to SGBV among men, women, girls and boys through community campaigns, school campaigns and workers campaigns Employ women in groups instead of individuals and assign them female supervisors wherever possible Allocate tasks to women that allow them sufficient time to attend to their household needs Establish a code of conduct on worker-community relations and inform all workers on the rules and regulations governing the host communities Institute a grievance mechanism that also captures community concerns related to workers behaviour and SGBV Enact and enforce human resource policies against sexual harassment and abuse in the workplace 	Company/ Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Risk of child labour and abuse	<ul style="list-style-type: none"> Raise awareness related to child labour and abuse through community campaigns, school campaigns and workers campaigns Limit the eligibility age for employment to not below 15 years of age for all contractors and sub-contractors Incorporate opportunities for apprenticeship for the youth in the community and internships for the young ones with a certificate in vocational training during construction phase 	Company/ Contractors	<u>Contractor</u> : Included in construction cost <u>Company</u> : Included in community health, safety and security cost (USD 100,000)
Loss of physical cultural resources	<ul style="list-style-type: none"> Conduct further consultations with chiefs during vegetation clearing and land preparation to avoid interference with any non-documented cultural/religious sites In case of chance finds, the construction activity shall be stopped, the site be secured and the responsible authority be notified 	Company/ Contractors	Included in construction cost
OPERATION PHASE			
Physical Environment			
Visual impact	<ul style="list-style-type: none"> An environmental flow of at least 5.8 m³/s shall be released into Gbedin Falls at all times Vegetation maintenance along the transmission line and access road shall be restricted to the right of way 	Company	To be included in project design and updated cost estimates
Soil erosion	<ul style="list-style-type: none"> Drainage arrangements shall be installed along the access road (culverts, ditches) 	Contractors	Included in construction cost
Land contamination	<ul style="list-style-type: none"> All permanent facilities where fuel and hazardous materials are used or stored shall be equipped with secondary containment, oil traps, spill kits and absorbent materials 	Contractors	Included in construction cost

Impact Source	Mitigation Measures	Responsibility	Estimated Cost
GHG emissions	<ul style="list-style-type: none"> Conduct pre-impoundment clearing of trees in the reservoir in order to reduce emissions from decay of organic matter in the reservoir 	Contractors	Included in construction cost
Flow alterations	<ul style="list-style-type: none"> An environmental flow of at least 5.8 m³/s shall be released into Gbedin Falls at all times 	Company	Included in operation rules
River impoundment	<ul style="list-style-type: none"> Conduct pre-impoundment clearing of trees in the reservoir in order to minimise the risk of water quality deterioration 	Contractors	Included in construction cost
Sediment trapping	<ul style="list-style-type: none"> Reservoir sedimentation shall be reduced using the flushing gate and/or by drawing down the water level and using excavators Sediment flushing should be confined to flood periods to reduce the sediment concentration and allow spillage of surface water after the flushing period in order to wash away the silt deposited in the downstream reaches 	Company	Included in operation rules
Water pollution	<ul style="list-style-type: none"> Storage and handling of fuel and hazardous materials shall be kept away from the river Sanitary water treatment facilities shall be maintained All permanent facilities where fuel and hazardous materials are used or stored shall be equipped with secondary containment, oil traps, spill kits and absorbent materials 	Company/ Contractors	Included in construction cost
Biological Environment			
Fish entrainment	<ul style="list-style-type: none"> Consider installation of a fish screen (or reductions in trash rack openings) at the intake to reduce fish entrainment and mortality 	Company/ Contractors	Included in project design and construction cost
Degradation of aquatic and riparian habitats in the downstream	<ul style="list-style-type: none"> An environmental flow of at least 5.8 m³/s shall be released into Gbedin Falls at all times In case of power station outage during periods when there is no spilling over the dam, a compensation flow shall be released by immediately opening the flushing gate If daily peaking is considered in the detailed design, then conduct an environmental flows (EFlows) assessment to determine the acceptable peaking pattern 	Company	Included in operation rules
Establishment of invasive plant species	<ul style="list-style-type: none"> Disturbed areas shall be restored immediately after the construction and maintenance works All invasive plant species shall be removed during routine vegetation maintenance Importation of exotic trees and soil from other places (e.g. for restoration or as ornamentals) shall be prohibited 	Company/ Contractors	Included in construction cost and project operation cost
Human Environment			
Restricted land use	<ul style="list-style-type: none"> Sensitise communities about the prohibited and permissible activities within the transmission line wayleaves Award contracts for vegetation clearing/maintenance to the women groups and/or other community members 	Company	Included in operation and maintenance cost
Potential conflict with mining operations	<ul style="list-style-type: none"> Appoint an engineering consultant to assess alternative routing of the transmission line (and access road) to avoid crossing Kitoma hill 	Company	Included in project planning and design cost
Restricted access to fishing at Gbedin Falls	<ul style="list-style-type: none"> Ensure access to the reservoir area for local fishermen in order to provide alternative fishing grounds 	Company	No cost
Promotion of rural electrification	<ul style="list-style-type: none"> Give priority to the project-affected communities for provision of rural electrification 	Company	No cost
Health and safety risks	<ul style="list-style-type: none"> Ensure compliance to strict occupational health and safety procedures and exposure limits Ensure institution and compliance of fire safety plan and procedures 	Company	Included in operation and maintenance cost

Impact Source	Mitigation Measures	Responsibility	Estimated Cost
	<ul style="list-style-type: none"><li>• Increase safety awareness amongst public regarding risk from electrocution<li>• Ensure safe operation of the dam, and develop a flood warning system		

10 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

10.1 Introduction

This chapter describes the monitoring programme for the Gbedin mini hydropower project. Monitoring involves the continuous measurement or periodic review of mitigation activities and their effectiveness.

The overall responsibility of implementing the monitoring programme rests with the Company as the project proponent. However, the various monitoring activities will be conducted by the institution implementing the respective management actions (combined with compliance monitoring by the Company or Owner's Engineer). The monitoring programme has therefore been divided into a Construction Contractors' monitoring programme and a Company's monitoring programme, respectively.

The present monitoring programme also outlines the reporting responsibilities, both the Company's requirements towards the Contractors and the Company's statutory responsibilities towards the respective government offices and financiers, as well as the auditing and evaluation system designed to verify the quality of the monitoring data and enforce compliance with the prescribed standards and requirements.

The objective of the monitoring plan is to:

- Provide checks on the implementation of the mitigation measures (activity monitoring) and early indications of progress, or lack thereof, with respect to achievement of objectives (outcome monitoring)
- Identify corrective measures or the redesign of mitigation measures (proactive action), if the originally planned mitigation measures are not sufficiently effective

The total timeframe of the monitoring period is not time-bound and it should last until the project impacts have been mitigated or fully compensated. In practical terms, the implementation schedule and cost estimates have been set according to the expected time needed to achieve the performance targets.

10.2 Construction Contractors' Monitoring Programme

10.2.1 Introduction

The Construction Contractors' monitoring programme sets out the monitoring responsibilities of the Contractors and will be contractually enforced by the Company. The detailed monitoring system should be further elaborated by each Contractor and incorporated into their Environmental, Health and Safety (EHS) Plan (see Section 9.3). Consequently, the monitoring costs have not been estimated here, as the Contractors' monitoring responsibilities will be included in the tender package upon which the tenderers will develop their base rates. The costs of the construction-related environmental and social monitoring will therefore be within the contract price.

10.2.2 Monitoring Methods

Generally, the monitoring of construction practices and mitigation measures will be based on visual inspections at the construction sites. In addition, the Contractors will be responsible for monitoring the outcome of their management actions on the physical, biological and human environment. The performance indicators, the means of verification and the monitoring frequency are described in Table 41. It should be noted, however, that the exact monitoring methods need to be defined and agreed upon at a later stage as part of the contractors' EHS Plan.

Table 41: Proposed monitoring methodology for the Construction Contractors.

Management Issue	Performance Indicators	Means of Verification	Monitoring Frequency
Landscape and land cover management	<ul style="list-style-type: none"> Quantity and quality of vegetation clearing Quality of landscaping at restored sites Plant species used for re-vegetation Number and location of spoil heaps Cleanliness of construction site 	<ul style="list-style-type: none"> Visual inspections Photographic documentation Interviews 	Weekly inspections
Soil erosion and sedimentation control	<ul style="list-style-type: none"> Number and location of silt trap fences / sedimentation ponds Timing and duration of in-stream works Water quality parameters 	<ul style="list-style-type: none"> Visual inspections Photographic documentation Interviews Water quality measurements in the main river downstream of the construction areas 	Weekly inspections Monthly water quality measurements (daily during in-stream works)
Waste and wastewater management	<ul style="list-style-type: none"> Amounts and types of waste generated, sorted, recycled/reused, treated and disposed Number, location and status of waste disposal sites Number and status of toilet facilities Wastewater quality parameters Quality of secondary containment structures Labelling of hazardous waste Evidence of pollution spill contingency plan 	<ul style="list-style-type: none"> Visual inspections Photographic documentation Interviews Wastewater quality measurements at source (see Appendix 11) 	Weekly inspections Weekly wastewater quality measurements
Air pollution control	<ul style="list-style-type: none"> Frequency of water spraying on roads and stockpiles Evidence that trucks cover loose materials Location and timing of waste burning Ambient air quality (PM₁₀) at site and sensitive receptors (i.e. towns affected by construction traffic) 	<ul style="list-style-type: none"> Visual inspections Photographic documentation Interviews PM₁₀ measurements at construction sites and roadsides using standard air sampling equipment (conforming to EC Directive 89/336/EEC and ISO 12103-1) (see Appendix 12) 	Weekly inspections Weekly air quality measurements
Noise management	<ul style="list-style-type: none"> Timing of blasting operations Blasting practices Evidence of hearing protection used by workers Evidence of noise control devices Noise levels (dB) at site and sensitive receptors (i.e. towns affected by construction traffic) 	<ul style="list-style-type: none"> Visual and auditory inspections Interviews Blasting records Noise level measurements (Leq, dBA) at construction and blasting sites, as well as receptor, using a standard sound level meter (conforming to class 2 according to IEC 61672-1:2002) (see Appendix 13) 	Weekly inspections Weekly noise measurements, or daily in case of non-compliance with IFC Noise Level Guidelines
Physical cultural resources	<ul style="list-style-type: none"> Number of chance finds Evidence of chance finds procedures 	<ul style="list-style-type: none"> Visual inspections Photographic documentation Interviews 	Weekly inspections

Management Issue	Performance Indicators	Means of Verification	Monitoring Frequency
Occupational health and safety	<ul style="list-style-type: none"> • Number of workers trained in safety procedures • Percentage of workers using Personal Protective Equipment (PPE) • Structural integrity of workers' accommodation and sanitary facilities • Access to health services by workers • Malaria prevalence rate in workforce • HIV/AIDS prevalence rate in workforce • Evidence of emergency preparedness and response plan • Incident statistics (Total Recordable Injuries, Fatalities, Lost Time Injuries, Restricted Work Case, Medical Treatment Case, First Aid Case, Near Miss, Reports on Unwanted Occurrences) 	<ul style="list-style-type: none"> • Visual inspections • Interviews • Photographic documentation • Incident reports 	Daily monitoring
Traffic and transportation safety	<ul style="list-style-type: none"> • Evidence of traffic and transportation safety plan • Traffic incident rate (including workers, community and livestock) • Observed speed of construction vehicles • Number of drivers trained and equipped with license • Evidence of signing, warnings and controls 	<ul style="list-style-type: none"> • Visual inspections • Speed checks • Photographic documentation • Interviews 	Monthly inspections and checks
Security Arrangements	<ul style="list-style-type: none"> • Compliance with Voluntary Principles on Security and Human Rights • Evidence of training of security personnel in the use of force and arms • Number of security related grievances raised by the communities and workers 	<ul style="list-style-type: none"> • Visual inspections • Photographic documentation • Interviews 	Weekly inspections
Labour management	<ul style="list-style-type: none"> • Proportion of local population on overall project workforce • Proportion of women employees on overall project workforce • Evidence of written contracts • Number of worker grievances • Age of workers • Quality of workers accommodation • Proportion of unskilled workforce that have had their skills upgraded 	<ul style="list-style-type: none"> • Visual inspections • Interviews • Employment contracts 	Weekly inspections

10.2.3 Roles and Responsibilities

Contractors

In addition to the compliance monitoring by the Company (see below), the Contractors shall self-monitor their compliance with the Construction Contractors' ESMP. The Contractors will perform routine monitoring inspections using pre-established checklists. The self-monitoring system shall be based on the methods outlined in Table 41.

The Contractors shall prepare monthly reports to the Company's Environmental and Social Management Unit describing the implementation of the Construction Contractors' ESMP, including key performance indicators, as well as any deviations, incidents or accidents and corrective measures taken.

When a non-conformance is detected and is not, or cannot be, immediately resolved, then a corrective action process will be initiated by the Contractor. On completion of the corrective or preventive action, the Company's Environmental and Social Management Unit will confirm and record all the necessary details.

Company

The Company will supervise and monitor compliance with commitments included in the Construction Contractors' ESMP. This will be achieved by routine inspections of construction activities and review of written documentation. For this purpose, the Company's Environmental and Social Management Unit will prepare inspection checklists and regularly take part in the Contractors' self-monitoring inspections.

The Company's Environmental and Social Management Unit will prepare monthly reports on the overall ESMP implementation including the performance and compliance with the Construction Contractors' ESMP. The report will be based on the corresponding monthly reports from the Contractors and on the findings from the routine inspections. The monthly report will be submitted to the Company's management and distributed to other relevant stakeholders as appropriate.

The Company's Environmental and Social Management Unit will organise weekly meetings with the Contractors where environmental and social performance will be discussed and, where necessary, any additional mitigation measures will be agreed upon.

The Company's Environmental and Social Management Unit will also prepare annual environmental and social management reports to the Company's management and as part of its statutory responsibilities towards the Government. The annual report will include both the Construction Contractors' ESMP and the Company's ESMP performance.

Government

The concerned government institutions will carry out inspections and audits as they may deem fit. The county and district administrations and their technical officers are expected to take part in joint inspection and monitoring sessions with their national counterparts.

AfDB

AfDB will monitor ESMP and RAP implementation and compliance with AfDB requirement standards through review of quarterly ESMP/RAP implementation reports as part of the quarterly progress reporting. In addition, AfDB will carry out supervision missions during project implementation and also project completion supervision.

10.3 Company's Monitoring Programme

10.3.1 Introduction

The Company will be required to monitor the performance of the Company's ESMP. This section therefore provides an outline of the Company's monitoring programme which will be elaborated further prior to the start of the mitigation and enhancement programme. The detailed monitoring procedures should be included in the Company's Environmental and Social Action Plan (cf. Section 9.4).

10.3.2 Environmental Flow Release

The Company shall be responsible for continuous monitoring of the environmental flow in order to ensure compliance. A flow sensor can be installed and be connected to a data recording unit or directly to the control-system at the power station. The cost of these facilities shall be included in the tender bids and be part of the contract price.

Performance Indicators

- Environmental flow release (m³/s) at Gbedin dam/weir

Means of Verification

- Data recording unit (or power station control system) for environmental flow

Monitoring Frequency

Environmental flow shall be monitored on a continuous basis.

Roles and Responsibilities

The Company shall be responsible for the monitoring activities. Environmental flow will be monitored by the plant operators.

10.3.3 Biodiversity Monitoring

Performance Indicators

- Number of trees cut outside the project boundary and RoW
- Presence of invasive plant species in the project area
- Number of animals (including birds and bats) killed by electrocution and wire collision
- Number of IUCN red-listed animal species observed in the project area

Means of Verification

- Visual observations by project staff and local people
- Monitoring reports by professional biologists
- Interviews with hunters and fishermen

Monitoring Frequency

The Environmental and Social Management Unit will record biodiversity observations on a continuous basis in their daily inspections. Professional biologists will be hired to produce biodiversity monitoring reports (on terrestrial and aquatic ecology) at least twice; during the early stages of construction (prior to dam construction) and during the initial filling of the reservoir (prior to commissioning). In addition, biodiversity monitoring should be conducted in the early phase of project operation.

Roles and Responsibilities

The Company's Environmental and Social Management Unit will be responsible to hire the services of professional biologists while also recording all biodiversity observations during their daily inspections.

Expert reports shall be submitted to the company's management and the findings shall be included in the regular monthly reports.

10.3.4 Community Health, Safety and Security Monitoring

Performance Indicators

- Number of preventive health campaigns
- Disease prevalence and incidence
- Number of communal sanitation facilities constructed and maintained
- Number of communal water supply facilities constructed and maintained
- Number of traffic accidents involving community
- Number of security-related grievances
- Number of reported sexual and gender based violence (SGBV) cases

Means of Verification

- Household surveys
- Visual inspections
- Hospital/health centre reports
- Grievance register

Monitoring Frequency

Monthly collection/compilation of statistics from service providers, hospital/health centres, local police and grievance register.

Roles and Responsibilities

The monitoring will be carried out by the implementing organisation, i.e. either the Company's Environmental and Social Management Unit or the service providers. If the task is delegated to a service provider, then it should submit quarterly reports to the Environmental and Social Management Unit, which in turn will incorporate the latest monitoring data into the regular reports to the Company's management.

The initial data on community health, safety and security shall be collected at the start of the programme and serve as a baseline against which to monitor future progress. The baseline survey shall be included as an integral part of the programme.

10.3.5 RAP Monitoring

A Resettlement Action Plan (RAP) for the Gbedin project has been prepared as a stand-alone report. The below is a summary of the monitoring and evaluation programme outlined in the RAP. The monitoring costs have been included in the RAP budget.

Performance Monitoring

Performance monitoring will focus on the actual progress of the implementation of the planned resettlement activities. This will be an internal function conducted by RREA and the results will be reported on a monthly basis. This will be the responsibility of the Resettlement Implementation Unit and will focus on measuring inputs into the resettlement compensation and livelihood restoration program and their outputs. Focus will be on the following indicators:

- Number of PAPs to whom the compensation packages have been disclosed by gender and age
- Number of displaced households that have consented to their compensation packages by gender and age
- Number of displaced households that have received their compensation packages by gender and age

- Number of displaced households allocated replacement land by gender and age
- Number of displaced households enrolled for the livelihood restoration programme by gender and age
- Number of displaced vulnerable households supported during the transition period by gender and age
- Type of support given to displaced vulnerable households
- Number of grievances received by gender
- Number of grievances resolved by gender
- Timeframe for resolving grievances
- Nature of grievances by gender and age
- Expenses towards compensation, income restoration, relocation/transition allowance
- Number of fishermen with access to alternative livelihoods.
- Staffing resettlement unit by gender

Impact Monitoring

Impact monitoring will assess whether the desired objectives and commitments have been achieved. Impact monitoring will be conducted by a third party and the results will be shared with RREA for adjustments wherever necessary. Impact monitoring is recommended on a bi annual basis, relying on the reports from the internal monitoring as well as supplemental investigations through observations and random interviews with PAPs.

- Total farmland per displaced household
- Increase in crop production per year
- Number of displaced households that have opened up new farmlands by gender and age of household head
- Average size farmland per displaced household by gender and age of household head
- Number of displaced households having 3 meals a day
- Nature of household assets among displaced households
- Amount of fish catch per fisherman per day by gender and age of household head
- Ease of access to natural resources (fruits, spices, timber) by gender of household head
- Nature of unresolved grievances
- Timeframe within which escalated grievances are resolved
- Proportion of the total grievances received escalated beyond to District level
- Proportion of the total grievances resolved through the courts of law
- Nature of grievances resolved through the courts of law
- Number of displaced households with alternative sources of income by gender and age of household head
- Number of households employed by the project by gender and age of household head

Completion Audit

Upon conclusion of the resettlement implementation activities, a completion audit should be conducted. This will be conducted by an external entity with the objective of assessing completeness of the implementation of the resettlement program particularly whether livelihoods have been restored or improved sustainably. A comprehensive livelihood survey is recommended at this stage to facilitate comparison with the pre project conditions. Key issues to be audited include:

- Level of participation of affected households in decisions regarding location of new replacement farmland, choice of farm inputs (tools, seeds and fertilisers, labour options (hired or family labour) training, credit support among others.
- The sustainability of the alternative livelihoods provided to PAPs

- Effectiveness of the measures taken to protect the interests of the affected vulnerable persons and groups
- Adequacy of replacement land in terms of quality , quantity, accessibility and security of tenure
- The nature of community development initiatives undertaken and their adequacy to addressing the community needs as well as effectiveness of the sustainability measures instituted.
- Effectiveness of livelihood restoration measures
- The food security situation of the households compared to the pre project situation

The audit will identify gaps, if any, and make recommendations on the way forward. The completion audit should be conducted by regulating authority or by an independent third-party.

Independent and Post Evaluation

An evaluation will be conducted at least 5 years after the completion of the implementation of the livelihood restoration plan, whichever will be applicable. The objective of the evaluation will be to assess the effectiveness of the resettlement and or livelihood programs, the impact of these programs on the affected households, the adequacy and appropriateness of the interventions undertaken during the resettlement and or livelihood restoration and the economic status on the economically displaced households.

10.3.6 Capacity Building Monitoring

Performance Indicators

- Number of staff employed in the Environmental and Social Management Unit
- Number of RREA staff trained
- Number of training sessions provided to other stakeholders involved in RAP/ESMP

Means of Verification

- Employment record
- Training records

Monitoring Frequency

The performance of the capacity building plan will be monitored on a continuous basis.

Roles and Responsibilities

There will not be a separate monitoring system for the capacity building activities. However, the capacity building events will be captured in the regular monthly reports prepared by the company's Environmental and Social Management Unit.

10.3.7 Stakeholder Engagement Monitoring

Performance Indicators

- Number of stakeholder consultations
- Number of grievances (received, resolved and pending)

Means of Verification

- Meeting minutes
- Grievance register
- Interviews

Monitoring Frequency

The performance of the stakeholder engagement will be monitored on a continuous basis.

Roles and Responsibilities

There will not be a separate monitoring system for the stakeholder engagement. However, the issues raised by the stakeholders in consultation meetings and the status of grievances will be included in the regular monthly reports prepared by the company's Environmental and Social Management Unit.

10.4 Reporting System

10.4.1 Monthly Reporting

The Construction Contractors will prepare monthly reports on their environmental and social performance and their compliance with the Construction Contractors' ESMP. The reports will be submitted to the Company's Environmental and Social Management Unit and be based on the monitoring system described in Section 10.2.2.

The Company's Environmental and Social Management Unit will compile monthly reports that will be forwarded to the Company's management and shared with the concerned stakeholders. These reports will be based on the monthly reports from the construction contractors and on monitoring data from the company's own environmental and social management programme.

10.4.2 Quarterly Reporting

While the Construction Contractors will be required to report monthly, the service providers (e.g. NGOs) involved in the Company's ESMP should report on a quarterly basis. These quarterly reports will be submitted to the Company's Environmental and Social Management Unit and the latest report will feed into the monthly reporting cycle described above.

10.4.3 Annual Reporting

The Company's Environmental and Social Management Unit will prepare annual reports on the Company's overall environmental and social management performance. The annual report will be submitted to EPA and other government agencies as part of the company's statutory responsibilities towards the Government. The report will also be disseminated to the other project stakeholders.

10.5 Auditing and Evaluation

In addition to the monitoring and reporting system described above, the Company should establish an auditing and evaluation system in order to obtain independent verification of its environmental and social performance and external checks on its compliance status.

Audits and evaluations might be commissioned by the government regulators and/or the lenders (e.g. AfDB) as they may deem fit. It is assumed that audits/evaluations will either be carried out by external consultants hired directly by the Company, or by a Panel of Experts appointed by the lenders.

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APPENDICES

Appendix 1: Terms of Reference

Appendix 2: Team Members

Appendix 3: Minutes of Meetings

Appendix 4: Attendance Lists

Appendix 5: Notice of Intent

Appendix 6: Information Brochure

Appendix 7: Socio-economic Questionnaire

Appendix 8: Notification Letter to Guinea

Appendix 9: Mobilisation Letter

Appendix 10: Biological Baseline Assessment Report

Appendix 11: Sanitary Sewage Discharge Standards

Appendix 12: WHO Air Quality Guidelines

Appendix 13: IFC Noise Level Guidelines