ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

SIERRA MINERALS HOLDINGS 1 LIMITED

BAUXITE MINING PROJECT

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Executive Summary

Project Background

Sierra Minerals Holdings Ltd. (SMHL) is a joint venture known as VIMETCO Group that owns license to mine bauxite in the south eastern Province of Sierra Leone. The lease area is located in five chiefdoms within Bo, Moyamba and Bonthe Districts.

For SMHL to continue with its operations in the Concession area, the Environment Protection Agency (EPA/SL) is requesting for an Environmental and Social Impact Assessment (ESIA) before a License can be renewed. The ESIA should outline the existing environmental and social conditions within the mine site and the surrounding communities identify potential impacts of the project and propose mitigation measures that SMHL should undertake during its project operations.

Tropical Environmental Design Associates (TEDA) was retained by SMHL to prepare this ESIA with the following Terms of Reference (TOR).

1. Describe and assess the prevailing baseline environmental and socio-economic conditions of the study area.
2. Produce project overview including: management, Infrastructure and methods of production.
3. Describe the national and international regulatory framework applicable to bauxite mining in Sierra Leone.
4. Determine project alternative scenarios.
5. Identify, predict and determine the intensity of the impacts on the receptors using the information obtained from objective 1.
6. Propose mitigation measures that would be used to minimize these impacts.
7. Produce a summary of an Environmental Management Plan (EMP) based on the information obtained and that contained in the EMP and,
8. Conduct a Public Consultation and Disclosure meetings with all stakeholders including the affected communities at chiefdom, district and regional levels. These will be held to solicit feedback from all stakeholders' concerns, and if possible propose further mitigation measures.

Brief Description of the Project

SMHL produces about 1.4 million metric tonnes of bauxite annually from five main deposits at Gbonge, Gondama, Jenega, Konta, and Wunde. It has a complex washing facility at Gondama with a capacity of 300t/hr. and a recovery of more than 65 percent. The bauxite mined is shipped to Constanta in Romania for ALUM Tulcea the primary alumina manufacturing company that produces 600,000 tpa.

The proven washed bauxite reserves in the SML lease area are 12.5 million metric tonnes with an overall grade of 51% Al_20_3, 48% available alumina (av. Al_2O_3) and 3.0 % $Si0_2$ but total reserves should be at least 30 million metric tonnes. This reserve estimate will support production for approximately 20 years at an annual production rate of 1.7 million metric tonnes. The bauxite reserves are dispersed 20% around the washing plant and 80%, 14-18 km haulage distance from the washing plant.

The exploration program involves line cutting, pitting, drilling, sampling and assaying. The entire lease area was prospected and classified by an earlier company, Sieromco into measured, indicated or inferred resources. Based on this available information, SMHL has primarily been engaged in validating these reported resources in four deposits (Konta, Wunde, Jenega and Gbonge) by generating its current reserve base and the extension of SMHL mine life.

Infrastructure and Machinery

Summarily, the existing facilities and owner assets include:

- Senior staff Camp – 14 double houses and lodging facilities with 7 rooms.
- Two administrative buildings, 2 canteens, mechanical workshop area, laboratory, store, warehouse and a fuel station at the main plant site at Gondama.
- Harbour facility with dryer, 9 barges, 4 tug boats, fuel storage tanks and conveyors at Nitti.
- Five power Generating plants.
- Tailing storage facilities,
- Stockpile facilities (ROM & Washed).
- A fleet of vehicles including 30 MAN trucks and 32 Volvo trucks.
- A fleet of mining machinery including excavators, dozers, frontal loader, graders, compactors and a wide range of support equipments.etc.
- Project Access (Land and Sea).

Water resources within/proximity to SMHL lease are abundant. Due to the large quantities of water required by bauxite wash process, water is sourced at the Taia River and pumped to a 5000 m^3 capacity reservoir which in turn runs to the plant site by gravity flow.

SMHL has a highly skilled and experienced workforce with an organizational management capable of running the project at management and supervisory level. More than 95% of the workforce is Sierra Leonean and majority of the employees are skilled with technical expertise in handling mining related jobs.

Regulatory Framework

In accordance with the national and international regulatory framework for mining and due diligence requirements of the lending institutions, the submission and acceptance of this ESIA is a mandatory precursor for the renewal of license for this project. These regulatory framework and policies were used in the preparation of this report.

Baseline Conditions

The baseline data used in the preparation of this report was based on field visits carried out between September and November 2012. They complemented those previously collected from other sources. Stakeholder consultations were undertaken to determine the additional data required for the evaluation of the baseline conditions and potential impacts of the project. Following the stakeholder consultations, a field survey was undertaken with the purpose of obtaining an overview of the entire study area that would further complement the information gathered during the consultative meetings.

Environmental baseline conditions studied include: topography, climate, drainage, geology, water resources, flora, fauna, and socio-economic data including demography, health and sanitation, education, water supply, agricultural practices and land tenure.

Project Impacts and Mitigation

Project Benefits

The exploitation of mineral resources such as bauxite is benefitting SMHL and its allied companies financially. Apart from this direct benefit to the company, an array of other direct and indirect benefits that the project could have on the mining community and the country at large are as follows:

***Economic Benefits**:* In 2010 SMHL Vimetco acquired the bauxite mines from Titanium Resources Group (TRG) with a market capital of $189 million. The injection of capital expenditure in foreign exchange has boosted the economy of Sierra Leone in terms of foreign exchange earnings. The project is also generating economic benefits to the GOSL in terms of taxes, duties and royalties as specified in the mining code.

Job Creation: The project directly and indirectly is injecting money into the local economy through salaries to workers and supplies outsourced locally which thereby increases the purchasing power of the local population. This is indirectly benefitting the small business groups in the community and the local tax collection system.

Roads Infrastructure: Since operations started, SMHL has reconstructed and resurfaced all roads in the lease area and it has continued to invest in maintenance of local roads with other neighboring companies in the project area. This is facilitating a speedy movement of goods, agricultural produce and people within and outside the concession area.

Community Development Initiatives: Since November 2012, the company has been financing community development initiatives within the purview of SMHL Foundation in the five chiefdoms and in the following priority areas of interventions:

- Continued rehabilitation of major roads and haul roads in the concession area and Joint venture rehabilitation of other major roads in the Moyamba District;
- Construction of Maternity and Child Health Post, hand dug wells fitted with pumps and class-room buildings.
- Provision of building materials to households affected by fire accidents in the community;
- Provision of services and supplies to the Serabu Hospital and Mokanji Police Station; and
- Offer of scholarships and tuition to students resident in the mining community.

Notwithstanding the above positive impacts, SMHL operations continue to have various negative biophysical and socio-economic impacts in its operations. These were predicted using established procedures, standards and by means of professional and subjective judgments. Most of these impacts were rated from insignificant to moderate. With no mitigation measures applied, most of these are either minor or moderate. The table below presents a summary of the projects' impacts and mitigation.

When all the impacts are considered the two most prominent are those that are prevalent on surface water, including the hydrology and natural drainage systems in the natural environment and the disconnect existing between the communities expectations and apprehensions and the realistic gains which may accrue through a more equitable transfer mechanism. Although there will be a number of social impacts of high significance, the majority of the impacts on social conditions are of moderate

significance. These social impacts must be compared with the predicted benefits of the mining activities, as indicated in Section 1. The positive economic impact of the mines is highly significant, and the revenue from taxation that will accrue to government provides resources that can be used to significantly improve the condition of infrastructure in the South east region of the country. The economic benefit to the local economy is also significant, since the project will not only support several hundred employees directly, but it will also support significantly more of their dependents. It is estimated that, on average, each employee will support eight dependents or family members. This should result in a general improvement in standards of living in the study area and provides an alternative livelihood to the current subsistence farming.

Summary of Project Impacts: SMHL Bauxite Mining Project.

No	Environmental Issue	Source of Impact (Activity)	Impact	Affected Community(ies) /Receptors	Significance			
					Timescale	Area	Magnitude	Likelihood
Bio-Physical								
1	**Topography**	Vegetation Removal , Excavation of Overburden, Opening of Mine Panels, Back Filling, Leveling, Grading.	Land Disturbance, Soil Compaction, Slope Displacement.	Gondama Konta Jenega Wunde Gbonge	Permanent	Local	Moderate (Low severity)	Likely
2	**Geology**	Removal of overburden, Excavation from mine panels.	Soil erosion, Sedimentation in streams and valleys	Gondama Konta Jenega Wunde Gbonge	Permanent	Local	Moderate (Low severity)	Very Likely
3	**Air**	Land Clearing, Excavation, Earthmoving, Storage of materials, Handling and Transportation.	Air Pollution	Machine operators, Nearby Communities, Villages along haul roads, Personnel at plant site	Short-term	Local	Moderate	Likely

4	**Noise**	Machine operation, Hauling of ore, Ore beneficiation, Stockpiling, Power generation, Bauxite drying, Loading.	Noise Pollution	Gondama plant site, Nitti Port, Mine panels, Haul roads, Matta camp.	Short-term	Local	Low - Moderate	Likely
5	**Surface Water**	Vegetation remova,l Excavation, Construction and rehabilitation of road infrastructure, Construction and rehabilitation of mine facilities, Ore beneficiation, Stockpiling, Mine Reclamation and Closure.	Soil erosion, Run-off, Sedimentation in streams and valleys, Water pollution, Changes in local hydrology.	All communities located within the mine lease	Short-term	Local	Locally high	Very Likely
6	**Visual Resources**	Mining operations, Construction, Demolition.	Negative effect on the View Shed in the rural environment	All communities located within the mine lease, Communities located along haul roads and out of the lease area	Medium	Local	Moderate (Low severity)	Likely

7	**Accidental Release of Sludge from TSF**	Ore beneficiation	Release and discharge of sludge into dams and local drainage systems, Increase in turbidity, conductivity and in-organic particulates in the drainage system.	Communities in the downstream sections of the lease area, Gondama plant site.	Short-term	Local	Low	Likely
8	**Wildlife Protected Areas and Cultural Properties**	No Significant Impact - NSI	(NSI)	(NSI)	(NSI)	(NSI)	(NSI)	(NSI)
9	**Borrow Pits and Quarry Sites**	Quarrying and Road rehabilitation work.	Soil erosion, Open pits become breeding ground for insect disease vectors, Intrusion of sediments into farm lands.	Villages along main haul and access roads.	Short-medium term	Local	High	Likely
10	**Flora and Fauna**	Vegetation removal	Loss of flora and fauna	Entire lease area.	Permanent	Local	Low-Moderate	Very Likely
Socio-economics								
11	**Community Health and Safety**	Mine related activities	Accidents, Incidents, Spread of communicable diseases.	SMHL personnel Communities within operational area.	Short-term	Local	Low	Likely
12	**Traffic and road Safety**	Vehicular transportation Motor bike riders Pedestrians.	Accidents	SMHL personnel Communities along haul roads.	Short-term	Local	Low	Likely

13	**Population Movements**	Migration	Spread of communicable diseases, Prostitution, Disruption of Social and Cultural values, Drug and alcohol abuse Theft, Domestic Violence. Noise.	Entire mining community	Long	Local	Moderate	Very Likely
14	**Gender Impacts**	Socio-economics	Land Ownership, Teenage pregnancy and early Marriage, Increase in early school drop-out.	Entire mining communities	Long	Local	Low - Moderate	Very Likely

No	Environmental Issue	Mitigation Measures
Bio-Physical		
1	**Topography**	Reclaim Mined-out Areas, Reclaim Stockpile Areas, Use designated routes in the wet season.
2	**Geology**	Separation of super soil from sub soil during removal. Proper grading and reshaping of the disturbed Adequate crop suitability procedures for reclamation work.areas. Prompt timing of re-vegetation on reclaimed lands to avoid top soil removal in the early rain events. Establishment of sediment raps, bunds and where necessary construction of diversion ditches. Regular inspection of reclamation and repair works where needed; and Use of rock mulch on unprotected surfaces.
3	**Air**	Dust Suppression in the Dry season, Provision of mask to employees in dusty areas, use of gaseous control equipment at plant site, apply traffic safety rules and regulations, reduce speed limits, construct speed bumps in villages along haul roads,
4	**Noise**	Future facilities with high noise impacts should be located well away from noise sensitive areas. Mine faces should be used as noise barriers in the immediate vicinity of villages such as Gbonge, Jenega and Konta. Protective hearing devices should be used when employees are at work especially at or near earth-moving equipment, wash plants and power houses.
5	**Surface Water**	Stockpiles and overburden should not be placed at nearby drainage ways. Waste oil, fuel and other lubricants should be stored in strong containments. Tailings Management Plan should be properly implemented. As much as possible, leakages into earth fill dams should be avoided. Efforts should be made in the wet season to ensure that rain water is diverted from the TSF
6	**Visual Resources**	Where construction of power lines would be required, features should be designed so as to achieve landscape designs Impoundment dams should be rehabilitated to meet international standards. Burrow pits and mine faces should be graded
7	**Accidental Release of Sludge from TSF**	Rehabilitation, development and implementation of the Tailings Management Plan coupled with regular inspection programme

No	Environmental Issue	Mitigation Measures
8	**Wildlife Protected Areas and Cultural Properties**	(NSF)
9	**Borrow Pits and Quarry Sites**	The pits should be closed up immediately after use Quarry sites must be included in mines closure and reclamation plans
10	**Flora and Fauna**	Prompt mine reclamation activities in the mined out areas should be enhanced. If vulnerable or endangered species exist within the mine sites, measures should be taken to create alternative sites.
Socio-economics		
11	**Community Health and Safety**	Provision of additional health facilities to the five affected chiefdoms; Provision of health services to all workers and their families, which will avoid new demands on health services by Project out-of-area workers. Avoid and minimize environmental effects that have potential to affect health, including dust, noise, Preventions should be taken against fire accidents
12	**Traffic and Road Safety**	Provide driver safety training to all workers. Impose speed limits; Schedule truck traffic along the public highways to avoid peak hours; and Introduce safety campaigns for the communities.
13	**Population Movements**	Give job preference to the local population Job opportunities such as poultry and piggery farming, vegetable gardening, bakery, brick making, entertainment centres
14	**Gender Impacts**	Training; establishing micro credit schemes and through serving as a market for the agricultural produce

Analyses of Alternatives

Analyses of alternatives constitute part of this ESIA. The purpose is to improve on project design, construction and operation decision making based on feasible project alternatives as prescribed by the International Finance Corporation (IFC, 2006). It provides the basis for identifying optimal project alternatives that are consistent with the goals of the mining company, funding organization, the government, the mining community and the policy and regulatory framework established for the mining industry.

Project alternatives that were considered for SMHL project include:

- No Action alternative;
- Alternative for location of staff accommodation;
- Bauxite processing location;
- Mine closure.

The adoption of the no-action alternative would mean that the project would remain in its current condition with no mine-related development activity by SMHL. This scenario would mean that the Environmental Management Plan and the community Development Action Plan (CDAP) that are prepared would not be implemented. As such, the anticipated project benefits such as employment, foreign exchange earnings, infrastructure development and community development initiatives would not improve in the concession area and the country as a whole. This will result in the continuation of in migration into the area and the resultant poor state of local economy, infrastructure and other public services.

Following the depletion of the Mokanji deposits in 1982, Sieromco relocated its operations to Gondama. The accommodation provided for SMHL staff are located 20 – 40 miles away from the plant site. The mining activities at the Gondama site do not require total off-site accommodation especially for supervision work during the second and third shifts. The option therefore is the relocation or expansion of staff accommodation closer to the mine site. Proximity to the mine site would lead to the following benefits:

- Reduction in travel time to work;
- Increased work supervision at all times;
- Proximity to the only Medical Hospital in the mining area;

- Decrease in the running cost of vehicles;
- Extension of overtime work for certain staff categories;
- Increase in the opportunity for the expansion of the Gbonge deposits and future expansion of shipping facility closer to the four bauxite deposits at Mattru.

The existing processing plant is in a closer proximity to the five major deposits. For operational considerations, the Tailings Storage Facility (TSF) is located as close as possible to the plant site to reduce cost of transportation of the slurry. The potential for the existing facility to near its storage capacity is high considering mine life of SMHL operations. Consideration should be given for an alternative storage facility in the near future.

Tailings Disposal and Storage will involve a construction of mine pits in the Gbonge area into tailings storage containment. The slurries would be deposited in the pits as mining continues. Filling would continue for less than a year and after a decanting period, revegetation would start followed by a full reclamation work based on the mine reclamation plan.
The major disadvantages of this alternative would be related to short term mine plan as this operation will concurrently go on with other mining operations.

Construction of a new storage facility would require concurrent construction work and mining operations with little obstruction. Construction work would however be more expensive as materials such as sand and gravel would have to be transported from a distance outside the mining area.
Preferred alternative for the two options would be controlled by key factors including costs, time of construction, and availability of equipments, weather conditions and the expected life of the mine operations.
Mine reclamation and closure activities at SMHL operations are implemented to establish a beneficial post-mining land use, in the case of this project it will consist primarily of agricultural lands. This option requires millions of dollars in earth moving activities, and it cannot be considered as the best option for the open pits. The preferred options would be to identify those pits (especially those around Gbonge) to fill with water in the wet season for use by the community at the end the mine life. Backfilling of these pits with tailings slurries would be another feasible option considering the life of the existing tailings facilities at the plant site.

Public Consultation and Disclosure

This section defines the Sierra Leone requirements for conducting stakeholder consultation and disclosure activities during the ESIA process.

Public Consultation and disclosure meetings for this ESIA were held in respect of the renewal of license at chiefdom, district and regional levels between January 25th and 28th 2013.

1. Serabu on the 25th January 2013 – Chiefdom level

2. Moyamba District on the 26th January 2013 – District level

3. Bo Town on the 28th January 2013 – Regional level

The meetings were meant to allow all stakeholders stay informed on the current updates on SMHL operations, allow all stakeholders voice their opinions, grievances and provide meaningful suggestions for sustained operations of the project.

The key objectives of the public consultation and disclosure as set-out by the Sierra Leone Environmental Protection Agency (SLEPA) as part of the international requirement for public hearings to be undertaken for the approval/renewal and issuance of an Environmental Licence are;

- Inform stakeholders (individuals, communities, local interest groups, Government officers, local NGOs, Community Based Organizations, affected and interested parties) of the important aspects of the SMHL-Vimetco Bauxite Project;
- Provide an opportunity to consult with local communities, stakeholders, civil activists etc to voice out their concerns and perceptions regarding the project;
- Consult comprehensively as far as possible by disseminating information about the nature of the project, identify, and discuss the public concerns(potential project's impacts) about the project;
- Obtain feedback on perceptions and concerns by means of a public exposure of the ESIA draft document;
- Solicit public comments and encourage input on preferred alternatives, mitigation measures and similar aspects on project implementation.

- Respond to all stakeholders as far as possible and address the concerns and issues that are raised.

To ensure full participation and contribution of community and stakeholders, notification via the local media, print media, letters, telephone calls and display of banners, indicating time, date and locations of the public hearing were undertaken prior to the disclosure process.

The following are the summary of the findings, comments and input from key government officials, participants and affected communities at the three levels where the consultations and disclosure meetings were held. These inputs have played a definitive role in shaping the focus of the ESIA document and the development of mitigation/amelioration measures.

- Community Development undertaken by the company.
- Environmental impacts of the project on communities (e.g.: Noise, Pollution of air and water bodies)
- Socio-Economic benefits to the community (e.g. Youth employment, skills training etc.)
- Environmental degradation of community agricultural land.
- Disposal of used / scrap items (e.g. tyres, chemicals etc.).
- Tailings outflow and threat to nearby water sources.
- Construction / tarring of nearby road networks.
- Effective Monitoring and Evaluation of the implementation of the ESIA report and the EMP especially on the part of the EPA and the Ministry of Mines etc.
- Collaboration and Consultation with the local people by the company.
- Company to expand on the road rehabilitation work to other surrounding areas (e.g. Rutile-Bumpeh road).
- Company to embark on capacitating its workers in relevant areas, providing skills training opportunities and the promotion of other economic activities for the community.
- EPA-SL and the Mines Ministry to liaise up with local councils to enforce the implementation and Monitoring of all these plans by the company.

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Abbreviations/Acronyms

CAM Community Affairs Manager

CDAP Community Development Action Plan

CHC Community Health Centre

CITES Convention on International Trade of Endangered Species

db Decibel

EHSG Environmental and Health Safety Guidelines

EMP Environmental Management Plan

ERCP Emergency Response and Contingency Plan

EPA/SL Environmental Protection Agency/ Sierra Leone

EPCC Engineering, Procurement, Construction and Commissioning

ESHIA Environmental; Social; and Health Impact Assessment

ESAP Environmental and Social Action Plan

ESMP Environnemental and Social Management Plan

EU European Union

GOSL Government of Sierra Leone

Km Kilometre

IUCN International Union for Conservation of Nature and Natural Resources

MCHP Maternal and Child Health Posts

MRCP Mines Reclamation and Closure Plan

ML Mining Lease

NGO Non-Governmental Organization

PFC Perflouronated Carbon

PHU Peripheral Health Unit

SMHL Sierra Minerals Holdings Ltd

STD	Sexually Transmitted Disease
T/hr	Tonnes per hour
TEDA	Tropical Environmental and Design Consultants
TOR	Terms of Reference
TOC	Total Organic Compounds
UNFCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization

Currency Exchange Rate {Mid-November; 2011}

1 US$ = € 1.29 =Le 4350

Section 1.0 - Introduction

1.1 Background

Sierra Minerals Holdings Ltd. is a joint venture known as VIMETCO Group that owns license to mine bauxite in the south eastern Province of Sierra Leone. The lease area is located in five chiefdoms within BO, Moyamba and Bonthe Districts. A brief description of the company's business overview is presented below:

- About 1.4 million tonnes of bauxite is produced annually from five main deposits at Gbonge, Gondama, Jenega, Konta, and Wunde.
- It has a complex washing facility at Gondama with :
  - A capacity of 300t/hr.
  - A recovery of > 65%
  - A total content of Al203>53% and;
  - A low content of SiO2 <4%.
- Its harbor facilities located at Nitti (40km. from Gondama) include: a bauxite dryer, push boats, barges and a loading facility.
- The bauxite mined is shipped to Constanta in Romania for ALUM Tulcea the primary alumina manufacturing company that produces 600,000 tpa.

For SMHL to continue with its operations in the Concession area, the Environment Protection Agency (EPA/SL) is requesting for an Environmental Impact Assessment (ESIA) before a License can be renewed. The ESIA should outline the existing environmental and social conditions within the mine site and the surrounding communities to identify potential impacts of the project and the proposed mitigation measures that SMHL should undertake during its project operations.

1.2 Terms of Reference

This Environmental and Social Impact Assessment report has been prepared in accordance with the stipulations of the EPA/SL and the following Terms of Reference (TOR) received from SMHL.

1. To describe and assess the prevailing baseline environmental and socio-economic conditions of the study area and secondary data collection.

2. Produce project overview including: management, Infrastructure and methods of production.
3. Describe the national and international regulatory framework applicable to bauxite mining in Sierra Leone.
4. Determine project alternative scenarios.
5. Identify, predict and determine the intensity of the impacts on the receptors using the information obtained from objective 1.
6. Propose mitigation measures that would be used to minimize these impacts.
7. Produce a summary of an Environmental Management Plan based on the information obtained and that contained in the EMP.
8. Conduct a Public Consultation and Disclosure meetings with all stakeholders including the affected communities at chiefdom, district and regional levels. These will be held to solicit feedback from all stakeholder's concerns, and if possible further mitigation measures.

Tropical Environmental Design Associates, Architects, Engineers, Environmental Designers and Development Consultants (TEDA) were retained by SMHL to prepare this ESIA.

1.3 Structure of the Report

As much as possible, this ESIA followed the Guidelines provided by the EPA/SL.

Section One: This section presents the introduction that explains project background, Terms of Reference, purpose, scope, objectives, study limitations and methodology.

Section Two presents the project description including management, infrastructure, machinery, ore reserves, mining and security.

Section Three is a summary of the legal and institutional framework for environmental issues related to mining in Sierra Leone.

Section Four presents details if the environmental baseline conditions.

Section Five presents the direct impacts associated with the project and mitigation measures needed to address the impacts.

Section Six presents a summary of the Environmental Management Plan proposing residual impacts with the pertinent measures to be addressed during project operations.

Section Seven presents conclusions and recommendations for sustained bauxite operations in the lease area.

1.4 Project Setting

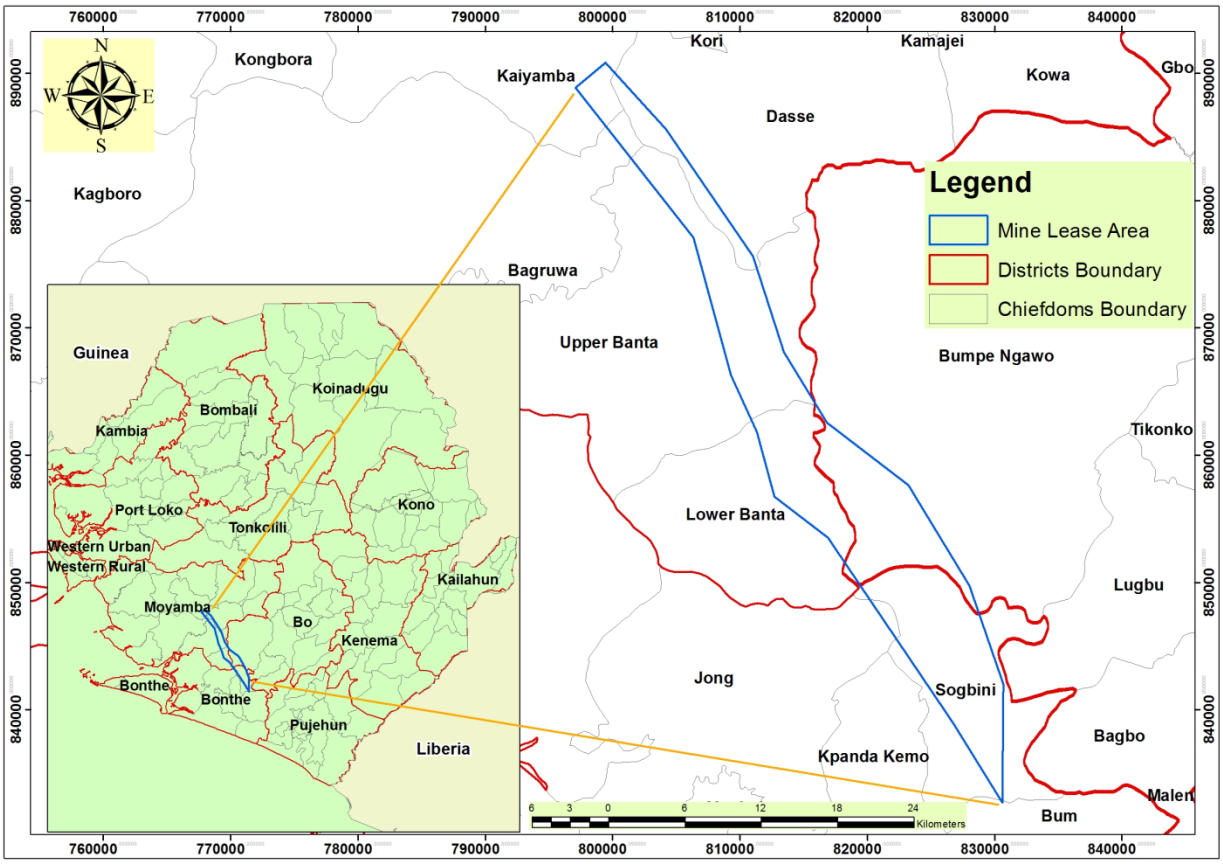
The project setting is divided into two impact areas: a. Areas of direct social and environmental impacts immediately and directly affected by the mining operation namely, mine panels, plant site, haul roads, Nitti Port, Matta Camp and the affected communities within the lease area. b. Areas of project influence where most of the environmental impacts are influenced by project activities either within or outside the lease area. Examples of these are villages outside the lease area but linked to the haul roads and portions of those chiefdoms that are out of the lease area.

The lease area is about 163 kilometers south east of Freetown with the plant site and shipping facilities located at Gondama and Nitti respectively. The bauxite concession covers an area of 321.2 square kilometers as delineated in Exploration License EXPL 2/2001. Its principal deposits are concentrated in Gbonge, Gondama, Jenega, Konta and Wunde. The road leading to Mattru from Freetown which constitutes part of the haul road passes through the lease area for about 59.5 km. There are many villages that are affected by the mine activities, but those mostly affected currently include: Gbonge, Gondama, Jenega, Konta and Wunde. SMHL owns a residential camp at Matta (out of the concession area) where accommodation and recreation facilities are located 20 km from Gondama and Nitti respectively. The entire camp is fenced and guarded. It consists of 14 duplex houses for senior staff, 1 building for kitchen and a recreational area, 1 gym building; other building/utility/services that house the generator and, laundry.

The entire project area is traversed by unpaved roads with the major ones leading to the five chiefdom head quarter towns of Gbonge, Bumpeh, Gbangbatoke Banta Mokele and Mano Dase. A number of haulage and access roads constructed during the early mining period that were not reclaimed are used as foot paths to farms and villages

The proven washed bauxite reserves in the SML lease area are 12.5 million metric 4eigh with an overall grade of 51% Al_20_3, 48% available alumina (av. Al_2O_3) and 3.0 % $Si0_2$ but total reserves should be at least 30 million metric 4eigh. This reserve estimate will support production for approximately 20 years at an

annual production rate of 1.7 million metric 5eigh. The bauxite reserves are dispersed 20% around the washing plant and 80%, 14-18 km haulage distance from the washing plant.



Map 1. SMHL Lease Area (ML1/05).

1.5 History and ownership of Bauxite Deposits

The exploration of Bauxite in Sierra Leone started in the 1920's with the recording of low-grade bauxites in and around the Freetown Peninsular and Kabala in the Northern Province. In 1958, the bauxite potential in the Kasila Group Geology was initiated with the mapping of the Mokanji and Gbonge Hills. On the basis of this study, the Sierra Leone Ore and Metal Company Limited (Sieromco) was formed as a wholly owned subsidiary of a Swiss Company, Alusuisse.

In 1961, Sieromco signed an agreement with the GOSL entitling Sieromco to prospect for and mine bauxite in certain parts of the country. Sieromco commenced mining bauxite in Sierra Leone in September 1963 in the Banta/Gbangbatoke and Dasse Chiefdoms in the Moyamba District. Sieromco mined in the Mokanji area continuously for more than 19 years.

In 1982, following the depletion of the Mokanji deposits, Sieromco relocated its operations to Gondama (approximately 26 km south-east of Mokanji) and resumed mining in the Banta Mokelleh Chiefdom. Sieromco mined the Gondama deposits continuously until January 18, 1995, when the company suspended operations and abandoned the mine site as a result of the civil war.

Alusuisse requested a consulting Firm BH&P to prepare a feasibility study in April 1995 for a possible reopening of the Sieromco mines. The objectives of the evaluation were to:

- Confirm the practicality of the mining and transportation methods;
- Evaluate possible alternatives; and
- Confirm and update the cost of projections.

Other considerations were also given to the possibility of combining the operations with Sierra Rutile with arrangements made for contract mining.

Observations made took cognizance of many aspects of mining based on a ten year operating experience and detailed operational data that were proven accurate.

On October 19, 2000, the GOSL reached an agreement with Alusuisse to acquire the assets and minerals and mining rights of the company under the Sieromco Share Purchase Agreement. In December 2000, Sieromco finally shutdown all its business dealings in Sierra Leone and handed over its assets to the GOSL and relinquished Mining Lease 2131.

Sierra Rutile Limited (SRL) purchased these assets from the GOSL under the Sale and Purchase Agreement of 20th. November 2001; and on December 1st of the same year, SRL was granted exploration license EXPL 2/2001 for the area formerly covered by the Sieromco Mining Lease 2131. On 7th December, 2001, SRL, with consent of the GOSL, assigned its rights under the above exploration license, to Sierra Minerals Holdings Ltd.1. (SMHL) to fulfill all its obligations, title and interest.

SMHL was incorporated in British Virgin Islands and registered on October, 2001. On 3rd. June 2004, SMHL entered into engineering, Procurement, construction and commissioning (EPPCC) Agreement with PW Mining.

Another feasibility study was prepared and presented to the Government of Sierra Leone (GOSL) in May, 2003. The study which formed the basis of a re-start Plan was based on sound financial and technical fundamentals considering the infrastructural and administrative synergies between SRL and SMHL1.

An Environmental and Social Impact Assessment was undertaken by Aqua Terra Consulting during the period February and March 2003 that served as the basis for the environmental impacts of the project discussed in the Feasibility Study. In January 2005, SMHL was granted Mining Lease ML1/05 covering an area of 321.7 km.

SMHL operated with two major contractors: PW Mining International, a full service contract mining company which operates throughout Africa, and, CZAK Group which was involved in the shipping of the ore product and other port operations. In 2008, SMHL was acquired to Vimetco Group and two years later, SMHL, being a subsidiary of Vimetco Group continued with its mining operations selling all products to ALUM Tulcea Refinery in Romania.

Map 2. SMHL Areas of Influence

1.6 Purpose and Objectives of the Study

This ESIA has been prepared to address potential impacts associated with SMHL bauxite operations including the issues and concerns raised by the affected communities. It:

- Describes the prevailing baseline environmental and socio-economic conditions of the study area and secondary data collection.
- Produces project overview including: management, Infrastructure and methods of production.
- Describes the national and international regulatory framework applicable to bauxite mining in Sierra Leone.
- Determines project alternative scenarios.
- Identifies, predicts and determines the intensity of the impacts on the receptors using the information obtained from objective 1.
- Proposes mitigation measures that would be used to minimize these impacts and,
- Produces a summary of an Environmental Management Plan based on the information obtained and that contained in the EMP.

During the preparation of the ESIA, the consultant was expected to conduct a Public Consultation and Disclosure meetings with all stakeholders including the affected communities at chiefdom, district and regional levels. These were held to solicit feedback from all stakeholder's concerns, and if possible further mitigation measures.

1.7 Scope of Study

In pursuance of achieving the above objectives, the Consultant has encompassed the following tasks/scope of works:

1. Worked closely together with the Company's Environmental Health and Safety Department.
2. Referred to all relevant existing environmental documents including local, national, and international legal and regulatory framework for bauxite mining, especially with particular reference to literature, documentations and data source of Vimetco SMHL Ltd in Sierra Leone.
3. Ensured that the final ESIA conformed to 'best practice' norms; and met conventional International Standards for Environmental, Social Policy and Procedures, and National requirements.

4. Described and assessed salient environmental and social concerns within the mining and processing activities of the Company, with particular emphases on the area of Influence 1.

5. Determined the current environmental and social baseline conditions of the project site and its surroundings on the basis of the existing data on geology, hydrology, ambient air and water quality, biological diversity, demography and socio-economic parameters.

6. Identified and assessed the environmental and social issues associated with the mining, production and exporting activities of the Company; and determined mitigation measures to minimize any potential adverse environmental and social impacts during the operational and post-mining phases of the activities.

7. Prepared an ESIA document based on the requirements of EPA-SL.

The environmental and socio-economic baseline for the ESIA has been based on data already gathered; as well as baseline conditions observed in the course of our field visits to the site (3 visits from 5th to 10th October 2012); and other available relevant documents obtained through local governmental and non-governmental organizations.

1.8 Study Constraints and Limitations.

This ESIA was expected to commence in August 2012 with the aim of submitting the report to the client in October 2012. Thereafter, an onward submission and feedback from EPA would take place before a public consultation and disclosure process. Although the consultant worked closely with the client, some delay was caused in finalising the report and to receive the license.

Othe factors that acted as limitations to the study include:

- Absence of government officials, NGOs and and other local leaders in the consultative meetings during the field work;
- Inadequacy of updated documentation including maps and other unclassified documents;
- Absence of some community members to participate fully in the consultative meetings due to the limited time available between farm work, meeting gatherings and other domestic responsibilities;

- Secondary data that were collected on the villages were not reliable as these have not been frequently updated. This is particularly so in the case of demography and agricultural production trends.
- It was not possible to undertake a detailed taxonomic assessment of fauna and flora species due to the limited time available;

Instead, the assessment presented here supplements other studies already undertaken in previous years.

1.9 Study Approach

The approach to this ESIA consists of the following phases as outlined in the EPA Act of 2008 as amended in 2010: Screening, Scoping, Impact Assessment and Public Disclosure.

Screening: This is the initial phase which decides if an ESIA is required for the project and to determine the extent to which the assessment will be. According to the EPA Guidelines and safeguard policies of the lending institutions, this is a Class A project because it has the potential to have significant environmental impacts, which in turn may have an effect on the facilities and those communities that are affected by mining operations. As required by EPA Act, a Screening form was completed and submitted to EPA detailing the need and level of the assessment, the acceptability of the consultant and the public participation process.

Scoping: The scoping phase involved identification of key issues in the screening phase that were further investigated based on desktop study of relevant environmental and social data collected from published reports and previous studies of the project area. Stakeholder consultations were undertaken to determine additional data required for the evaluation of the baseline conditions and the potential impacts of the project. Public meetings were held in which a diverse group of community members including local authorities, traditional leaders, opinion leaders, local council representatives, youths and women's groups were invited to participate in the surveys.

A door to door sample socioeconomic survey (using a semi-structured questionnaire) was conducted in 43 communities spanning the five chiefdoms (Upper Banta, Lower Banta, Kpanda Kemoh, Bumpe Ngao and Dasse Chiefdoms respectively).

Other key environmental issues associated with the project that were identified and discussed during scoping consultation include impacts on:

- Biophysical Environment: Air quality, Noise quality, Surface water quality, Ground water quality, Soils, Land use capability and Biodiversity.
- Socio-economic and cultural Environment: Demography, education, health and sanitation, water supply, agriculture and farming practices, Social and Political organizations.

Impact Assessment Phase: This involved an assessment of the significance of the potential impacts including the cumulative impacts and recommended mitigation measures that could minimise impacts. The methodology applied for this assessment is presented in the methodology section that is outlined below. An Environmental Management Plan (EMP) has been prepared that clearly defines all the residual and other specific actions that SMHL undertakes to implement the measures that will minimise and mitigate any negative impacts on the human, social and environmental aspects within the project area. A summary of the EMP is produced under a separate chapter of this report. The plan includes an Environmental Monitoring Plan, Emergency Response and Contingency Plan (ERCP), Tailings Management Plan (TMP) and Mine Reclamation and Closure Plan (MRCP).

1.10 Methodology

The methodology for collecting data for the preparation of this ESIA was based on desk study, stakeholder consultation and field survey.

Desk Study: Relevant reports, literature and other documents were collected and a detailed review of the secondary data was undertaken during the course of the study. The major reports included the following:

- Feasibility study report of 2003
- SMHL ESIA and Environmental Social Action Plan (ESAP) reports of 2003
- Exploration and survey reports prepared for SMHL and previous owners the bauxite deposits.
- Community Development Action Plan (CDAP) report of 2010.
- Environmental Management Plan report of 2010.
- SMHL 3rd.quarterEnvironmental Monitoring report of 2012.

- SMHL Environmental Report of 2012 for License renewal.
- National and International Policy Documents and,
- Public Data that is available from the Internet.

All of these provided more information about the project and contributed to the improvement of the data collection.

Impact Prediction: An assessment of the significance of the impacts was made using established standards and professional judgment. The conventions that were adopted include: a. Significant Rating Scales; b. Timescales; c. Spatial Scale; d. Likelihood and, e. Severity.

The significant rating scale developed by Weaver and Caldwell (1999) was adapted for this study. This is explained in Table 1. Timescales are related to the estimated duration of the impacts. The timescales for rating the impacts in this report are short-term (0-5yrs) medium term (6- 20 years) and long-term (more than 20 years). Short-term impacts are those that occur during construction and initial operation activities that may or not be mitigated during the construction period or after.

Spatial scales which describe the spatial extent of an impact in terms of the amount of area affected, i.e. localized or widespread were expressed as follows:

- Localised i.e. an impact limited to a small part of the project's operational area e.g. a few hundred hectares in extent.

- Study Area i.e. impact limited to the immediate vicinity of the project area.

- Regional i.e. impact limited to the general vicinity of the project area.

- National i.e. impact limited to the country as a whole.

- Global i.e. impact limited to the global environment.

Likelihood is the probability that the impact would occur or not. It is explained as: very unlikely, unlikely and likely. This criterion was applied to all the potential negative impacts in order to determine whether or not the impacts can be minimised.

The severity of an impact was determined by the magnitude of the significance based on the extent to which the impact would change under existing conditions or how it would impact upon another receptor. It is explained as very severe, severe, moderately severe, slightly severe and no effect.

The application of checklists and interaction matrices finally enabled the assessment to arrive at: a. Brief description of the expected or predicted environmental changes that would result during the operation of the project. b. Measures that would be implemented to avoid adverse impacts on the environment and, c. An assessment of the possible alternatives including proposed actions.

Table 1 Environmental Significance Rating Scale

Very high	Of the highest order possible within the bounds of impacts which would occur. In the case of negative impacts, there would be no mitigation and/or remedial activity to offset the impact at the spatial or timescale for which it was predicted. In the case of positive impacts there is no real alternative to achieving the benefit.
High impacts	In the case of negative impacts, mitigation and/or remedial activity would be feasible but difficult, expensive, time-consuming or some combination of these. In the case of positive impacts, other means of achieving this benefit would be feasible, but these would be more difficult, expensive, and time-consuming or some combination of these.
Moderate	Impact would be real but not substantial within the bounds of those, which could occur. In the case of negative impacts, mitigation and/or remedial activity would be both feasible and fairly easily possible. In the case of positive impacts, other means of achieving this benefit would be about equal in time
Low	Impact would be of a low order and with little real effect. In the case of negative impacts, mitigation and/or remedial activity would be either easily achieved or little would be required, or both. In the case of positive impacts, alternative means for achieving this benefit would likely be easier, cheaper, more effective, less time-consuming, or a combination of these
Very low	Impact would be negligible. In the case of negative impacts, almost no mitigation and/or remedial activity would be needed, and any minor steps that might be needed would be easy, cheap and simple. In the case of positive impacts, alternative means would almost all likely to be better, in one or a number of ways, than this means of achieving the benefit.
No effect	No impacts, not even a very low impact on the system or any of its parts.

Stakeholder Consultation: Stakeholder engagement provided the team an opportunity for the stakeholders to ask questions discuss the project and express any concerns they have, so that SMHL will be able to respond to comments received. The main objectives of the stakeholder consultation process were to:

- Facilitate open communication with all interested stakeholders;
- Build an open relationship with the local community of the lease area;
- Provide timely and easily understood information to stakeholders in an appropriate non-technical format;
- Open consultation with all stakeholders to ascertain and discuss their opinions and concerns;
- Propose and establish formal and informal public consultation and participation procedures;
- Establish accessible and effective systems for reporting, investigating and resolving grievances separately for both SMHL and the affected community; and
- To establish stakeholder engagement as an integral part of on-going environmental and social impact assessment activity, making sure that mitigation measures are addressed.

The surveys gathered consensus information about key existing conditions, such as infrastructure and microeconomic trends. The questions in the community survey covered the following areas:

- Community infrastructure, including education, health care facilities etc.
- Social and cultural institutions.
- Gender issues.
- Social and economic trends.
- General opinion on the operation of SMHL.
- Crop Compensation and,
- Drinking water facility.

Field Survey: Following the stakeholder consultation, a field survey was undertaken with the purpose of obtaining an overview of the entire operational area that would complement information gathered during the consultative meetings. Specifically, site walks were conducted particularly around the mine

sites and dams and the routing of the biophysical and social issues that arise as a result of project operations. Topographic maps at a scale of 1:50,000 were used as a base for mapping of the biophysical features. GIS technology and software were used for capturing and analysing field data.

Socio-economic Survey: A door to door sample socioeconomic survey (using a semi-structured questionnaire) was conducted in 43 communities spanning the five chiefdoms (Upper Banta, Lower Banta, Kpanda Kemoh, Bumpe Ngao and Dasse Chiefdoms respectively). The questionnaire were administered by trained enumerators (9) drawn among resident community members of mostly teachers. They were closely supervised to ensure effective administration of survey questionnaire and in turn report to the consultant in charge. The data collected were coded and entered into the SPSS version 16.0 spread sheet by a trained data entry clerk. Detailed analysis undertaken using frequency counts, descriptive statistics, cross tabulations, to identify statistically significant differences between the results of the various segments.

The household survey was based on a random sample of 180 households and focuses on gathering data on the socioeconomic baselines of the community influenced by the mining operations. The questions were designed to seek information on the population and dwelling units, income, livelihood, health, community participation, resource use and general attitude towards Vimetco SMHL and concerns/opinions and expectations of the community in the project area. The questionnaire were administered by trained enumerators (9) drawn among residence community members mostly teachers. They were closely supervised to ensure effective administration of survey questionnaire and in turn report to the consultant in charge. The data collected were coded and entered into the SPSS version 16.0 spread sheet by a trained data entry clerk. Detailed analysis undertaken using frequency counts, descriptive statistics, cross tabulations, to identify statistically significant differences between the results of the various segments.

Focus Group Discussions: Focus Group Discussions were conducted in which a diverse group of community members including local authorities, traditional leaders, opinion leaders, local council representatives, youths and women's groups were invited to participate. These generally consisted of focus group discussion/meeting. A total of 5 focus group discussions were held in each of these chiefdoms as shown below. The issues discussed covered the following areas: a. Community infrastructure. B. Social and cultural institutions. C. Access to public Services such as education, health and sanitation. D. Gender issues. E. Social and economic trends and, f. Agricultural production.

All the views expressed by the affected communities helped to identify and evaluate the social and environmental impacts and the formulation of the mitigation measures. Details of the socio-economic survey are presented in the Annex of this report.

The household survey was based on a random sample of 180 households and focused on gathering data on the socioeconomic baselines of the community influenced by the mining operations. The questions were designed to seek information on the population and dwelling units, income, livelihood, health, community participation, resource use and general attitude towards Vimetco SMHL and concerns/opinions and expectations of the community in the project area.

1.11. Project Benefits

Apart from the direct financial benefit to the company, an array of other direct and indirect benefits that the project could have on the mining community and the country at large are outlined below.

Economic Benefits*:* The capital expenditure over the life of mine was estimated in 2003 at $28.6 million in nominal terms excluding capital investment by contractors. This was mainly associated with refurbishment and purchase of new equipment. In 2010 SMHL Vimetco acquired the bauxite mines from Titanium Resources Group (TRG) with a market capital of $189 million. The injection of this amount of money in foreign exchange has boosted the economy of Sierra Leone in terms of foreign exchange earnings. The project is also generating economic benefits to the GOSL in terms of taxes, duties and royalties as specified in the mining code.

Secondly, the project directly and indirectly is injecting money into the local economy through salaries to workers and supplies outsourced locally which thereby is increasing the purchasing power of the local population.

Job Creation: SMHL is continuing to create permanent employment in its operation for over 700 permanent staff and about 200 for casual workers. Job creation is benefiting people at the local and national levels going well beyond welfare improvements for employees themselves. This is having a positive effect throughout the local economy resulting in increased demand for goods and services, and for business and income improvement.

Roads Infrastructure: Most of these roads built before SMHL operations were totally damaged during the war. The haulage roads to the Gbonge deposits required major road construction work. The existing road from Gondama to Nitti harbour was also in a serious state of disrepair as a result of lack of maintenance during inter-war years. Since operations started, SMHL has reconstructed and resurfaced all roads in its operational area and is investing in maintenance of local roads with other 17eighbouring companies in the project area. This is facilitating a speedy movement of goods, agricultural produce and people within and outside the concession area.

Community Development Initiatives: Since November 2012, the company has been financing community development initiatives within the purview of SMHL Foundation in the five chiefdoms and in the following priority areas of interventions:

- Continued rehabilitation of major roads and haul roads in the concession area;
- Joint venture rehabilitation of other major roads in the Moyamba District;
- Construction of Maternity and Child Health Post with facilities at Kanga in the Lower Banta Chiefdom;
- Construction of hand dug wells fitted with pumps in six towns and villages;
- Construction of class-room building for a junior secondary school at Badjia Junction in Dasse Chiefdom;
- Provision of building materials to households affected by fire accidents in the community;
- Provision of services and supplies to the Serabu Hospital and Mokanji Police Station; and
- Offer of scholarships and tuition to students resident in the mining community.

All the above interventions by SMHL are measures that are expected within the framework of the Company's corporate responsibility. Implementation plans are being developed, with initial efforts scheduled for next five years in terms of quality of life improvements, and long-term social and economic improvements.

Section 2 – Project Description

This section gives an overview of the project including mining methods and infrastructure. Details of SMHL project overview presented here are those obtained during the field survey.

2.1 Project Management and Workforce

The SMHL has a highly skilled and experienced workforce with an organizational management capable of running the project at management and supervisory levels. It comprises the General Manager, Department Managers, Supervisory positions, Foreman positions and the General Staff in the form of administration, maintenance, and support services.

SMHL's General Manager is based at the mine site, and reports to the CEO and manage the SMHL operations through a structure of Five (5) Departmental Managers and Five (5) Unit Managers. SMHL Organizational Structure is presented in Figure 9. The General Manager has the overall responsibility for SMHL operations and collaborates with the other Departmental Managers, including the Production and Geology Manager, Technical and Repairs Manager, Procurement and Logistics Manager, Finance and IT Manager, Human Resource and Administration Manager. The responsibilities of these Departmental Managers will encompass the whole SMHL operations, thus providing valuable human resources for the SMHL Manager to utilize.

An effective recruitment methodology and an ongoing training and development programs improve the quality of the personnel to maintain efficiency and sustainability.

A further reduction of the SMHL workforce by contracting operations with clearly defined boundaries and measurable production units reflect reduction in operating cost models. The operations that are wholly or partly contracted are as follows:

- 10% Transportation of ore mined to the Washing Plant;
- 10% Transportation of washed bauxite to Nitti; and
- Security Service provision.

SMHL Department/Unit personnel numbers classified into expatriates, and SL employees and contract are summarized in the following table. Beginning February 2012, the mine has operated on three (3) shifts each on eight (8) hours schedule for a twenty-four (24) hours period. Haulage fleets will be run on two (2) shifts beginning at 7^{00} am to 23^{00} pm at night. The remaining third (3^{rd}) shift is schedule for ore processing, repairs and maintenance only at the plant site.

Vimetco, like any other mining projects in a production stage and with a good human personnel management record world-wide, operates it's mine with normal hours of work not less than or more than 44 hours per week.

Table 2. Summary of Personnel Distribution

No	Departments	Personnel	Expatriates	SL Managers	SL Supervisors	General Staff
1	Production and Geology	134	5	2	2	125
2	Technical and Repairs	304	7		2	295
3	Procurement and Logistics	12	2		2	8
4	Financial and IT	5		1	3	1
5	Human Resources and Administration	25	2	1	2	20
6	Mechanical Energy	1	1			0
7	Community Affairs	2		1	1	0
8	Environmental Health and Safety	15		1	1	3
9	Quality and Laboratory	33		1		32
10	Goods Receipt	1				1
	Total	**532**	**17**	**7**	**13**	**485**
11	**Security G4S**	**166**				
12	**Sub-Total**	**688**				

2.2 Infrastructure and Machinery

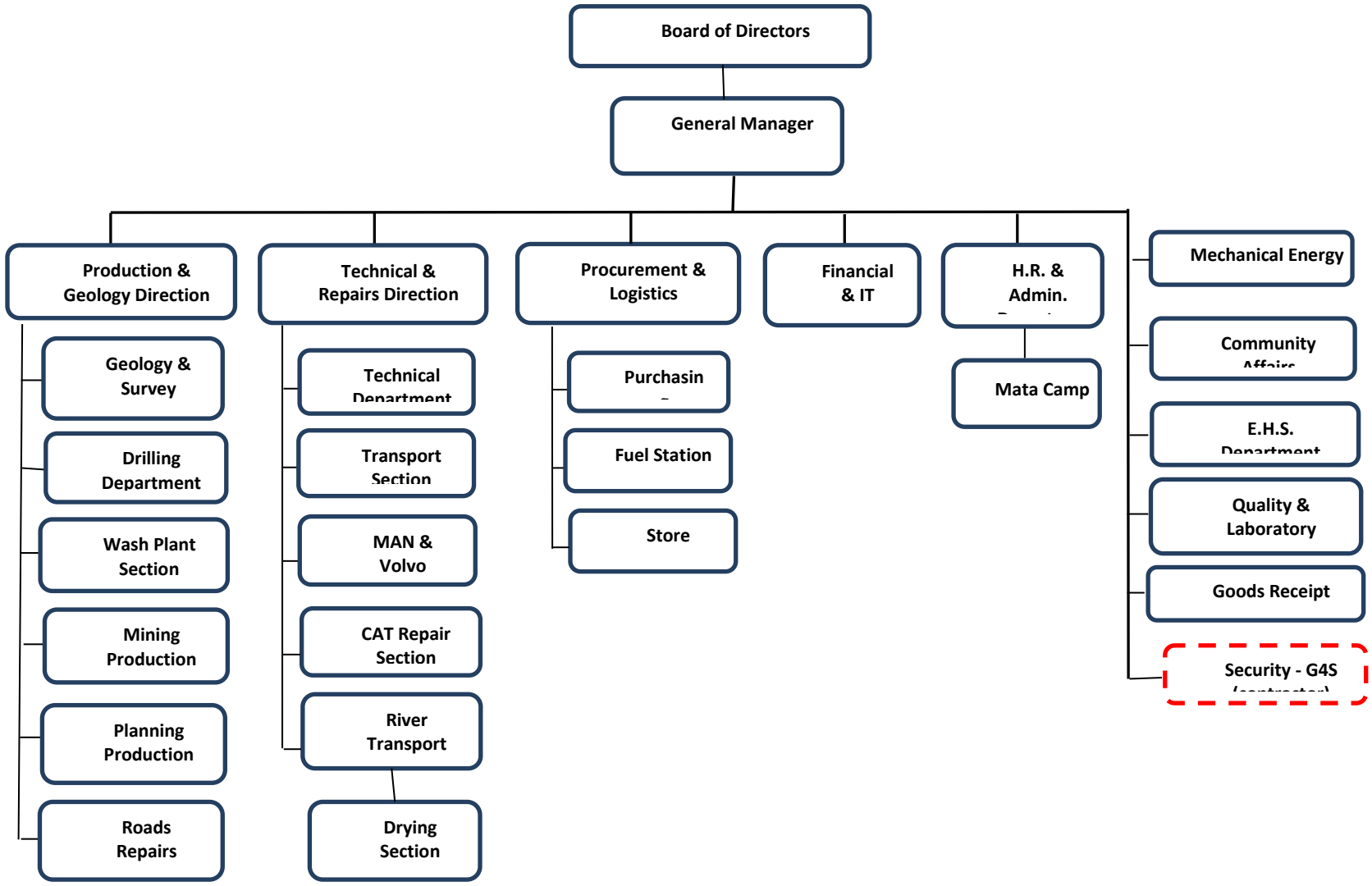
The existing facilities and owner assets for SMHL operations include:

- Senior staff Camp – 14 double houses and lodging facilities with 7 rooms.
- Two administrative buildings, 2 canteens, mechanical workshop area, laboratory, store, warehouse and a fuel station at the main plant site at Gondama.
- Harbour facility with dryer, 9 barges, 4 tug boats, fuel storage tanks and conveyors at Nitti.

- Five power Generating plants.
- Tailing storage facilities,
- Stockpile facilities (ROM & Washed).
- A fleet of vehicles including 30 MAN trucks and 32 Volvo trucks.
- A fleet of mining machinery including excavators, dozers, frontal loader, graders, compactors and a wide range of support equipments.etc.
- Project Access (Land and Sea).

Water resources within/proximity to SMHL lease are abundant. Due to the large quantities of water required by bauxite wash process, water is sourced at the Taia River and pumped to a 5000 m^3 capacity reservoir which in turn runs to the plant site by gravity method.

Fig 1. SMHL ORGANIZATIONAL STRUCTURE



2.3 Ore Reserves and Exploration Methods

In 2003 the proven and probable bauxite reserves in the lease area were estimated at 12.5 million metric tonnes with an overall grade of 53.1 percent Al2O3, 50.1 percent available alumina (av. Al2O3) and SiO2. This reserve estimate has supported the production for the last ten years at an annual production of 1.2 million metric tonnes. These reserves were established from the systematic drilling and sampling carried out by Sieromco.

SMHL accepted the estimated resource figures during the course of their due diligence study in late 2009 undertaking by SC BELEVION IMPEX SRL. Based on historical data and those recently generated by SMHL-Vimetco, a proven and probable reserve of 31 million tonnes of washed bauxite ore, grading 50.1 to 49.1% Al_2O_3 and 3.0 – 4.0% SiO_2 have been reported. This reserve estimate will support production for approximately 18 years at an annual production rate of 1.7 million metric tonnes. The current reserves have been estimated from the Gondama Konta, Wunde and Gbonge groups of deposits.

Exploration work programme is in progress (i.e. mapping, drilling and sampling) to verify the tens of millions of bauxite within or around the beneficiation plant and the Gbonge deposits in order to establish newer deposits and to increase the current reserve status of SMHL lease. Development drilling and sampling are also being carried out to support mine planning and eventual mining.

The exploration program involves line cutting, pitting, drilling, sampling and assaying. The entire lease area was prospected and classified by Sieromco into measured, indicated or inferred resources. Based on this available information, SMHL has primarily been engaged in validating these reported resources (Konta, Wunde, Jenega and Gbonge) in generating its current reserve base and the extension of SMHL mine life. Exploration pitting and drilling are initially done on a wide grid of 160 X 40 meters and then closed in to 80x40 meter grid spacing for a resource purpose. Drill/pit grids are further reduced to a 40x40 or 40X20 meter grid for the purpose of estimating reserves.

Drilling is done using EVH Explorer 2012 Reverse circulation rig. The rig generates chips of laterite or bauxite that are cut by drill bits down hole. The drill chips are sent to a sample collecting bin by an air pressure. The drill chips are sampled and logged in approximately 1m intervals. Each sample is bagged and labelled for assaying at Gondama Laboratory.

At mine site laboratory samples are weighed to determine the bulk weight of each sample. Particle size of samples which are +16mm, are reduced to ensure sample is 100% passing 16mm screen. Samples are mixed to obtain a homogeneously representative sample and then split into two. One half is stored as reserve sample and the remaining portion is oven dried at 105^{o}C. Dried sample are crushed and pulverized to 95% passing 500microns for PIMA and XRF analyses. Using the Portable Infra-red Mineral Analyzer (PIMA), all the samples were analyzed for Total Alumina, Total Silica and Iron Oxides.

Ore Modeling

Preliminary ore modeling has been undertaken on the few of the deposits using Mine Map, a resource/reserve modeling and mine planning software program which uses both inverse distance weighting (IDW) and geostatistics to estimate reserves.

The drill hole data on the deposits are processed to meet the database upload requirements of the software. Initial investigations on grade are made in terms of Available Alumina (AA), which is defined as "percent alumina minus percent silica". Definition of the database and upload of data are done, followed by extraction of drill hole sections.

The drill holes are colored on the basis of grade. Using cut-offs of 48% AA, mineralized zones on each section were demarcated, which would subsequently serve as constraints for block grade assignment.

Grade interpolation is done in a regularized block model using inverse distance weighting (IDW) techniques. Block sizes are 10m by 10m in the y and x directions, and 5m in the z direction. Powers of 2 and 3 respectively were used, to enforce preferential weighting along strike over the cross-strike direction. This is done in compliance with the notion that controls on mineralization (primarily lithological) have a greater influence along the strike of the ore body than across.

2.4 Mining and Ore Beneficiation

SMHL bauxite project at Gondama, southern Sierra Leone is based on auto-generated 'self-mining'; however, the project still requires significant level of capital expenditure inflows to procure the required mining fleet and necessary support equipment. Prior to this time, the project was on contract mining which became more costly on a unit cost basis and in November 2010, SMHL-Vimetco took over the mining operation.

The production planning periods include the short-term plan (One Year) and a long-term plan (or more years). The short-term plan is target oriented and driven more by Alum-Tulcea demand and

specifications of the washed bauxite product while the long range plan are covered by mining options, mining sequence, mine development, operating cost estimates and strategic issues related to the overall improvement of the mining operations.

Fig 2. Wide-Angle View of Administrative Building; Processing Plant; and Environs

The SMHL bauxite mining is an open cast mining which requires no blasting of the ore prior to its excavation. The overburden is removed by dozers and the ore is freely dug or ripped with dozers (D8, D9). Prior to mining a deposit, the area is demarcated of its ore limit (Staking-out done by mine surveyors); the demarcated area is then striped/cleared of vegetation and Topsoil, Overburden removed, using a D8/D9 CAT bulldozer. The vegetation and Topsoil are stored and the overburden stockpiled. The rotted vegetation and or Topsoil are stored for subsequent use in land re-forestation and the overburden for reclamation purposes after depletion.

The exposed ore is then mined and excavated, loaded into 20 -25 tonne class off-highway rear dump trucks, and transported to the washing plant. Multiple mining faces are developed and mined simultaneously to achieve required blending. The material processing consist of feeding, crushing, washing, vibratory-screening, classifying and storing of the bauxite ore to produce an exportable

material with a grade and reactive silica content that will satisfy costumer/market demands. Process water for the plant is pumped from the Taia River over a distance of about 1.8 km to an existing water reservoir of about 5,000 m^3 from where the water gravitates to the washing plant.

The washing operation involves the removal of clays, silicate and ferruginous minerals/materials which enters into the slimes as tails and the hand picking of gangue materials from the conveyor belts. The aim is to upgrade the alumina content and reduce the silica content from the run of mine feed to a marketable product.

To yield the 1.7 million tonnes of washed bauxite per year the plant operates at a minimum of 18.3 hours per day and 310 days per year. The maximum production rate depends upon the efficiency of the mining methods and grade controls, since grades and ore recovery are the principal issues in achieving a marketable product.

A supplementary new water pump has been installed in the plant to recycle used water in order to reduce/decrease the quantity of water extracted from the Taia River. In an effort to reduce the amount of slimes discharged into the tailings pond, the granulometric cut of the finest recovered bauxite in the plant have been reduced from 2mm to 1mm to increase plant recovery/production and hence reduce the volume of tails disposed into the ponds and hence the streams/rivers down valley. **Figure3** represents a simplified processes flow diagram involved/employed in the recovery of washed bauxite ore through the beneficiation plant.

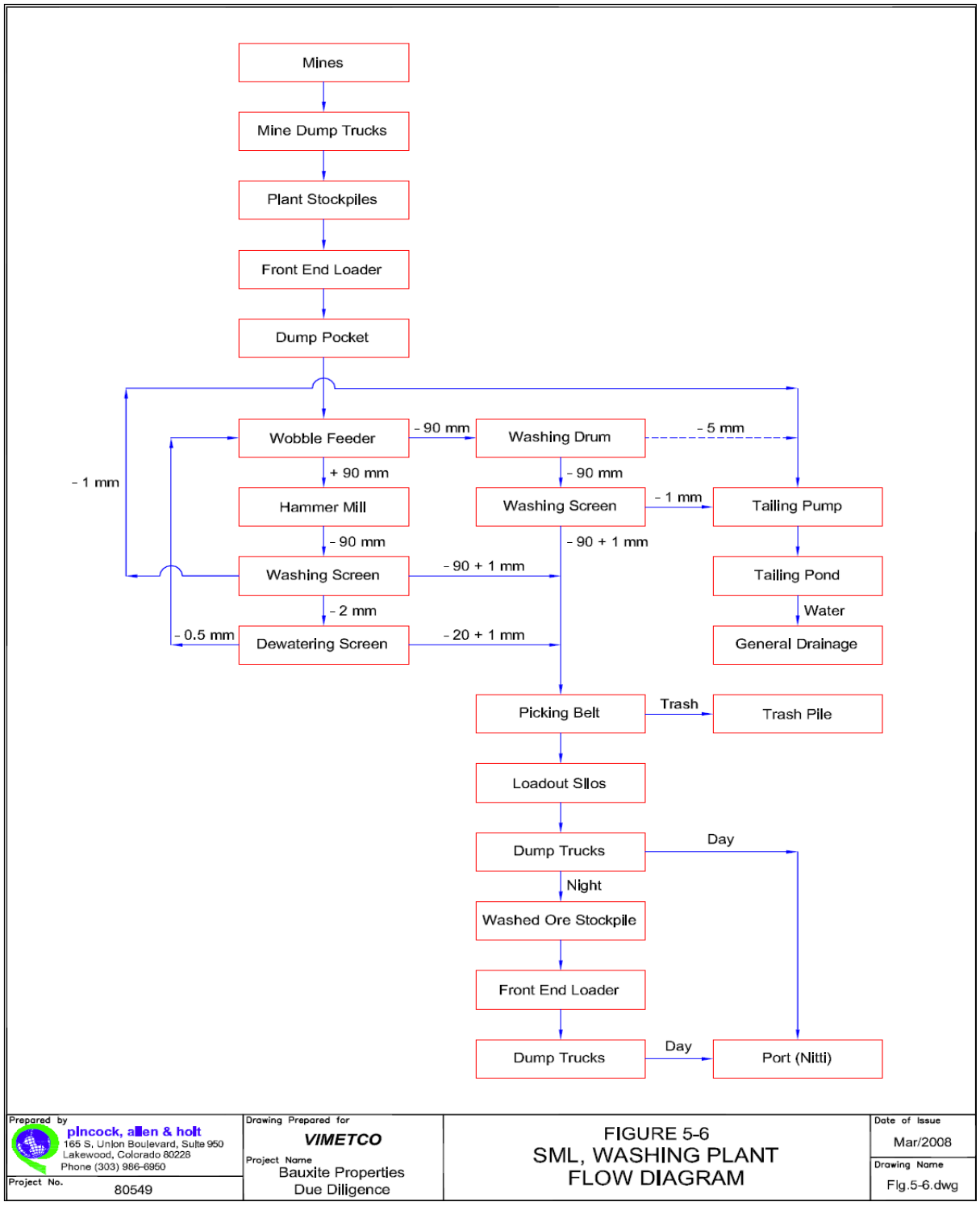


Fig: 3 SMHL Washing Plant Flow Diagram

2.5 Bauxite Product Shipping

Final bauxite product is transported by road to the marine port at Nitti in haulage units of 30 tonne capacity. The distance between the Gondama Washing Plant and Nitti is 38 kilometers. At Nitti, the bauxite is stockpiled in preparation for shipment.

The existing dryer located at Nitti harbour is reported to have a rated drying capacity of 110 mtph. The moisture content of washing plant bauxite product is expected to be 14-15% without the use of any dewatering agents or dewatering screens. However, high moisture content bauxite is difficult to handle due to its 'stickiness' and tendency to freeze in extremely cold weather conditions in parts of Europe. Moisture reduction from 14-15% down to around 10%, will therefore be necessary to improve its handling characteristics.

During shipment, the bauxite is loaded from the stockpile by front end loaders onto the conveyor and into the barges of 2,000 tonne capacity. The loaded barges are moved by pushboat down the Sherbro River to the Atlantic to meet the ore carriers that are specially adapted with mobile lifting cranes fitted with grabs to load the bauxite into the ship. These ore carriers are generally compartmentalized into hatches so that they can load more than one type of product in one shipment. The capacities of the ore carriers that have been loaded from this port vary from 25,000 to 40,000 metric tons.

2.6 Power Generation

SMHL runs three Power Generation each located at Nitti, Gondama and Mata camp where accommodation and recreation facilities are located 20 km from Gondama and Nitti respectively.
Back-up generators will be stationed at the village and construction camp in case of a power outage in the distribution grid that will normally supply these sites.

2.7 Water Management

The main sources of water in the mines are from the Taia River and the dams that have been constructed not far from the mining locations. Process water for the plant is pumped from the Taia River over a distance of about 1.8 km to an existing water reservoir of about 5,000 m^3 from where the water gravitates to the washing plant naturally. The table below (Table 5) is a survey carried out to measure

the volumetric flow rate of the Taia River along and across a cross-section of the river, where SMHL pump station is erected.

The major water uses at SMHL include:

- Ore beneficiation;
- Dust suppression;
- Water use in toilet facilities;
- Vehicle wash-down; and
- Irrigation at the nursery site.

All these sources meet the demands at SMHL with no recycling methods applied as yet.

Ground water abstraction is negligible even though one hand dug well has been constructed for drinking purposes.

Consistent wet weather conditions during the first half of the reporting period there was an increase in the need for dust suppression along haul roads and other surface activities.

Table 3 Volumetric Analyses of Flow Rates of the Taia River

No.	At a given cross - section	Width (m)	Depth (m)	Speed of River (m/h)	Discharge/Recharge Rate (m3/h)
1	Taia River Volumetric Flow rate (Discharge) =	1436	1.2	1000	1,723,200
2	Reservoir Recharge Rate (Pipe)=	0.086		4000	342

2.8 MINES SECURITY

During the period from January 2003 to December 31, 2007, the mine site was under the protection of SRL security force on a fulltime basis. In 2008, the G4S security service providers took over that responsibility on January 1, 2008. All SRL personnel with good records were absorbed into the new G4S

security force. Suitable applicants were recruited and trained to fill the remaining vacant positions and provide protection for all SMHL mine facilities.

The current G4S security force consists of 168 guards comprising 2 expatriate managers, 3 senior supervisors, 15 junior supervisors, 12 master guards and 136 general security guards. The G4S and the Sierra Leone Police Force (SLPF) establish a dual-purpose force comprising a Security Protection Force (i.e. SLPF) who are armed to provide defensive capability in and around the mine facilities and a Security Guard Force (G4S) to protect company assets against theft.

Over the past years, the SMHL mining areas have been incident free and the main focus of the security force has been loss prevention. The SMHL Security Force has an excellent relationship with local community leaders and local government authorities.

Section Three - Policy, Legal and Instituitional Framework

3.1 National Legislations

Constitution of Sierra Leone, 1991

For the purpose of mining activities, the Constitution makes provision for the protection of the rights of individuals to private property, and also sets principles under which citizens may be deprived of their property in the public interest as described in *Section 21*. It also makes provision for the prompt payment of adequate compensation and access to the court or other impartial and independent authority for the determination of the land owner's interest or right, and the amount of any compensation to which he/she is entitled and for the purpose of obtaining prompt payment of that compensation.

Relevance to the Project: SMHL project is a central development activity that makes use of the human and biophysical environment. As such, an EMP and crop compensation procedures are implemented to address these issues.

The National Environmental Policy: 1990

The National Environmental Policy (NEP) was approved by cabinet since 1990 and was subsequently revised in 1994 (GOSL, 1994). The policy objectives are to:

- Secure for all Sierra Leoneans a quality of environment adequate for their health and well-being;
- Conserve and use the environment and natural resources for the benefit of present and future generation; restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere; to preserve biological diversity, and uphold the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and promote understanding of the essential linkages between the environment and development and to encourage individual participation in environmental improvement efforts.

Relevance to the Project: This ESIA was carried out to fulfil the obligatory requirements of the NEP since mining is likely to have significant impacts on the environment.

The Mines and Minerals Act, 2009

This has been established to

- consolidate and amend the law on mines and minerals;
- to promote local and foreign investment in the mining sector by introducing new and improved provisions for exploration, mine development and marketing of minerals and mineral secondary processing for the benefit of the people of Sierra Leone;
- to ensure that management of the minerals sector is transparent and accountable in accordance with international best practice;
- to promote improved employment practices in the mining sector;
- to improve the welfare of communities adversely affected by mining;
- To address mining leases and license's requirements;
- to introduce measures to reduce the harmful effects of mining activities on the environment and;
- to provide for other related matters.

The Wildlife Conservation Act, 1972

The Wildlife Conservation Act of 1972 was enacted to help regulate the utilization and protection of wildlife resources. However, the bill is characterized by inadequate capacity for implementation and enforcement and insufficient and unsustainable sources of funding. The bill is also outdated and merits review and update to reflect current trends in wildlife protection.

Factories Act 1974

The Factories Act of 1974 addresses workers health and safety issues associated with factories. Portions of the construction activities fall within the definition of a factory based on the following conditions:

- Part II section 3(v)-"any premises in which mechanical power is used in connection with the making or repair of articles of metal or wood incidental to any business carried on by way of trade or for purposes of gain".

The Factories Act also includes machines safety, safe working conditions, sanitary amenities, periodic inspections, factory registration, and guidelines for reporting injuries, accidents and industrial diseases.

Relevance to the Project: SMHL Environmental Health and Safety Plans have been designed to conform to the provisions of this Act. All persons employed by SMHL are required to undergo medical examinations to ascertain their fitness and also to maintain their health and safety at the workplace.

Forestry Act: 1988

The mining of bauxite involves the clearing of the natural vegetation or forest within its operational area.

Section 18 of this Act stipulates that: The Chiefdom Council of any chiefdom may conclude an agreement with the Chief Conservator of forests providing for the constitution as a community forest of any land within the chiefdom, subject to the approval of the District Officer for the District in which the land is situated.

Every Agreement under this section shall:

- Describe the area included in the forest by reference to geographical features, markers, co-ordinates and measurements and indicate the same on a map of suitable scale, which shall be annexed to the agreement.
- Describe the forest resources and potential of the area.
- Indicate the purpose of the forest, such as supply of fuel, building poles, production of commercial timber, protection of soil and water supplies.
- Contain a detailed inventory of any rights that will be suppressed upon the constitution of the forest and provide for adequate compensation for such rights; either in money or through the allocation or equivalent rights in other land within the chiefdom.
- Contain a list of existing rights that will be confirmed by the agreement.
- Be valid for such period not exceeding 99 years as is reasonable in view of the purpose for which the forest is to be constituted.

Relevance to the project:

SMHL's commitment to the Factories' Act is detailed below in the Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment due to Air Pollution, Noise, and Vibration (ILO No. 148).

The National Minerals Agency Act 2012

The National Minerals Agency Act is established to:

- Promote the development of the minerals sector by effectively and efficiently managing the administration and regulation of mineral rights and minerals trading in Sierra Leone.
- To undertake geological surveys;
- To establish a National Minerals Agency Board that will provide technical and other support to the agency.

Environmental Protection Agency Act, 2008 and Environmental Protection Agency (Amendment) Act, 2010

This Act established the Sierra Leone Environmental Protection Agency (SLEPA), to provide for the effective protection of the environment and for other related matters. It mandates the EPA among others to:

- Advise the minister on the formulation of policies on all aspects of the environment.
- Issue environmental permits and pollution abatement notices for controlling the volume, types, constituents and effects of waste discharges, emissions, deposits or other sources of pollutants of substances which are hazardous and dangerous to the quality of the environment.
- Prescribe standards and guidelines relating to ambient air, water and soil quality, air pollution, water, land and other forms of environmental pollution including the discharge of waste and the control of toxic substances.
- Ensure compliance with any environmental impact assessment procedures laid down in the planning and execution of development projects.
- Impose and collect environmental protection levies in accordance with this Act or regulations made under this Act.

Section 24 of the Act lists project activities requiring an Environmental Impact Assessment license which include mining.

Sections 25 and 26 describe factors for determining whether a project requires an environmental impact assessment and the contents of the environmental impact assessment respectively.

The Act describes the procedures to be followed to obtain permits for both existing and proposed undertakings through the conduct of environmental impact assessments.

The Environmental Protection Agency (Amendment) Act, 2010 gave executive powers to the Board.

Relevance to the Project: Land, water, forest and air resources are major components of the natural environment. Bauxite mining operations at all stages are impacting on these resources.Extractive uses of these resources are guided by the various programmes, plans, regulations under the EPA/SL. Adherence to the relevant legal provision is a requirement in the entire course of SMHL operations.

Local Government Act, 2004

The Act establishes the Local Council (LC) as the highest political authority in the locality and confers legislative and executive powers to be exercised in accordance with this Act. This Act in its *First Schedule under Section 2* establishes the localities, namely: districts, towns and cities. *Part II* of this schedule also establishes the number of Paramount Chiefs in each LC. The *Third Schedule* establishes the functions devolved to the LCs. The *Fourth and Fifth Schedules* establish departments under each LC, and a Valuation List and Rate Books respectively.

Relevance to the Project: Public consultation and community involvement constitute a core element of SMHL operations. The implementation of the Community Development Action Plan is done in collaboration with the local council.

National Lands Policy, 2005

As provided in the Constitution, the 2005 National Land Policy makes provision for the compulsory acquisition of land in the public interest. The principles of the land policy include among others:

- The principle of land as a common national or communal property resource held in trust for the people and which must be used in the long term interest of the people of Sierra Leone.

- Compensation to be paid for lands acquired through compulsory government acquisition will be fair and adequate and will be determined, among other things, through negotiations that take into consideration government investment in the area.
- Local Authorities (City and District Councils) may negotiate for land for project development purposes, but all such grants should be properly documented and processed.
- No interest in or right over any land belonging to an individual or family can be disposed of without consultation with the owner or occupier of the land.

No interest in or right over any land belonging to an individual or family can be compulsorily acquired without payment, in reasonable time, of fair and adequate compensation.

***Relevance to the project*:** During mining, large land areas are acquired for exploration, excavation and removal of bauxite deposits. SMHL management will therefore be required to ensure proper reclamation work.

3.2 International Regulatory Framework

Sierra Leone is signatory to many regulatory framework relevant to mining. Below is a summary of the key conventions, treaties and protocols.

United Nations Convention on Biodiversity

Sierra Leone became signatory to this Convention in 1994. This is one of the tools that translate the Principles of Agenda 21 also known as the Rio Summit. Parties to this convention affirm their right over their biological resources making sure that these resources are used in a sustainable manner.

The relevance of the CBD stems from the fact that mining activities result to:

- Loss of habitat and fragmentation and the resultant development of waste rock dumps;
- Pollution of habitats and water supplies and the creation solid waste such as tailings;
- Green House gas emission resulting from the use of heavy duty machinery.

If adequate mitigation measure measures are not undertaken biodiversity in the project area could be threatened or lost.

Relevance to the Project: As much as possible SMHL operations will involve implementation of mitigation measures for biodiversity conservation. Sierra Minerals Holdings Ltd. will develop a strategic response to biodiversity conservation and management to enable it to meet the wide range of expectations of all stakeholders with interests in the company and its activities.

In the area of biodiversity conservation, SMHL will develop partnership with leading international organizations and institutions through local institutions and NGOs who will provide a conservation perspective on the challenges and opportunities raised by mining operations. An outline of strategic biodiversity issues will be carried out with a concept note setting out a case for biodiversity conservation and management. Key elements of the strategic thrust will be developed to help SMHL improve on its biodiversity performance through:

- Identification of major threats, challenges and opportunities to the conservation and management of biodiversity in the mining area;
- Identification and development of partnership for biodiversity conservation;
- Identification of cross cutting issues addressed by other community organizations; and
- Development of small projects on biodiversity conservation.

United Nations Framework Convention on Climate Change (UNFCC)

As a signatory to this convention in 1995, Sierra Leone gathers and share information on greenhouse gas emissions. The mining of bauxite requires enormous use of fossil fuel in the heavy equipment with negative implications for the production of harmful emissions. Further, Aluminum is produced by the electrolysis of alumina. Carbon dioxide is produced by the chemical reaction of oxygen in the carbon lined steel pots in which alumina is produced. In this process, the perflouronated carbon compound (PFC), tetraflouramethane (CF4) and hexaflouroethane C2F6) are the powerful greenhouse gases generated.

Relevance to the Project: An Environmental Monitoring Plan for air pollution has been prepared to address air emission in the mining operations. In the area of climate change, SMHL will work with the (IMMC) and other companies to increase energy efficiency across its production processes in the following ways:

- Identification of climate related risks and opportunities and development of responses that will be implemented and monitored using the existing Environmental Management Systems;
- Long-term modeling of likely changes in temperature and rainfall that could pose a hazard to SMHL's operations;
- Assessment of climate change impacts for both the operations and affected communities;

- Ensuring that SMHL's operations will withstand increased frequency and magnitude of extreme weather events;
- Joint venturing with nearby SRL to invest in biodiesel production and other agricultural production as alternative energy resources; and
- Assess other risks that do not have an immediate risk but will harm mining operations in other ways.

Convention on Wetlands of International Importance Especially as Waterfowl Habitat: (Ramsar Convention).

The objectives of the Ramsar Convention are to ensure the wise use of wetlands through stemming the progressive encroachment on and loss of wetlands now and in the future, while recognizing their fundamental ecological functions, and economic, cultural, scientific, and recreational value.

The Ramsar Convention on Wetlands (Ramsar) signed by Sierra Leone on 13 December 1999, became effective on 13 April 2000. Signatory countries to the Ramsar Convention agree to:

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

As a party of the Ramsar Convention, Sierra Leone has designated two coastal wetlands as Ramsar Sites, which are managed under Ramsar regulations.

Based on current information, no Ramsar-specific issues are associated with SMHL mining activities.

Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment due to Air Pollution, Noise, and Vibration (ILO No. 148).

Sierra Leone became signatory to this convention in 1961. Participating parties may accept the obligations of this convention separately in respect of air pollution, noise, and vibration. Measures instituted to occupational hazards associated with these impacts, shall be prescribed by national laws and regulations as outlined in the Factories Act of 1974.

Relevance to the Project

The Management of SMHL recognises that the safety and security of its employees and the communities in which it operates are an integral part of its operations. It sets up an environment in which people believe it is possible to work injury free, regardless of what role they perform. This is based on the following guiding principles and policy:

- It makes sure that all injuries are preventable. As such, any work that cannot be done safely should not be done;
- It ensures that training is provided for all employees so that people will work in a safe and responsible manner;
- It ensures that its health and safety performances comply with relevant legislation and exceed community expectations; and
- Avoid the unnecessary use of any hazardous chemicals. Promote awareness with regard to the storage of all hazardous chemicals and substances throughout the business. Ensure adequate steps to protect both human health and the environment where the use of such chemicals or substances is unavoidable.

As part of its Environmental Management Plan, an Occupational Health & Safety Plan is prepared with the following objectives:

- Define and communicate the principles, practices and expectations of Health & Safety objectives, SMHL project;
- Set out how the project is designed to manage and reduce risks associated with both routine activities and unplanned events;
- Define the criteria against which Health & Safety performance will be judged;
- Describe areas of Health & Safety responsibilities for the SMHL Project team, including Contractors;
- Describe the Occupational Health & Safety Standard Operating Procedures (SOPs) that will ensure that Health & Safety activities are organised, managed and reported in a systematic and consistent manner;
- Describe the development of the safety cases and safety plans;
- Ensure that the Project provides inherently safe and secure facilities;
- Address the process of ongoing assessment and continuous improvement of health and safety performance;

- To provide education and training for staff at SMHL's operations in health and safety issues;

The plan is applicable to all SMHL project related activities including camp and port facilities and contractors. In all cases, Contractors will be required to submit their safety management plans to SMHL for review and approval for use if is of a higher standard or exceed those provided by the Contractors.

Convention on International Trade of Endangered Species (CITES)

The Convention on the International Trade of Endangered Species (CITES) requirements went into effect in Sierra Leone on 16 January 1995. CITES is a convention that provides for the elimination and/or reduction in the trade of certain species, including endangered species. CITES provides a list of species that are required for protection against trade. Species listed in CITES are also those for which trade is strictly prohibited except in exceptional circumstances. The majority of the species listed in CITES are also listed as endangered or threatened by the International Union for Conservation of Nature and Natural Resources (IUCN). CITES also includes species that are not necessarily threatened but for which trade must be controlled to avoid the species becoming threatened or endangered. While a number of species exist in the project area, there are no specific issues related to them.

African Convention on the Conservation of Nature and Natural Resources

This convention was signed by Sierra Leone in 1968.The African Union (AU) took into force the protection of the natural environment. The main goals of the convention were to draw up a document that enhanced environmental protection fostered the conservation and sustainable use of natural resources, and brought together and coordinated policies in these fields. The states are to recognize the importance of the natural environment, and create laws and regulations that protect it.

World Health Organization (WHO 1999)

World Health Organization (WHO 1999) has established Noise Level Guidelines for various Land Uses. For residential dwellings or areas used for human habitation, WHO recommends that sound levels be no higher than 50-55 dB for 16-hours of exposure during daytime hours and 45 dB for 8-hours of exposure at night. WHO also recommends that persons should never be exposed to a maximum sound level

(Lmax) greater than 110 dB or a peak sound pressure level (instantaneous, not fast Lmax) greater than 140 dB for adults and 120 dB for children.

Relevance to the Project

An Environmental Monitoring Plan has been prepared specifically designed and implemented for collecting data on ambient air, water quality, noise level including release of pollutants of major concern and weather.

The Equator Principles (2003*)*

This is a set of guidelines signed by ten Banks from seven countries for assessing and managing environmental and social risk in project financing. The EPs, is based on the International Finance Corporation (IFC) Performance Standards on social and environmental sustainability and the World Bank Group Environmental, Health, and Safety Guidelines (EHS Guidelines). They are intended to serve as a baseline and framework for implementation by each adopting institution on its own social and environmental policies, principles and practices to its project financing activities.

The banks are pledging to apply this framework to all projects with a capital cost above US$ 50 million, in all industries globally, and commit 'not to provide loans directly to projects where the borrower will not or is unable to comply with [the banks'] environmental and social policies and processes'.

In a first step, banks will categorize a project in one of three groups, A, B, or C, (group A comprises the more risky projects) following the environmental and social screening criteria of the International Finance Corporation (IFC), the private sector arm of the World Bank Group.

For all group A and B projects, sponsors are requested to carry out an Environmental Assessment (EA) in line with the IFC Safeguard Policies, and World Bank and IFC Pollution Prevention and Abatement Guidelines. For all group A projects and certain group B projects the sponsor will also prepare and implement an Environmental Management Plan (EMP), consult with various stakeholders, and report on the implementation of the EMP.

A number of quality controls are envisaged: compulsory independent expert reviews of EAs and EMPs for group A projects; and independent expert review of compliance when judged necessary.

SMHL Response to these Policy Issues of the EQUATOR PRINCIPLES

Policy Issue 1.

The Banks categorize this project as a class A project and thus requires an Environmental and Social Impact Assessment.

Response

This document presents the ESHIA for Vimetco smhl to obtain a EPA-SL license of compliance to operate and manage its business. It contains an assessment of all aspects to ensure that they are environmentally sound taking into consideration the following:

- Evaluates a project's potential impacts in both the area of impacts and its surroundings.
- Evaluates project alternatives, mitigation measures and environmental management plans.
- Examines project alternatives, identifies ways of improving project selection
- Proposes implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; includes mitigating and managing adverse environmental impacts throughout the implementation of the project.

Policy Issue 2

The borrower consults project-affected groups, a comprehensive program of stakeholder and local non-governmental organizations about the project's environmental aspects and takes their views into account.

Response

Public Consultation will be undertaken involving all stake holders to outline the mitigating, monitoring and other measures require to prevent or minimize adverse effects and to enhance the project's beneficial effects. The report is summarily presented as part of this document.

Policy Issue 3

That an EMP be undertaken to bring the project into compliance with applicable national and international environmental requirements and the Banks with a view to outlining the mitigating, monitoring and institutional measures required to prevent, minimize, mitigate for negative impacts.

Response

An Environmental Management Plan has been undertaken and the report is presented under separate cover. The report is summarily presented as part of this document.

Policy Issue 4

Land acquisitions for mining are also likely to cause social disruption and economic loss for communities. As such, it is important that disturbance and loss to the affected communities due to the project are minimized through proper planning from a very early stage of the project.

Response

A base line socio economic survey is part of the scoping study to identify the degree of impact of the project on the affected communities and explore the possibility of minimizing these adverse impacts. No resettlement is envisaged in the existing project. Should there be any possible resettlement, a Resettlement Plan for the affected people will be prepared and implemented. In addition, extensive measures are currently taken to avoid displacement of people or other resettlement impacts.

The Equator Principles are aligned with the requirements of the International Finance Corporation (IFC), which has established a set of Performance Standards that govern environmental considerations of project financing. The IFC‟s Performance Standards have therefore been used as the yardstick against which to measure compliance with the Equator Principles. A summary of the IFC Safeguard Policies is presented below.

WORLD BANK/INTERNATIONAL FINANCE CORPORATION: SAFEGUARD POLICIES and GUIDELINES.

The following IFC/World Bank Operational Policies (OP) and guidelines are relevant to the SMHL Project.

- The World Bank, International Finance Corporation (IFC), and World Health Organization (WHO) Standards World Bank projects must address effects of the project on biodiversity. Biodiversity is defined at three levels (ecosystem, species, and genetic) and is often interpreted as a measure of biological complexity and variation within Project areas. Although there is little specific regulatory guidance on methods of assessing and monitoring biodiversity, the concept is widely interpreted, especially internationally, as a measure of ecosystem integrity and stability.

Key principles defined within both set of guidelines are as follows:

- Physical and economic dislocation should be avoided or minimized as much as possible.
- Unavoidable displacement should involve the preparation and implementation of a Resettlement Action Plan, which demonstrates how international best practices have been/will be met and defines a detailed approach and work plan to guide implementation, handover, and monitoring and evaluation.
- Resettlement should be viewed as a sustainable development program designed to improve the quality of life of those affected.
- Legal standing is not synonymous with eligibility: even those people with no recognizable legal right or claim to the land they are occupying should be considered eligible for resettlement assistance.
- Resettlement should be a consultative and participatory process: affected people should be consulted thoroughly, participate in the definition of resettlement policies and procedures, and in the end choose for themselves from among acceptable and clearly defined alternatives.
- ***OP 4.30 – Involuntary Resettlement***: International best practice for private sector-related resettlement is commonly defined by the June 1990 World Bank Operational Directive 4.30. This Operational Directive is applied around the world by private investors to govern involuntary resettlement associated with natural resource and infrastructure development. The Directive sets the benchmark against which such projects are gauged by international financial institutions, both private and multi-lateral. Operational Directive 4.30 is internationally acknowledged as one of the most comprehensive and efficient set of international standards with respect to the protection of the rights of affected people.

The key principles of this policy are:

- Physical and economic dislocation should be avoided or minimized where feasible;
- Unavoidable displacement should involve the preparation and implementation of a resettlement plan. All involuntary resettlement should be conceived and executed as development programs, with resettlers provided with sufficient investment resources and opportunities to share in project benefits;
- Displaced persons should be (i) compensated for their losses at full replacement cost prior to the actual move; (ii) assisted with the move and supported during the transition period in the resettlement site; and (iii) assisted in their efforts to improve their former living standards,

income earning capacity, and production levels, or at least to restore them. Particular attention should be paid to the needs of the poorest groups to be resettled;

- Community participation in planning and implementing resettlement should be encouraged. Appropriate patterns of social organization should be established, and existing social and cultural institutions of resettlers and their hosts should be supported and used to the greatest extent possible;
- Resettlers should be integrated socially and economically into host communities so that adverse impacts on host communities are minimized; and Introduction 1 - 28
- Land, housing, infrastructure, and other compensation should be provided to the adversely affected population. The absence of legal title to land should not be a bar to compensation.
- ***OP 4.01 – Environmental Assessment***: All projects proposed for IFC financing require an Environmental Assessment (EA) to ensure that they are environmentally and socially sustainable. Instruments used to perform the EA may include an environmental impact assessment, an environmental audit, a hazard or risk assessment, and an environmental action plan. All IFC projects must be categorized. This policy also sets forth the minimum requirements for public consultation and public disclosure for projects.
- ***OP 4.04 – Natural Habitats***: This policy affirms IFC's commitment to promote and support natural habitat conservation and improved land use, and the protection, maintenance, and rehabilitation of natural habitats and their functions in its project financing. IFC does not support projects that involve significant conversion or degradation of critical natural habitats.
- ***OP 4.09 – Pest Management*****:** This policy outlines IFC's support of the use of biological or environmental control methods instead of pesticides where there is a need for pest management. Criteria for the use of pesticides, when required, are described.
- **OP 4.11 - Safeguarding Cultural Property:** International best practices with respect to safeguarding cultural property in IFC-financed projects includes sites having archaeological (prehistoric), paleontological, historical, religious, and unique natural values. Operational Policy (OP) 4.11 specifies that the general policy of the World Bank is to assist in preserving cultural properties and to seek to avoid their elimination.
- ***OP 4.37 – Safety of Dams (September 1999 draft):*** IFC requires that dams be designed and constructed by experienced and competent professionals. For dams that are over 15 meters high; and dams between 10 and 15 meters that present special design complexities, IFC requires

reviews by a panel of independent experts, preparation of detailed plans, and periodic safety inspections.

The policy covers mine tailing dams as well as water storage dams.

- ***OPH 11.03 – Management of Cultural Property****:* IFC projects must comply with World Bank's OPH 11.03, Cultural Property, as appropriate in a private sector context.
- ***1995 – Open Pit Mining/Milling***: The open pit mining and milling guidelines describe requirements for tailing disposal, liquid effluent discharge, and air pollution control (including workplace air quality compliance). In addition, other general requirements are included for erosion and sediment control, development of a mine reclamation plan, sewage sludge and solid

  waste disposal management, workplace noise, confined space, hazardous material handling and storage, sanitation, worker safety, employee training, and record-keeping and reporting.
- ***1995 – World Bank Environment, Health and Safety Guidelines:*** These guidelines for mining and milling at open pit mines include information for tailings disposal, liquid effluents, ambient and workplace air quality, erosion and sediment control, mine reclamation, sewage sludge disposal, solid waste disposal, workplace noise, work in confined spaces, hazardous material handling and storage, general health and safety, training, and record keeping and reporting.
- ***1998 – Disclosure Policy****:* IFC is open about its activities and welcomes input from affected communities, interested members of the public, and business partners and will seek out opportunities to explain its work to the widest possible audience. This policy was developed in recognition of the importance of accountability and transparency in the development process.
- ***1998 – General Environmental Guidelines*****:** For financed projects in which no other specific environmental guidelines have been developed, general environmental guidelines may be used.

These guidelines emphasize pollution prevention, and are intended to minimize resource consumption, including energy use, and to eliminate or reduce pollutants at the source. General Environmental Guidelines include requirements for air emissions, liquid effluents, hazardous chemicals and wastes, solid wastes, and ambient noise.

- ***1999 – Child Forced Labor Statement:*** IFC will not support projects that use forced or harmful child labor. Forced labor, as defined in the policy statement, consists of all work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty. Harmful child labor consists of employment of children that is economically exploitive, or is

likely to be hazardous to, or interfere with, the child's education, or to be harmful to the child's health, or physical, mental, spiritual, moral, or *social development.*

- ***2001 – Hazardous Materials Management Guidelines***: Requirements of this guideline include screening to determine characteristics and threshold quantities for hazardous materials, development of a Hazardous Materials Management Program, and community involvement and awareness.
- **2003 – IFC Environmental Guidelines for Occupational Health and Safety:** This guideline covers general aspects of occupational health and safety and would be supplemented, as needed, with the appropriate national or international standards. Under this guideline, an Occupational Health and Safety Management Systems are required. Such a system would require provisions for ensuring an organizational framework to support the occupational health and safety program, a hazard prevention program, performance monitoring, and evaluation.

3.3 Institutional Framework

Ministry of Mines and Mineral Resources: The management of all mineral resources in Sierra Leone is within the purview of the Ministry of Mines and Mineral Resources (MMR) headed by a Minister. The Ministry has two divisions, Mines and Geological Surveys, both headed by Directors. The administrative wing of the ministry is headed by a Permanent Secretary. The main responsibility of this Ministry is to develop policies and programmes for the systematic and economic exploitation of the nation's mineral resources and to formulate regulations for the mining industry and related activities to ensure that the nation derives maximum benefit from the mineral resources. The specific responsibilities include:

- Formulation of policies for mines and minerals;
- Mining negotiations;
- Granting of concessions
- Mining and minerals exploration
- Geological surveys;
- Control of explosives for mining;
- Inspection of mining machinery and mine sites;
- Establishing relations with international mining and geological organizations and agencies; and

- Collaboration with relevant national and international organizations.

The National Minerals Agency: This is a new semi-autonomous government agency that is established by an Act of Parliament (National Minerals Agency Act 2012). It is responsible for the administration and regulation of the minerals sector. While the MMMR takes full responsibility of policy implementation, the NMA handles the responsibility of policy implementation. It works closely with other government agencies with the responsibilities in the mineral sector to support them in implementing those policy areas from which they are responsible and impact upon the mineral sector. It is also empowered to hire professionals and reward them according to their performance. The agency is overseen by a Board of Directors, which helps to remove it from day-day politics.

Environment Protection Agency: This is the agency responsible for the monitoring and enforcing all environmental regulations in Sierra Leone. Details of the roles and responsibilities are outlined in the EPA Act presented above.

Other Institutions and line Ministries responsible for environmental management issues in Sierra Leone include:

Ministry of Agriculture, Forestry and Food Security: To increase agricultural productivity, output, rural income and employment while ensuring adequate protection of the environment.

Ministry of Lands, Housing, Country Planning and the Environment: Conserves and manages the natural environment of the country; b. to address the issues of land acquisition, ownership and use.

Ministry of Transport and Communications: Addresses the issues related to transport and communications. This ministry is involved in land degradation and the introduction of pollutants in the natural environment, and as such mitigation measures are set for the ministry to implement in the amelioration of pollution.

Ministry of Local Government and Rural Development: Provides support to the MMMR to manage certain development funds, monitor the reclamation of mined out areas and coordinate the Diamond Area Community Development Fund (DACDF).

***Ministry of Tourism and Culture*:** To protect the country's heritage including monuments, cultural and historical sites. The development of tourism often leads to infrastructural activities that deter sound

environmental management. This ministry is therefore charged with the responsibility of environmental management in the Tourist industry.

Section 4 – Analyses of Alternatives

Analyses of alternatives constitute part of this ESIA. The purpose is to improve on project design, construction and operation decision making based on feasible project alternatives (IFC, 2006). It will provide the basis for identifying optimal project alternatives that are consistent with the goals of the mining company, funding organization, the government, the mining community and the policy and regulatory framework established for the mining industry.

Project alternatives that were considered for SMHL project include:

- No Action alternative;
- Alternative for location of staff accommodation;
- Bauxite processing location;
- Mine closure.

No Action Alternative

The adoption of the no-action alternative would mean that the project would remain in its current condition with no mine-related development activity by SMHL. This scenario would mean that the Environmental Management Plan and the community Development Action Plan that are prepared would not be implemented. As such, the anticipated project benefits such as employment, foreign exchange earnings, infrastructure development and community development initiatives would not improve in the concession area and the country as a whole. This will result in the continuation of in migration into the area and the resultant poor state of local economy, infrastructure and other public services.

The negative effect would also be seen in the physical environment where in the Taia River and its tributaries will be continuously impacted by discharge of effluents thereby reducing the surface water quality of the basin.

Location of staff Accommodation

The first plant site for bauxite mining including all mining activities was first around the Mokanji area. Following the depletion of the Mokanji deposits in 1982, Sieromco relocated its operations to Gondama (approximately 26 km south-east of Mokanji) and resumed mining in the Banta Mokelleh Chiefdom. Sieromco mined the Gondama deposits and has since continued operations there.

The two styles of accommodation provided for SMHL staff are located 20 – 40 miles away from the plant site where most of the mining activities take place. The mining activities at the site do not require total off-site accommodation especially for supervision work during the second and third shifts. The option therefore is the relocation or expansion of both junior and senior staff accommodation closer to the mine site. Proximity to the mine site would lead to the following benefits:

- Reduction in travel time to work;
- Increased work supervision at all times;
- Proximity to the only Medical Hospital in the mining area;
- Decrease in the running cost of vehicles;
- Extension of overtime work for certain staff categories;
- Increase in the opportunity for the expansion of the Gbonge deposits and future expansion of shipping facility closer to the four bauxite deposits.

Ore Processing Plant

The original ore processing plant for the bauxite mine was located at Mokanji. The plant was abandoned when mining relocated to the Gondama area in 1982. The existing processing plant is in a closer proximity to the five major deposits and is located within a valley thereby reducing noise level that impact on the surrounding village communities. For operational considerations, the tailings storage facility was located as close as possible to the plant site to reduce cost of transportation of the slurry. The potential for the existing facility to near its storage capacity is high considering mine life of SMHL operations around the five deposits. Consideration should be given for an alternative storage facility in the near future.

Two alternative methods for the disposal of the tailings generated at the site are proposed: a. Disposal and storage of existing slurries in a min pit and reuse of the existing infrastructure; b. Construction of a new facility within the same area close to the washing plant.

Tailings Disposal and Storage

This option will involve a construction of a mine pit into a tailings storage contained by perimeter embankments. The slurries would be deposited in the pit as mining continues. Filling would continue for less than a year and after a decanting period, revegetation would start followed by a full reclamation work based on the mine reclamation plan.

With perimeter fencing, the area would be secured with no additional impacts.

The major disadvantages of this alternative would be related to short term mine plan as this operation will concurrently go on with other mining operations.

Construction of a new storage facility

This option would require concurrent construction work and mining operations with little obstruction. Construction work would however be more expensive as materials such as sand and gravel would have to be transported from a distance outside the mining area. Also, the extent of land disturbance would expect to be greater.

Preferred alternative for the two options would be controlled by key factors including costs, time of construction, and availability of equipments, weather conditions and the expected life of the mine operations.

Mine Reclamation and closure alternatives

Mine reclamation and closure activities at SMHL operations are implemented to establish a beneficial post-mining land use, in the case of this project it will consist primarily of agricultural lands. The key activities will include re-grading disturbed areas to provide topographic relief that blends with the surrounding areas. Some of the structural measures that will be put in place will include diversions, backfilling and the construction of grass waterways. On the Gbonge Hills for example, cut and fills are part of the extraction and reclamation activities.

This option is requires millions of dollars in earth moving activities, and it cannot be considered as the best option for the open pits. Backfilling of these pits with tailings slurries would be another feasible option considering the life of the existing tailings facilities at the plant site.

Section Five – Environmental Baseline Conditions

This section presents the existing baseline conditions within the vicinity of the SMHL mine footprint against which the predicted impacts of the projects are analysed. It is divided into two main sections: Biophysical environment and socio-economic environment.

5.1 Biophysical Environment

5.1.1 Topography and Landforms

The topography of the project area is in the interior plains of the African continental mass approximately 80 to 100 km. wide. The elevation rises from the coast to the interior ranges between 50 and 300m above sea level. Conspicuous topographic features include: a. residual hills, b. High and low river Terraces, c .Lateritic Uplands, d. Undulating hills, e. Bottomlands and f. Inland Valley Swamps.

Residual Hills: The two residuals hills which are formed in a ridge like manner are the Mokanji and Gbonge Hills. The Mokanji Hills which trends in a south-west direction has nearly flat summits with elevations ranging from 45 to 100 meters. The colluvial foot-slopes occurring on the right hand of the ridge were excessively mined out by former Sieromco. The Gbonge hills trends in a north-northwest direction with outcrops on top of the ridge. The hills rise The hills rise above 152 meters above sea level running from Senjehun on the Sewa river through Gbonge to Kangahun covering a distance of 64 km.

Terraces: These cover a significant portion of the mined out area especially between Mosenesie and Gondama. They are generally related to the Taia River and its tributaries. They are relatively younger than the uplands and become more pronounced as the river flows south.

Laterites*:* Laterites occur in various forms and are mostly hard, brown, porous with hydrated ferric oxides and alumina and little silica. At higher elevations, they occur as crust of weathered rock masses and at lower elevations they occur as duricrust.

Undulating Hills: Theses are toposequences that are nearly level with concave slopes near the bottomlands. The bottomlands have shallow residual soils that develop from the weathering of bedrock of the colluvial foot slopes.

Inland Valley Swamps: Inland valley swamps are found in the bottomlands and are characterized by alluvial soils that are silty and poorly drained. They often tend to be narrow, long and flanked by

concave slopes on each side. Very often, there are small streams that are not deeply incised and dry up in the dry season. The width of these swamps varies between 20 and 80 metres and the length of the individual segments are usually between 3 and 5 km. Because of their low gradient and dense vegetation, the swamp has a very low rate of discharge.

5.1.2 Climate and Weather

The climatic conditions like many areas in Sierra Leone are warm and hot, with marked rainy season and dry season. The weather cycle is as follows: *Harmattan, Dry but humid, Disturbance line squalls, Steady rains, Disturbance line squalls, Dry but humid* and *Harmattan.*

The *harmattan* period occurs from late December to late January. Usually after the middle of January, the rainless and dry harmattan is replaced by a dry but humid period, which extends to the end of March. This is caused by a retreat of the harmattan air masses to the north and penetration of humid air from the Atlantic Ocean. The winds come mainly from the west. Often, heavy dew and fog occurs during the night and early mornings.

From March to the end of June, showers become more frequent, usually accompanied by thunderstorms. The storms travel east to west against the general wind direction. These disturbance line storms are usually preceded by a squall of easterly wind; they increase in intensity and frequency to the end of June. During this period, the weather is very changeable with high humidity. July, August, and into September are periods of heavy and usually persistent rains. A pause of dry weather conditions occurs in the rainy season during August with clear and humid weather.

Ninety percent of this rain falls during the rainy season from May to November, leaving the other five months with no more than 250mm of rainfall. Rainfall data obtained from a nearby station representative of the project area is presented in Table 8. The relative humidity ranges between 95 to 100 and the mean monthly temperature is almost constant varying from 25^{o}C in August to 28^{o}C in March. The mean daily maximum temperature is at its lowest in August and highest in March. The mean daily minimum is at its lowest in January and at its highest in May. A summary of the weather conditions that are experienced in the project area is presented in Table 3.

Table 4. Summary of Rainfall Data: SMHL Concession Area.

Year	Total Rainfall Annual	Max Rainfall/Year	Min Rainfall/Year	Mean	Standard deviation
2001	104.71	20.9	0	8.73	6.33
2002	103.16	24.51	0.28	8.6	6.17
2003	128.22	32.02	0	10.69	9.71
2004	96.65	22.99	0.18	8.05	5.4
2005	107.93	25.45	0	8.99	6.74
2006	104.49	26.53	0	8.73	6.36
2007	125.7	33.23	0	10.48	9.16
2008	108.31	24.05	0	8.33	5.79
2009	87.2	28.53	0	7.27	4.41
2010	120.72	26.26	0.08	10.06	8.44
2011	98.6	22.7	0	8.22	5.63
2012	18.3	11.59	0.02	1.53	2.34

Source: Sierra Rutile Environmental Monitoring Report.

51.3 Drainage and Hydrology

The Jong/Taia River constitutes the major drainage system in the project area. The Jong River drains from the Sula Mountains and Kangari Hills in the north central of Sierra Leone. The main tributaries include: Tikote, Kapui, Kwiva, Kati, Kpeyei, and Kwasi. They all flow in a southerly direction in a series of zig-zag and meanders that reflect the lines of structural weaknesses. In nearly all cases, the drainage

basins do not follow the Crestline of the two ridges but are imprinted on lower ground on the inland side of the ridges. Some of these basins have developed into inland valley swamps in their head and middle waters.

TABLE 5 Weather Cycle

Weather	Period/Duration	Characteristics
1. Harmattan	Late December to late January	- Low relative humidity - Increased wind strength - Dustry haze - High aftermoon temperature - High evaporation
2. Dry Humid	Mid January to mid March	- Heavy dew and fog at night and early mornings - Humid air from the ocean
3.Disturbance Line squalls	March – end of June	- Thunder storms & showers - Line squalls of easterly winds - High humidity - High Intensity rains
4. Steady rains	July – September	- High humidity - Low Temperatures - Long duration rains - Monsoonal
5. Line squalls		-

From Mano Dasse to Mattru, the river flows southerly in a series of meanders crossing the Mokanji-Gbonge ridge in a steep sided valley. At Wubange, it meanders south and it is joined by the Tikote river draining east from Gbangbama Hills; then by the Kwiva, which drains southwest from a flatland area around Serabu and crosses the Gbonge ridge in a deep valley at Badui.

The Kapui rises in a dissected plain northeast of the Mokanji Hills. It crosses the hills in a deep straight valley from Taninahun to Monghere, to receive the Kati, Kpeye and Kwesi tributaries in a wide flatland

and finally crosses at Yebeima in a series of incised meanders which continue westward to the Gbonge confluence. The Yebei and Gbendeye rise from a flat ground close to the head of the Kwesi from where they flow southwesterly across the strike ridge line at Gbangbatoke and Gbanbama respectively.

Some of these drainage patterns have developed into numerous inland valley swamps in their head and middle waters. The swamps tend to be long and narrow and are generally flanked by convex slopes. Actual widths of these swamps vary considerably, but the average is about 60m wide while the lengths of individual segments are usually between 3 and 5km. Many of the swamps dry up entirely in the dry season and those with low gradients become flooded in the wet season with a low rate of discharge.

The Taia river discharge has a mean flow rate of 668 m^3sec in the rainy season with maximum rates between 1000-1500 m^3sec in August and September. During the dry season, the mean discharge falls to 89 m^3sec but because of occasional storms there is generally an appreciable amount of water flow. Runoff is moderate with a mean of 89mm and 15mm in the wet and dry season respectively (Jayakaran, 1987). Like many other areas in the country, there is an annual excess of precipitation over Evapotranspiration demand. This lends itself to an analysis of a simple water budget accounting that will provide an opportunity to monitor the water status in the project area throughout the year. Further, it will provide numerical estimates of the amount of water surplus or water deficit and the periods of their duration that will be used to monitor changes in the groundwater status area.

The hydrology follows the seasonal rainfall pattern as the flow of the rivers is influenced by the inflow from their catchments. Annual peak flow, which is about 700m^3/sec usually, occurs in August and September. The flow starts to decrease in October when the rainfall is less and decreases to as low as about 5m^3/sec in April (ESCG, 1988).

During the rainy season there is an excess of precipitation over the reference Evapotranspiration that cannot be stored as soil water and therefore roughly represents that amount of rainfall input that becomes available for groundwater storage and runoff. The difference between annual precipitation and water lost in deep percolation and or surface runoff (EP) is also of interest, since it represents the actual use of water under local conditions imposed by the environment.

5.1.4 Geology

The geological formations (Precambrian age) found in the SMHL lease have a general NNW –SSE strike and dipping in a West-South-West direction**.** Bauxite mineralization in the SMHL exploration license area

is a result of tropical weathering of alumina-rich facies rocks of the Kasila belt, which formed the Mokanji, Gondama and Gbonge deposits. The bauxite in the project area is derived mainly from anorthosites (Mokanji type with 53-56% Al_20_3), leuco-gabbro (Gondama standard type with 52-54% Al_20_3), norite (Gondama 47-49% Al_20_3) and hornblende/hypersthene gneisses (Mokanji West type with 45-48% Al_20_3). These deposits do not form a continous ore body but rather, a chain of deposits with topographically controlled breaks in echelon to one another (Mackenzie, 1961).

The petrology of the hypersthenes gneisses indicates a typical texture of the fresh rock and bauxite laterites. Pale hard gibbsite material represents the plagioclase matrix, while red brown spongy spots rich in limonite represents the hypersthenes (ibid). The bauxite is fine-grained, generally friable and shows very little resistance to shock. The Gbonge anorthosite splits into two bands, probably becoming discontinuous, irregular with highly deformed lenses. The anorthosite comprises alternances of layers with almost pure plagioclase and layers rich in hypersthene. Quartzite with or without garnet and/or magnetite occurrences are visible on both sides of the anorthosite belts.

Gabbros and leuco-gabbro occur mainly in the Gondama and Gbonge areas as massive and largely undeveloped bodies with several elongated bands. The bands are highly deformed and have foliations. Norites are more abundant than originally reported and bauxite derived from this type of rock is massive, with low alumina and low silica. A long band of gabbros, leuco-gabbro and norite is also visible in the western part of the project area, (Wunde IVA, IVB).

Texturally, the Mokanji depositse is fine-grained, generally friable and shows very little resistance to shock. The Gondama deposits made up of anorthosite splits into two bands, probably discontinuous, forming irregular and highly deformed lenses. The anorthosite comprises alternating layers of pure plagioclase and hypersthene. Quartzite with or without garnet and/or magnetite occurrences are visible on both sides of the anorthosite belts.

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A long band of gabbros, leuco-gabbro and norite is visible in the Western part of the project area (Wunde IVA, IVB).

Gneiss bodies with hypersthene and hornblende generally surround the gabbros and anorthosite.

Structurally, the project area has a relatively simple tectonics generally comprising two fault systems that are visible in southern portion around Konta and Gbonge. The first fault system has a NNW – SSE orientation, delineating in the South the leuco-gabbro and norite formations (rich in bauxite) from Gbonge Hills. The second fault system has WNW – ESE, developed between the Gbonge bauxite deposits and Konta bauxite deposits. Generally, the bauxite deposits tend to have an iron-rich cap and pass down to silicious bauxite.

5.1.5 Surface and Groundwater

Detailed surface and groundwater studies previously prepared and those in past ESHIA reports provide the baseline information that facilitated the preparation of this impact assessment report. Tables 10 and Table 11 present a summary of the analytical results obtained for the two periods.

Results for the 2003 study indicate that pH for the selected sampling sites ranged from 4.6 to 6.4. These values are well below the WHO permissible limits. Electrical Conductivity results are within the threshold limit recommended by WHO for potable water. Faecal Coliform bacteria were found in 60percent of the samples while non-faecal coliforms were present in all the water samples. As such, drinking water from the contaminated sample points was a health risk. Nine out of the 15 samples had dissolved iron far in excess of WHO limits while manganese ions were below the 0.1mg/1 concentration. Concentrations of nitrate/nitrogen in all samples were also below the threshold limit and all other chemical ions were either zero or very minimal and within the permissible limits recommended by WHO.

The 2012 study indicate that Temperature of all the water samples measured was found to range from 26.1^{o}C to 25.2^{o}C with a mean value of 25.57^{0}C. These values are within the permissible limits for good drinking water.

Water turbidity found to be above the WHO limits were at the following sources:

- Tailings out flow – 25-9 NTU
- Meseki (enfluent) – 10.2 NTU
- Makepi Village Taia river – 12.6 NTU
- Tailings pond No. 5 – 5.2 NTU

The Conductivity values for all sample points were far below the tasted threshold. These values ranged from 16.10 -224µ/cm. with the largest variability for Mokepi well. Generally, the TDS for all locations

was low with a higher content in the Mokepi well. Aluminum ranged from 0.0 to 0.2mg/l all the sources are above the WHO limits, with the exception of Wunde (0.14mg/l).

According to WHO Limits. All the sources are above the WHO limits, except for Motuowo (0.05mg/l). Iron concentration above WHO limits were found in the following points: Maseki (Elfluent, 0.44mg/l) Mokepi (0.49mg/l Taia River). All the water points proved positive for E Coli with Moseki effluent and Mokepi Hand dug well too numerous to count (TNTC).

All but three of the water sampling points proved positive for Faecal Coliform with the highest compliance recorded for Mokepi well. Moseki effluent and Mokepi Taia River recorded the lowest compliance. The measured physico-chemical parameters happen to be within WHO maximum permissible levels, which implies that both the ground and surface water quality are not all that polluted. The high content of TDS mostly as the discharge suggests that wastes are being added to the Tailings dam from the washing plant. The Mokepi River shows high bacteria count indicating that the river is receiving organic pollutant from the nearby villages.

The heavy metal contents Fe, indicates some potential threat to aquatic life, as they are above WHO permissible limits. However, to sustain the ecological status of the Taia River, waste management practice of waste re-use through the use of the dams should be encouraged.

5.1.6 Soils and Land Use Capability

The soils that occur in the project area are mainly derived from the metamorphic rocks of the Kasila Group and on a minor scale from the igneous rock of the interior plains. The controlling soil forming processes include:

- Weathering of primary minerals to form toxic horizons.
- Leaching of soluble substances and the subsequent formation of secondary minerals.
- Plinthization and segregation of iron and subsequent formation of hardened plinthite, duricrust and laterite.
- Accumulation of surface soils to form epipedons (Odell et al, 1974).

As a result of the high rainfall and temperature, the silicate structures are broken with the resultant release of silica, aluminum, iron and bases. Hardened laterites, plinthites and duricrust form mostly on the uplands, though plinthite is often present in the poorly drained hydromorphic soils of the bottomlands.

On the colluvial foot-slopes are soils that are generally shallow to moderately deep, very gravelly loams to clays. On the hill-crests are residual soils that are well drained. Further down slope, the soils become moderately shallow to moderately deep, gravelly and well drained.

Land capability evaluation was undertaken for this assessment to enhance the matching of crop requirements in the reclamation processes using both the physical characteristics of the land and climatic factors. Representative of typical soils of the land facets were evaluated for their agricultural capability to produce various crops, using the following land attributes or qualities: Rooting space(r), Soil fertility (f), Availability of moisture (n), Availability of oxygen (o), and resistance to erosion (e). The FAO survey and land evaluation used in this report define 4 major landforms or facets within the lease area which were grouped under land system 21 here in known as the Makondu land system (UNDP/FAO, 1979).

Land quality was interpreted from the measurement of land factors taken in the field as follows:

- Measurement of effective soil depth (d) as a land factor defined rooting space (r) as a land quality.
- Measurement of nutrient status (n) , salinity (c), and soil reaction (a) defined Soil Fertility (f), as a land quality.
- Measurement of available water capacity (x) and Climate type (z) both defined Availability of moisture as a land quality as a land quality
- Measurement of drainage (w), flooding (fl) and permeability (p) as land factors defined availability of oxygen(o) as a land quality
- Measurement of slope steepness (s) and surface stones and rocks (y) both defined resistance to erosion (e) as a land quality.

Eight crops were selected for the pre-mining evaluation scenario based on the potential for Agricultural Land use. Table 6 shows the number of crops for which land suitability was systematically evaluated for all the 4 land facets in the study area:

The suitability classes defined within the FAO land system are as follows:

S1: High to Moderate: land with no or moderate to slight limitations for the sustained cultivation of a given crop. Relatively high yield and a good return on investment can be expected.

S2: low: Land with moderately to severe limitations for the sustained cultivation of a given crop. Adequate yields and a moderate return on investment can be expected.

S3: Very low: land with very severe limitations for the sustained cultivation of a given crop. Very low yields and only a marginal return on investment can be expected.

N: Nil, i.e. land having limitations which appears as severe as to preclude any possibility of successful sustained use of a given crop.

(Subscripts such as e, r, f, and m indicate the soil limitations that should be addressed by proper management for the sustained economic production of a crop at suitability classes of S2 and S3).

Location of Sampling Points and Rationale for Selection.

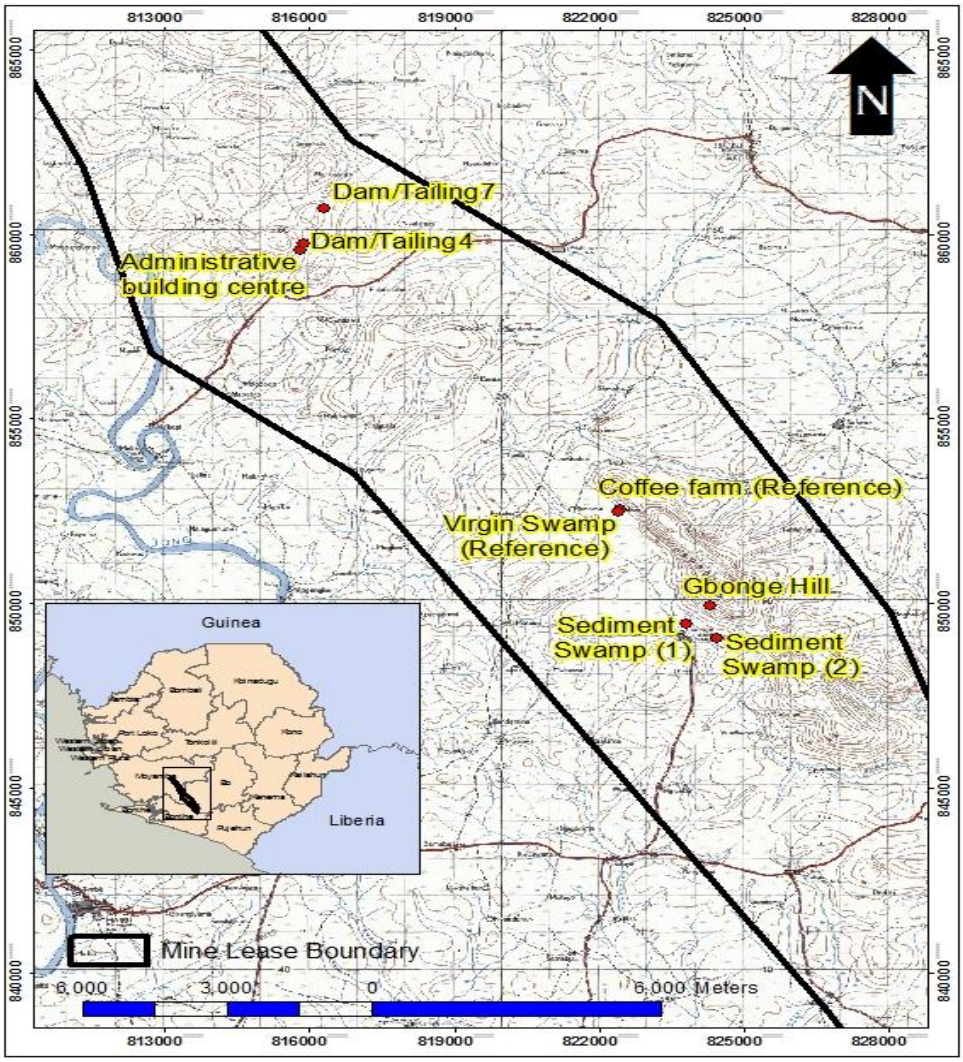
In order to evaluate land capability in the mining lease area, 3 auger borings were made in swamps, and 2 pits were dug at locations indicated on map 3. The rationale for choosing this sampling point was to assess the effectiveness of the reclamation process on land quality.

Site 2: The top –soil or overburden pile at the pile site of the on-going excavation at Gbonge hills. The rationale for choosing this sampling point was to evaluate the process of top soil management and its effects on soil fertility while piled up and waiting re-use for reclamation.

Site 3: An undisturbed coffee plantation with steep slope (24% slopes) in Jojohun. The rationale for choosing this sampling point was to provide a reference soil for the steep upland soils of facet 3 by which reclaimed land that were once on similar slopes before mining could be compared in terms of their agricultural capability.

Site 4: Swamps in close proximity to the mine sites at Gbonge. The rationale for choosing this sampling point was to assess whether the process of sedimentation (predicted in the 2003 ESHIA report for the resumption of mining by Vimetco by the Aqua Terra Consulting Firm) by runoff water flowing downhill from ore excavation sites is active (during the rainy season) and affecting soil fertility and crop production in any way.

Map 3 Sampling Locations SMHL Project Area.



Site 1: A reclaimed upland site at Gondama.

Site 5: A swamp site unaffected by mining activity was selected to provide a reference soil morphology by which swamps affected (if found) by mining activity may be compared and significant variations (if any) assessed for their implication on soil fertility.

At each location the following soil factors were estimated as follows:

- Nutrient status: darkness/blackness of colour, thickness of A or black horizon, root density and crop performance.
- Erosion hazard: presence and size of gullies, exposed crop/plant roots, slope percent, and stoniness and Percent land cover.
- Thickness of the true soil: (A, E and B horizons) in auger borings, gully or soil.

Analysis of the results: Results for the 5 sampling points indicated the following:

Land unaffected by mining activities in land facets 3 and 4 (see soil profile descriptions below), continue to exhibit similar land capability rating for agricultural use as determined prior to mining. This was evident in the morphology of the soils on the upland and low lands: The soils unaffected by mining were dark in colour (10YR 2/1, black, moist), thick in their A or surface horizons and had high density of roots from both crops and forest species. There was also 100% vegetative cover and absence of gullies on the uplands and sedimentation in lowland at the foot of its slope. Crop performance (e.g. Coffee on the upland and paddy rice in the swamps) was also very high. The current land uses on these soils appear to support productive, sustainable and environmentally sound.

Typical soil profile in land facet 3

Soil profile description of a typical soil in land facet 3, land system 21

District: Bonthe Chiefdom: Kpanda- Kemoh Village: Jojohun : GPS location: 29207896E, 0846012N Parent Material: Landscape position: backslope: Slope: 25% Vegetation: Coffee Plantation under secondary bush Land use: Cash crop production. Land system : 21 Facet: 3 Date : 21st October,2012 Pit Location: Coffee under Secondary forest	
Horizon	Description
A(0-10cm)	Very dark Brown (10YR 2/2. Moist); silty loam; strong sub-angular blocky; slightly sticky; slightly plastic; Common course to very fine roots; diffuse boundary to horizon below.
E(10-30cm)	Very dark greyish brown (10 YR 3/2, moist); gravelly silty loam; slightly sticky, slightly plastic, common coarse To fine roots; diffuse boundary to horizon below.
Bx (30-40cm)	Yellowish brown (10 YR 5/4, moist); Very gravelly silty loam; weak, fine sub angular blocky; slightly plastic, slightly sticky

Typical soil profile in land facet 4

Soil profile description of typical soil in land facet 4, land system 21

District: Bonthe Chiefdom: Kpanda - Kemoh Village: Jojohun: GPS location: 28N 0822397 0852458 Parent Material: colluvium Landscape position: Footslope Slope: 0-3 degrees Vegetation: Grasses. Land use: Rice and vegetable production Date : 21st November, 2012 Location of Monolith: Virgin IVS representing original state of soil before mining	
Horizon	Description
A(0-10cm)	Black(10YR 2/1, moist); Silty clay; weak, fine sub-angular blocky; very friable, slightly sticky; common, Coarse to very fine roots; abrupt boundary to horizon below
Bx (10-20cm)	Dark Yellowish Brown(10YR 4/6, moist), very gravelly coarse silty loam; massive structure; friable, slightly sticky; few fine to very fine roots; abrupt boundary to water table

1. The top–soil overburden was lighter in colour (see soil colour below: value and chroma of 4/5) , with little to zero land cover and absence of structural aggregates compared to the reference soils in 1 above. The process of overburden management as reported by the mining and environmental staff of Vimetco seemed to promote soil nutrient loss through volatilization, leaching , sheet or rill erosion, little or no addition of organic matter through composting , mulching or the planting and incorporation of leguminous cover crops. Since the reclamation process is delayed until after ore excavation has been completed for a mining site, the overburden is exposed to destructive climatic agents for as long as the excavation period lasted which, in some cases went on for over 3-4 years. The team of consultants in Aqua Terra consulting (2003), indicated in their ESIA report that there was need to "stabilize the soil material" in order to prevent "severe erosion and landslide". Evidence of low quality top soil may be seen in the low tree crop cover and deep gullies that characterize almost all reclaimed sites. Soil fertility (f) as a land capability quality for tree crops and annual crops is further degraded by these processes reducing the agricultural capability of the reclaimed lands to as low as S3 or N.

Non -use of cleared vegetation in composting- tree trunks, twigs, branches and leaves are buried or abandoned

A sharp deterioration in top soil colour of the original soil from a dark organic Value and chroma of 2/1 to a light value and chroma of 4/5 of exposed heaps of overburden on the Gbonge hills piled some 40 meters from the ore excavation zone.

2. Soils in swamps at the foot slopes (Land facet 4) of active mining hills are at a high risk of being buried by sediments from runoff during the rainy season. In their ESIA report on the impact of mining operations on Topography and Soils in the Vimetco concession area, the team of consultants in Aqua Terra consulting (2003) explained how "erosion and sedimentation "can release "large quantities of sediments" with "surface sludge moving down slope". Nine years following this prediction, heavy sedimentation was evident on swamp soils proximal to the Gbonge mining site. This was regarded an environmental flashpoint that should not be allowed to expand into community swamps as it has the potential to reduce the agricultural capability of the soils form S1 for paddy rice to as low as S3 or even N due to low fertility (f). Fertility decline can be caused by the burial or mixing of the organically rich and dark A or surface horizons with low nutrient inert materials from exposed soil parent materials or "not-soil" from the mining hills.

The following summarizes the evaluation of soils on the land facets assessed within the mining area:

- Land that was unaffected by the mining operations of Vimetco maintained their agricultural capability class in which they were originally classified.
- Poor topsoil management appears to have reduced the agricultural capability of the reclaimed lands to as low as S3 or N, making tree crop establishment largely unsuccessful.
- Sedimentation in some parts of the lowland appears to reduce the agricultural capability of the soils form S1 for paddy rice to as low as S3 or even N. This negative impact should be addressed through appropriated cost effective mitigates.

Based on pre mining crop suitability, the following conclusions are made:

- That the colluvial soils of the plains were rated as having the highest crop suitability of S1 for the cashew cash crop.
- That the soils of the Foot slope and Swamps were rated as having the highest crop suitability of S1 for paddy rice.
- The Cashew crop was the most suitable /adaptable for growing on all upland facets compared to other tree crops evaluated.
- Soils at the top of isolated hills were rated as unsuitable (N) for all the arable crops evaluated and rated as very low (S3) for growing tree crops. Erosion was cited as the most limiting factor to producing crops on the soils of this land facet.
- Soils on the steep side slopes show suitability ranging from S1 to S3 for all tree and arable crops, except rice.
- Four soil/land limitations to agricultural productivity, e, r, f, and m denoting, erosional hazard, low soil volume for adequate root space, soil fertility and moisture availability, were identified for soils in the lease area. These are the soil characteristics that need to be maintained or improved for the land capability rating of the soils to increase. They can therefore serve as indicators for monitoring mining impact on soil/land agricultural productivity.
- The limitation of erosion attributed to the upland poses a potential risk to sedimentation in the low lands.

The above baselines on land capability of soils within the Vimetco concession area may now be used to compare evaluate and predict mining impacts on soil productivity.

Table 6 Land Suitability of soils on 4 landform types under rain fed agriculture in the mining area.

Landforms (facets) within Land system 21	**Land suitability class (S1, S2, S3, N)**							
	Tree crops and cassava					Annual crops		
	Cashew	Cassava	Citrus	Coconut	Coffee	maize	g/nut	Paddy rice
Thin soils on hill tops (land facet1)	S3e	S3e	S3e	N	N	N	N	N

Moderately deep Colluvial soils on Plains(land facet 2)	S1	S2r	S3f	S3r	S3m	S2	S3r	N
Thin soils on steep backslope (land facet3)	S1	S2r	S3f	S2r	S3r	S2	S3	N
Swamps/drainage (land facet 4)	N	N	N	N	N	N	N	S1

Source: Adapted from UNDP/FAO (1979)

Legend

S1= highly to moderate suitability e= erosion hazard m= moisture availability

S2= low suitability r= rooting space

S3= Very low suitability f= Soil fertility N= Nil

5.1.7 Terrestrial Biological Environment

Flora

Four main terrestrial biological units are found in the concession area: High moist Fragmented Forest, Forest Re-growth, Upland Grasslands and swamps. The high moist fragmented forest is further divided in to three units: the Moist Evergreen forest, Moist Semi- deciduous forests and Secondary or Forest Regrowth.

Moist High Fragmented Forest: The moist evergreen is fragmented mostly found in clusters in the lowlands, along streams and river courses. Around settlements are also found moist evergreen (rain) forest interspersed with tree crops. But in the last few years, these have been drastically reduced as a result of timber exploitation for war rehabilitation works. The original dominant tree species mainly used as timber include: the *mahogany Khaya anthotheca*,****Entandrophragma utile*, E. angolensi*, E. cylindricum' Tetracarpidium conophorum, African cedar – Afzelia africana, African oak - Oldfieldia africana*, Terminalia ivorensis, T. superba, Piptadeniastrum africanum, Daniellia thurifera, Klainedoxa gabonensis, Brachystegia leonensis, Albizia ferruginea, Parkia biolor, Xylia evansii, Ricinodendron heudelotii, Hannoa klaineana, Erythrophleum ivorense, Irvingia gabonensis*, Mimusops heckelii, Cathormion altissimum, Amphimas pterocarpoides, Cynometra leonensis, Tieghemella heckelii*, Heritiera utilis, Lophira procera, Sacoglottis gabonensis*, Triplochiton***

scleroxylon* and Parinari excelsa. **Non-timber tree species include:** ***Musanga cecrotodes, carapa procera and myranthus arboresus.***

Moist Semi-deciduous Forest: The moist semi-deciduous forest has similar characteristics to the moist evergreen (rain) forest, but with a higher proportion of deciduous forest trees existing. They are concentrated in the Gbonge Hills area south west of the concession area and relatively closer to the coast. Before mining activities started, these forests found on hill tops were used mainly for logging and farming activities. The original dominant tree species that existed here include: ***Terminalia ivorensis, T. superb, Parkia bicolour, chlorophora regioa, Parinari excels, Erythrophleum ivorense*** and many other evergreen species listed above.

Secondary forests are the dense forests found in clusters representing the last stages of succession into mature forest after a long period of fallow. Their existence is due to their far away occurrences from settlements and former sites of villages that are now of extinction. Common tree species found here include: ***Musanga cecrotodes, carapa procera and myranthus arboresus***. Typical timber species of younger ages could be found including the ***Terminalia ivorensis, T. superb and Erythrophleum ivorense***.

Forest Regrowth (Farm Bush): Forest Re-growth is commonly known as farm bush that is derived from either of the above vegetation as a result of bush fallow cultivation. These farm bushes are found scattered throughout the area and are of varying ages ranging between five to twelve years. One to two years of fallow represents the early stages of regrowth consisting of very low shrubs, grasses and remnants of the previous root crops. Typical species include**:** ***Lantana Camara, Cissus afzelli, Manniophytum fulvum, Abrus precatorius, Smilax krausina and bovini*****.** As the fallows tend to develop further, pioneer forest species succeed the farm bushes and thickets if that area is no longer used for farming for a period of time. Typical species include: ***Dicrostachys glomerata, Harungana madagascariesis, Nauclea latifola, Alchorinear cordifolia and Trema guieenses and Elaesis guineensis.*** Older fallows often have common tree species such as ***Anisophyllea laurina and Alchornaa cordofolia.***

Upland Grasslands**:* Upland grasslands are found mainly in mined out areas that have not been revegetated and farm bushes that have been excessively been farmed and colonized by grassy vegetation due to poor and shallow soils and frequent burning in the dry season. Common grass species include**: *Andropogon gabonensis, Chasmodium Caudatum and Hyparrhenia rufa. ***Chasmodium caudatum*** is a valuable grazing grass that does not widely occur but gradually been replaced by ***Imperata Cylindrica*** **and** ***Pennisetum species.***

In the mined out areas are exotic and indigenous flora in the process of regeneration. Common among these are the fast growing ***Acacia leptocarpa and Paspalum plicatulum*** that were once used for rehabilitation by SIEROMCO Mines. The advantage of using these exotic trees is their ability to fix nitrogen in their nodules and their fire tolerant properties.

Inland Valley Swamps and Other Aquatic Vegetation**:** These are aquatic types of vegetation that occur in seasonally or perennially flooded valley bottoms. They are drained by sluggish fresh water streams that drain into the main rivers. Typical aquatic species include the ***raphia*** palm characterized by stilt roots and buttresses**, *mitragyna stipulosa*** and aquatic grasses and other water tolerant species which creep as undergrowth.

In addition to inland valley swamps are other wetlands encountered in the mining area. These are either artificially constructed or partially destroyed as a result of mining activities. They are either ponds that are in use or abandoned containing biodiversity with minor threats from damming and contamination.

Gallery forest: Gallery forest is found along the margins of the Taia River and other major streams, consisting of a dense canopy of trees.

Gallery forest tends to be scanty along the main streams and minor rivers partly due to removal of vegetation along the river margins to make way for farming activities.

5.1.8 Threats to Vegetation

Because of the current threat of deforestation on Sierra Leone's biological resources, studies have been carried out on over a thousand under-exploited economic plants (Cole & Macfoy, 1992; Turay; 1997;). Five main categories of uses have been mentioned with over 40% of these as medicinal, 21% as food and cash crops, 20% as timber trees and cottage industries and 15% as ornamentals used in horticulture. This list has been compiled and reproduced in Annex Table A-2.

Fauna

The mine site is located in an area that has been previously surveyed and reported in other studies (I.M.C. Mackay & Schnellman 1995; Knight Piesold Consulting 2003; Aqua Terra Consulting 2003). Many of the large birds and mammals are not present in large numbers due to human induced impacts. No detailed field studies were undertaken but reference was made to these previous studies with list of fauna species used during field survey for confirmation by local residents on the past and current presence of all species. This list was further used to determine the conservation status in terms of the following **IUCN status:**

EX (Extinct): No reasonable doubt that the last individual has died.

EW (Extinct in the wild): Known only to survive in captivity or as naturalized populations well outside its previous range.

CR (Critically Endangered): The species is eminent risk of extinction in the wild.

EN (Endangered): The species is facing an extremely high risk of extinction in the wild.

VU (Vulnerable): The species is facing an extremely high risk of extinction in the wild.

NT (Near Threatened): The species does not meet any of the criteria that would categorize it as risking extinction but it is likely to do so in the future.

LC (Least Concern): There are no current identifiable risks to the species.

DD (Data Deficient): There is inadequate information to make assessment of the risks to this species.

Some species were assessed using an earlier set of criteria. The Species assessed using this system have the following instead of Near Threatened and Least Concern categories:

Table 7 Species Conservation Status

LR/cd	**Lower Risk/conservation dependent**	Species which were the focus of conservation programmes and may have moved into a higher risk category if that programme was discontinued

LR/nt	**Lower Risk/** **near threatened**	Species which are close to being classified as Vulnerable but are not the subject of conservation programmes.
LR/lc	**Lower Risk/** **least concern**	Species for which there are no identifiable risks.

Notes:

- The taxonomy and naming of the individual species is based on those used in existing Wikipedia articles as of 21 May 2007 and supplemented by the common names.
- The Convention of International Trade in endangered Species of Wild Fauna and Flora (CITES).

The following is a summary of the description of the fauna that exist in the concession area as categorized above.

Primates: A total of 9 primates are said to have existed and recorded in and around the mining area. Four of these are listed as Endangered and Lower risk concern. They include:, Olive and Green monkey, the western Baboon, Olive Baboon, the Gorrila, Chimpazee, Colobus monkey, Black and white monkey and the Patas. The widespread of vegetation removal due to mining and farming makes it difficult for most of these species to be visible. The widespread trade in bush meat and the hunting of animals to be used as pets are also responsible for the gradual dwindling of these primates.

Rodents: Rodents make up by far the largest order of mammals. Depending on the type of habitats, they can live in large numbers, and are smaller in sizes though often weighing up to 25kg. The most popular of these include: the ground squirrel, the flying squirrel, cane rats and mouse of different order and genus. They are more widely distributed in young farm bushes and grassy vegetation. The scaly tailed squirrel is found around old and abandoned settlements and very thick and moist shrubs.

Ungulates: Ungulates are even-toed animals such as antelopes whose weight is borne about equally by the third and fourth toes. They are of great economic value to humans all over the world. They are preferred game species with very high prices in the mining towns and villages. Eight of these are commonly found existing in the area. These include duikers of the common duiker, maxwell's duiker, yellow-backed duiker, bongo, royal duiker, black duiker and the bushbuck and Jetinks duiker. Their status has been affected by the extensive alteration of the natural habitat combined with hunting and trapping. Most of the mining area has been severely overhunted and the antelope population is critically low.

Lagamorphs (Hares & Rabbits): The two families that exist include: hare/rabbits and Pikas that resemble rodents but classed as super-families and thus classed under separate order. They have four in scissors and an upper jaw instead of two. Common are the Lepus microtis and hares.

Hedge Hogs/Shrews and Moles: These are recognized by their spines though they look like rats. The most common is the four-toed hedgehog. The African Pygmy hedge hog for example, is a nocturnal animal that begins foraging from dusk to dawn. It has a lifespan of about two to three years in the wild. Shrews are insectivorous mammals that seldom resemble mice and moles and are stout bodied burrowers. Common among these are the tiny musk shrew and the mouse-tailed shrew.

Amphibians/Bats/Reptiles: No threatened amphibians are recorded in the area. They are mostly found to exist in the mine area in the narrow corridors of the Taia river and other main streams, open woodlands and swamps. Common among these include: the Buffalo toad, banana frog, lime red frog, mottled squeaker, long-tailed running frog and the river frog.

Bats are animals whose forelimbs are developed as wings making them the only mammals capable of flying. Common among them are fruit bats, Light-winged Lesser House Bat, Gland-tailed Free-tailed Bat, Little Free-tailed Bat, Sierra Leone Free-tailed Bat, and the Dwarf Free-tailed Bat. Some of these bats are identified as a source of protein for the local residents.

Throughout the area are numerous reptiles ranging from lizards to snakes. The common agama (Gecko) that is red headed is the most common lizard. It can be found climbing rocks and walls preying on insects. The dwarf African crocodile is said to be common in the Taia river banks. It is very slow, nocturnal and digs out burrows to hide and rest in the day. Very numerous snakes are found to exist in the area. They range in size from small snakes like the red spitting cobra to the King cobra. Other

common snakes include the green and yellow mamba, the adder, viper, yellow bellied house snake and the python. A list of these venomous snakes is produced in the Annex Table A.

Birds: Of the 626 birds recorded in Sierra Leone, 23 are said to be of global concern, 12 are globally threatened. Moreover, 437 of this total are recorded to be residents in Sierra Leone and 137 are regular visitors. Ten sites are established as important Bird Area (IBA) of which 3 are unprotected. There is a high degree of endemism, but relatively few are threatened. Subsistence hunting of large birds and game birds has led to a general decline in bird populations. The mining area does not fall within any of the above categories. However there exist many bird species that are characteristic of the coastal and interior plain area of south west of the country.

5.2 Socio-economic Environment

5.2.1 Demography

The population of Moyamba District using the last 2004 census figure is 260,910. The total density is estimated to be 60 persons per square km. This is almost the average figure for the mining population that concentrates along the main roads in towns like Mokanji, Moriba Town, Mogwemo and Gbangbatoke. The population is unevenly dispersed among the chiefdoms within the mining community. As expected, there is a greater concentration of population in villages around mining sites and chiefdom headquarters. The civil conflict ten years ago and its adverse impacts on all types of economic activities have certainly caused the population to migrate from some chiefdom.

Another common feature of the population is its youthfulness with over 40% aged less than 15 years. There is a relative shift in the age pattern of fertility with an earlier onset of reproduction, and an earlier peak of fertility, and a high ratio of performance in the younger ages for the entire project area. The reasons that seem to account for these include:

- the relatively low status of women in the communities;
- the relatively younger population;
- earlier onset of child bearing, especially through teenage pregnancies;
- high dropout rates from schools which give younger women little alternatives than to start their families; and
- relative absence of family planning methods.

Table 8 Demographic Profile of Communities in the Zone of Influence.

District	Chiefdoms	Total population	Male	Female
Moyamba	Bumpeh	32,363	15,172	17,191
Moyamba	Dasse	10,879	5,082	5,797
Moyamba	Lower Banta	25,954	12,369	13,585
Moyamba	Upper Banta	8,219	4,087	4,132
Bonthe	Kpanga Kemoh	7,661	3,688	3,973

Source : *2004 National Population* Census

Public Health is within the purview of the Peripheral Health Unit (PHU) of the Ministry of Health and Sanitation. It is the delivery point for primary health care with three main categories. The Community Health Centre (CHC) found in almost all chiefdom headquarters carries out health prevention measures, cures, promotes health activities. It is also in charge of overseeing the other PHUs in the area. All of the five chiefdoms have at least one community Health Centre. Community Health Posts perform similar functions to CHCs but have fewer facilities and often refer patients to health centres. Maternal and Child Health Posts (MCHP) are the first level of contact on the ground and are found in most villages in all chiefdoms. All these health units refer difficult cases and emergencies to Serabu Hospital, which is the general hospital with medical, surgical, laboratory, radiological and other diagnostic and treatment services.

Maternal health has remained poor. Although accurate statistics for the chiefdoms as a whole are not available, it is estimated that the maternal mortality ratio high. Contributory factors are cultural practices such as gender power imbalances, the low level of education among girls, and poor access to skilled birth attendance.

One recent innovation in the public health sector is the introduction of “Free Health Care Medical Insurance” that was launched in 2010. It is a system of free health care for pregnant and breast feeding

women and children under five funded by the United Nations Fund for Population Activities (UNFPA), The World Bank and the Department for International Development (DFID).

Malaria is the main reason why outpatients consult in local health centers. It is responsible for about 30 percent of all hospital attendances and is listed first in the top ten causes of mortality in all age groups under the age of 16 years. People are however willing to use bed nets which can be treated with permethrin to control mosquitoes.

Children under five are predisposed to outbreaks of immunizable diseases such as measles, tetanus and whooping cough since there is both low immunization coverage and poor mother-child health monitoring in the area. The overall immunization coverage has however increased over the years. Poor nutrition and inadequate growth monitoring may lead to malnutrition and delayed mental and physical development among children under five.

The reproductive health of adolescents and youth also continues to be a major health challenge. Contributory factors include forced marriages, and poor access to information and youth-friendly reproductive health services. High levels of sexual debut, teenage pregnancy, school drop-outs and resultant low level of education are manifestations of this health challenge for the girl child. The communities also have their own stock of indigenous knowledge about the treatment of a variety of illnesses such as malaria, fever, general pains or sicknesses, post-natal sickness, poisoning, etc.

5.2.3 Water Supply

The main sources of drinking and domestic water are from shallow wells, streams, swamps and the ponds that are constructed by the mining company. Even though some of these wells were constructed by NGOs over the years, they are not regularly treated or monitored to ascertain the quality of water. Without the provision of various water sources by SMHL, access to water for many in the community is lacking. There are more much evidence of water pollution as a result of the bauxite mining and processing operations. Sanitation facilities are limited especially in the smaller settlements where often no pit latrines exist.

Water sources in the mining community are from rivers, streams and wells with some fitted with hand pumps. The Taia River and its tributaries serve as a permanent and valuable source of water which is

used mainly for mining, fishing, and for human consumption. Apart from those noted above, other perennial surface-water sources available in the area are the reservoirs and ponds that have been constructed for mining which were abandoned a long time ago by the then SIEROMCO Minerals. The main water body that constitutes ground water occurrences is the Kasila series, the Taia river terraces and the Inland Valley swamps. The Kasila is usually shallow in the wet season rising to about 0.5m below the ground surface in some areas. Generally, ground water level decreases with seasonal fluctuation in precipitation. In the dry season, ground water drops linearly with no recharge from rainfall.

Ground water analyses have been previously undertaken in villages around project sites from existing hand dug wells. The results indicate that ground water quality characteristics are controlled by fluctuations in water levels in the systems (ESCG), 1990; IMC Mackay and Schnellman, 1997; Aqua Terra Consulting, 2004). In the wet season, water from most of the wells is often clean with pleasant taste. In the dry season on the other hand, some of the water in the wells become dry or coloured with unpleasant taste. The laterites become highly soluble in the wet season making the water acidic. The study by Aqua Terra Consulting indicates that pH for the selected water points ranged from 4.6 – 6.4 with a mean value of 5.6. These values are outside permissible limits of 6.5 – 8.5 as recommended by World Health Organization (WHO). All the points had turbidity value of 5NTU, which is the maximum threshold for clear water as recommended by WHO. Faecal coli form bacteria were discovered in 60 of the samples. As such, drinking water from these points is a health risk.

5.2.4 Education

The level of education in the mining community is relatively low. There are less than 20 Secondary schools in the entire concession area, even though few primary schools exist. Of these, Lower Banta has the largest number of all the schools, followed by Bumpe and Dasse respectively. Overall, the number of students enrolled at both primary and secondary schools has drastically increased in the last three to four years. This has led to the increase in the density of classes that is far beyond average. The increase is affecting the efficiency and capacity of the educational system especially at the primary stage.

The GOSL and a number of NGOs are providing educational services in terms of construction of buildings, provision of teaching and learning materials. However, certain factors are standing the way of improving the educational processes within the chiefdoms including: overcrowding classrooms; poor

quality of school buildings; poor spatial distribution of schools; inadequacy of school buildings; low wages for teachers; high failure rates of school children in public exams; and a large number of over-aged children.

5.2.5. Land and Water Resources

The right to land in the area is vested in the community. Ownership is inherited for specific lineages or household with the eldest male administering the land. At community level, authority over land is vested in the chiefs and the overall power over land in the entire chiefdom is vested in the paramount Chief. Land acquisition for mining has a direct adverse impact on the livelihood especially when agriculture is the main livelihood source for the community. Though land shortage is not a major concern raised by the community, the issue of proper and adequate rehabilitation of mined out areas is raised as a matter of concern. The communities argued that there would be adequate land for farming if the mined out areas could be adequately rehabilitated with fertile top soil.

Other constraints to land resource utilization in the farming communities include:

- Low capital base and high costs of inputs;
- Lack of mechanization as a result of terrain configuration;
- Low level of management skills;
- Low level of incentives for farmers such as lack of cooperatives that can assist farmers in bulk purchasing and access to attractive markets.

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5*.2.6. Transport and Communications*

Apart from the principal Mokanji – Gbangbatoke – Nitti Port road, which is regularly maintained by SMHL, the road network other than the feeder haulage roads in the mining area is poorly maintained. Feeder roads to most of the villages are hardly ever graded, although SMHL has also done considerable work in maintaining the road to Gbonge from Gondama. Modes of transport are limited especially during the wet season.

5.2.7. Social and Political Organizations

There is a strong social and political influence within the communities ranging from strong community spirit, special bonds, civic bonds, networks, extended friendships and trust to enable communities to

act together effectively to pursue common objectives. There is a low level of social ties that influences community development especially in areas of decision making. The ability to mobilize resources is generally low in all four chiefdoms, so also is their capacity for financial management and revenue generation. Based on membership, the predominant social institutions are highly skewed towards men. The members of a group interviewed were usually heads of households and therefore almost always males; the number of women members remains negligible. The extent to which women and, to a lesser degree, youth, can draw on this form of social capital is, therefore, limited. The wide variety of community or village level institutions and organizations that may have impact on community development programmes in the area can be divided into: Governmental, Indigenous and Non-Governmental Organizations.

Government Institutions include: Associations established to promote specific development activities under the supervision of extension officers, e.g. Project Management Committees (PMC); Village Development Committees; Ward Development Committees (WDC); Local level Party Organizations set up to organize elections or act as channels of government based on political patronage.

Indigenous Organizations include: Traditional Authorities- chiefs and elders; Groups set up to organize mutual support activities; Producers' Unions; Women's Associations; Work Groups; Social Clubs of young men and women set up to achieve social activities; Church/Mosque Organizations with strong political and social structures.

Non-Governmental Organizations are the key actors in the community development process. They operate in all the communities by providing them with schools, wells and pumps, clinics, micro-credits, etc.

Local Council is a recent innovation in public administration after its demise in the early 1970's. As an entity, they are bedeviled by the lack of adequate logistical support and capacity to effect the desired change in the communities. Community's awareness for development in the area id therefore limited.

5.2.8. Land Tenure

Land acquisition for mining has a direct adverse impact on the livelihood especially when agriculture is the main livelihood source for the community. Though land shortage is not a major concern raised by

the community, the issue of proper and adequate rehabilitation of mined out areas is raised as a matter of concern. The communities often argue that there would be adequate land for farming if the already mined out areas could be adequately rehabilitated with fertile top soil. Community engagement with all stakeholders will therefore constitute the cornerstone to establishing and maintaining long term support for the implementation of the MRCP.

5.2.9. Economic Activities

Cash cropping and subsistence farming are the two major systems of agriculture. The main cash crops grown today are oil palm, coffee and whilst there has recently been extensive planting of cassava for garri production. The main subsistence food crops grown are rice, cassava, sweet potatoes, maize, beans, groundnuts, cocoyam, millet, sorghum, peas, sesame, and yams. A range of vegetables are grown throughout the year including tomatoes, spring onions, pepper, eggplants and cucumber.

Trees planted on reclaimed mined out lands are used for a wide range of reasons including: a source of fuel and building materials and, to improve soil moisture and fertility. The main fruit trees are jackfruit, avocado, mango, oranges and pawpaw.

While socio-economic and cultural changes are impacting upon the community development with evidence of a growing appreciation of gender concerns, the differences in gender roles and rights remain intact and distinct in all the chiefdoms. The farming production economy, which is prevalent in most parts of the chiefdoms, typifies this - a family enterprise with clearly defined gender roles with men as the key decision-makers, except for women-headed households who often get engaged in petty trading. Men control about 70% of the family expenditure with women controlling about a 25% and other members of the family, mainly sons, control the rest. Women still control only a limited range of activities and have restricted access to decision-making in the community. They lack decision-making power on land tenure issues and rarely own productive resources such as land or tree crops. They have limited sources of income compounded by the inability to access markets for their products. Other challenges faced by women include constrained access to information and a paucity of resources to address issues such as sanitation in the homestead.

Besides people working in the mines, about 90% of the households in the community are farmers, while many other people undertake other occupations such as petty trading, fishing and bike taxi driving. Based on the 2010 survey, the average sustainable land holding in the chiefdoms is 0.90 ha per household with an annual agricultural income of about $350. Those engaged in fishing have a higher income of about $1250 per year. The important categories of expenditure are education, food/household essentials, health care, farming, taxes, transport, credit and home building. The costs that are considered to impose hardships on a family are,- education, acquiring a piece of land for housing, and health services. People are able to save during the productive seasons of November to February. However, savings are inadequate to address needs during the wet season months of June, to September when incomes are low and expenditures high.

Table 9 Main Sources of Income in Selected Villages

Income Source/Combination	Frequency	%
Farming	1017	90.56
Petty Trading	**12**	**1.07**
Cottage Industry	9	0.81
Government Workers	27	2.41
SML Employees	32	2.85
SRL Employees	11	0.98
Others	15	1.34
Total	**1123**	**100**

Source: Baseline CDAP Survey, July, 2010

There are some variations in the ways the population derives its income. The larger settlements of Gbangbatoke, Mokanji, Gbonge and Mosenesie and Walihun, carry higher populations derive their incomes from either government or NGOs due to the level of education attained by these people. Employment with the two mining companies operating in the area offers another source of income for some of the local community although this is limited by the low education and skills level available. Company employment policy has a preference for locals in the recruitment of unskilled jobs.

The community is further constrained in exploiting more fully its financial capital as it lacks access to credit facilities. Financial services, such as banking and savings services, are under-developed or unavailable. For instance, there are no micro-credit lending institutions to facilitate the expansion of micro-enterprise development.

5.2.10. SURFACE LAND OWNERSHIP

Surface land ownership in the mining lease area and other parts of the provinces is vested in indigenous families. Landowners generally use surface lands for permanent occupation in the form of physical structures, tree plantations and temporary occupation in the form of shifting cultivation and cattle grazing.

The agreement with the GOSL through the Mining Agreement, establishes SMHL's right to occupy and utilize permanently and temporarily within its mining lease such parts of the surface land, whether government owned or otherwise, as may be reasonably required for accessory works and installations that are necessary or useful for its operations, and such part of the surface as may be required for its prospecting and mining operations.

SMHL pays annually, in advance, a surface rent under the mining lease for all land occupied or used. This amount will be distributed among the Paramount Chiefs, Landowners and Chiefdom Administration.

Through the Ministry of Agriculture, with its listing of fees for economic and subsistence crops, SMHL makes satisfactory arrangements for payment of a fair and reasonable compensation for damage to any crops, trees, farms, Permanent and temporary structures or works that occur as a result of prospecting and or mining operations.

Section SIX – Potential Impacts and Mitigation Measures

This section discusses the existing and potential environmental and social impacts that are associated with SMHL operations and the mitigation measures required to minimize these impacts to acceptable levels. The section only deals with the existing project operations and not past activities and impacts that were conducted by previous studies or future mining operations other than the current deposits that are being mined.

6.1. Biophysical Environment

6.1.1 Topography

Mining activities at SMHL operational areas involve the removal of vegetation and the opening up of mine panels. Vegetation is also removed in areas that are used for the stockpiling of overburden and ore. Topsoil removal and subsequent stripping of the overburden is done with the use of bulldozers and excavators with the resultant alteration of the topography and landforms. Mining progresses further with backfilling of mine panels that are levelled to match the pre-existing landscape as much as possible. Other concurrent activities involve haulage and other road rehabilitation works undertaken especially during the wet season.

A total of about 1300 acres of land area has been disturbed as a result of this activity and the impact is expected to last forever though with less severity. Under the current mining methods, the significant rating scale for this activity is moderate. The use of heavy equipment such as bulldozers, excavators and trucks utilized during the mine's operation is also resulting in soil compaction in the wet season often beyond permeability which can lead to the creation of pools after periods of heavy rainfall.

The major mitigation measure for the above impacts is the reclamation of mined out areas to a near original habitat. The Mine Reclamation and Closure Plan (MRCP) that has been prepared for SMHL that details the major activities involved in grading and levelling of the local topography that is currently been disturbed. A summary of this plan is presented under a separate chapter of this report.

The overburden materials and the ore stockpiles are often susceptible to erosion and can lead to sedimentation of waterways. To mitigate this impact, detention storages should be constructed to collect open pit water and runoff drainage to ensure that the receiving environment water quality is achieved prior to discharge.

The use of heavy equipment such as bulldozers, excavators and trucks utilized during the mine's operation is also resulting in soil compaction in the wet season often beyond permeability which can lead to the creation of pools after periods of heavy rainfall.

To mitigate the impact of compaction in the wet season, designated routes should be utilized for the movement of heavy vehicles and machinery and the transportation of ore and other materials from the deposit sites. The implementation of these measures will eventually be not much of a concern for the project.

6.1.2 Air Quality

The common operations that impact on air quality include land clearing, excavation, earth moving, and storage of materials, handling and transportation. The mechanization includes the use of ripper bulldozers, excavators, tippers/dumpers and graders. Other operations include the use of stockpile materials, drying and loading of the bauxite at Nitti Port, operations at the mechanical workshop and the burning of farm bushes during the dry season by local residents.

Air emissions that result from these activities include carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur SO_x), Total Organic Compounds (TOC), and Carbon dioxide (CO_2). The major source of air emissions is the combustion of diesel fuel used by the mine equipment fleet, mobile mining equipment, other transportation, process plant operations, and the production of electricity. The receptors include machine operators and nearby personnel within the plant site. The impact of such emission on air quality is however minimal and the impacts are insignificant in the long term.

No assessment has been undertaken on the estimated rate of emission but it is expected that the predicted concentration of these Green House Gases would be well below the criterion for all the receptors and dust generation would only be severe in the dry season. Air quality assessment thus constitutes a key environmental monitoring plan for SMHL operations. SMHL should ensure that a periodic checking on regular emissions based on monitoring instrumentation is made and subsequent reporting that describes conditions and corrective measures to avoid future impact on air quality.

Airborne particulates become very high during the dry season but very low in the wet season when emissions are only limited to vehicular operations from mining and ore beneficiation. The receptors

include project site boundary, nearby villages especially those settlements along major haul roads. The impact is only high in the dry season and insignificant in the wet season.

There is an increase in dust with increasing traffic especially on the haul roads between Gbonge, Gondama and Nitti. This affects the local communities within the access road and this is expected to continue throughout the life of the mining operations. The scale of the impact is however local and may increase only in the dry season.

Mitigation measures need to be implemented to reduce the level of dust. This will include: reduction in speed limits. Construction of speed bumps through villages and stabilization of road materials in sensitive spots along the haul roads. Dust suppression through watering should form a major activity all throughout the dry season to mitigate the impact of dust on the affected receptors. Vehicular operators are also advised to adhere to the safety rules especially those introduced during training programmes. With these mitigation measures applied, there will be no short-term and long-term impacts.

6.1.3 Noise

Most of the noise at the mine site is generated from activities of mining equipment such as excavators, bulldozers, frontend loaders, mine trucks and stationary equipment including the wash plant, power plant, dryer building at Nitti Port and the mechanical workshop. Heavy truck movement along the haul road is another source of noise.

The plant site is located within a valley about 3 kilometres from the nearest village and separated from it by farm bush. As such, it is unlikely that noise will impact on local residents. However, noise is having effects on the workers in and around the plant site where most of the fixed noises are located. Noise is having effects on wild life in the areas of mining activities; and since mining and ore processing go on for two to three shifts a day. Highly significant noise levels will occur in the open pits and plant area all year round.

It was not possible to calculate daytime sound pressure levels for the various components. But SMHL environmental report for the third quarter of this year estimates noise levels for the various locations and the results are reproduced in Table 16.

Table 10 Summary of Noise Monitoring Results.

Location	SOUND	UNIT
Washing Plant	79.2	db
Volvo Garage	80.6	db
Cat Garage	83.8	db
Vulcanizer Garage	80.43	db
Laboratory	70.69	db
Gondama Stockpile	85.22	db
Gbonge Mine Pit	82.19	db
Average	80.3	
Mean	80.3	
SD	4.7	

The noise levels for all the stations range between 70.69 and 85.22 decibels. The high noise level at the Gondama stockpile was attributed to the high vehicular traffic (including dump trucks and light vehicles) plying the haul road at the time of monitoring. All the equipment or noise sources however meet the required noise limit for most mine operations of less than 85dBA. The maximum noise level at station Nl 1 (Washing Plant) would be expected to be above the measured limit of 79.2 decibels, especially when other noise generating machinery (Loader) and the nearby generator that supplies electricity to the entire plant site are nearer.

During the field work, it was estimated that on the average, there were not more than 100 truck trips two ways from mine panels to wash plant and to Nitti Port. This noise traffic will have a relatively minor effect on the noise receptors along the main haul roads. These short-term noise impacts to residents will be minimal but can be locally significant to employees in certain work areas at the plant site and mine panels.

Noise mitigation measures to be considered for SMHL operations are as follows:

- Future facilities with high noise impacts should be located well away from noise sensitive areas possibly adjacent to the stock pile areas around the plant site.
- All the heavy equipment and vehicles should be kept in good repair.
- Some of the existing stationary noisy equipments should be insulated by screens or sheds.
- Currently, no noise standard requirements have been established for Sierra Leone, but it is recommended that in general, operations should meet the international noise standard requirements.
- Mine faces should be used as noise barriers in the immediate vicinity of villages such as Gbonge, Jenega and Konta.
- Protective hearing devices should be used when employees are at work especially at or near earth-moving equipment, wash plants and power houses.

6.1.4 Geology and Soils

The topsoil in the area is thin and residual on both the foot slopes and hill slopes where most mining activities take place. The major impact of mining on the local geology is visible in the removal of overburden that is used in construction works and the excavation of ore deposit from the mine panels. Soil erosion results due to this activity and the impact is high during heavy rainfall events when most soils are washed and deposited in streams and valleys. This impact is unavoidable even though the physical disturbance is low in the short and long term. Whilst these impacts could be significant, mitigation measures follow the same procedures outlined for the reclamation of the mined out areas.

The topsoil is however recovered, stockpiled and eventually used in the reclamation works. The suitability of these soils for crop productivity constitutes part of this ESIA as a mitigation measure. SMHL will implement the rehabilitation programme for the soils by comparing the quality of the pre-disturbed soil to that of the exposed soils in the mined out areas. This will set up the criteria for soil enhancement for different crops.

Major mitigation measures include:

- Separation of super soil from sub soil during removal.
- Proper grading and reshaping of the disturbed areas.
- Adequate crop suitability procedures for reclamation work.

- Prompt timing of re-vegetation on reclaimed lands to avoid top soil removal in the early rain events.
- Establishment of sediment raps, bunds and where necessary construction of diversion ditches.
- Regular inspection of reclamation and repair works where needed; and
- Use of rock mulch on unprotected surfaces.

6.1.5 Surface Water

Mining activities at SMHL project sites adversely impact on surface water quality. These processes include:

- Vegetation removal for mining leaving behind very large tracts of land exposed to direct rainfall and soil erosion. The eroded materials are transported into waterways thereby increasing surface water turbidity.
- Runoff from solid wastes in water bodies resulting in contamination and blockage.
- Spillage of fuel or oil which will contaminate nearby drainage ways.
- Runoff from waste disposal sites from the plant site and Camp.

Impacts to surface water quality from these activities can have a locally high significance if no mitigation measures are applied as a result of changes in water quality.

Currently, streams and other water bodies are being monitored at sensitive locations to ensure that mining activities do not affect the downstream supply systems. The washing Plant does not require any chemical reagent in ore processing. The decant water is thus expected to meet the IFC effluent discharge guidelines.

To mitigate the adverse impacts on surface water quality, the following measures are proposed:

- Stockpiles and overburden should not be placed at nearby drainage ways.
- Waste oil, fuel and other lubricants should be stored in strong containments.
- Tailings Management Plan should be properly implemented. As much as possible, leakages into earth fill dams should be avoided.

Efforts should be made in the wet season to ensure that rain water is diverted from the TSF. This is achieved by constructing ditches around the perimeter of the TSF and channelled to the nearby drainage system.

6.1.6 Visual Resources

The former Sieromco mine pits and the current mined out areas around Gbonge deposits are the main intermittent views around haul roads characterized by lower shrub vegetation and secondary forests. Activities that are associated with visual impacts include former mine pits and scars, abandoned power lines, former Sieromco plant sites around Mokanji, perimeter fences, traffic flow, dusts and accumulation of these on leaves, speed bumps, burrow pits, tailings storage facilities and mine faces. The major receptors include villages along main haul and access roads. These impacts are localized and occur in the short term especially in the dry season. The following measures are proposed to minimize visual intrusions that are outlined above.

- Where construction of power lines would be required, features should be designed so as to achieve landscape designs.
- Burrow pits and mine faces should be graded so as to achieve professional landscape designs.

Impoundment dams should be rehabilitated to meet international standards.

6.1.7 Accidental Release of Sludge from Tailings Storage Facility

The facility was constructed with mechanisms that protect direct discharge of sediments into the earth filled dams. Any failure is likely to have a discharge into these dams and local drainage systems downstream of the facility. This could increase turbidity, conductivity and inorganic particulates in the systems. Because of the relative immobility of the mud and the seasonality of weather conditions, the severity of such an impact would be expected to be local and low with an overall impact rating of moderate (high severity; low likelihood).

Recommended mitigation measures to minimize the impact potential include rehabilitation, development and implementation of the Tailings Management Plan coupled with regular inspection programme.

6.1.8 Wildlife, Protected Areas and Cultural Properties

There are no significant wildlife habitats reported to exist in the concession area, no wildlife sanctuaries or protected site habitats have been identified in the study corridor. Therefore, no mitigation measures are recommended. No known protected cultural or historical sites were identified except those found surrounding villages including local religious facilities, local monuments, holy trees/springs or old burial grounds. These sites will not directly be affected by land expropriation or lie in the vicinity of the works.

6.1.9 Borrow Pits and Quarry Sites

Borrow pits and quarries are opened within road corridors in order to supply sub-base material and crushed stone. The principal environmental concerns relate to the visual effects of quarrying and the effects of access road rehabilitation works. There is less concern regarding impacts on development in agricultural lands or close to settlements, since there does not seem to be a high probability of such sites are being developed. Nevertheless, these aspects need to be considered during future quarry site development.

The principal concerns in relation to borrow pits include:

- Access roads and borrow pits themselves may be developed in materials which are highly erodible, and may contribute to enhanced erosion of a sensitive landscape;
- Deep pits may be developed which are a safety hazard to people especially if they fill with water during the wet season and become breeding grounds for insect disease vectors;
- Since borrow pits will almost certainly be developed close to the road corridors, even if they are not located in agricultural lands, access roads will probably have to traverse cultivated land, with adverse effects on landholders if they are not properly reinstated when pit use ceases.
- Even though the landscape has only average visual quality borrow pits will probably be developed in elevated parts of the landscape, and scarring by working faces can permanently spoil an otherwise pleasant view.

6.1.10 Flora and Fauna

The mining activities of SMHL operations include clearing of vegetation for mining and stockpiling and the deposition of mine spoils in unspecified areas. All these activities are impacting on the flora and fauna species even though some of the land areas were previously disturbed before SMHL operations. The impact is low to moderate of ecological value such as the loss of habitat, disturbance of rare species and wild life. With increase in population in the concession area, the demand for bush meat increases with the purchasing power of the people working for SMHL. The modification of the habitat is expected to last long, but with implementation of mitigation measures, short, medium and long term impacts will be expected to be favourable.

There is also an ensuing expansion of farming activities to meet the food demands for the mining community. This type of farming that is practiced has negative impacts only in the short term and is localized. The following mitigations are proposed:

- Prompt mine reclamation activities in the mined out areas should be enhanced.
- If vulnerable or endangered species exist within the mine sites, measures should be taken to create alternative sites.

6.2. Socio-economic Impacts

This section analyses the negative socio-economic impacts of the project activities on the social, economic and biophysical environment and describes the recommended mitigation measures to minimize, or mitigate these negative impacts.

6.2.1 Community Health and Safety

The GoSL provides Free Primary Health Care to children under the age of five and their mothers. SMHL employees and their families have access to the health clinic at the mine site and referrals are often made to the Serabu Hospital located 11 km. from the Gondama site. The likelihood of accidents and work-related illnesses on the job as well as accidents occurring between mining related equipment and local vehicles are inherent at SMHL operations. Though located in a rural setting, the mining area is about 10 km. away from the closest medical facility and the likelihood for accidents to occur is assumed to be low.

Only a few foreign workers are hired by SMHL most of these are highly educated mine engineers. Therefore, the risk of spreading communicable diseases as a result of the project is considered minor (medium severity; low likelihood). However, SMHL and its senior staff personnel should initiate discussions of communicable diseases and sexually transmitted diseases into its health and safety plans.

The mitigation measures recommended to address this impact include the following:

• Provision of additional health facilities to the five affected chiefdoms;

• Provision of health services to all workers and their families, which will avoid new demands on health services by Project out-of-area workers.

• Avoid and minimize environmental effects that have potential to affect health, including dust, noise, and any effects that may negatively affect livelihood resources, such as contamination of the rivers or farmlands.

- Preventions should be taken against fire accidents and security should be imposed at all times.

6.2.2 Traffic and Road Safety

The expansion of SMHL operations to Gbonge has increased vehicular traffic over the last few years. Heavy vehicular transportation between Gondama and Nitti Port is estimated at about 6 trips per trucks per shift and between Gbonge and Gondama 10 trips per shift per truck. This increase is of major significance especially when the haul roads are concurrently been used by both SMHL and other public vehicles. In some cases these haul roads are used by commercial bike riders. Similarly, pedestrians along the road alignment will be exposed to the greatest risk. The greatest at risk are the linear settlements such as Gbonge, Konta, Gondama, Mosenesie, Foala and Wunde.

Drivers, bike riders and pedestrians are gradually becoming accustomed to the increased traffic and vehicle speeds, and it is likely that the number of accidents will show any level of concern.

Most of the traffic is currently associated with the Project is between Gondama and Gbonge.This traffic represents relatively minimal safety risk to other vehicles. But the traffic between Gondama to Nitti Port poses a greater risk to local residents as it is being used by other public vehicles. As such, the increase in traffic is rated a moderate impact (moderate severity; moderate likelihood).

Mitigation measures include:

- Provide driver safety training to all workers, including contractors, who are expected to drive as part of their duties, especially to be alert for pedestrians along the private haul road;
- Impose speed limits;
- Schedule truck traffic along the public highways to avoid peak hours; and
- Introduce safety campaigns amongst the communities.

Implementation of these measures would reduce the impact to minor scale. The unpaved road requires excessive repairs and maintenance to support traffic flow in the wet season.

6.2.3 Population Movements

With the existing high level of unemployment in the country, any development of projects such mining is expected to attract a huge number of people seeking for jobs. Since the restart of bauxite mining, the project area has attracted a large number of people seeking for job and providing support services such as petty trading and commercial sex work. The influx in the area is cumulative as there are other mining operations going on in nearby communities. The increase in population is expected to increase with the demand for goods and services. The negative impacts that are occurring include; prostitution, spread of diseases such as HIV and AIDS, STDs, disruption of social and cultural values of host communities, drug and alcohol abuse, theft, domestic violence and noise. These impacts are expected to last for a long time on a wider local level, but the significance is moderate.

To minimize such impacts, SMHL is expected to give job preference to the local population and only when the local population is exhausted that hiring should be made from outside the mining community.

There is also a need for an increase in the provision of goods and services by introducing job opportunities such as poultry and piggery farming, vegetable gardening, bakery, brick making, entertainment centres, etc.

6.2.4 Gender Impacts

SMHL mining operations like most industries are having a severe impact on gender. These include: a. Impacts on land ownership, b. impacts on economic activities, c. teenage pregnancy and early marriage. Land is mainly owned by the section chiefs who are mainly male. At family level, land is mainly owned by the eldest male (in the case of inheritance) or by the father who is the head of the household. Surveys that have been done in the area indicate that men have more access to land for farming activities than women. This situation may likely have a negative impact on the productive potential of women in many of the villages in the area. The major economic activities include small scale farming, fishing and petty trading. Due to the increase in the transportation cost, many women sell their crops at farm gate prices to traders, thus getting less from the crops they cultivate.

There are variations in the roles and responsibilities in relation to economic activities. Women are mainly involved in market gardening and men largely involved in working in the mines, swamp and upland rice cultivation.

There is a high level of teenage pregnancy in the project area. They survey reported that girls generally drop out of school at an early stage. Many of the young girls who drop out school as a result teenage pregnancy eventually end up in the bigger settlements like Moriba Town, Mokanji and Gbangbatoke.

Social activities such as video shows and dances are responsible for the increasing rate of teenage pregnancy.

There are few secondary schools existing in the five chiefdoms. Failure to complete secondary school education would mean an early marriage as there are no other socio-economic pursuits than trading. Women in the community generally marry at an average age of 17 years and are liable to bear an average of 8 children during the child bearing period.

These impacts outlined above are expected to last a long time occurring at a local scale. The severe impact would be low to moderate and irreversible in some cases. Mitigation measures to address these impacts include:

- Through SMHL's corporate social responsibility program, it can promote other sectors of the economy through training, establishing micro credit schemes and through serving as a market for the agricultural produce by women.

- To prevent idleness among teenagers which lead to pregnancy, they should be provided with family planning strategies and activities that promote social interaction and positive community behaviour. Some of these social activities may include sports competitions with the nearby schools and theatre.

- Women, whose roles are mainly production and reproduction should participate actively in decision-making processes concerning community life.

6.2.5 Community Expectations and Apprehensions

Bauxite mining has been going on the area for over fifty years by both SMHL and former SIEROMCO Company. These have continued to provide employment opportunities and community development initiatives in all the affected chiefdoms. These communities especially the two chiefdoms of Banta feel that SMHL should provide more. Their job and other economic expectations continue to be high including their proximity to the nearby SRL Ltd. Company.

Interactions between SMHL and the community continue to go on to address concerns and complaints such as destruction of farmlands with inadequate crop compensations to farmers, dissatisfaction over

reclamation methods, pollution in streams and rivers, inequitable implementation of development projects etc.

Failure on the part of SMHL to address the concerns and needs of these local issues can have a direct impact on the acceptability of the project within the host communities. The study however reveals that the mining operations are expected to have a positive rating of project benefits to these communities. Recommended mitigation measures to address these issues include the following:

- Implement and promote a more systemic grievance resolving mechanism associated with SMHL project; and
- Implement the Community Development Action Plan (CDAP) and the ESIA (this document) that outlines the stakeholder consultation process which is the means to optimize local economic benefits and the promotion of SMHL's corporate social responsibility. Successful application of the process has the potential to increase the significant rating of the impact of the operations..

6.3 Cumulative Impacts

However, irrespective of their nature, the impacts of mining are likely to be experienced across the region where mine concessions have been granted. Although it is not the role of this ESHIA to recommend management for other mining operations, and the other operations must be subject to their own EIA processes, the impacts of mining in the region must be seen holistically and appropriate management measures must be implemented to limit the cumulative negative impacts of this and adjacent mining concessions. It will therefore be important for the mining operations to communicate and develop co-operative strategies to mitigate their cumulative impacts.

Both social and biophysical impacts can be expected to be cumulative in nature. The most important cumulative impacts are:

- Positive social impacts will result to improved economic conditions in the region. The creation of a number of mining operations will result in the creation of a large, albeit dispersed market for goods and services, which will significantly stimulate the local economy and act as a catalyst for the government to improve service delivery in the region.
- Negative social impacts, for instance:
  - o a population influx (due to other mining operations)
  - o Price inflation

o Change in livelihood from agriculture to mining

o Increased social delinquency

- Ecosystem function in terms of terrestrial faunal species is already heavily degraded. Thus the miming activities will compound the existing faunal impoverishment due to existing land use and settlement. Most threatened large mammals and birds have been impacted nationally by unsustainable exploitation and previous land use patterns. Further loss of such species due to the potential impacts would exacerbate this loss. The significant loss will need to be addressed as post mining activities such as farming may likely not reverse this situation. These impacts cannot be mitigated in the near future. It is however proposed that a Strategic Environmental be made for the entire two mining communities that will address this issue.

- Impacts on water quality and quantity in the Taia river system and ultimately the entire region.
- Diversification of mining operations in Bonthe and Moyamba Districts: There is an ongoing exploration programme for dry mining by SRL that likely overlap with current mining activities at SRL and SMHL. The most important cumulative impacts that is associated withese activities are those related to the diversification of mining operations in the two communities. These impact may be difficult to assess as all the activities are different from each other and the ESIA that is prepared can be considered as site specific assessing set of activities only associated with a single operation.
- The road transport infrastructure connecting the two projects to one another needs to be recognised in terms of its cumulative effect, rather than simply relative to each of the individual projects. Even though the infrastructure is already in place, an important public concern is dust generated by haulage trucks and other publc transport. A mitigation action that will be pursued by the two mines is to resurface the haul roads with bitumen especially for post mining use.

Cumulative impacts have been addressed in the mitigation measures identified in this Study; and these mitigation measures have been incorporated in the ESMP. Some of the mitigation measures will require the setting up of cooperative structures with other mining concessionaires within the region.

Section Seven – Environmental Management Plan

This Environmental Management Plan for SMHL is complimentary to the Environmental and Social Impact Assessment (ESIA) presented in this report that clearly defines all the residual and other specific actions that SMHL undertakes to implement the measures that will minimize and mitigate any negative impacts on the human, social and environmental aspects within and around the operational area.

Four main environmental plans are outlined for implementation including: a. Environmental Monitoring Plan, b. Emergency Response and Contingency Plan for health and safety workers and properties, c. Tailings Management Plan and d. Mine Reclamation and Closure Plan. Attention is also paid to specific environmental elements including air, noise, and waste and water quality. Proper implementation of the plans will be supported by Standard Operating Procedures (SOP's), Training, Documentation, Monitoring, Evaluation and Reporting. Corrective actions will be suggested for review by management.

7.1 Environmental Monitoring Plan

The Environmental Monitoring Plan is specifically designed and implemented for collecting data on ambient air, water quality, noise level including release of pollutants of major concern and weather.

The objective of air quality management on the mine site is to minimise the generation of suspended concentrations of deposition of mine derived dust both at the nearest residential villages around the mine and those linear settlements along the haul roads. To monitor air quality, SMHL will operate and maintain a network of 4 depositional dust gauges on the mine site to be monitored monthly in accordance with National and International standards. A book keeping system will be developed for presenting the raw data. This will be in a form of tables and graphs of the original data. The tables will further be used to produce statistical summaries which will form the basis of further analysis and interpretation.

The major sources of noise in mining and related operations in SMHL's operational area include loading, excavation, crushing, screening, beneficiation, movement of heavy earth moving vehicles and truck loading. The locations are the mine sites at Gbonge, Konta, and Wunde, The Washing Plant at Gondama, Nitti Port and along the main haul roads. Noise levels shall be monitored both during day and evening on the same day while in operation.

The water quality monitoring plan is developed to satisfy the water quality requirements of the EPA/SL. It is designed to provide information regarding the overall water quality within SMHL project sites, identify potential water quality problems related to the project operations and how such factors can be controlled, and to develop measures for the protection and mitigation of water quality. In situ and analytical water quality monitoring will be performed over a nine month period during the first week of each month from April to December. The date, time, location, weather conditions and the in situ water quality data will be recorded on a standard form which will later be transcribed into an electronic format in a Microsoft Excel Spreadsheet. GPS coordinates and photographs will be taken at each site to document conditions at the time of sampling.

7.2 Emergency Response and Contingency Plan (ERCP)

This Plan **is** Sierra Minerals Holdings Ltd. operation's guide to all procedures and courses of action that should be followed in the case of any on-site emergency. It identifies those responsible for taking action immediately after the discovery of and during the response to an emergency, as well as their respective duties.

Specifically, it will:

- address any disaster, mishaps or accidents that will disrupt the normal operations of the industry;
- guide the administration to be better prepared to respond to emergencies in its operational area in an effective manner; and
- Ultimately, help to save the lives, reduce property loss or damage as well as the company's liability.

The plans that have been developed for a number of emergencies include:

Fire/Explosion Emergency: In preparing for fire incidences, the Environmental Health and Safety Officer (EHSO) will be responsible for training a team that will respond to all accidents in how to suppress fire, rescue personnel and all other drills relating to fire incidences.

The response plan for fire or explosion will require an immediate action and to undertake a recovery operation to restore essential services to the mine site, cleaning and replacement of materials and equipments that were damaged.

Accidental spills or release of hazardous materials: The purpose of the Spill Prevention and Control Plan is to establish procedures and guidelines to prevent oil discharges on SMHL Project sites at Gondama, Nitti Port and Mata Camp. This Plan specifically establishes proper procedures and equipments needed to address any potential discharges of oils.

SMHL owns six barges that transport bauxite materials from Nitti Port. For spills or release of hazardous materials in these barges, both preventive and preparatory measures have to be undertaken. A special emergency response procedure will be developed for both measures.

Road Accidents: The major operational areas of SMHL are interspersed with villages mostly situated along the main road from Mokanji to Nitti Port, from Mosenesie to Gondama, to Serabu and Mattru. These roads are used both by public transport, Sierra Rutile Mines and SMHL.

Currently, SMHL outsources contractors that transport mine products to the plant and to Nitti Port. The contractors will be required to sign agreement with SMHL for compliance with all codes and regulations that bind transportation of mine products. All vehicles will be equipped with first aid kit and fire extinguishers.

Floods: The overall objective of this plan is to support the timely and coordinated response to anticipated floods in the rainy season. This will effectively minimize the impact of such floods on personnel, infrastructure and the environment. The major receptors will include: mining sites, haulage roads, main road between Gondama and Mosenesie, main tributaries of the Taia River and the inland valley swamps within the project area. Other specific sectors to be affected will include: water and sanitation, bridges and culverts, road sections, communication infrastructure, meteorological and other monitoring equipments and disruption of electricity.

Crisis Situations/Social Strife: These situations are brought about by unpredictable circumstances that degenerate into uncontrollable proportions causing chaos. To address these incidences, SMHL will develop a plan for the dissemination of information to the public. This will include setting up a mechanism for dealing with grievances in such that issues can be addressed formerly and amicably.

Roles and Responsibilities*:* A team of qualified personnel from within SMHL's management will have direct responsibilities for addressing all emergencies presented above. These include:

- The General Manager is the overall head who will be responsible for coordinating all activities and actions at the project site.

- The Environmental Health and Safety Manager who directly reports to the site manager will be responsible for the overall implementation of the EHS Plan.
- The Environmental Officer (EO) will assist the EHSM in responding to all emergencies by coordinating efforts with other site personnel to mitigate the potential hazards, assist EHSM to prepare reports, disseminate information on emergencies to staff, work site supervisor during emergencies, to remediate events and report accordingly.
- The Community Affairs Manager (CAM) will be responsible for all matters that have to do with public relations. In consultation with the General Manager, he will be responsible for communications with the public including information on incidents in particular to the affected community and the Government.
- He will lead the site Supervisors in responding to emergencies and work with the HSO to remediate potential hazards and emergencies**.**
- Site Supervisors who will be responsible for identifying potential events and coordinating any response to events that occur in their work area.
- A response team which will be recruited and trained by the EHSM for all emergencies on site.

Communication and Monitoring: The methods and procedures that will be applied in the event of emergencies will include: a. Internal Communication that will be used to alert workers to hazards by means of alarms, cell phones and radios. b. Training will be required during the workshop for all employees on this system of communication.

SMHL will establish and maintain a monitoring system of its activities that could have an environmental health and safety impact. This will include a recording of information on performance, and an evaluation of compliances with legal and other requirements.

7.3 Tailings Dam Management Plan

Currently, Gondama plant site has two dumps for storing the sludge which is a slurry mixture of mineral suspended matters and industrial water. The two sludge settling and storage dumps are built to be operated and to function independently so that the repairs or emergency interventions do not disturb the main activity. The sludge settling pond no.1 is built East from the washing plant and consists of three washing sludge retention ponds separated by embankments (separating dams) and provided with clear and storm water discharge spillways. The sludge settling pond no. 2, built west from the washing

plant takes into consideration the settling operations and water clearing operation under normal parameters before the water is discharged in the water streams.

SMHL's production target is set up at 1.7 million tons of washed bauxite per year, the washing plant operating with a production capacity of 330 tons/h. The washing operation consists of removing the tailings with clay, ferruginous mineral silica content, pieces of rocks from the conveyor belts as well as other materials which are in the ore composition. Therefore, as calculated in the time frame and for the purpose reaching a good washing efficiency, the washing plant requires 10,000 cubic meters of water/ day.

CURRENT SITUATION	Volume of Water Required by Plant/Day)	Pond Current Water Capacity (m^3)	No of supply Days/Pond	Mean Sea Level
POND WATER CAPACITY				
Pond 6 Capacity	10,000	558,645	55.86	45.6
Pond 7 Capacity		290,181	29.02	49.6

To reduce the quantity of water used in the bauxite washing operations, a study was prepared concerning the installation of a new pumping station in order to recirculate and reuse the clear water so as to reduce the caught water requirement and water discharged to surface outlets. This would also lead to a reduction in the costs associated with the electric power currently consumed from using the open system and which could be applied in the next stage. An additional water pump has been installed in order to reduce the quantity of water caught from Taia River.

The downstream side of the embankment shall be provided with spillways, grassy berms to prevent the mentioned incidents (which are likely to cause failures of the hydro-technical constructions, including dump closing, if the depression curve is above the attention level) from happening.

Monitoring: The monitoring is achieved by the sludge dump operator and the daily and/ or weekly observations, readings are recorded in the Registry Book for the control and monitoring of the settling pond behaviour over time, where the day, hour, data taken in the measuring points, comments and conclusions are recorded.

The monitoring activity is mainly focused on verifying the following elements whose purpose is to minimize the ecological, social and economical risk situations.

The monitoring of the sludge deposit area and the embankments freeboard shall include the recording of the area width, the hydraulic surface area and the excessive accumulation of storm waters in the pond.

The monitoring also consists of quarterly land surveys which provide updated information regarding the coordinates and levelling of the area as compared to reference data, so that the horizontal and vertical movements on the sinking landmarks comply with the limits set up in the regulation and not endanger the embankments safety.

The sludge dump operation is monitored by the following measuring and control systems:

- Hydrometric gauges;
- Fix and mobile topographic landmarks network;
- Control and sinking landmarks, mileposts, placed in the areas sensitive to wetting;
- Observation areas for possible ex-filtration's;
- Sampling and monitoring points for the quality of waters discharged into the water streams.

The current assessment activity concerning the safety of the sludge dump components mainly consists of the following:

- Daily checking by the internal personnel of the constructions, operational facilities, slurry transport ducts slipways operation. Responsible Chief Miners, Topometer SMHL
- Daily reading of the piezometric level at the observation drillings. Responsible Environmental Labs
- Verification of potential movements at the landmarks monitoring the hydro-technical constructions safety and stability.
- Verification twice a year of the topographic landmarks height levels and coordinates, of the horizontal and vertical movement value in the case of control landmarks positioned on the crest and slopes of the pond.

The monitoring of the embankment constructions behaviour in time is a job assignment of the operating personnel and the results interpretation shall be made by the engineer responsible for the sludge dump supervision.

Monitoring of the sludge dump also includes physical- chemical analyses performed in the laboratory by means of fix and mobile instrumentation in order to check the compliance of the emissions and emissions within the maximum accepted limits stipulated by the regulations in force for the following environmental factors:

- Air – analysis of the air emissions shall be performed once a year in the area bordering the sludge dump and the analyses results shall be interpreted against the suspended dust and particulate matter maximum accepted limits stipulated by the regulations in force.
- Surface water – physical- chemical analyses shall be performed on the water discharged to the outlet at intervals as specified for each of the characteristic indicators: suspended matters, heavy metals. The results of these analyses shall also be compared to the maximum approved limits stipulated by the applicable regulations.
- Soil – soil samples shall be taken from the sludge dump vicinity at least once a year, especially from those areas located in the main direction of the wind and laboratory analyses shall be performed to determine the heavy metal content at 30cm average depth.

The alternative to build successive ponds and embankment downstream from the operational ponds of the eastern dump is under analysis, however, such possibility can only be taken into consideration during the last years of operation and useful deposit running-off in the mining perimeter, in order not to endanger the safe operation of the dams and possibly of the embankments raised at maximum height of the crest as stipulated in the regulation.

7.4 Waste Management Plan

This Waste Management Plan (WMP) was prepared for bauxite mining activities by Sierra Mineral Holdings, I. Ltd (SMHL). The plan addresses methods of handling, storing and disposing of wastes that will generated during SMHL's operation. Specifically, it describes the procedures, methods and framework that will be applied to waste generation and disposal.

The objectives of this Management Plan are to:

- Establish Standard Operating Procedures (SOPs) for SMHL construction, operations and closure activities;
- Define the company's requirements and procedures to guide the Project Management Team and other Project contractors;
- Define roles and responsibilities of the waste management team;
- Present remedial measures to minimize waste generation; and
- Define monitoring and reporting procedures for waste management.

The plan addresses the management of both industrial and domestic waste. The plan covers all activities that could result in the generation of waste and the potential adverse effects of waste and domestic waste throughout all phases of the Project. The main issues that are addressed include:

- Types of wastes to be generated:
- Methods used to identify those wastes;
- Handling procedures and
- Methods of disposal

The types of wastes that are expected to be generated during the construction and operational stages of the project are identified. Depending on the types to be generated, certain wastes are expended to be disposed of at site, reused or recycled. The waste disposal facilities and methods of disposal are fully discussed in this plan**.**

Waste Management Procedures

SMHL will apply the following management procedures for waste.

Waste Recycling: SMHL consults with the community on the demand for any recyclable products such as scrap metal, used tires, cardboard and wood which may have a value or a use locally. The company also plans to look at commercial options for recycling; if recycling facilities are available and accessible on a commercially-justifiable basis, waste will be recycled. If not, waste will be disposed of in accordance with this Management Plan

Solid Waste: This includes all office wastes, concrete, steel, rubble, timber, plasterboard and mixed construction waste. These are all classified as non-hazardous. These will mainly be generated during the operational phase with minor amounts generated in the construction and decommissioning phases.

5.4 Liquid Wastes

The procedure for managing these wastes includes the following:

- Any spills will be cleaned up using absorbent materials and placed in bins;
- There will be no onsite disposal of liquid direct to the soil surface or storm water collection system; and
- Non-hazardous waste bins will be finally disposed of to the incinerator or the landfill which is an engineered cell within the Tailings Storage Facility (TSF).

Litter: This includes any general litter on-site, and the objective is to minimise the visual impact of litter on the site and surrounding area, and minimise the potential to attract vermin. This will be achieved through the provision of appropriate disposal facilities around the project site.

Mine and Processing Waste: For the mine and processing wastes, it is the responsibility of the Operation Manager to undertake waste characterization and manage the monitoring program to ensure that the proposed waste management practices are appropriate to the wastes being generated. .

Responsibilities, Training and Record Keeping

During SML's operation, the Environment Health and Safety Manager will be responsible for the operation and record keeping of the Waste Management Plan.

Monitoring and Control

The following monitoring programs will be undertaken by SML and appropriate records will be kept.

- Refuse quantity and material delivered to the domestic waste facility, hazardous waste facility and composing facility;

- Surface and groundwater monitoring;

- Surrounding vegetation and soils around waste facilities; and

- Non-environmental features, such as, fences, roads, and signs.

Notice will be placed around the landfill and hazardous facility to promote worker and resident safety. The Environmental, Health and Safety Manager will be responsible for distributing and maintaining these notices and signs. The wastes facilities will be maintained with security in prevent unauthorised access to the landfill site.

7.5 Occupational Health and Safety Plan

This Occupational Health and Safety (OH&S) Plan is Sierra Minerals Holdings Ltd. operation's guide to all procedures and courses of action that should be followed to ensure the effective management of worker health and safety by SML Project. The plan contains the methods that shall be used to prevent adverse effects occurring during construction and operations of the project, monitoring and determining for effective mitigation measures.

In this regard, all employees and contractors of SMHL will adhere to the OH & S procedures contained in this report to ensure a timely response to employees' health and safety. It has also been prepared to addresses the requirements that are set out in the guidelines of the International Finance Corporation (IFC), the Environment Protection Act 2009 of Sierra Leone and the National Environmental Policy of 2000. It is also expected that the Plan will be reviewed and updated to meet the requirements of the international safety standard, OHSAS 14001.

Purpose and Scope

The purpose of this Occupational Health & Safety Plan is to:

- Define and communicate the principles, practices and expectations of Health & Safety objectives, SMHL project;
- Set out how the project is designed to manage and reduce risks associated with both routine activities and unplanned events;
- Define the criteria against which Health & Safety performance will be judged;

- Describe areas of Health & Safety responsibilities for the SMHL Project team, including Contractors;
- Describe the Occupational Health & Safety Standard Operating Procedures (SOPs) that will ensure that Health & Safety activities are organised, managed and reported in a systematic and consistent manner;
- Describe the development of the safety cases and safety plans;
- Ensure that the Project provides inherently safe and secure facilities;
- Address the process of ongoing assessment and continuous improvement of health and safety performance;
- To provide education and training for staff at SMHL's operations in health and safety issues;

The plan is applicable to all SMHL project related activities including camp and port facilities and contractors. In all cases, Contractors will be required to submit their safety management plans to SMHL for review and approval for use if is of a higher standard or exceed those provided by the Contractors.

Roles and Responsibilities

The General Manager is the overall head who will be responsible for coordinating all activities and actions at the project site. He will work with other managers who will be responsible for specific activities that will have to do with the health and safety of workers. Along with the Environmental Health and Safety Manager and the Community Affairs Manager, he will also be responsible for all other relations outside the project site as and when needed to make sure that the mining community is adequately informed about events.

Hazard Identification and Risk Analyses

All hazards identified at SMHL operations are assessed in accordance with the Risk Matrix prepared in this plan which takes into account the probabilities of occurrence and severity of consequences in relation to personnel and assets of the project and surrounding environment. In this regard, all employees and contractors will be involved in the training of hazard identification and risk assessment process so that day-to-day hazards are identified and control measures are determined and implemented.

The following steps that SMHL plans to identify and manage risks during the life cycle of its operation will include:

- Identification of hazards that exist in the project area;
- Assessment of risks entailed in these hazards;
- Evaluation of the degree of the risk represented by each hazard;
- Evaluation of the consequences resulting from the hazards by selecting the category which best describes the effects of the mishaps on personnel, the general public and the environment.

Identification of Hazards

This will entail gathering of information on biophysical, chemical and technical properties of the project site and surrounding areas. Inclusive of these are artificial accidents and natural hazards such as fire, explosion, equipment failures etc.

Table 11 Potential Hazards and associated Scenarios: SMHL Mines.

	Hazard	**Scenario**	**Location**
1.	Fire	Vegetation	Haul road
		Mine Facilities	Mechanical Workshop
		Power Station	Administrative Building
		Bauxite Drier	Wash Plant
		Vehicles	Nitti Port
		Barges	Residential Camp
		Mining machinery (excavators, dozers etc)	Mine Panels
2.	Noise/Air/Heat/vibration	Rotating and moving equipment	Wash plant, Workshop, Nitti Port, Mine panels.
		Welding.	
3.	Accidents	Vehicle/Automotive Machinery	Haul roads/workshop stockpile area/wash plant

		Wash Plant	Wash plant
		Falls of Ground	Workshop
		Electrical	Wash plant, camp, Nitti Port.
		Maintenance and Repairs Accidents	Wash plant, workshop, Nitti port
4.	Oil Spills	Fuel Station	Mechanical Workshop
		Barge	Parking Lot
		Mechanical Workshop	Matta Camp, Nitti Port, Plant site
		Wash Plant	
		Power Plant	
5.	Explosions	Gas Cylinders	Workshop, Kitchen
		Volatile Substances	General store, workshop, barge
		Electricity	Plant site, Matta camp, Nitti Port
		Fuel Station	Workshop
		Mine Panels	Gbonge, Wunde, Gondama, Konta,
		Kitchen	Matta camp
6.	Tailings Storage Facility Failure	Seepage within embankment	Plant site
		Rupture of conduit	Plant site
		Increase in water level	Plant site
		Blockage of pipeline	Plant site
7.	Flooding	Surface inundation	Plant site, stock pile areas, mine panels, ROM pad
		Open cut drainage	Mine panels, haul roads, plant site etc.

		Storage reservoir	
8.	Release of chemicals	Analytical laboratory, welding, repairs	Plant Site
		Workshop	

Risk Analyses

Knowledge of potential risks from these natural hazards, in both the environment, mine facilities, mine personnel and the public is necessary for establishing the health, safety, and environmental management objectives and how to manage them with the most appropriate mitigation measures. The determination of the risk of an incident/accident associated with each hazard at the project's operational sites will entail:

- Identification of the potential failures or accidents;
- Quantification of the material that may released when any failure takes place;
- An estimation of the probability of occurrences; and
- An evaluation of the effects of such occurrences based on certain scenarios such as most probable and worst case events.

Table 12 Risk Analyses for potential Hazards at SMHL Mine Site

Risk	**Scenario**	**Frequency**	**Consequences**				**Result**
			Pers	Env	Pub	Fac	
Fire	Camp	C	a	d	c	a	Ca
	Wash plant	C	a	d	d	a	Ca
	Power house	C	b	d	b	b	Cb
	Workshop	C	b	d	d	a	Ca
	Fuel station	C	a	c	c	a	Ca
	Admin. building	C	a	c	c	a	Ca

	Nitti port	C	b	a	c	a	Ca
	Barge	C	c	a	d	a	Ca
	Vehicles	B	b	c	c	a	Bb
	Haul roads	B	c	b	b	a	Bb
Explosion	Propane gas	C	b	d	c	c	Cb
	Volatile substances	B	b	c	c	c	Bb
	Electricity	B	b	c	c	b	Bb
	Fuel station	A	b	c	c	b	Bb
Spills	Fuelling	B	c	b	d	c	Bb
	General stores	C	c	c	d	c	Cc
	Barge	C	c	c	c	c	Cc
	Workshop/wash plant	C	c	c	d	c	Cc
	Parking lot	C	c	b	d		
TSF/Dam Failure	Seepage/outflow	A	d	b	b	c	Ab
	Rupture of conduit	B	d	b	c	b	Bb
	Increase in water level	A	d	b	c	b	Ab
	Pipe blockage	A	d	c	d	c	Ad
Flooding	Surface inundation	A	c	b	b	b	Ab
	Open cut drainage	B	d	b	b	c	Bb
	Storage reservoir	C	d	c	c	d	Cc

	Stockpile	C	d	c	d	c	Cd
	Haul roads						
Accidental release of chemicals	Laboratory	b	b	c	c	d	Bb
	Volcanizer	B	b	c	d	d	Bb
	Welding	B	b	c	d	d	Bc
Sewerage Wastes	Overflow	C	c	c	d	c	Cc
	Blockage	C	c	c	d	c	Cc
	Seepage						
Accidents	Haul roads	A	b	b	d	d	Ab
	Mine panels	B	b	d	d	c	Bb
	Workshop	B	b	d	d	c	Bb
	Barge loading	C	b	d	d	c	Cb
	Power plant	C	b	d	d	c	Cb
	Wash plant	C	b	d	d	c	Cb
	Kitchen	C	b	d	d	b	Cb
Civil strife	Mine site	A	b	d	c	d	Ab
	Community	B	c	d	b	d	Bc

*Frequency: Highly likely – A; Likely – B; Possible – C; Unlikely – D.

*Consequences (On personnel, Public, Environment, Facility): Catastrophic – a; Critical – b; Marginal –c;

Negligible

Purchasing and Control of Materials and Services

To minimize the hazards and risk associated with the supply of materials and services form contractors and other service providers, SMHL will:

- Incorporate its health and safety requirements in the tender specification all major contracts.
- Reserve the right to review of the tendering of contractors' health and safety systems and performance prior to the commence of any business;
- Require the contractor to examine SMHL's procedures such as hazard identification and risk assessment, permit to work, safety risk assessment, communications and emergency response;
- Train employees and contractors in the health, safety and environmental implications associated with purchases and the control measures available to minimise risks associated with identified hazards;
- Incorporate health, safety and environmental requirements into purchase specifications and /or purchase orders;
- Ensure that employees and contractors are consulted prior to purchase of materials and equipment with potential health and safety issues;
- Reserve the right to inspect and verify materials against purchase specifications;
- Ensure that provision be made for a competent person to check the health, safety and environmental implications of any new chemical and for material safety data sheets (MSDS) to be made available to employees prior to use of the chemicals concerned; and
- Keep MSDS Registers up to date and in a form accessible to employees and sub-contractors in an emergency situation.

Standard Operating Procedures

To meet the above objective, SMHL will prepare and implement operational procedures which will be accessible to all personnel working on the Project. All employees and contractors will be trained in the relevant SOPs listed below.

- PPE
- Working at Height
- LOTO
- Hazardous Substances Storage & Handling
- Fire & Explosion Safety

- Crusher Operations
- Loading & Unloading Operations
- Electrical Safety
- Plant & Equipment – General Site Housekeeping
- Machinery Use/ Machinery Guarding
- Dust Control
- Fork Lift Truck Operations
- Flammable Gases - Storage & Use; and
- Vehicle Operations (Driver Competence and Vehicle Maintenance).

Detailed SOPs will be required for all of the above with special emphasis placed on PPE provision. For the provision of PPEs, SMHL will be responsible for ensuring that all personnel are provided with appropriate personal protective equipment (PPE) which conforms to the relevant standards and project requirements as listed below:

- Safety helmet;
- Eye protection;
- Gloves;
- Footwear
- Skin protection by way of sunscreen;
- Clothing to protect skin against burns by heat or fire;
- Clothing to protect skin against toxic or volatile chemicals;
- Noise/hearing protection.

Only personnel with the prerequisite training and qualifications will be authorised to use any specialist PPEs. Other visitors to the project site including sub-contractors and suppliers shall comply with the PPE requirements stipulated by the General Manager. For all employees entering the project site, the minimum PPE shall include:

- long sleeved protective clothing;
- safety footwear;
- safety helmet;
- safety spectacles/goggles; and

- gloves (if conducting any manual tasks).

First Aid Responses

The key objective of the First Aid response is to demonstrate that there is an effective emergency response process put at the mine site put in place to reduce the impact of an emergency to levels that meet the expectations and needs of personnel, and the mining community. All the personnel at the project site will be first trained, from which a specialist team will be set up and trained in the first aid response plan that will involve the identification of potential risks and the provision of feedback to improve on the response plan. First aid boxes will be installed at all strategic locations including vehicles that are in use during operations. To achieve the above objectives, SMHL shall undertake the following:

- Ensure that qualified first-aid is provided at the project site at all times;
- Equipped first-aid station and eye wash points should be provided close to all work places where immediate flushing with water is the recommended first-aid response.
- Develop and maintain first-aid procedure;
- Develop an emergency response plan to include the procedure and structure for emergency response;
- Develop specific potential emergencies as outlined in the risk matrix; and
- Prepare and implement an emergency response manual for the project to include procedures for integrating SMHL procedures with other contractors' procedures.

Incident/Accident Reporting

The objective is to demonstrate that appropriate procedures are put in place for the systematic reporting of accidents, incidents and near misses; and for an effective follow up and review of safety performance made to prevent measures of adverse situations. The process will include:

- An identification of the causes of incidents and accidents;
- Ensuring a systematic approach for reporting and investigating incidents and accidents; and
- Preventing future accidents and incidents.

The Safety Officer will compile and maintain records of each accident/incident occurring, including details in each case of any corrective action taken. To achieve this, SMHL shall develop, implement and maintain incident/accident reporting and investigating procedure to include:

- Incident reporting system;

- Accident reporting system; Corrective action register with records of all occurrences and progress on the follow up of corrective actions.

Employee Health and Safety Data System

SMHL will maintain a data system for the collection, storage, analysis, retrieval and dissemination of all health and safety information on its employees.

In collaboration with SMHL medical personnel, the EHS Manager and the Human Resources Manager, the Safety Officer shall develop, implement and maintain a procedure for the collection, maintenance and confidential retention of employee health and safety information. The procedure will detail performance indicators that will be compared to similar mining operations. Such data will be reported on monthly basis.

To ensure the integrity of SMHL project and safety of its personnel, a health monitoring system will established to ensure that employees are fit for work and be able to work safely at all times. To achieve this, SMHL shall develop, implement and maintain a health monitoring procedure which will include:

- A medical report prior to employment;
- Injury management and return to work system; and
- Fitness for work procedures.

Monitoring and Training

Occupational health and safety monitoring programs will be established to verify the effectiveness of prevention and control strategies. The occupational health and safety monitoring program should include: Safety inspection and testing which will include regular inspection and testing of all safety features focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained. Monitoring and analyses should be conducted according to internationally recognized methods and standards.

Training activities for employees and visitors should be adequately monitored and documented. Emergency exercises, including fire drills, should be documented adequately. Other service providers and contractors will be required to submit to SMHL adequate training documentation before start of their assignment.

7.6 Mine Reclamation and Closure Plan

Under the current EPA/SL requirements, SMHL is required to provide updates to the reclamation Plan as mining proceeds. These updates will include revision of the reclamation and closure plan that will address the actual site conditions. It will include new data such as the reclaimed sites to date, proposed waste dump sites, etc. Periodic reviews of the plan will be undertaken in accordance with EPA/SL requirements.

The reclamation plan that is developed is in consistent with the following guidelines and regulations:

- Guidelines addressed by the EPA/SL,
- Best standard practices of the International Finance Corporation (IFC),
- SMHL guidelines for reclamation of tailings pond and other facilities.

The reclamation objectives for the plan include:

- Converting areas disturbed by mining to a condition appropriate for pre-mining uses such as cropland and small residential development.
- Decommissioning and salvaging on mine sites, facilities, buildings, equipments and ancillary facilities.
- Ensuring the mitigation of adverse impacts in the post mining scenario, including residual problems such as soil erosion, slope failures, waste piling on slopes, and ground water seepage from mine works.
- Establish a long-term biophysical stability in the disturbed areas so as to minimize the requirements for long-term monitoring.

Mine Reclamation and Closure Methods: SMHL has been engaged in reclamation activities concurrently with mining, thereby reducing reclamation costs at the end of the project as well as developing and improving reclamation techniques to maximize vegetation success and productivity.

The activities to be undertaken by SMHL will include:

- ***Slope Stability and Surface Water Protection:*** Some of the structural measures that will be put in place will include diversions, backfilling and the construction of grass waterways. On the Gbonge Hills for example, cut and fills will be part of the extraction and reclamation activities.
- ***Soil Salvage and Redistribution:*** Materials that are used for reclamation will be collected from previously stockpiled wastes produced prior to excavation. The quantity of soil that will be placed over the entire site will vary according to the availability or volume of stockpiles, the plant species that is used, and the proposed land use of the site and the steepness of the slope.
- ***Surface Grading and Seedbed Preparation:*** Surface grading will be consistent with the surrounding topography. Sediment and erosion control measures may include installation of silt fences, diversion channels and sediment traps. The final result will be a scenario of land use that will be safe for farming by the local community. For the mine panels, reclamation will involve stabilizing the panel surfaces and establishing vegetation cover. Backfilling will be carried out until a ***Salvaging and Demolition of Facilities:*** Demolition procedures for all facilities will include removal of: a. hazardous materials from sites; b. equipments and buildings; c. power lines; d. burial of concrete foundations etc.

***Specific Reclamation Methods*:** Specific reclamation activities will be undertaken including:

- **Access roads** constructed during Sieromco period. The major roads to Gbonge, Walihun, Nitti and Mokanji are used both by SMHL and the public with repairs done by the former. These may not be required for closure, but the repair works will be taken over by the Sierra Leone Roads Authority (SLRA). Only access and haulage roads of no economic significance will be closed by ripping to remove compaction and regarding to blend with the local terrain.
- ***Waste Facilities:*** The closure of this facility will include salvaging of the soil to cover the dump site shaped to enhance good drainage conditions. This cover will be revegetated using the necessary soil treatment.
- ***Stockpiles:*** Progressive reclamation of these sites will include regarding, construction of soil cover, and revegetation. It is expected that all stockpiles will be completely processed prior to closure. The covered and reclaimed areas will be monitored and where necessary, maintained for years.
- ***Tailings Pond:*** Currently, physical upgrading of the tailings pond at Gondama is necessary and this will be initiated very soon. Plans are also ahead for a new tailings facility to be constructed. Reclamation and closure of any these facilities will commence at the end of the mining

operations. Based on the available information on the physical structure of the pond, the establishment of vegetative cover is the most suitable strategy. Revegetation trials will be undertaken to select the most effective method. Because of its physical properties, additional growth medium would be required to enhance stabilization and plant growth. Once properly stabilized, revegetation will be done accordingly.

- gentle rolling topography is established. Methods of revegetation will include seeding, plant propagation and tree or shrub planting. Alley Farming will be introduced to minimize the commonly bush fallowing practices. The method will provide green manure from hedgerows for the tree crops, provide shade during fallow periods, create barriers that will control soil erosion on sloping lands and provide wood-fuel for domestic purposes.

Community Involvement: In the implementation of this MRCP, SMHL will implement an effective and transparent engagement, communication and verifiable reporting arrangements with the company's stakeholders making sure that the affected communities are given the opportunity to ask questions discuss the plan and express any concerns they may have, so that SMHL will be able to respond to comments received.

Closure Cost Estimates, Implementation schedule and Monitoring: The closure estimate presented herein is based on the general assumption that mining will proceed as planned, and the concurrent reclamation activities would be based on the mine plan of operations as amended. The estimated cost (Table 13) is $26,675,000.00. This estimate is based on the assumption that SMHL continues to undertake the rehabilitation and future decommissioning at the end of the project. The highest cost estimate is that for returning the land to its prior use for agriculture and forestry. It must be however noted that although SMHL is performing concurrent reclamation, adequate monitoring report is not available to provide details of the quality of work performed so far. Also, due to the fact that SMHL has not produced plans indicating final limits of mining and land disturbance, the estimates have been prepared based on professional judgment. An estimate based on actual plans may result in an estimate higher than these provided.

Post closure monitoring will be undertaken to ensure that the reclamation and closure objectives are met. The aspects that will be monitored will include:

- Vegetation: Site inspection to determine abundance and composition, and the overall success of revegetation.

- Slope Stability: Site inspection of physical conditions for soil erosion and slope failures at the end of the wet season.
- Water Quality: monitoring of parameters for quality and recovery.

- ***Security Deposit***: A security deposit to be provided by SMHL is considered as part of the reclamation and closure liability for the mines. The estimate that is provided here assumes that SMHL is performing progressive reclamation activities. As such, SMHL should be entitled to a reduction in the security requirements agreed upon between SMHL and the GOSL. At the time of preparing this report, no security bond has been prepared and this is anticipated as soon as possiblic.

7.7 Public Consultation and Disclosure Plan

The Public Consultation and Disclosure meeting was held for SMHL-Vimetco Bauxite Project's ESIA draft report on Monday 28th January 2013 at Serabu, Moyamba and Bo City Council Hall (Regional level meeting). The consultation was meant to provide stakeholders including local residents, non-governmental organizations (NGOs), civil society groups, government and other interested parties with project information and to allow them to fully participate once more in the preparation of the ESIA final report and its implementation process. The meeting was chaired in Krio for common understanding, a total of about 121 participants were recorded in the attendance list. The meeting started off with both Christian and Muslim prayers.

Key Objectives of the Public Disclosure and Consultation Process

The key objectives of the public consultation and disclosure are to:

- Inform stakeholders and the broader public of the important aspects of the SMHL Bauxite Project's ESIA draft report,
- Provide an opportunity to consult with local communities, affected parties, stakeholders, civil activists etc to voice out their concerns and perceptions regarding the project's ESIA draft report,
- Consult comprehensively by disseminating information about the nature of the project, scoping, identifying and discussing the public concerns about the project;

- Obtain feedback on perceptions and concerns by means of a public exposure of the ESIA draft document;
- Solicit public comments and encourage input on preferred alternatives, mitigation measures and similar aspects on project implementation.
- Respond to all stakeholders as far as possible and feasible address the concerns and issues that have been raised so far.

Parties in Attendance

The following groups and organizations were considered as key stakeholder groups:

- Affected villages/community members;
- Paramount Chiefs (PCs);
- Community/Traditional Leaders;
- Government Authorities (EPA-SL and Ministry of Mines' officials)
- Special Interest Groups including the Civil Society;
- Members of the Media;
- Human Right Activists;
- Women Leaders;
- Local Council representatives;
- Youth Groups;
- Ordinary Community Members

NB: Findings, comments and input from key government officials, media representatives, local Council members, human right activists, affected communities and other participants played a definitive role in shaping the focus of the ESIA draft document and the development of mitigation/amelioration measures.

Issues of Concern

Several related issues were designed for discussions and these include:-

- Identification of the major positive and adverse impacts of the project;
- Identification of potential benefit enhancement and mitigation measures, and
- Other relevant issues

During this consultation process, a number of other project implementation related issues were identified by the stakeholders and these are presented in this report.

Table 13 Summary of issues and concerns raised during the rounds of Public Consultation.

Issue	Raised by	Response
Full participation in project implementation	Community elders, Local council	A logical framework for project implementation is prepared in the CDAP to address this issue
Employment opportunities for indigenes	Paramount chiefs, community elders, Local council	SMHL commits itself to use local labour as much as possible. Most jobs that are available are advertised.
Community participation in mine administration and management	Paramount chiefs, District chairman, Community elders	Bauxite Foundation has been set to district Council Chairman.
References to mitigation measures for noise, dust, water pollution and biodiversity	Al stakeholders	Mitigation measures contained in the ESIA will be applied to address these issues.
Clarification of the Right of Way (ROW) for public vehicles using haul roads.	Paramount chiefs, community elders, Special interest groups.	Road safety measures are put in place by the Safety Officer to address this. All roads within the concession area were constructed by SMHL and past mining companies
Clarification on local content	Special interest groups	The need is for a local content regulation to be established to LC issues such as supply chains, technological competences, investments and employment
Use of hazardous and toxic	Special interest groups	The mineral waste from mining

substances in mining		and processing is chemically inert and therefore poses no risk.
Rehabilitation of Tailings Storage Facility (TSF)	Paramount Chiefs, Community elders, local council.	A Tailings Management Plan has been prepared to address this.
Tendering processes for contractors	Community elders, Special interest groups	Implementation framework is prepared to address this
Project benefits to the communities.	All stakeholders	Communities will stand to benefit from the project through the royalties and taxes paid to government. Communities also benefit through jobs, economic opportunities and local development initiatives.
Responsibility for liability		SMHL has indicated its intention to conduct a liability assessment. This and other past ESIA provides an indication of the baseline conditions before mining, so that future impacts can be minimised.
Conflict between the employed and the unemployed	Community elders, special interest groups.	Conflict, and human rights issues are being investigated as part of the study. SMHL is sensitive to these issues and will look into this issue

Inadequate engagement prior to exploration	Paramount chiefs, land owners, community elders	Continuous stakeholder consultation and information Dissemination will be undertaken to promote dialogue between itself and communities
Inadequate compensation for exploration activities	Paramount chiefs, land owners, community elders	In the longer term, compensation will be guided by a detailed and consulted plan.
Poor reclamation works at Gbonge site	Paramount chiefs, Local council, community elders, special interest groups, Line Ministries.	Past mining activities at Gbonge were undertaken by Other contractors. SMHL has undertaken this responsibility and proper reclamation activities are ongoing.
Erosion and sedimentation in swamps and bottomlands.	Affected communities, Paramount Chiefs	Mitigation measures are developed in the ESIA to address this.
Grievance Management Mechanism.	Community elders	Grievance management procedures are part of this report.

Grievance Mechanisms

The following mechanisms will be applied to ensure that grievances can be properly filed, and that fair and appropriate consideration be given to those issues.

- The Community Affairs Manager will be responsible for building relationships with the surrounding communities and collecting and disseminating information;
- Public meetings will be held on a regular basis to provide a forum for open communications;

- Relationships will be built with local, district and regional authorities, including Paramount Chiefs, Community elders, the Chairmen of the District Councils, and other officials at the Ministerial level;
- Formal meetings with individual stakeholders and SMHL personnel will be held as needed to assure follow up and confidentiality on identified issues and concerns;
- A formal process or plan for receiving and responding to grievances will be developed and implemented by the General Manager, through the EH&S Manager and Community Affairs Manager;
- The grievances will be reviewed by the General Manager, through the EH&S Manager and Community Affairs Manager and appropriate action taken.

Section 8 – Conclusions and Recommendations

8.1 Conclusions

When all the impacts are considered the two most prominent are those that are prevalent on surface water, including the hydrology and natural drainage systems in the natural environment and the disconnect existing between the communities expectations and apprehensions and the realistic gains which may accrue through a more equitable transfer mechanism. Although there will be a number of social impacts of high significance, the majority of the impacts on social conditions are of moderate significance.

The positive economic impact of the mines is highly significant, and the revenue from taxation that will accrue to government provides resources that can be used to significantly improve the condition of infrastructure in the South east region of the country . The economic benefit to the local economy is also significant, since the project will not only support several hundred employees directly, but it will also support significantly more of their dependents. It is estimated that, on average, each employee will support eight dependents or family members. This should result in a general improvement in standards of living in the study area and provides an alternative livelihood to the current subsistence farming.

There is however the need for the Company to institute a more systemic mechanism for the resolution of social contentions and provide a more effective platform for dialogue with the host communities and other stakeholders. It would also be imperative that the Community Development Action Plan (CDAP) be validated and implemented.

8.2 Recommendations

- Agricultural Development Fund should be made available through the District Council
- Ensure prompt payment of surface rent and compensation to the appropriate beneficiary
- Re-assessment/re-evaluation of total land area slated as concession zone
- Involve the communities in land negotiation and benefit sharing mechanism in order to avoid future disputes and disruption in the mining operation.
- Develop sustainable livelihood framework in the community – skills training, scholarships, income diversification schemes etc

- Implement the Community Development Action Plan. (CDAP).
- Embark on effective land reclamation and rehabilitation scheme.

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ANNEXES

Annex A - Table 1. Summary of Surface and Ground Water Quality: SMHL Operational area.

Parameters	Water Temperature	PH	Turbidity (NTU)	Conductivity (µs/cm)	TDS (mg/l)	Aluminum (mg/l)	Copper (mg/l)	Dissolved iron (mg/l)	Nitrite (mg/l)	Phosphate (mg/l)	E.Coil (cfu/100ml)	Faecal Coliforms (cfu/100ml)
Location												
Tailing Dam 3	25.6	7.6	25.90	16.40	8.60	0.49	0.06	0.23	0.09	17.80	155.00	25.00
Moseki Enffluent	25.8	7.4	10.20	16.10	8.10	0.52	0.03	0.44	0.04	9.20	180.00	120.00
Mokepi Taia River	25.6	7.2	12.60	16.80	8.40	0.46	0.03	0.49	0.07	9.40	220.00	165.00
Mokepi H.D Well	25.5	6.5	0.04	224.00	112.00	0.31	0.06	0.47	0.03	2.80	25.00	10.00
Tailing Dam 5	25.5	6.4	5.20	98.10	49.10	0.23	0.03	0.35	0.03	22.40	85.00	0.00
Gondama H.D Well	25.7	6.3	0.05	44.70	22.60	0.21	0.07	0.01	0.04	5.90	5.00	0.00
Wunde H.D Well	25.1	6.4	1.80	23.40	11.80	0.14	0.05	0.09	0.04	5.90	5.00	0.00
Gbonge H.D Well	26.1	6.7	0.20	28.70	14.50	0.51	0.01	0.13	0.05	14.60	-	0.00
Motuowo H.D	**25.6**	**6.5**	**3.40**	**21.30**	**10.70**	**0.26**	**0.05**	**1.10**	**0.03**	**9.10**	**15.00**	**5.00**

Table – 2. Flora [Plant Species]

Species of High Economic Value

Timber	Cottage Industries	Fibres	Carvings	Medicinal	Domestic/Cosmetic
mahogany Khaya anthotheca*, Entandrophragma utile*, E. angolensi*, E. cylindricum*, (African walnut) Plakenetia conophora* Tetracarpidium conophorum, (African cedar) Afzelia africana,(African oak)- Oldfieldia africana*, (African teak) Chlorophora excelsa, Terminalia ivorensis,	Lonchocarpus cyanescens and Indigofera suffructiosa (Blue-indigo dye), Bixa orellana, Baphia nitida, Harungana madagascariensis (orange-red dyes); Cola nitida, Anacardium occidentale (brown dye), Alchornia cordifolia, Mucuna pruriens (Black dye). (Craterispermum laurinum) (Apocynaceae, Asclepiadaceae,	Ceiba pentandra, Bombax buonopozense, Gossypium hirsutum, Funtumia Calotropis procera, Clapertonia ficifolia, Urena lobata, Corchorus olitorius, Triumfetta cordifolia Agave sisalana),	(Diospyros spp., Dalbergia melanoxylon), Albizia gummifera, Afrormosia laxiflora, Pterocarpus erinaceus, Dichostachys glomerata. Mitragyna stipulosa, Baphia nitida, Spondias purpurea (Gambia plum) S. mombin (fits plum), Gmelina arborea	Erythrina senagalensis, Abrus precatorius Coix lachryma-Jobi (the tears of Job). Carthomion altissimum, Tetrapleura tetraptera, Lagenaria siceraria, Strychnosspinosa Crescentia, cujete(calabashes), Luffa aegyptica and L. acutangula (loofah gourd).	Dichapetalum toxicarium (broke-back), Erythrophleum guineense, Strophanthus hispidus, Rauvolfia vomitoria, Voacanga africana, Allophyllus africana, Paullina pinnata, Adenia cissampeloides, Strychnos usambarensis, Cnestis ferruginea, Alafia multiflora, Dichrostachys glomerata, Carapa procera, Alchornea cordifolia

T. superba, Piptadeniastrum africanum, Daniellia thurifera, Klainedoxa gabonensis, Brachystegia leonensis, Albizia ferruginea, Parkia biolor, Xylia evansii, Ricinodendron heudelotii, Hannoa klaineana, Erythrophleum ivorense, Irvingia gabonensis*, Mimusops heckelii, Cathormion altissimum, Amphimas pterocarpoides,	Solanaceae, Euphorbiaceae' Moraceae (Funtumia elastica F. africana) (Hevea brasiliensis Albizias A. zygia, A. gummifera, A. andianthifolia		(Musa sapientum),		Craterispernum laurimum, Blighia sapida, Mareya micrantha, Mucuna pruriens, Adenia lobata' Tephrosia vogelii, Cassia sieberiana, Phyllanthus discoideus, Terminalia macroptera, Butyrospermum paradoxum, Vitellaria paradoxa, Hymenocardia acida, Anthocleista procera, Grewia carpinofolia, Dioscorea dumetorum, Urginea indica. Ageratum conyzoides, Cassia absus , Solanum nigrum, Euphorbia hirta, Phyllanthus

Cynometra leonensis, Tieghemella heckelii*, Heritiera utilis, Lophira procera, Sacoglottis gabonensis*, Triplochiton scleroxylon*, Parinari excelsa, Bussea occidentalis, Pentaclethra microphylla					amarus, Centella asiatica, Borreria verticilata Biden pilosa, Spigelia anthelmia, Desmondium gangeticum, Boerhavia diffusa, Gynandropsis gynandra. Cassia alata, C. tora, C. podocarpa, C. occidentalis (stinking weed) Corchorus olitorius (pot-herb kren-kren).

Table -3. Species of Agricultural Value (Crop Plants)

Wild Fruits	Cereals	Vegetables	Leafy Vegetables	Beverages	Legumes/Nuts/spices
Tamarindus indica (sour tumbler), Tarrietia utilis (African almond), Detarium senegalense (dita), Dacryoides trimera (damzon), Vitex doniana (black plum), Anisophyllea laurinia (monkey apple), Spondias mombin (fits plum), Flacourtia vogelii (black berry), Omphalocarpum pachysteloides (botlem),	Oryza sativa (white rice) O. glaberrima (brown rice) O.brachyantha O. barthii O.longistaminata. Zea mais (Kus Kus) Magaritiferum (Sorghum) Pennisetum americanum (Bulrush Millet) Digitaria exilis (Fundi).	Lagenaria siceraria (white pumpkin, Solanum macrocarpon (wild jakato) S. dasyphyllum, Trichosanthes cucumerina (snake tomato) Beilshmielda mannia (tola) Luffa acutangula Citrullus lunatus Cucurbito pepo Ricinus communis Arachis hypogea.	Bidens pilosa (bush needle), Portulaca oleracea (rat's ear), Crassocephalum biafrae (bologi), Basella alba (broad bologi), Talinum triangulare' bologi), Emilia coccinea Ocimum basilicum (patmenji) Struchuim sparganophora (water bitters).	Coffea stenophylla (Garcinia kola) (anticongestant, diuretic and antipyretic). Cymbopogon citratus (lemon grass), Ocimum gratissimum (tea bush) Hyptissuaveolens (bush tea bush). Thaumatococcus daniellii (Ketenfe)' Dioscoreophyllum cumminsii (serendipity berry). Elaeis giuneensis (oil palm)'	Mentha spicata (mint), Cinnamonum zeylanicum (cinamon), Xylopia aethiopica (symingi), (Nicotiana rustica). Physiogstigma venosum (calabar beans), Parkia biglobosa (kenda, locust beans) and Voandzeia subterranea (bambara groundnut). Diospyros heudelotii (bush palm kernels), Telfairea occidentalis (oyster nuts), Butyrospermum paradoxum (shea butter) Pentaclethra macrophylla

Chrysophyllum cainita (bobby water), Erythrococca anomala (bush lime), Mammea americana (mammy supporter), Passiflora foetida (passion fruit), Uvaria chamae (finger fruit), Salacia senegalensis (malombo), Uvaria afzelii (monkey finger), Citropsis articulata,				Raphia vinifera (raffia palm).	(fawei). Pentadesma butyracea (sodei)

Table – 4 Common Animal Species

Primates	Antelopes/ Ungulates	Rodents	Carnivores	Reptiles	Reptiles	Bats
Green Monkey, Western Baboon, Black and White Colobus Monkey, Patas Monkey, Diana Monkey, Red Colobus Monkey, Olive Colobus Monkey, Guinea Baboon, Lesser-Spot Nosed Monkey, Campbel's Monkey, Olive Baboon,	Giant Eland, Western Hartbeet, Zebra Duiker, Jetink, Red- Flank Duiker, Black Duiker, Yellow-Back Duiker, Bush Buck, Maxwell's Duiker, Blue Duiker, Royal Antelope, Sitatunga.	Scaly-Tailed Squirrel, Ground Squirrel, Flying Squirrel, Cane Rat,	Cape Clawless Otter, Honey Badger, African Civet, Two spotted Civet, Slender Mongoose, Dermidoff's Galago, Brush-tailed Porcupine, Crested Purcupine, Gambian Mongoose, Marsh Mongoose, Wild Cat Golden Cat,	Spitting Cobra Black Mamba Green Mamba Yellow Mamba Rhino Viper Boa Constrictor Python Puff Adder Waglers Viper Falco naomanni: VU Agelastes Melleagrides: (VU)	Gallinago Media Sterna Balaenarum Ceratogymna Cylindricus C elata Phylastrephus Baumanni Laniarus Furatti Malaconotus Lagdeni Illadopsis Rufescens Lampronis Cupreo	Moloney's Flat-headed Bat (LC)Dark-brown Serotine (NT) Cape Serotine (LC) Banana Pipistrelle (LC) Rendall's Serotine (LC) Somali Serotine (LC) White-winged Serotine (LC) Allen's Pipistrelle (DD) Tiny Pipistrelle (LC) Light-winged Lesser House Bat (DD) Dark-winged Lesser House Bat (DD) African Yellow Bat (LC) White-bellied Yellow Bat (LC) Nut-colored Yellow Bat (LC) Schreiber's Long-fingered Bat (LC) Gland-tailed Free-tailed Bat (LC) Little Free-tailed Bat (LC) Sierra Leone Free-tailed Bat (LC) Angolan Free-tailed Bat (LC) Dwarf Free-tailed Bat (LC) Spurrell's Free-tailed Bat (L

Table – 5 Summary of Project Impacts: SMHL Bauxite Mining Project.

No	Environmental Issue	Source of Impact (Activity)	Impact	Affected Community(ies) /Receptors	Significance			
					Timescale	Area	Magnitude	Likelihood
Bio-Physical								
1	**Topography**	Vegetation Removal , Excavation of Overburden, Opening of Mine Panels, Back Filling, Leveling, Grading.	Land Disturbance, Soil Compaction, Slope Displacement.	Gondama Konta Jenega Wunde Gbonge	Permanent	Local	Moderate (Low severity)	Likely
2	**Geology**	Removal of overburden, Excavation from mine panels.	Soil erosion, Sedimentation in streams and valleys	Gondama Konta Jenega Wunde Gbonge	Permanent	Local	Moderate (Low severity)	Very Likely
3	**Air**	Land Clearing, Excavation, Earthmoving, Storage of materials, Handling and Transportation.	Air Pollution	Machine operators, Nearby Communities, Villages along haul roads, Personnel at plant site	Short-term	Local	Moderate	Likely

4	**Noise**	Machine operation, Hauling of ore, Ore beneficiation, Stockpiling, Power generation, Bauxite drying, Loading.	Noise Pollution	Gondama plant site, Nitti Port, Mine panels, Haul roads, Matta camp.	Short-term	Local	Low - Moderate	Likely
5	**Surface Water**	Vegetation remova,l Excavation, Construction and rehabilitation of road infrastructure, Construction and rehabilitation of mine facilities, Ore beneficiation, Stockpiling, Mine Reclamation and Closure.	Soil erosion, Run-off, Sedimentation in streams and valleys, Water pollution, Changes in local hydrology.	All communities located within the mine lease	Short-term	Local	Locally high	Very Likely
6	**Visual Resources**	Mining operations, Construction, Demolition.	Negative effect on the View Shed in the rural environment	All communities located within the mine lease, Communities located along haul roads and out of the lease area	Medium	Local	Moderate (Low severity)	Likely

7	**Accidental Release of Sludge from TSF**	Ore beneficiation	Release and discharge of sludge into dams and local drainage systems, Increase in turbidity, conductivity and in-organic particulates in the drainage system.	Communities in the downstream sections of the lease area, Gondama plant site.	Short-term	Local	Low	Likely
8	**Wildlife Protected Areas and Cultural Properties**	No Significant Impact - NSI	(NSI)	(NSI)	(NSI)	(NSI)	(NSI)	(NSI)
9	**Borrow Pits and Quarry Sites**	Quarrying and Road rehabilitation work.	Soil erosion, Open pits become breeding ground for insect disease vectors, Intrusion of sediments into farm lands.	Villages along main haul and access roads.	Short-medium term	Local	High	Likely
10	**Flora and Fauna**	Vegetation removal	Loss of flora and fauna	Entire lease area.	Permanent	Local	Low-Moderate	Very Likely
Socio-economics								
11	**Community Health and Safety**	Mine related activities	Accidents, Incidents, Spread of communicable diseases.	SMHL personnel Communities within operational area.	Short-term	Local	Low	Likely
12	**Traffic and road Safety**	Vehicular transportation Motor bike riders Pedestrians.	Accidents	SMHL personnel Communities along haul roads.	Short-term	Local	Low	Likely

13	**Population Movements**	Migration	Spread of communicable diseases, Prostitution, Disruption of Social and Cultural values, Drug and alcohol abuse Theft, Domestic Violence. Noise.	Entire mining community	Long	Local	Moderate	Very Likely
14	**Gender Impacts**	Socio-economics	Land Ownership, Teenage pregnancy and early Marriage, Increase in early school drop-out.	Entire mining communities	Long	Local	Low - Moderate	Very Likely

Table – 6 Summaries of Mitigation Measures

No	Environmental Issue	Mitigation Measures
Bio-Physical		
1	Topography	Reclaim Mined-out Areas, Reclaim Stockpile Areas, Use designated routes in the wet season.
2	Geology	Separation of super soil from sub soil during removal. Proper grading and reshaping of the disturbed Adequate crop suitability procedures for reclamation work.areas. Prompt timing of re-vegetation on reclaimed lands to avoid top soil removal in the early rain events. Establishment of sediment raps, bunds and where necessary construction of diversion ditches. Regular inspection of reclamation and repair works where needed; and Use of rock mulch on unprotected surfaces.
3	Air	Dust Suppression in the Dry season, Provision of mask to employees in dusty areas, use of gaseous control equipment at plant site, apply traffic safety rules and regulations, reduce speed limits, construct speed bumps in villages along haul roads,
4	Noise	Future facilities with high noise impacts should be located well away from noise sensitive areas. Mine faces should be used as noise barriers in the immediate vicinity of villages such as Gbonge, Jenega and Konta. Protective hearing devices should be used when employees are at work especially at or near earth-moving equipment, wash plants and power houses.
5	Surface Water	Stockpiles and overburden should not be placed at nearby drainage ways. Waste oil, fuel and other lubricants should be stored in strong containments. Tailings Management Plan should be properly implemented. As much as possible, leakages into earth fill dams should be avoided. Efforts should be made in the wet season to ensure that rain water is diverted from the TSF
6	Visual Resources	Where construction of power lines would be required, features should be designed so as to achieve landscape designs Impoundment dams should be rehabilitated to meet international standards. Burrow pits and mine faces should be graded
7	Accidental Release of Sludge from TSF	Rehabilitation, development and implementation of the Tailings Management Plan coupled with regular inspection programme

No	Environmental Issue	Mitigation Measures
8	Wildlife Protected Areas and Cultural Properties	(NSF)
9	Borrow Pits and Quarry Sites	The pits should be closed up immediately after use Quarry sites must be included in mines closure and reclamation plans
10	Flora and Fauna	Prompt mine reclamation activities in the mined out areas should be enhanced. If vulnerable or endangered species exist within the mine sites, measures should be taken to create alternative sites.
Socio-economics		
11	Community Health and Safety	Provision of additional health facilities to the five affected chiefdoms; Provision of health services to all workers and their families, which will avoid new demands on health services by Project out-of-area workers. Avoid and minimize environmental effects that have potential to affect health, including dust, noise, Preventions should be taken against fire accidents
12	Traffic and Road Safety	Provide driver safety training to all workers. Impose speed limits; Schedule truck traffic along the public highways to avoid peak hours; and Introduce safety campaigns for the communities.
13	Population Movements	Give job preference to the local population Job opportunities such as poultry and piggery farming, vegetable gardening, bakery, brick making, entertainment centres
14	Gender Impacts	Training; establishing micro credit schemes and through serving as a market for the agricultural produce

ANNEX B - Socio-economic Analysis

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1.0. Demography

1.1. Population

Table A-1 Basic Population figures of Sample Households

Chiefdoms	Total Household sampled	Sample population		No. of people in household						Mean household size	Total number of households
		Men	women	3	4	5	6	7	>8		
Upper Banta	39	26	13	1	3	7	2	8	18	7.67	299
Lower Banta	39	24	15	0	4	3	4	3	25	11.1	433
Kpanda Kemoh	41	34	7	0	3	5	6	6	21	8.41	345
Bumpe	41	30	11	0	3	5	9	4	20	8.51	349
Dasse	20	15	5	2	1	1	3	4	9	7.85	157

Source: field survey, 2012

Table A-2 Age Distribution of Sample Households

Household composition	Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	Total
Number of household members aged 65 years and above	28	51	42	32	25	**178**
Number of males aged 41- 64 years	35	46	37	35	18	**171**
Number of females aged 41-64 years	37	57	38	41	17	**190**
Number of males aged 16-40 years	39	56	31	67	22	**215**
Number of females aged 16-40 years	32	66	50	52	16	**216**
Number of females aged 6-15 years	32	75	49	62	27	**245**
Number of males aged 6-15 years	30	80	35	43	16	**204**
Number of male children 0 – 5 years	24	51	23	21	27	**146**
Number of female children 0 – 5 years	26	32	44	13	14	**129**
TOTAL	**283**	**514**	**349**	**366**	**182**	**1694**

Source: field survey

1.2. Household characteristics

Analysis of socioeconomic data at chiefdom level in the selected communities studied, show that majority of interviewed respondents were males (71.7%). Although the nature of these are male dominated as indicated in the number of respondents, the team solicited information from a substantial number of women (28.3%). This implies that the reported socioeconomic issues in the chiefdoms have included both men and women feelings and perceptions.

As presented in Table A-3 majority of the interviewed respondents in the chiefdoms where data were collected are married (86.7%). Cases of widowed were very low if not non-existence in some chiefdom. With an exception of the Upper and Lower Banta Chiefdoms, where the number of widows was reported (10.3 and 7.7% respectively), the remaining of the chiefdoms had no widows.

An overwhelming majority of respondents were heads of household while 14.8 percent were de jure household heads that were either never married, were divorced or widowed female headed households. Among the male respondents, the large majority (85.2%) were de facto heads of households.

An analysis of the educational status of respondents, which was defined in terms of different levels of schooling are presented in Table A 3. There were considerable variations observed among respondents regarding their educational attainment. In most cases some respondents cited more than one level of education. In addition to formal schooling some also cited Koranic education. However, 60.1% of respondents had no formal education (illiterate), 12.3% up to primary school and 10.4% up to secondary level. Only a small proportion had attained tertiary education. This group comprised teachers and employed members of staff residing in the chiefdoms. In general, this implies that many people in the project area had limited opportunities to access income generating activities that demands educational skills.

On average, a high proportion of respondents had a mean age of 55.6 years and a standard deviation of 15.7 years. Dasse, lower Banta had the highest number of aged respondents, while Kpanda Kemoh had the lowest number.

Other household characteristics

Table A 4 provides information on other characteristics of household dwellings in the surveyed communities, such as ownership, roofing, wall and flooring materials. An overwhelming majority of respondents (94.4%) indicated that they owned house in their respective communities surveyed. The type of roofing, wall and flooring materials can be viewed as an indicator of the quality of housing, a dimension of wealth, as well as indicator of health risk.

Table A-3 Socioeconomic Characteristics of Respondents by Chiefdom

Household characteristics		Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	**TOTAL**
Sex	Male	66.7	61.5	82.9	73.2	75.0	**71.7**
	Female	33.3	38.5	17.1	26.8	25.0	**28.3**
Marital status	Single	15.4	2.6	7.3	12.2	5.0	**8.9**
	Married	74.4	89.7	92.7	87.8	90.0	**86.7**
	Widowed	10.3	7.7	0.0	0.0	5.0	**4.4**
Education level	Illiterate	55.3	69.2	64.9	52.9	53.3	**60.1**
	Primary school	21.1	2.6	10.8	14.7	13.3	**12.3**
	Secondary school	0.0	15.4	16.2	5.9	20.0	**10.4**
	Graduate/tertiary education	5.3	7.7	5.4	14.7	6.7	**8.0**
	Vocational/technical school	5.3	0.0	0.0	2.9	0.0	**1.8**
	Religious school	7.9	5.1	2.7	8.8	6.7	**6.1**
	No answer	5;3	0.0	0.0	0.0	0.0	**1.2**
Age	Years (Mean)	55.8	57.9	52.7	54.0	59.9	**55.6**
Residential status	Permanent resident	92.3	100	100	100	100	**98.3**
	Resident absent	2.6	0.0	0.0	0.0	0.0	**0.6**
	Member of non-resident household	5.1	0.0	0.0	0.0	0.0	**1.1**

Source: field survey, 2012

The Table shows that 41.4% of houses have iron sheets roofing. A significant proportion of this galvanized iron sheets roofing were found in Dasse (61.1%) followed by communities in the Upper Banta chiefdoms; compared to 43.9% of surveyed communities in the Bumpe Chiefdom that had their roofing materials made up of dilapidated thatched grass. For wall materials, 40.6% of surveyed communities

Floor materials like earth and sand pose a health problem because they may be a source of dust. They are also more difficult to keep clean

Table A-4 Types of Housing Facilities in the Communities

Household characteristics		Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	TOTAL
Own house?	Yes	89.7	92.3	97.6	100.0	90.0	**94.4**
	No	10.3	7.7	2.4	0.0	10.0	**5.6**
Roof materials	Tiles	21.8	12.8	0.0	2.4	0.0	**8.8**
	Iron sheets	59.5	30.8	43.6	24.4	61.1	**41.4**
	Well-maintained thatched grass	13.5	25.6	30.8	26.8	27.8	**24.7**
	Dilapidated thatched grass	0.0	15.4	25.6	43.9	0.0	**19.5**
	Others	5.4	15.4	0.0	2.4	11.1	**6.3**
Wall materials	Burnt bricks with plaster	5.4	2.6	0.0	0.0	0.0	**1.7**
	Burnt bricks without plaster	5.4	12.8	2.5	2.4	5.6	**5.7**
	Mud bricks with plaster	27.0	7.7	17.5	12.2	16.7	**16.0**
	Mud bricks without plasters	10.8	10.3	47.5	14.6	5.6	**19.4**
	Well-constructed poles and mud	51.4	46.2	20.0	34.1	66.7	**40.6**
	Poorly constructed/ maintained poles and mud	0.0	17.9	12.5	36.6	5.6	**16.0**
	Others	0.0	2.6	0.0	0.0	0.0	**0.6**
Floor materials	Cement	24.3	7.7	15.0	19.5	27.8	**17.7**
	Mud but smooth	27.0	38.5	45.0	17.1	38.9	**32.6**
	Dust but smooth	13.5	20.5	2.5	22.0	16.7	**14.9**
	Dust and rough	35.1	30.8	37.5	41.5	11.1	**33.7**
	Others	0.0	2.6	0.0	0.0	5.6	**1.1**

Source: Field survey, 2012

1.2.1. Household Assets

In general, household asset ownership is low (Table A 5). Respondents were asked whether they own physical household assets. The responses are presented at Table xxx. The results show that:

- 70% (n=126) households have a radio with highest proportion in Kpanda Kemoh and Bumpe chiefdoms. Interestingly, radios are owned only by the male headed households implying a low asset base among female headed household members.
- Slightly above half of the sampled households (53.9%) own a large pestle and mortar with high proportion in communities in the Upper Banta chiefdoms. These are used for pounding food for home consumption.
- 74 households (41.1%) have mobile phones with highest in Kpanda Kemoh Chiefdom.
- Nine households, all male headed, have a TV and a generator. Six of these reside in the Lower Banta Chiefdom. These are not found in Upper Banta and Kpanda Kemoh Chiefdom.

- Twelve households have a sewing machine, 4 of which are found in Upper Banta and Dasse chiefdoms
- In all communities surveyed only 11 (male headed) households own a bike and five had motorcycles.

TableA-5 Distribution of Assets by Number of Households

Assets	Chiefdoms						
	Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	Number of household Survey	%
Radio	21	21	36	31	17	**126**	**70 .0**
Television/generator	0	6	0	1	2	**9**	**5.0**
Sewing machines	4	0	3	1	4	**12**	**6.7**
Pestle and mortar	31	33	1	20	12	**97**	**53.9**
Mobile phones	11	18	27	5	13	**74**	**41.1**
Wrist watches	5	14	22	12	8	**61**	**33.9**
Bikes	2	4	2	1	2	**11**	**6.1**
Motorcycles	1	2	0	1	1	**5**	**2.8**
Cars	0	2	0	0	0	**2**	**1.1**
Others	1	1	0	0	0	**2**	**1.1**
						399	

Source: Field survey, 2012

1.2.2. Infrastructure: Roads

The road network was generally poor in most of the company's operational areas. This is particularly evident in many of the communities in Bumpe, Dasse and Upper Banta chiefdoms respectively. The roads are inaccessible during the raining season and transport is difficult to obtain due to the bad nature of the roads. Many people in the communities therefore either travel long distances on foot or by bicycle or motorcycle ('okada'). The roads in Kpanda Kemoh chiefdoms are preferably accessible all year round.

1.3. Household drinking water

To assess the socioeconomic conditions under which the population lives, respondents were asked to give specific information about their household environment. The survey collected information about drinking water, including the source, perceptions about the quality of drinking water, any treatment prior to drinking and persons who usually collect the water. The source of drinking water is an indicator of whether or not the water is suitable for drinking. Sources of water believed to be relatively free of disease are improved sources such as piped water into dwelling units; public taps/standpipes, bore holes, protected dug wells, protected spring and rainwater. Non improved sources, like unprotected dug wells, unprotected springs, and surface water are more likely to have disease-causing agents that have a negative impact on health.

Table xxx presents information on the drinking water of households at the chiefdom level of Vimetco operational communities. With the exception of households in Kpanda Kemoh chiefdoms that obtain drinking water from improved sources: 51.2% from tap and 41.5% from protected well/bore hole respectively, more than sixty percent of the respondents obtains drinking water from non-improved source: 26.1% from unprotected well/bore hole and 34.4% from river/streams.

Table A-6 Sources of Water for Domestic Use

Chiefdom	Sources of water for domestic use					
	Tap	Protected well/ bore hole	Unprotected well/bore hole	River/ stream	Spring	Rainwater
Upper Banta	2.6%	5.1%	38.5%	51.3%	2.6%	.0%
Lower Banta	2.6%	12.8%	48.7%	33.3%	.0%	2.6%
Kpanda Kemoh	**51.2%**	**41.5%**	0.0%	4.9%	2.4%	.0%
Bumpe	9.8%	22.0%	22.0%	46.3%	.0%	.0%
Dasse	5.0%	10.0%	20.0%	40.0%	20.0%	5.0%
Total	28	35	47	62	6	2
	15.6%	19.4%	26.1%	34.4%	3.3%	1.1%

Source: Field survey data 2012

Most of the respondents (48.6%) were of the view that the quality of water unsafe, 32.4% said it is good and 19% mentioned that the water is muddy.

Table A-7 Perceived Opinion of the Quality of Water

	Perception on the quality of water		
Chiefdoms	**Good**	**Muddy water**	**Unsafe**
Upper Banta	7.7%	2.6%	89.7%
Lower Banta	5.1%	38.5%	56.4%
Kpanda Kemoh	92.7%	.0%	7.3%
Bumpe	10.0%	40.0%	50.0%
Dasse	55.0%	10.0%	35.0%
Total	32.4%	19.0%	48.6%

A significant proportion of the respondents (77.3%) do not treat water for drinking purposes. It was only in Kpanda Kemoh and Dasse were 92.7% of the respondents indicated that the quality of water in their community was good. This finding corroborates with the sources and treatment of drinking water in their community.

Table A.8 Treatment of Water for Domestic Use

Chiefdoms	**Yes**	**No**
Upper Banta	5.3%	94.7%
Lower Banta	7.9%	92.1%
Kpanda Kemoh	78.0%	22.0%
Bumpe	5.0%	95.0%
Dasse	5.3%	94.7%
Total	**22.8%**	**77.3%**

1.3.1. Who Fetches Water

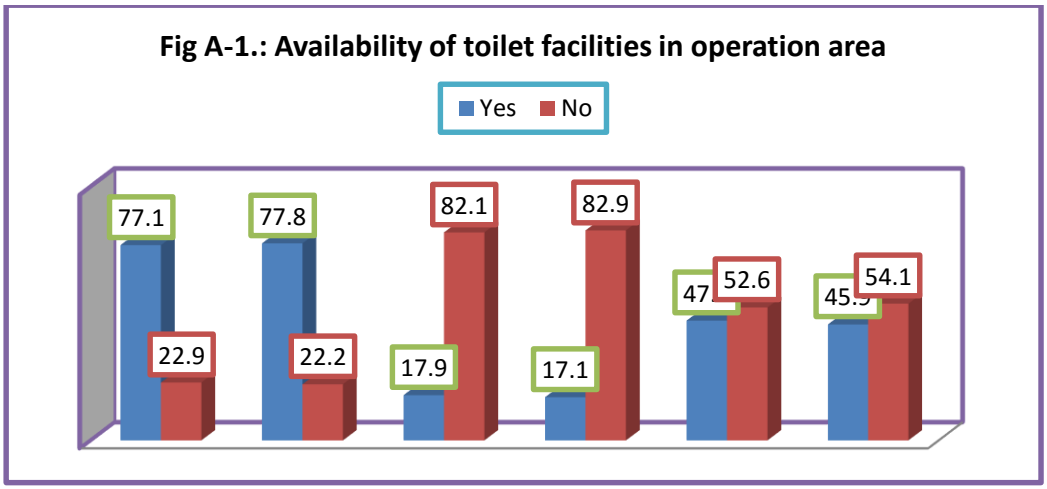
The traditional image of a woman as a mother and housewife underline a clear-cut division of labor between men and women. Women perform the bulk of household work. Their domestic responsibilities include food production, processing, preparation and storage as well as the provision of fuel and water, sanitation, cleaning the house and laundry. Hence the role of fetching water as it has been revealed by the respondents (men and women) is clearly the responsibility of women (48.9), men (5%), boys (37.2%), girls (60.0%), women and girls 1.1%, However, men who do not have wives do the fetching of water for themselves.

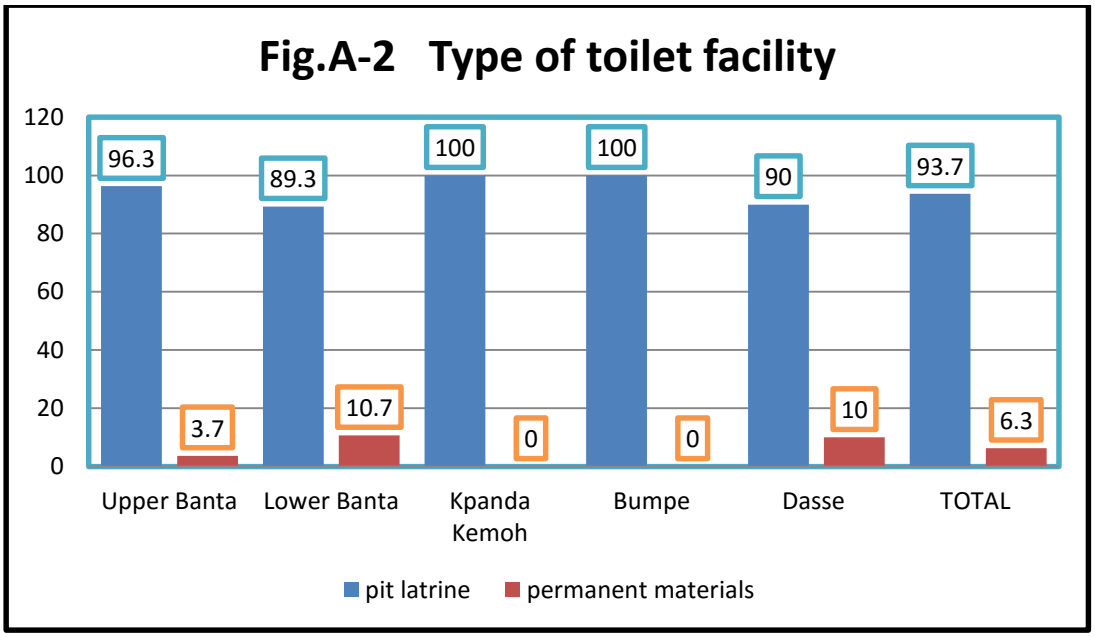
1.3.2. Sanitation facilities

Poor sanitation coupled with unsafe water sources increases the risk of water-borne diseases and illnesses due to poor hygiene in the company's operational areas. Studies have shown that the absence of proper toilet facilities and improper disposal of faecal material increases exposure to the risk of diseases like dysentery, diarrhoea, and typhoid fever. Members of households with improved sanitation facilities are less likely to contract these communicable diseases.

Figure xxx shows that overall, 54.1% of households had no toilet facility available. This is so particularly in communities in the Bumpe, Dasse and Kpanda Kemoh Chiefdoms respectively. Others in the Upper Banta and Lower Banta reported to have access to toilet facility. The most common toilet facility is the open pit latrines (93.7%), which is more likely to be used by majority of the households.

Fig A-1.: Availability of toilet facilities in operation area





1.4. Economic activity

Data collected on the main economic activity of household members is presented in table A 9. The Table shows the limited opportunities available in the chiefdoms. In the communities surveyed, most adults are engaged in agriculture in their own account as their primary and secondary economic activities. Very few have business as their main economic activity. In upper Banta there is a greater possibility of accessing formal employment than the rest of the chiefdoms were Vimetco operations are taking place. Hunting and collection of forest products are not primary economic activity of any person but is an important subsidiary in Lower Banta and Upper Banta respectively.

Data on the use of health facilities are presented in Table xxx below. These show that, overall, 84.9% of survey households have some form of health care available in the communities. The health care service provision is provided through the community health centres and clinics with wider provision available to the population.

Table A- 9 Distribution of Economic Activities of Household Members by Chiefdoms

Economic activity	Primary						Secondary					
	Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	Total	Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	Total
Farm work own land	25	26	38	39	14	**142**	14	7	29	35	2	**87**
Livestock raising	0	0	1	0	0	**1**	5	0	2	1	0	**8**
Business	2	3	3	0	2	**10**	5	5	2	1	1	**14**
Collecting forest products	0	0	0	0	0	**0**	1	1	0	0	0	**2**
Hunting (part time)	0	0	0	0	0	**0**	0	3	0	0	0	**3**
Retired	0	1	0	0	0	**1**	0	6	0	0	0	**6**
Disabled and unable to work	2	2	0	0	0	**4**	1	1	0	0	0	**2**
Agriculture labour	2	0	8	0	0	**10**	3	4	2	0	0	**9**
Sharecropping only	1	0	0	0	0	**1**	1	0	0	0	0	**1**
Religious leader, teacher	1	2	1	3	0	**7**	0	2	0	2	0	**4**
Artisan	1	1	0	0	0	**2**	0	7	0	0	0	**7**
Transport	0	1	6	0	0	**7**	0	0	7	0	0	**7**
Unemployed	0	0	6	0	0	**6**	2	0	3	0	0	**5**
Public service	2	0	0	0	0	**2**	1	0	0	0	0	**1**
Private service	1	0	1	0	0	**2**	9	0	0	1	0	**10**
Others specify	1	5	0	2	5	**13**	0	1	0	0	9	**10**
Total Number of People	**38**	**41**	**64**	**44**	**21**	**208**	**42**	**37**	**45**	**40**	**12**	**176**

15. Health services

Table A-10 Health Facility Available in the Community

Chiefdoms	Health centres	Clinic	TOTAL
Upper Banta	29 (87.9%)	4 (12.1%)	33
Lower Banta	18 (100.0%)	0 (.0%)	18
Kpanda Kemoh	40 (97.6%)	1 (2.4%)	41
Bumpe	23 (57.5%)	17 (42.5%)	40
Dasse	19 (95.0%)	1 (5.0%)	20
Total	129 (84.9%)	23 (15.1%)	152

Source: Field survey data 2012

Table A-11 Use of the Health Services

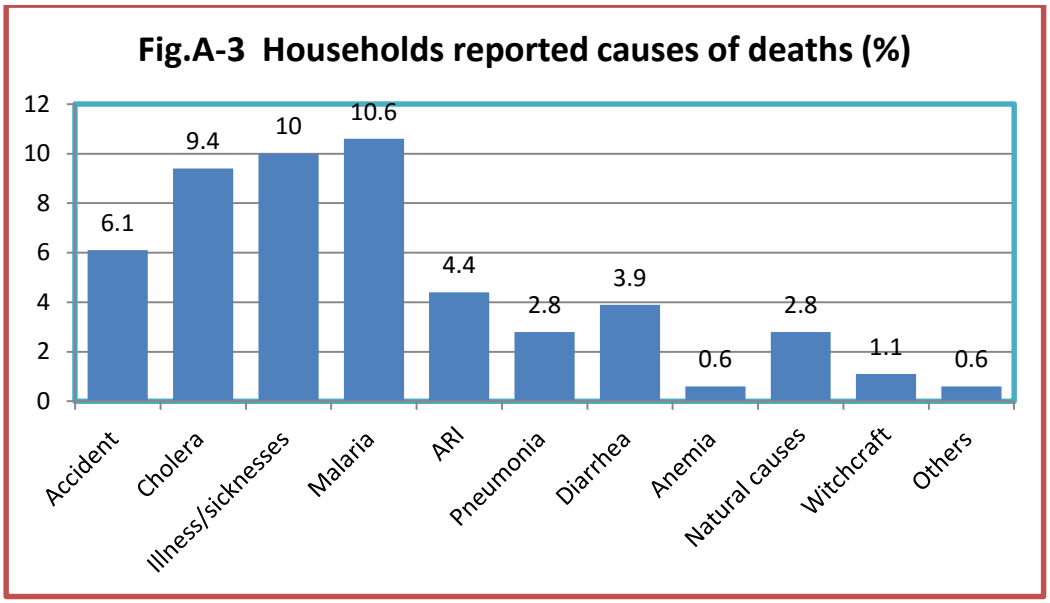
Use of the health services	Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	Total
Antenatal check-ups	27	15	19	20	20	101
Giving birth in hospital	19	15	33	7	19	93
Vaccination services	17	14	39	24	20	113
Sick family members	17	15	24	6	18	81
Taking medicines for sick people	9	3	22	1	2	32
%	**56.1**	**51.7**	**63.3**	**45.0**	**20.6**	

Source: Field survey data 2012

When asked whether they have used this health services in the community and for what purpose, majority of the respondents answered in the affirmative. High levels of these households reported members of their families had used the vaccination services but there is no information available as to what vaccinations have been given or whether courses are completed. There have been strong campaigns to increase vaccination in rural areas and this appears to have been successful.

A significant proportion of households also indicated using the antenatal check-ups for the number of births in the survey villages. The high number of reported use of ante-natal check-ups indicates increase awareness of the risk of home deliveries and high levels of hospital deliveries. Other households reported that someone was sick.

Overall, 50.6% of households reported deaths. There is no historical data on sickness or deaths. Registration of births and deaths is only possible in cities and is not universal even where possible. Figure A 3 records the family stated cause of death – these reflects the lack of medical diagnosis, the lack of autopsy facilities and prevalence of belief in witchcraft. There was no sufficient time to investigate what people really understand by these records and this would make an interesting.



1.5. Household income and expenditure

1.5.1. Household Income

Table A-12 Source of Household Income by Gender

	Upper Banta		Lower Banta		Kpanda Kemoh		Bumpe		Dasse		**Total**	**Average annual income (Leones)**
	M	F	M	F	M	F	M	F	M	**F**		
Subsistence crops	21	15	25	1	37	3	35	6	13	**2**	**152**	856,243
Tree cash crops	22	3	22	2	12	1	19	1	4	**0**	**66**	599,378
Livestock/poultry	8	8	1	17	0	11	0	3	0	**2**	**51**	235,274
Vegetable and fruits	11	14	8	4	8	15	14	23	5	**2**	**90**	172,333
Agriculture wage labour	12	4	4	0	21	3	5	1	6	**1**	**51**	366,411
Non-farm wage labour	3	9	3	1	16	3	3	0	4	**0**	**35**	241,142
Formal employment	9	2	2	0	2	1	2	0	0	**0**	**12**	1,206,666
Income from microenterprises	4	0	1	0	4	7	1	0	1	**1**	**15**	633,000
Business	2	5	5	0	1	2	3	0	1	**1**	**13**	1,765,615
Pension/remittance	2	0	0	0	0	0	0	0	1	**0**	**3**	5,033,333
Rent/interest	3	0	0	1	0	0	0	0	0	**0**	**2**	75,000
Asset sale	2	0	0	0	1	0	0	0	0	**0**	**2**	100,000
Mining income	9	8	13	1	17	0	0	0	3	**0**	**55**	1,833,890
Selling firewood and charcoal	2	2	1	0	1	0	1	0	0	**0**	**5**	75,000
Selling bush meat	5	0	0	0	1	0	0	0	0	**0**	**3**	100,000
Others	4	0	1	0	0	0	0	0	0	**0**	**3**	466,666

Table A-13 Imputed Mean Household Income

Household income	N	Annual Income (Le.)		
		Mean	Std. Deviation	Total equivalent (US$)
Subsistence crops	152	856,243.4211	1,454,446.88286	
Tree cash crops	66	599,378.7879	1,175,001.32589	
Livestock/poultry	51	235,274.5098	229,132.19577	
Vegetable and fruit	90	172,333.3333	162,313.60961	
Agriculture wage labour	51	366,411.7647	568,832.63537	
Non-farm wage labour	35	241,142.8571	497,715.49532	
Formal employment	12	1,206,666.6667	2,792,852.34884	
Income from micro-enterprises	15	633,000.0000	704,003.34821	
Business	13	1,765,615.3846	5,481,381.05375	
Pension/remittance	3	5,033,333.3333	8,631,531.34347	
Rent/interest	2	75,000.0000	106,066.01718	
Asset sale	2	100,000.0000	141,421.35624	
Mining income (surface rent, compensation)	55	1,833,890.9091	3,225,519.87583	
Selling firewood and charcoal	5	75,000.0000	64,807.40698	
Selling bush meat	3	100,000.0000	86,602.54038	
Others	3	466,666.6667	416,333.19989	

The study further revealed that most of the crops cultivated by farmers are local variety sourced from market retailers, friends and relatives and proceeds from seed bank. There are instances in which NGOs working in the communities of the operation area provides seeds to farmers for cultivation.

1.5.2. Average Land Size Owned and Used for Crop and ownership by gender

Land is the basic resource depended upon by a majority of rural communities in Sierra Leone. The amount of land owned and/or operated varies between communities' dependence on the availability of land resources and the nature of social structures governing access to land. In the selected villages of the five chiefdoms, the average land size owned by individual households ranged from 1.1 to 3.5 ha with the overall mean land size being 2.4 ha (Table A 21). The main use of the land is crop production. The main crops that are being grown in these chiefdoms/villages are cassava and rice. In these chiefdoms, the average land size set for cassava and rice range from 3.0 ha to 3.5 ha with an overall average being 3.25 ha.

In terms of ownership of crops grown by households, both the men and women in the households participate in cultivation of these crops. The results show greater participation of the gender in crops such as rice, cassava, groundnuts, vegetables and yam production. Agroforestry crop, such as oil palm, cocoa and coffee, production activities is a mostly male dominated as reported by 58.1% of the respondents. Also a significant proportion of the women are engaged in the production of beans and benni seed.

Table A- 21 Distribution of Crops by Land area occupied (ha) and ownership by Gender

Crops grown	N	Average land area (ha)	Ownership by gender (%)		
			Mainly men	Mainly women	Men and women equally
Rice	110	3.0	17.4	7.0	75.7
Cassava	128	3.5	16.3	11.1	72.6
Groundnuts	32	1.5	5.4	24.3	70.3
Potatoes	23	0.9	12.5	29.2	58.3
Agroforestry crops (oil palm, cocoa, coffee)	27	3.0	58.1	9.7	32.2
Maize	66	2.0	10.0	35.7	54.3
Vegetables (leaf vegetables, pepper, okra, egg plants)	26	1.1	3.8	34.6	61.5
Yam	48	3.5	10.0	26.7	63.4
Others (bennie, beans)	88	2.8	5.2	44.8	50.0

Source: field survey 2012

Table A- 22 Purpose of Growing Crops in Survey Households (%)

Crops grown	Purpose	Chiefdoms					
		Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	TOTAL (%)
Rice	Income/cash earner	4 .2	0.0	0.0	11.4	7.7	**5.4**
	Household food	25.0	72.2	0.0	11.4	53.8	**27.0**
	Both	70.8	27.8	100.0	77.1	38.5	**67.6**
Cassava	Income/cash earner	13.6	4.0	0.0	10.8	5.3	**6.8**
	Household food	9.1	12.0	0.0	5.4	31.6	**9.8**
	Both	77.3	84.0	100.0	83.8	63.2	**83.5**
Groundnuts	Income/cash earner	18.2	0.0	0.0	6.7	0.0	**8.8**
	Household food	0.0	0.0	0.0	13.3	0.0	**5.9**
	Both	81.8	100.0	100.0	80.0	100.0	**85.3**
Potatoes	Income/cash earner	14.3	0.0	0.0	11.1	0.0	**8.3**
	Household food	0.0	0.0	0.0	22.2	0.0	**8.3**
	Both	85.7	0.0	0.0	100.0	66.7	**83.3**
Agroforestry crops (oil palm, cocoa, coffee)	Income/cash earner	9.1	0.0	72.2	0.0	0.0	**48.3**
	Household food	9.1	0.0	0.0	0.0	0.0	**3.4**
	Both	81.8	0.0	27.8	0.0	0.0	**48.3**
Maize	Income/cash earner	0.0	0.0	0.0	0.0	7.7	**1.4**
	Household food	9.1	0.0	0.0	70.0	15.4	**24.3**
	Both	90.9	100.0	100.0	30.0	76.9	**74.3**
Vegetables (leaf vegetables, pepper, okra, egg plants)	Income/cash earner	0.0	0.0	0.0	0.0	0.0	**0.0**
	Household food	14.3	33.3	0.0	0.0	0.0	**7.7**
	Both	85.7	66.7	100.0	0.0	100.0	**92.3**
Yam	Income/cash earner	8.3	0.0	0.0	4.8	0.0	**3.4**
	Household food	16.7	6.2	0.0	38.1	33.3	**22.0**
	Both	75.0	93.8	100.0	57.1	66.7	**74.6**
Others (benni, beans)	Income/cash earner	5.9	0.0	0.0	10.3	0.0	**4.4**
	Household food	23.5	37.5	0.0	37.9	40.0	**29.7**
	Both	70.6	62.5	100.0	51.7	60.0	**65.9**

Source: Field survey data 2012

Across chiefdoms, the overriding purpose of growing crops was for both cash income and household food supplies. From the table above, overwhelming majority of respondents (92.3%) grow vegetables for both cash income and household food; 85.3% groundnuts, 83.3% potatoes and 83.5% cassava. For agroforestry crops, the survey households were divided for both income/cash earner and both. However, agroforestry crops production were not found in Lower Banta, Bumpe and Dasse Chiefdoms.

1.5.3. Loss of land for agriculture and other purposes

Overall, 54.3% of household's survey revealed that they are likely to affected by the loss of land to the project, when compared to 45.7% of respondents who said no. The most obvious impacts of this loss of land to agricultural include:

- Removal of vegetation cover, will severely alter the availability of food and loss of access to common resources
- Pose environmental and social challenge due to potential disruptions to ecosystems and local communities
- Mud erosion on swamps will lead to loss of swamps
- Destroy livelihood activity
- Crop yields are affected due to declining soil productivity/soil fertility
- Loss of farmland will cause insecurity in farming

1.5.4. Farming system

Household respondents indicated the major farming systems commonly practiced in the chiefdoms is mixed cropping (94.9%), mixed farming (80.8%) and sole cropping (57.1%). Analysis is tabulated in table A 23.

Table A-23 Type of Farming System

Farming system		Upper Banta	Lower Banta	Kpanda Kemoh	Bumpe	Dasse	TOTAL (%)
Mono cropping	Yes	0.0	100	100	15.4	60.0	**57.1**
	No	0.0	0.0	0.0	84.6	40.0	42.9
Mixed cropping	Yes	93.5	100	100	84.2	93.8	**94.9**
	No	6.5	0.0	0.0	15.8	6.2	5.1
Mixed farming	Yes	0.0	100	100	83.8	41.7	**80.8**
	No	0.0	0.0	0.0	16.2	58.3	19.4
Livestock/pastoral	Yes	100	100	100	7.1	50.0	35.5
	No	0.0	0.0	0.0	92.9	50.0	64.5

1.6. Community Involvement

1.6.1. Participation in community activities

Members of the household interviewed were active in a range of different community activities with 84.1% households reporting membership of one or more group. However, a significant proportion of respondents (41.9%) in Upper Banta said they do not belong to any community groups.

Table A-24 Household Participation in Community Groups

Chiefdoms	Does any member of the household belong to a community group?	
	Yes	No
Upper Banta	58.1%	41.9%
Lower Banta	90.0%	10.0%
Kpanda Kemoh	94.1%	5.9%
Bumpe	91.7%	8.3%
Dasse	85.0%	15.0%
Total	84.1%	15.9%

Source: field survey 2012

Table A-25 Proportion of Households involved in Community Group Activities

		Community water management committee	Village loans and savings scheme	Youth clubs	Women/ mother group	Gang groups	Farmers association	Workers union	Cooperative
Upper Banta	Male	0.0	100	66.7	0.0	100	66.7	0.0	0.0
	Female	100	0.0	33.3	100	0.0	33.3	0.0	0.0
	Both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lower Banta	Male	100	60.0	53.8	0.0	0.0	33.3	50.0	0.0
	Female	0.0	40.0	46.2	100	0.0	66.7	50.0	0.0
	Both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kpanda Kemoh	Male	100	66.7	25.0	3.6	0.0	37.5	100.0	0.0
	Female	0.0	0.0	20.0	96.4	100	25.0	0.0	0.0
	Both	0.0	33.3	55.0	0.0	0.0	37.5	0.0	0.0
Bumpe	Male	60.0	66.7	85.7	16.7	0.0	50.0	100	0.0
	Female	40.0	33.3	14.3	66.7	0.0	25.0	0.0	0.0
	Both	0.0	0.0	0.0	16.7	0.0	25.0	0.0	0.0
Dasse	Male	0.0	0.0	83.3	0.0	0.0	66.7	0.0	100.0
	Female	100.0	0.0	16.7	100	100	33.3	100.0	0.0
	Both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		Community water management committee	Village loans and savings scheme	Youth clubs	Women/ mother group	Gang groups	Farmers association	Workers union	Cooperative
Upper Banta	Male	0.0	100	66.7	0.0	100	66.7	0.0	0.0
	Female	100	0.0	33.3	100	0.0	33.3	0.0	0.0
	Both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lower Banta	Male	100	60.0	53.8	0.0	0.0	33.3	50.0	0.0
	Female	0.0	40.0	46.2	100	0.0	66.7	50.0	0.0
	Both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kpanda Kemoh	Male	100	66.7	25.0	3.6	0.0	37.5	100.0	0.0
	Female	0.0	0.0	20.0	96.4	100	25.0	0.0	0.0
	Both	0.0	33.3	55.0	0.0	0.0	37.5	0.0	0.0
Bumpe	Male	60.0	66.7	85.7	16.7	0.0	50.0	100	0.0
	Female	40.0	33.3	14.3	66.7	0.0	25.0	0.0	0.0
	Both	0.0	0.0	0.0	16.7	0.0	25.0	0.0	0.0
Dasse	Male	0.0	0.0	83.3	0.0	0.0	66.7	0.0	100.0
	Female	100.0	0.0	16.7	100	100	33.3	100.0	0.0
	Both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (N)		**11**	**30**	**79**	**66**	**3**	**55**	**8**	**1**

Source: field survey 2012

Table A -26 Household Participation in Community Meetings

	Does anyone in your household participate in community meetings?	
	Yes	No
Upper Banta	100.0%	.0%
Lower Banta	94.3%	5.7%
Kpanda Kemoh	97.5%	2.5%
Bumpe	100.0%	.0%
Dasse	100.0%	.0%
Total	98.2%	1.8%

Source: field survey 2012

Data were collected on participation rates in community meetings. Overall, 98.2% of respondents reported that household members do participate in community meetings. For those households that do

not participate in community meetings revealed that it is as a result of the high level of poverty and most times meetings are not called. Table A 27 presents the percentage of households having members attending community work meetings of different types: many households attend more than one type of meeting. Community gathering/meeting and social/religious work and club are the most commonly attended. About 43% host political gathering and fewer communities are involved in community construction works. The high rate declared for women's attendance at community meeting is interesting as the team has found that fewer women than men have been observed as attending community consultation meetings relating the Vimetco Bauxite mining project.

Table A-27 Household Members attending Community Meetings, Percentage of Households.

Chiefdoms	Social/religious work	Community gathering/ meetings	Political gathering /meetings	Club	Community construction works	Others
Upper Banta	16	27	10	11	7	1
Lower Banta	31	34	34	30	31	6
Kpanda Kemoh	34	28	20	36	21	0
Bumpe	7	17	1	12	4	0
Dasse	19	17	14	4	4	5
TOTAL	107	123	79	93	67	12
PERCENT (%)	59.4	68.3	43.9	51.7	37.2	6.7

1.6.2. Women's participation in meetings

Household perceptions of women's participation (by contributing to decision making) were that an overwhelming majority of them (96.4%) believed were able to participate in community meetings. Overall, 63.7% of households believed that it was difficult for women to participate in meetings, primarily because they had less time available, gender discrimination, farming activities and through other work to do with childcare and domestic chores that prevented participation of women in community/public meetings.

1.6.3. Social mobilization activities

Table A- 28 Awareness Raising Programmes

Chiefdoms	Empowerment		Health and sanitation		Women and reproductive health		Women literacy		adult literacy		Others	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

Upper Banta	42.9	57.1	93.8	6.2	34.6	65.4	5.0	95.0	0.0	100	0.0	100
Lower Banta	95.0	5.0	100	0.0	84.6	15.4	25.0	75.0	25.0	75.0	0.0	0.0
Kpanda Kemoh	53.7	46.3	100	0.0	46.3	53.7	0.0	100	0.0	100.0	0.0	100
Bumpe	0.0	100.0	100	0.0	60.0	40.0	50.0	50.0	90.0	10.0	50.0	50.0
Dasse	10.5	89.5	15.8	84.2	10.5	89.5	10.5	89.5	10.5	89.5	0.0	100
Total	**49.6**	**50.4**	**42.3**	**57.7**	**42.3**	**57.7**	**7.0**	**93.0**	**13.3**	**86.7**	**4.1**	**91.8**

Source: field survey 2012

Table A-29 Income Generating Programmes

Chiefdoms	Formal saving and credit		Informal savings/ osusu		Cooperative		Agriculture extension		Livestock raising		Bee keeping		Goat raising		Poultry	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Upper Banta	14.3	85.7	58.1	41.9	0.0	100	5.3	94.7	**57.1**	42.9	10.5	89.5	21.1	78.9	5.5	94.4
Lower Banta	25.0	75.0	93.9	6.1	25.0	75.0	**50.0**	50.0	**90.9**	9.1	**72.7**	27.3	**100**	0.0	**78.6**	21.4
Kpanda Kemoh	37.5	62.5	82.9	17.1	5.1	94.9	**70.0**	30.0	**70.0**	30.0	7.7	92.3	**89.5**	10.5	**51.4**	48.6
Bumpe	0.0	100	90.0	10.0	**80.0**	20.0	**50.0**	50.0	0.0	100	50.0	50.0	0.0	100	0.0	100
Dasse	0.0	100	5.0	95.0	5.0	95.0	10.5	89.5	0.0	100	0.0	100	0.0	100	0.0	100
Total	**22.4**	**77.6**	**68.9**	**31.1**	**9.2**	**90.8**	**40.7**	**59.3**	**58.3**	**41.7**	**15.5**	**84.4**	**63.9**	**36.1**	**34.5**	**65.5**

Source: field survey 2012

- Informal savings (Upper Banta, Lower Banta, Kpanda Kemoh, and Bumpe)
- Cooperative (Bumpe)
- Agriculture extension (Lower Banta, Kpanda Kemoh, Bumpe)
- Livestock raising (Lower Banta, Upper Banta, Kpanda Kemoh)
- Bee keeping Lower Banta, Bumpe)
- Goat raising (Lower Banta, Kpanda Kemoh)
- Poultry (:Lower Banta, Kpanda Kemoh)

1.7. General perceptions

1.7.1. Community needs and concerns

The following common concerns were raised by considerable number of FGDs participants across the concessionary zone:

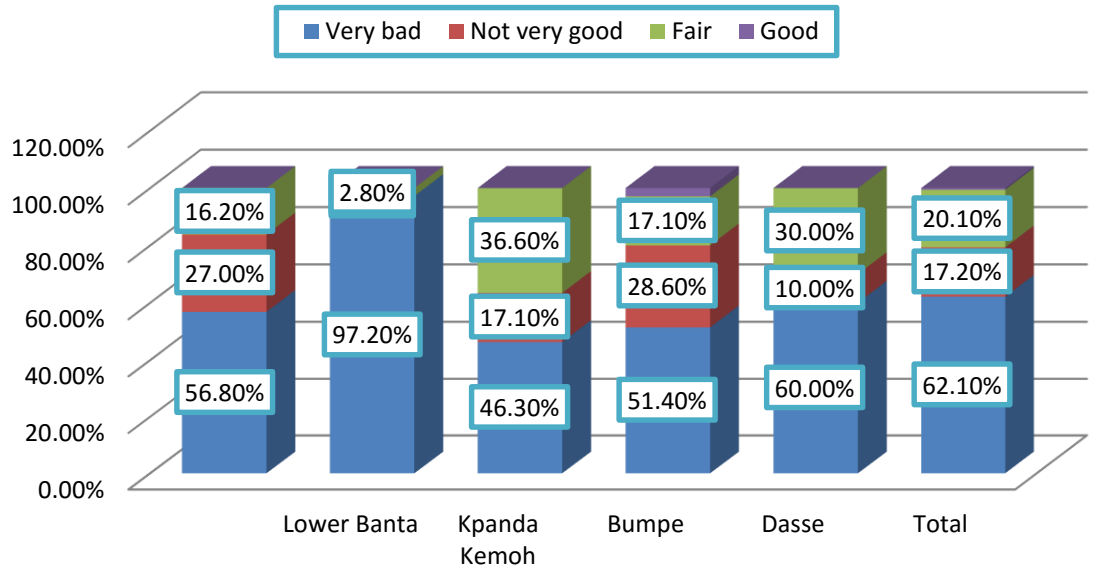
- The benefits received from the mining company is not commensurate to their needs

- Mining in the communities are done in an haphazard manner, especially in the Gbonge (Kpanda Kemoh Chiefdom) and these was considered unacceptable as it is not economical and environmentally friendly.
- Land owners are not involved in the negotiation process for their land;
- Road network in their chiefdoms are deplorable
- Lack of knowledge about the acreage assigned as concession zone for the mining operation
- Agricultural Development Fund is not beneficial for the farmers; rather it is benefiting only the paramount chief and the Ministry of Agriculture, Forestry and Food Security Officials.
- Frequent delay in the payment of both surface rents and compensation for land and crop loss
- No positive impact on the socio-economic status of the affected communities – no alternative livelihood opportunities are not provided by the company
- No proper rehabilitation of mined areas with economic trees

1.7.2. Perceptions of Environmental Quality

There is no marked difference in the perceptions of the natural environment among the different communities (figure A 4). Slightly more than sixty percent of the respondents (62.1%) had a negative opinion about the environmental conditions of the operational communities in the last two years. An overwhelming majority of respondents (97.2%) in Lower Banta felt that the quality of the environment is very bad. In all, the communities expressed the deplorable status of health and sanitation hygiene conditions, deforestation and soil degradation, pollution (air and noise) and health risk resulting from dust emissions.

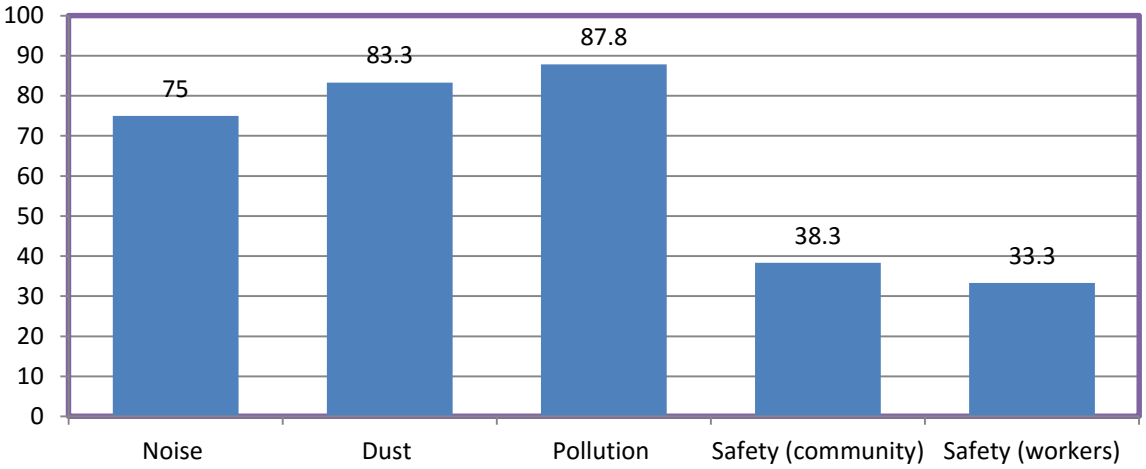
Fig A-4 Perceptions of environmental quality, all surveyed households and by community



1.7.3. Problems with Vimetco operations

When survey respondents were asked whether there were any problems associated with Vimetco operations in the area, the most commonly reported issue was pollution (mentioned by 87.8% of respondents), dust (83.3% respondents) and noise (75.0% respondents).

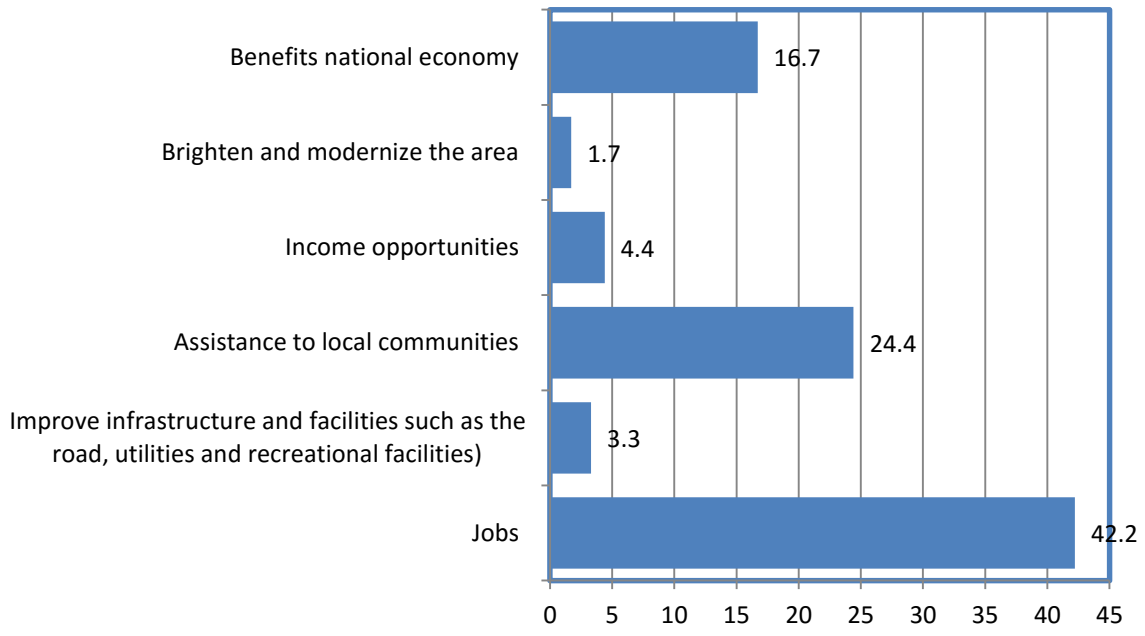
Fig. A-5 perceived problems with Vimetcos operations in the area



1.7.4. Advantages of Vimetco operations

When asked whether there are any advantages of Vimetco presence in the area, the most commonly named benefits were jobs, assistance to the community and benefits to the national economy. However, small proportion of respondents felt that the company operations will not help provide an improved infrastructure and facilities such as the road, utilities and recreational facilities; income diversification opportunities and brighten and modernize the area (Figure A 6). The general perception of the bauxite mining activities in the chiefdoms was viewed as a curse than a blessing. They said that the mining activity has not contributed meaningfully to community development initiatives rather than the destruction of the natural environment. To reverse this trend the community recommends a thorough review of concession agreements reached to reflect mutual benefits for all relevant stakeholders in the mining process.

Fig. A-6 Perceived advantages of Vimetco bauxite mining in the operation area



ANNEX – C Summary of issues discussed in FGDs across the surveyed communities

1. **Loss of land used for agricultural and other purposes to bauxite mining by SMHL Vimetco**

The community members expressed willingness to loss their land used for agriculture and other purpose to bauxite mining operations in their community. They indicated that this can only be possible provided the following conditions are met by the company: increase surface rent and compensation; provide training and employment opportunities for the community; provide improved and affordable medical facilities and prompt and appropriate rehabilitation of the mined out areas for future use.

2. **Surface rent payments for mining land**

The surface rents paid to community for mining land was viewed by all affected communities as too small. While stakeholders generally clamour for the rate of surface rent payments to be increased, some stakeholders believe that surface rents are disproportionately distributed amongst the different stakeholder groups. Some argue that the percentage for the Paramount Chiefs is too large; others believe Local Councils are getting the lion's share. Some stakeholders would like the involvement of all stakeholders in deciding the level of surface rent payments. In a focus group discussions or discussion meetings, the communities expressed that most times these amounts are paid annually and untimely and often the indirect payments are too bureaucratic. The distribution of surface payment rents across the communities interviewed is as shown in the table below. Note that while the payment rates are

established by law, the distribution is determined in consultations among the GOSL (mainly the MLGCD), Chiefs and Local Councils, although it is not clear how a final decision is made. There is concern that decisions are made in a subjective and non-transparent manner for the distribution of surface rent payment. The communities indicated that there is a need to re-negotiate the amount paid per annual per acre of land and increase on the current amount paid and these monies are to be paid monthly, and that direct payment should be made to the landowners themselves.

Table 3 Distribution of Surface Rents

Stakeholder group	% of Total payment
Land owners	50%
Paramount Chiefs	15%
Local Council	15%
Chiefdom Development	10%
Constituency Development Fund	10%
Total	100%

Source: FGDs meetings 2012

3. **Relocation of villages**

The entire affected villages/communities are unwilling to relocate to another community. They however expressed dissatisfaction over the current status of relocated villages/communities. The participation of affected people is limited not only because stakeholders are not actively involved in the discussions on relocation but, more importantly, there is no assessment of the changes in lifestyles and capacities needed to overcome successfully a major disruption of local families. Participants in a focus group discussion indicate that in any future village relocation, the company should build modern structures and provide all socio-cultural structures (such as place of worship, educational and health facilities etc.), renegotiate compensation fees and provide relief services to the people in the relocated village(s) for the first three consecutive years after relocation.

4. **Compensation payment and method**

The factors that should determine the level of compensation payment for crops destroyed due to mining activities are:

- Adopt a procedure to determine the cost of crops/assets involved. This should be done in close consultation with landowners.
- Negotiate directly with the landowner and reach consensus on the amount.
- Amount of payment should be commensurate to the crop/asset destroyed.
- Develop a framework for compensation payment with the involvement of the local communities

Although ministry officials are involved in the crop compensation exercise, crop owners would like the economic life of the crops to be considered in the evaluation.

5. **Economic and Community Development issues**

So far the company has provided the following benefits as reported by the affected communities: community Barry, good road network, secondary school in the chiefdom, and improved medical facilities. The participants in the focus group meetings said that the community should address their concerns; the most common response was to assist with improving community infrastructure and facilities such as the road, utilities, and recreational facilities. Other recommendations that the company should provide training for community members provide information on job opportunities and services and adhere to the highest standards for environmental protection.

6. **Contribution of mining to national economy**

The general perception of the bauxite mining activities in the chiefdoms was viewed as a curse than a blessing. They said that the mining activity has not contributed meaningfully to community development initiatives rather than the destruction of the natural environment. To reverse this trend the community recommends a thorough review of concession agreements reached to reflect mutual benefits for all relevant stakeholders in the mining process.

7. **Health and Environmental Sanitation Problems:**

The communities expressed deplorable status of the health and sanitation hygiene condition of their communities. The major environmental, health and sanitation concerns resulting from the mining in the community includes:

- Pollution
- Erosion
- Deforestation and soil degradation
- Noise
- Dust
- Health problems – malaria, diarrhoea, high blood pressure and problems associated with ageing.
- Problem of sanitation.

To resolve these problems, the following measures were proposed:

- Reduce dust emissions using appropriate measures
- Develop soil erosion prevention plan
- Rehabilitate mined out areas
- Provide improved and affordable medical facilities for communities
- Provision and maintenance of improved road network in the community

8. **Increase in crime rate**

The most common crime in the communities identified by focus group participants are:

- Thieving
- Prostitution
- Disregard for local authorities

9. **Issues related to safety and accidents**

The major safety and accidents problems reported by the FGDs participants include:

- Boulders rolling from haulers/dumper trucks
- The creation of dams/ponds that does not support aqua-culture due to high concentration of harmful chemicals
- Persistence dust emissions thereby increasing the possibilities of frequent accidents. For example two accidents reported occurred in Gbonge and Badja respectively

With the establishment of Environment and Safety Management within the corporate environment, health, occupational and safety issues are vigorously addressed. No serious incident of occupational hazards and safety problems were reported resulting from the dredging operation at the moment.

10. **Community concerns and needs**

The following common concerns were raised by considerable number of FGDs participants across the concessionary zone:

- The benefits received from the mining company is not commensurate to their needs
- Mining in the communities are done in a haphazard manner, especially in the Gbonge (Kpanda Kemoh Chiefdom) and these was considered unacceptable as it is not economical and environmentally friendly.
- Land owners are not involved in the negotiation process for their land;
- Road network in their chiefdoms are deplorable
- Lack of knowledge about the acreage assigned as concession zone for the mining operation
- Agricultural Development Fund is not beneficial for the farmers; rather it is benefiting only the paramount chief and the Ministry of Agriculture, Forestry and Food Security Officials.
- Frequent delay in the payment of both surface rents and compensation for land and crop loss
- No positive impact on the socio-economic status of the affected communities – no alternative livelihood opportunities are not provided by the company
- No proper rehabilitation of mined areas with economic trees

ANNEX - D - Socio-Economic Baseline Survey Questionnaire

A. IDENTIFICATION AND LOCATION INFORMATION

Date of interview:	
Name of Village:	
Time interview started: Time ended: Time spent:	
Questionnaire No. :	Date:
Distance to the project area (Km):	
Status of Road from Village to the ^project area: (1= Accessible all year round, 2= Accessible half of the year, 3= Inaccessible all year round)	
Ethnic Groups: (1 =MENDE, 2 = TEMNE, 3 = LIMBA, 4 =LOKO, 4 = others specify)	
GPS coordinates of residence (waypoint)	(i)Longitude: (ii)Latitude:

B. SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

Variable	Response	Codes
1. Gender [SEX]		1=Female, 2=Male
2. Age of Respondent in years [AGE]		
3. Household Status [HHSTAT]		1 = Head, 2 = Spouse
Marital status [MSTATUS]		1=Single, 2= married, 3= consensual union 4=Widowed, 5= Divorced,
Residential status		1. PRP (Permanent Resident); 2. RA (Resident Absent) 3. Member of non-resident HH; 4. Visitor: 9. Other (specify); 0. No Answer
Religion		1. Muslim; 2. Christian (specify denomination) 99. Other (specify); 0. No Answer
Number of persons in household [HHSIZE]		
Household composition		
Number of household members aged 65 years and above [HHMEM]		
Number of males aged 41- 64 years [MALES]		
Number of females aged 41-64 years = [FEMALES]		
Number of males aged 16-40 years [MALES]		

Number of females aged 16-40 years [FEMALES]		
Number of females aged 6-15 years [FCHILD]		
Number of males aged 6-15 years [MCHILD]		
Number of male children 0 – 5 years[MINF]		
Number of female children 0 – 5 years[FINF]		
Level of education of respondent [EDUCAL]		1. Illiterate; 2. Primary School; 3. Secondary School; 4. Graduate/Tertiary education, 5.Vocational/Technical School; 6.Religious School (literate in Arabic); 0. No. Answer
Housing		
Do you own house?		
Roof materials		1. Tiles 2. Iron sheets 3. Well-maintained thatched grass 4. Dilapidated thatched grass 5. - Other, specify
Wall materials *(Observe and tick-off, but ask if in doubt):*		1. Burnt bricks with plaster 2. Burnt bricks without plaster 3. Mud bricks with plaster 4. Mud bricks without plaster 5. Well-constructed poles and mud 6. Poorly constructed/maintained poles and mud 7. - Other, specify
Floor materials *(Observe and tick-off, but ask if in doubt):*		1. Cement 2. Mud but smooth 3. Dust but smooth 4. Dust and rough 5. - Other, specify
WATER		**1.**
Source of water for domestic use		2. Tap 3. Protected well/bore hole 4. Unprotected well/bore hole 5. River/stream 6. Spring 7. Rain
How is the quality of water		1. Good, 2. Muddy water, 3. Unsafe, 4. Other (specify)
How do you treat water before using for domestic use?		

Who fetches water?		1. Women 2. Men 3. Boys 4. Girls 5. Other (specify) ----------
Economic activity		
Main economic activity		1. Farm work own land; 2. Livestock raising; 3. Household; 4.business; 5. Hunting; 6. Collecting forest products; 7. Hunting (part-time); 8. Retired: 9. Disabled and unable to work; 10. Agriculture labour; 11. Sharecropping only; 12. Religious Leader, Teacher; 13. Artisan; 14. Transport; 15. Unemployed; 16. Student; 17. Public service; 18. Private Service; 99. Other (specify); 0. No Answer
Secondary economic activity		1. Farm work own land; 2. Livestock raising; 3. Household; 4.business; 5. Hunting; 6. Collecting forest products; 7. Hunting (part-time); 8. Retired: 9. Disabled and unable to work; 10. Agriculture labour; 11. Sharecropping only; 12. Religious Leader, Teacher; 13. Artisan; 14. Transport; 15. Unemployed; 16. Student; 17. Public service; 18. Private Service; 99. Other (specify); 0. No Answer
Sources of income and expenditure		
Household income	Mainly who (1 – male; 2 – female	Annual income (Le.)
a) Subsistence crops		
b) Tree cash crops		
c) Livestock/poultry		
d) Vegetables and fruit		
e) Agriculture wage labour		
f) Non-farm wage labour		
g) Formal employment		
h) Income from micro-enterprises		
i) Business		
j) Pension/remittance		

k) Rent/interest		
l) Asset sale		
m) Mining income (surface rent, compensation)		
n) Selling firewood and charcoal		
o) Selling bush meat		
p) Others specify		

Household expenditure

	Mainly who (1 – male; 2 – female	Annual income (Le.)
a) Food		
b) Bush meat		
c) Clothing		
d) Reading/Educational materials		
e) Medicines		
f) Livestock		
g) Farm inputs		
h) Transportation/cell phone costs		
i) Marriage and funeral expenses		
j) Alcohol/palm wine		
k) Expenditure for income generation activities		
l) Saving/loan and interest payments/osusu		
m) Others specify		

Is there any work or employment done by household members likely to be affected by the loss of land to the project?

a) Yes
b) No

If yes, describe what the impact will be? ----------

Ownership of trees and livestock

What trees does the household own?

Types of trees	Household use code 1 Used for income code 2

	Both code 3
Fruits	
Cocoa	
Coffee	
Kola	
Oil palm	
Citrus/orange	
Plantain	
Mango	
Others specify	

7. Do you keep **Livestock?** [LSTOCK]_____(1 = yes, 0 = no)

8. If yes, state the five major livestock kept in your household, their number, purpose and ownership.

Livestock	Number	Ownership 1 = mainly men, 2 = mainly women, 3 = men and women equally	Purpose 1 = for food, 2 = cash income, 3 = both cash and food, 4 = work, 5 = social prestige (sign of wealth, 6 = transport, 7 = others (specify) ----------
1.			
2.			
3.			
4.			
5.			
Other physical assets			
radios owned			
Televisions/generator			
Sewing machines			
Pestle and mortar			
mobile phones			
wrist watches			
bikes			
shops			
motorcycles			
cars			
Others specify			

Farming Activities

What are the five (5) most important crops which your household cultivate? Rank in order of importance. 1 = most important, 5 = least important **[IMPCROP]**

Crops	Variety 1=Improved 2=Local	Land area occupied (ha)	Sources of Seeds 1 =Market retailer, 5=friends/relatives, 6 = other farmers, 99 = others (specify)	Ownership 1 = mainly men, 2 = mainly women, 3 = men and women equally	Purpose 1 = income/cash earner, 2 = household food supplier, 3 = for both cash income and household food
1.					
2.					
3.					
4.					
5.					

Which of the **Farming system** is commonly practiced by your household? [FARMSYST]

Farming system		**Response**	**Codes**
1.	Mono-cropping/sole cropping		1 = yes 2 = no
2.	Mixed cropping		
3.	Mixed farming		
4.	Livestock/pastoral		

Community involvement

Does any member of the household belong to a community group?

a) Yes
b) No

If yes, who belongs to which ones?

Membership	**Gender (1 – male, 2 – female**
Community water management committee	
Village loans and savings scheme	
Youth club	
Women/mother group	
Gang groups	
Farmers association	
Workers union	
Cooperative	
Other groups	

Does anyone in your household participate in community meetings?

a) Yes
b) No

Is yes, which ones?

a) Social/religious work
b) Community gathering/meetings
c) Political gathering/meetings
d) Club
e) Community construction works
f) Any other work (specify)

If no, why not?

Do women participate in meetings?

a) Yes
b) No

Are there difficulties about the participation of women?

a) Yes
b) No

If yes, please describe----------

Does your town have the following social mobilization activities?

Awareness raising programme	**Yes**	**No**	**Income generating programmes**	**Yes**	**No**
a) Empowerment			g) Formal saving and credit		
b) Health and sanitation			h) Informal savings/osusu		
c) Women and reproductive health			i) Cooperative		
d) Women literacy			j) Agriculture extension		
e) Adult literacy			k) Livestock raising		
f) Others specify			l) Bee-keeping		
			m) Goat raising		
			n) Poultry		
			o) Others specify		

Health services		
Health facility available in the community		1. Heath centres 2. Clinic 3. Dispensaries 4. Hospital 5. Traditional healers

		6. Other specify
What do the use of the health services for?		1. Antenatal check ups 2. Giving birth in hospital 3. Vaccination services 4. Sick family members 5. Taking medicines for sick people
Did any member of your household died last year		1. Yes 2. No
If yes, what was the cause of the death?		1. Accident 2. Cholera 3. Illness/sickness 4. Malaria 5. Acute Respiratory Tract Infection 6. Pneumonia 7. Diarrhea 8. HIV/AIDS 9. Anemia 10. Natural causes 11. Witchcraft 12. Tuberculosis 13. Others specify
Does your household have a toilet facility?		1.Yes; 2 No If yes, mention the type e.g. 1. Pit latrine 2. Permanent materials

Asset loss

Is the household affected by asset loss for the project?

1. Yes
2. no

GENERAL PERCEPTIONS OF THE COMMUNITIES

a) In your opinion, what is your general perception of the natural environment in your community in last two years?
   1. Very bad
   2. Not very good
   3. Fair
   4. Good
   5. Very good

   Why do you think so.?

---

b) Perceptions, possible concerns and expectations of the local people vis a vis the potential employment opportunities of the proposed project

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c) Communities attitudes towards Vimetco SMHL

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d) Problems in the Vimetco operation in the area

1. Noise;
2. Dust;
3. Pollution;
4. Safety (communities);
5. Safety (workers)

e) What advantages does the Vimetco bauxite mining operation provide for this community?

1. Jobs,
2. improves infrastructure and facilities such as the road, utilities and recreational facilities,
3. assistance to local communities,
4. income opportunities,
5. brighten and modernize the area,
6. benefits national economy

ANNEX E

1. **ESIA Licences**
2. **SMHL Business Registration Licence**
3. **SMHL Mining Agreement**
4. **Receipt of SMHL Surface Rent Payment 2011**