

EXECUTIVE SUMMARY

Environmental Assessment (EA) is a tool currently used by the Environmental Protection Agency (EPA) for ensuring that projects are carried out in a coordinated manner in order to identify impacts and reduce environmental risks.

TREL is a registered company, owned by Africa Renewable Ltd incorporated in UK and La Societe Biokola incorporated in Cote d'Ivoire on a 50/50 basis. TREL was incorporated on the 1st of October 2010, as a limited liability company to operate as a biomass producer extracting and handling agro-industrial by-products under a sustainable management regime.

The company has entered into an eight-year contract with Ghana Rubber Estate Ltd to fell its rubber tree plantations that are under tapping on site covering an estimated area of 4,800 hectares. The company has been set up to harvest, chip and store about 120,000MT of rubber plantations annually into semi-finished agro-industrial by-products for export to major biomass industries in Europe.

Due to the increasing demand for biomass mainly driven by a variety of incentives schemes across Europe in order to comply with the 2020 targets, TREL wishes to take advantage of this booming market, the enabling political and economic environment, the Free Zone Enterprise tax incentives as well as the availability of over 4,800 hectares of agro-industrial by-products to operate in Ghana. In the long term, TREL may explore other sources of biomass products in West Africa.

Being committed to complying with national regulations covering its operations TREL is submitting this preliminary environmental report (PER) to the EPA for the purpose of obtaining the necessary environmental clearance to harvest, chip, store and export over 120,000MT/year of wood products to the major markets in Europe. The proposed project specifically seeks to harvest the rubber trees, transport them to the roadside, cut trees into wood chipping and pellets, transport the semi finished products to a dedicated storage facility and later export to Europe via the Takoradi Ports.

The components of the proposed project (i.e. harvesting of rubber trees, conditioning of open storage facility and exporting of the product to Europe) will

both be performed simultaneously using local contractors. The harvesting of the rubber trees will require special equipment and technology and TREL will import to Ghana brand new equipment or high -quality second hand with few operational hours from Europe or the USA.

The storage facility will have to be conditioned and TREL plans to utilize local workforce and materials to carry out such works. This will involve, filling and draining, fencing and lighting, grading and gravelling of the surface, laying of 20cm concrete layer for the wood chips to be stored and building of necessary support infrastructure for the site.

The study identified both constructional and operational phase impacts associated with the project as highlighted in the main document (See Chapter 5). However, constructional phase impacts of the open storage facility are temporary in nature ceasing when construction is completed whilst the operational phase impacts persists and are identified as follows: the increased noise impacts from operating machines, emission of exhaust from machinery, traffic impacts on public roads, likely spills of fuel/oil and grease from operating equipment, Biodiversity, wetland contamination, occupational health and safety & employment generation will be some of the key issues to address due to their impacts on the environment.

The potential impacts associated with the machinery operation will have limited impacts on human settlement since the entire rubber plantations is a Ghana government reserved area for plantation development under the landed Properties of Ghana Rubber Estate Ltd and Firestone Ghana Ltd (Miscellaneous Provision) Act 1977. The report will seek to establish the likely impacts the project have on sensitive environments such as operational noise impacts, air quality , dust of construction activities for warehouse, traffic impact on public roads, and receiving water bodies within the plantations that may be made unsuitable for recreational use & affects aquatic life. Even though the responsibility for ensuring sustainable operations remains with GREL as the owner and developer of the plantations, TREL is cognizant of any additional impacts that will come as a result of the harvesting activities. This is because the use of heavy machinery is most likely to contribute to increase values in environmental parameters such as impacts of high total suspended solids (TSS), which can result in solids settling to the bottom or

wash up on the banks and decompose, causing offensive odour and depleting oxygen in the receiving water body; high BOD/COD are related to the organic matter content of the decomposed leaves and wood products which may cause depletion of the oxygen content and creates unpleasant tastes and odour in the receiving water body; Oil & Grease interferes with natural recreation, agricultural use, toxic to certain species of fish, destroys vegetation along the shoreline and poses fire hazard when present on the water surface in sufficient amounts. Other potential impacts have also been identified, evaluated and assessed thoroughly in this report. (Table 9: Impact Assessment – Magnitude of Impacts)

The process has also identified solid waste management as one major problem that will confront the project particularly the conditioning of the storage facility. The construction phase will generate dirt, dust, pieces of wood and construction materials, and this may have some negative environmental impacts requiring attention.

For the construction phase, they include construction waste management, noise, dust and air pollution, traffic impact of tipper trucks involved in construction activities, alteration of existing landforms, storm water management, erosion control, occupational health & safety issues and employment.

Appropriate measures have been recommended for adoption to mitigate the possible negative environmental impacts of the project. Some of such include the use of the STMA or a private waste contractor to dispose of the solid wastes in accordance with municipal guidelines.

Additionally, a monitoring programme to ensure adequate performance of environmental management systems (EMS) - traffic management plan, utilities management plan, occupational health and safety plan, storm water management and erosion control plan, waste management plan and emergency response plan have been suggested to management for implementation. This will be applied by both contractors for the conditioning of the storage facility and management of TREL and would be fully implemented in compliance with project requirements.

1.0 INTRODUCTION

1.1 General

There is a global demand to exploit environmental resources in a sustainable manner in order to minimize adverse environmental impacts on the ecosystem, promote environmentally friendly and cost effective operations and ensure high safety standards for both employees and products. This can be achieved only if projects are planned, designed and managed with due regard to environmental consequences.

In keeping pace with this global demand on environmental issues, the Environmental Protection Agency (EPA) has prescribed a planning tool and a permitting process for projects to ensure they meet the sector environmental permitting guidelines for different industries including the introduction of the renewable energy sector. In compliance with the prescribed processes and the guidelines, TREL, through their appointed consultant, is carrying out the Environmental Preliminary Assessment (EA) study of the proposed project to be located in Western Region of Ghana.

The project will comprise the extraction, chipping, storage and export of agro-industrial by-products including the conditioning of a storage facility warehouse to store semi-finished wood by-product and later transport to Takoradi port for export to European markets.

Takoradi Renewable Energy Ltd (TREL) is in the process of applying for Free Zone Enterprise status to extract the agro-industrial by-product of the Ghana Rubber Estate Ltd which will be exported to targeted markets to be used in the Biomass industries to meet the Green House Gas reduction initiative by the year 2020 announced by European Commission on promoting the use of renewable energy resources.

The inception and operation of the project will require both skilled and unskilled workforce to operate the various departments that will originate from the extraction activities, transport of wood products to both open shed and port, supporting utilities, maintenance of equipment and sanitary and administrative facilities.

1.2 Project Background

Sub-Saharan Africa has conditions conducive to supplying biomass on a large-scale and on sustainable basis. This can be sourced from existing agro-industrial plantations without threatening the large rainforests in the area. In fact, conserving this natural forest is extremely important. With care, expanding the use of biomass for energy purposes cannot only help combat climate change worldwide but can also address the energy generation shortages across the region.

The Ghana Rubber Estates Ltd (GREL) has rubber tree plantations estimated at about 13,000 hectares, out of which 4,800 hectares are over aged and under tapping and remain to be replanted in the foreseeable future. The company embarked on a project to fell all under tapping rubber plantations to be replaced with new plantations to revamp their operations.

However, there are no major outlets for the old, felled rubber trees to be processed in a sustainable regime but to be left to decay or burnt in-situ. The volume currently used by local charcoal producers, fire wood traders or carpenters are minimal, comprising less than 8% of the total volume of 150,000 tons per year.

Subsequently, Takoradi Renewable Energy Ltd (TREL) realizing the business potential that exist in the biomass industry in sub-Saharan Africa has undertaken to add value to this agro-industrial by-product by linking this by-product to major markets in Europe. The company consequently signed an eight year contract with Ghana Rubber Estates Ltd to extract, process, transport and exports these rubber trees to major markets in Europe. The project aims to create value in the supply chain process through the application of appropriate technologies and investment to meet the investment goals. This line of activity will be new to the port as no biomass export business of this scale has ever been developed in Ghana.

The extraction chain will use the latest forestry technology equipment to minimize CO₂ emissions and damage to soil.

The plantation is located at about 50km West of Takoradi port. Biomass will be wood chipped directly at the plantations, then stored in a conditioned open storage area 10km away from the port and loaded onto a cargo vessel of a minimum of 15,000 tons every 6-7 weeks for export to the available markets.

The proposed project will create opportunities for both GREL and the local communities as follows:

- Income generated from the sale of the biomass will guarantee the continuation of the replanting programme which is currently dependent on international rubber prices. At the moment, there is little incentive to replant the trees when the world prices of rubber falls, a situation that will change by the introduction of the biomass revenue.
- With the introduction of the industrialized extraction chain, charcoal producers, timber and wood traders will access greater volume of wood that they need to make the trade regular and sustainable
- The start up of biomass export will create employment opportunities (both skilled & unskilled) to the local communities in Ghana leading to a much improved standard of living
- Generation of revenue to government through the payment of various taxes.
- Siting operations in Takoradi makes economic factors most attractive to avoid high cost of transportation to the port for export.
- The establishment of an open storage facility to store the chipped biomass product near the port in readiness for export all year round will afford availability of raw material for immediate loading onto vessels to avoid increasing cost related to demurrage charges.

The Environmental Assessment Report as a planning/decision-making tool will:

- Identify and examine all the environmental impacts associated with the extraction, chipping into dedicated trucks , transport to open storage facility and port as well as the land preparation and construction of the open warehouse and associated structures
- Identify any potential environmental impacts associated with the operational phase of the proposed undertaking
- Integrate the findings from the assessment into the final project designs, construction and operation
- Propose mitigation and environmental improvement measures to address any adverse environmental impact resulting from this undertaking
- Put in place a monitoring plan to assess effectiveness and appropriateness of the proposed mitigation measures

1.3 Regulatory and Legal Obligations

The submission of the EA report will satisfy the statutory requirements under the Environmental Assessment Regulations 1999 (L.I.1652) of the Environmental Protection Agency (EPA) for acquiring an environmental permit.

Apart from the EPA Act 1994 (Act 490) and LI 1652 that empowers EPA to ensure compliance by all undertakings with the laid down EIA procedures in the planning & execution of all development projects, other legal requirements include:

- **Ghana Free Zones Boards Act, 1995 Act (504) and Free Zone Regulations, 1996 (L.I. 1618)**

It is aimed at promoting economic development through, inter alia, the attraction of direct foreign investment, employment creation, transfer of technology, enhancement of the technical and managerial skills of Ghanaians and the diversification of experts. L.I.1618 defines the free Zone enterprise obligation to the environmental regulations of Ghana.

- **Ghana Investment Code 1985, PNDC Law 116**

The 1985 Investment Code PNDCL 116, requires that the effects of an enterprise on the environment be taken into consideration.

- **Factories, Offices and Shops Act, 1970 (Act 328)**

The Factories, Offices and Shops Act, 1970 requires registration of the company with the Department of Factories Inspectorate to enable inspections of the premises of the project by an inspector of factories to ensure compliance with provisions of Acts relating to Health, Welfare and Safety of Workers.

- **Fire Protection Act, 1994 and Fire Protection Regulations**

For compliance with the provision of fire fighting regulations and provision of suitable firefighting equipment

1.4 Export of biomass products via port of Takoradi

According to industry experts, the combined demand for woody biomass of energy utilities in Europe is expected to grow from 13 million odt/year in 2010 to 33 million odt/year in 2015 and to 57 million odt/year in 2020.

The forecast is based on:

- Current use of biomass in the companies' renewable energy portfolio
- Capacity under construction
- Announcement of projects; and
- Investment targets as announced

Furthermore, in June 2010, EU member states submitted their National Renewable Energy Action Plans (NREAP) to provide further detail on how they plan to meet their obligatory country specific CO2 reduction targets through increased deployment of renewable energy production

Table 1.0: Some EU Member States Biomass Plans Set Out In NREAP (MW)

Forecast demand	Current Capacity	Expected Capacity
	2011	2012
Belgium	1,211	1,281
Denmark	1,017	2,779
Italy	2,206	5,254
Netherlands	1,430	2,892
Spain	596	1,187
UK	580	3,140
Sweden	2,641	2,872

The table above presents data on some EU member states biomass action plans which shows that most European countries will have higher demands for Biomass for electricity and heat energy resources especially the following: Sweden, Italy, Denmark and the UK.

Table 2.0: Export Schedule

Vessel capacity		Year 1	Year 2	Year 3-4	>Year 5
Expected load capacity 15,000 (MT) / MONTH	Forecasted Demand	150,000(MT)	300,000(MT)	600,000(MT)	>750,000(MT)

1.5 Target Market

The forecasted increase in demand for biomass is mainly driven by a variety of incentive schemes across Europe in order to comply with the 2020 targets (20% of energy generation in Europe to be sourced from renewable energy by 2020).

The European Commission foresees biomass playing a vital role in reaching Europe's 2020 targets for sustainability, not least because biomass has a number of well-known advantages as an energy source:

- It reduces carbon emissions substantially if sustainability aspects are carefully managed
- It is a proven technology
- It can function as reliable base-load capacity
- In many applications it is relatively capital-light

2.0 PROJECT DESCRIPTION

2.1 Project Location

The rubber plantation is located in Abura-Ahanta in the Ahanta West District of the western region covering over 13,000 hectares. The Ghana Rubber Estates Ltd operates a 15,000MT capacity rubber processing plant at Apimenim also in the Ahanta west district and about 30km from Takoradi port.

The proposed warehouse facility is located at APOWA a suburb of Takoradi and about 10km away from the port of Takoradi. The total land coverage for this facility is 4.1 hectares (10.13 acres) acquired by Takoradi Renewable Energy Ltd from the present owner General Development Company Ltd- saw millers, wood processing and quarry aggregates.

Fig.1.0. Location map showing Administrative Districts of Western Region

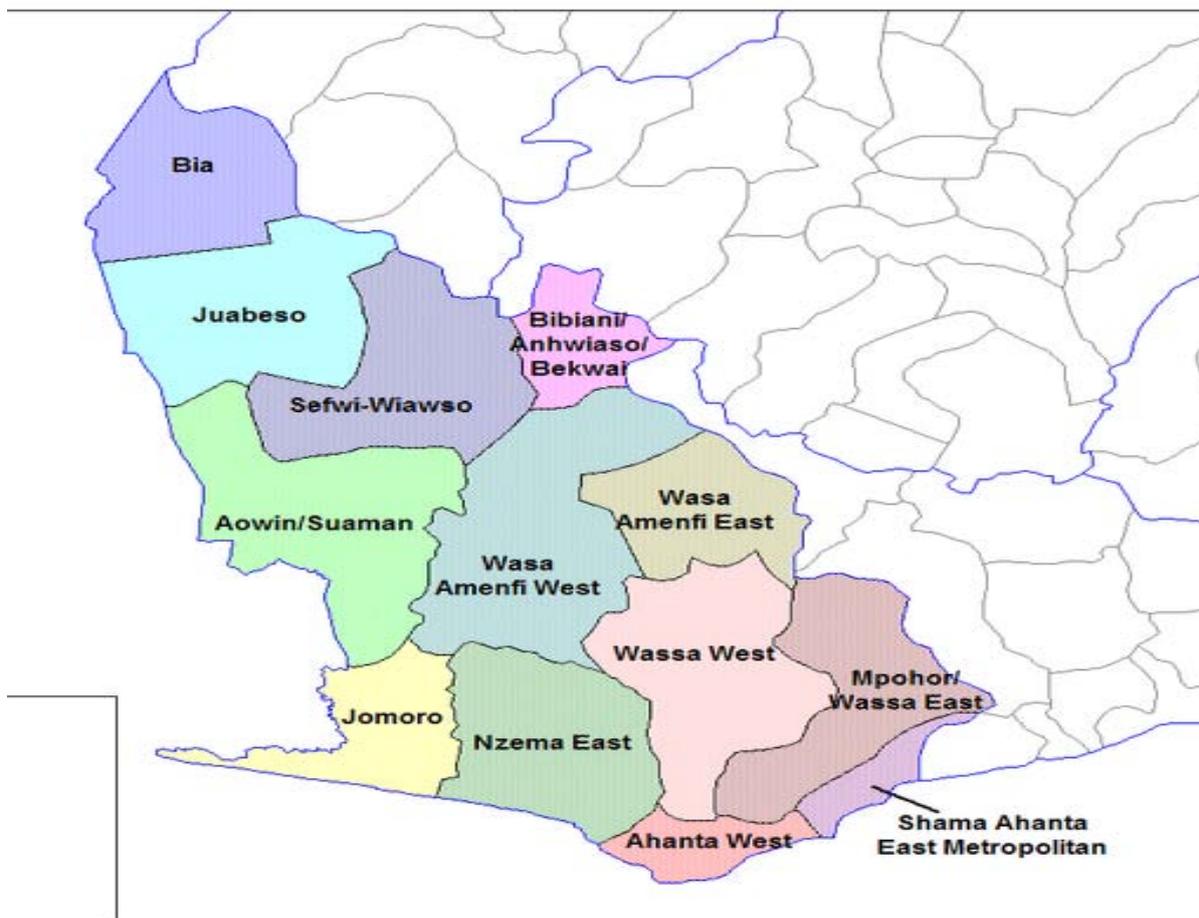
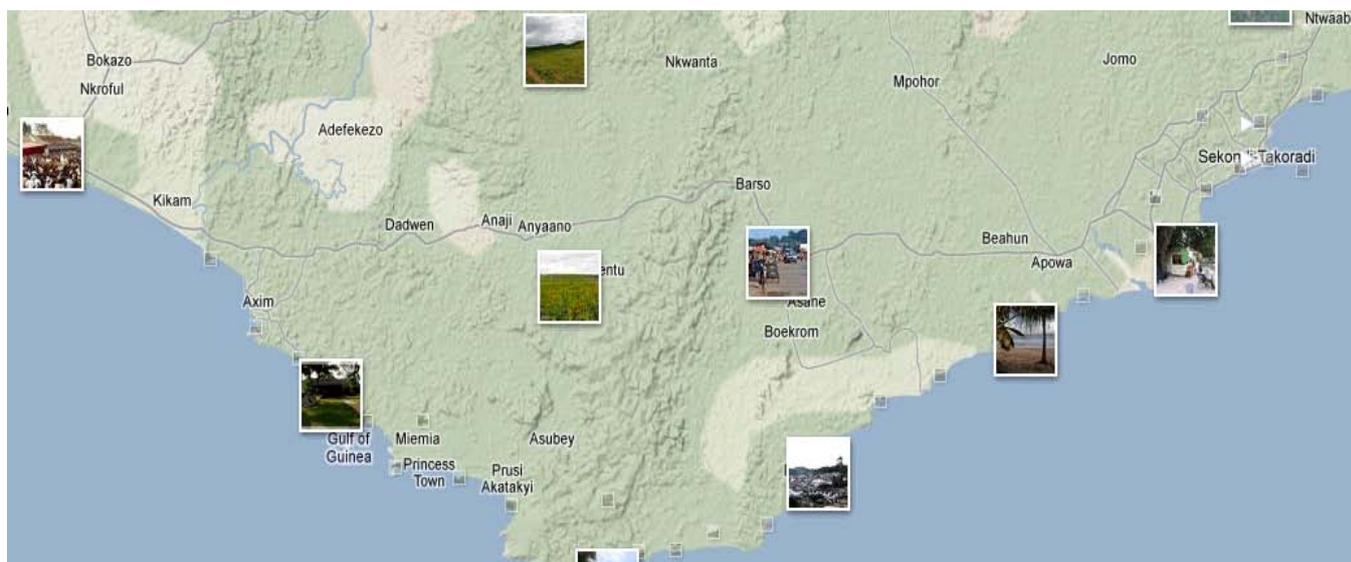


Fig.2.0 Location map showing plantation of rubber trees and some villages within the project district in Ghana



2.2 Site Description

The Ghana Rubber Estate limited rubber plantation covers a total land area of over 13,010 hectares out of which 4,800 hectares of rubber trees are currently over aged and under tapping. GREL is also the technical operator of the rubber out grower plantations project (ROPP) which began in 1995.



Picture: A section of Rubber Plantations showing access road into Plantations

2.3 Description of site for open storage facility

The site acquired for the storage of the biomass by-product from the rubber plantation is located at Adowa, within the premises acquired from General Development Company. The terrain is generally gently sloping into the low-lying area that serves to drain the entire area thus requiring filling to enable the location of the warehouse project and associated facilities on firm foundations. The northern

side is hilly with scanty vegetative cover of shrubs and grass. The engineering consultants have been tasked to engineer the area in such a way that the hilly overburden lateritic soil can be removed to backfill the low land to create even floor for the construction of the warehouse foundations. The civil drawings and constructions plans are being discussed and finalized for work to commence.

Fig. 3.0: Site information in pictures



Picture 1: South View of proposed Warehouse



Picture 2: View of sawmills west of proposed site



Picture 3: Eastern View of Proposed Site



Picture 4: Western View of Saw mil

2.4 Land use Zoning

The zoning status of the site for the warehouse facility is industrial reminiscent the presence of other industrial activities of General Development Company, a Timber firm and there is also a cocoa processing industry across the main road about 3 km south of the proposed site. The western site is bordered by the General Development Company operating saw mill as shown in picture 3 whilst the eastern site is another saw mill under development.

The site for the plantations is a reserved land for plantations development under the government landed properties of Ghana Rubber Estates Ltd and Firestone Ghana Ltd (Miscellaneous Provisions) Act 1977. The route to the port is part of the major route linking the western corridor to the port of Ghana and neighboring Cote D'Ivoire. Though an industrial area, there is every indication that the Apowa community will spread near the proposed site as a result of infrastructural expansion of STMA as a direct result of the commercial discovery and extraction of oil in the Western Region.

2.5 Raw Materials

2.5.1 Construction Phase

For both the extraction of the biomass by-product from the plantations and the construction of the open warehouse facility the major raw materials would include but not limited to the rubber trees ,steel beams, roofing sheet, cement, stones, quarry chippings, gravel/sand, water, nails, paint, wood, tiles, PVC pipes, glass etc. The details of civil drawings are being discussed and finalized, but it will be possible to reuse some of the waste associated with the material for the construction phase. The overburden soil for instance will be used to fill low lying zone whiles any other waste will be controlled to avoid impacts on the environment.

2.5.2 Operational phase- Extraction, Chipping, Transport and Storage

For the extraction phase of the project, the basic raw material is the agro-industrial by-product of the Ghana Rubber Estates Ltd over aged rubber trees. About 4,800 hectares of rubber plantations expected to be harvested during the 8 year contract

period and an estimated quantity of 1.2 million tonnes of biomass to be exported to European markets.

The chipped rubber trees would be transported to the open storage facility and Takoradi port by bulk haulage vehicles (bhv). These would be covered haulage trucks to avoid wood spillage on the busy roads both to the warehouse and port.

Table 3.0 Raw material

Type	Source	Packaging
Chipped Wood	Ghana Rubber Plantations Ltd	Chipped into Trucks for Transport to open storage facility and port

2.5.3 Utilities projections for operational phase

Table 4.0: Utilities projections (sources and demand)

Type	Source	Demand Capacity
1. Electricity	Electricity Company of Ghana	100KVA
2. Water	Ghana Water Company Ltd	200,000 litres
3. Diesel	Oil Marketing Companies	1.2 million litres/ yr.

NB: For electricity and water actual consumptions will be established during operational circumstances. The design capacities are quoted above.

2.6 Products

The final products of the company will be chipped wood which will be transported in bulk by haulage trucks to the open storage facility and port for export.

Table 5.0: Table showing final product, source and packaging

Type	Source	Packaging
Chipped wood	TREL open storage facility at Apowa	Bulk in enclosed trucks

2.7 Equipment and Infrastructure Facilities

Equipment/machinery for operations is presented in Table 6.0 below:

Item No.	Equipment	Qty	Estimated Cost (€)	Origin
BUSH				
1	Grapple Skidder	2	131,137	Europe/USA
2	Chainsaw	8	12,108	Europe/USA
3	Mobile Chipper	2	1,034,000	Europe/USA
4	Truck & Trailers	13 & 14	811,801	Europe/USA
5	Excavators	3	864,459	Europe/USA
6	Pick-up	1	20,141	Europe/USA
WAREHOUSE				
7	Storage Facilities	1	755,385	Europe/USA
8	Pay loader	2	217,580	Europe/USA
9	Conveyor Belt	3	370,482	Europe/USA
10	Pick-up Trucks	2	40,282	Europe/USA
PORT				
11	Front End Loader	2		Europe/USA
12	Conveyor Belt	1	123494	Europe/USA
Total			€3,701,211	

Table 6.0: Summary of equipment and machinery

2.8 Infrastructure Facilities

2.8.1 Harvesting of Rubber Trees at the Plantations

Infrastructural development of the area and social amenities are limited to settlement camps for the workers of the Ghana Rubber Plantations. There are about eight (8) of such settlements within the plantations provided with good drinking water via bore holes.

Apart from the inlets routes into the plantations for the harvesting phase, fuel loading facilities are anticipated during the harvesting phase of the project. This will save travel time of the equipment to refuel thereby increasing production output.

2.8.2 Open Storage Facility

The construction and operation of the open storage facility will require, workers changing rooms, staff office for administrative and secretarial duties, washing bay, parking lot for both small cars and big cars, access road and some public drains in the area.

The summary of the necessary infrastructure to be provided will include but not limited to:

- The construction of storage area to keep the chipped wood product
- Construction of office buildings for administrative and secretarial purpose
- The construction of fence infrastructure and maintenance within the main building
- A car parking areas for the big trucks and small cars
- Construction of washing bay, tools and lubricants stores
- Perimeter wall, gatehouse and a weigh-bridge

2.9 Description of Construction Works

The type of structures to be provided under the proposed project will involve the construction of an open storage facility and office building and will be roofed with long span industrial roofing sheets. The activities that constitute the construction phase will include the following

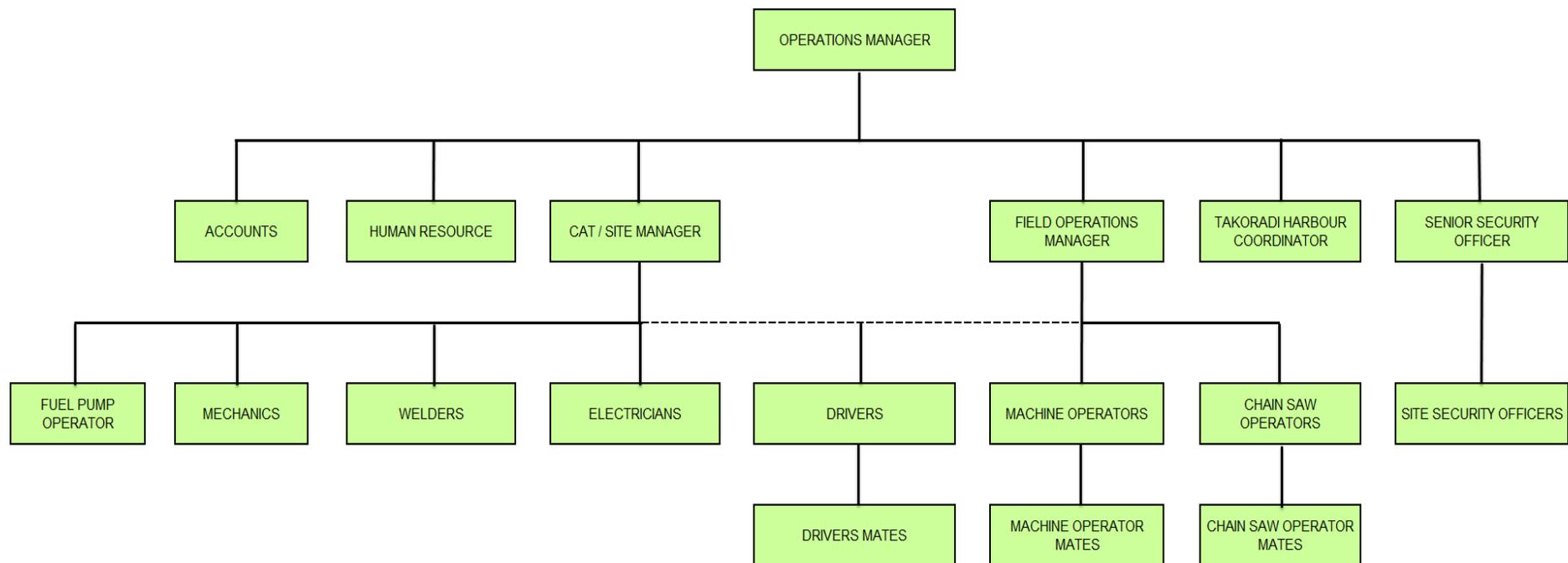
- ❖ Provision of site office and temporary fencing to cordon off construction area
- ❖ Construction of reinforced concrete foundations to thickness 200mm to hold stresses of movement of heavy trucks in the warehouse.
- ❖ Construction of enclosing fence for the warehouse and administrative blocks
- ❖ Excavation of trenches and construction of storm drains on the periphery of the site draining the area of storm water into the adjoining low lying Zone and also the necessary ducts to pipe in clean water from the GWCL.
- ❖ Construction of gatehouse, perimeter fence and access gate,
- ❖ construction of water storage structure to harvest and store rain water which could otherwise have run down the drains into other adjoining lands
- ❖ Construction of a washing bay and internal store rooms
- ❖ Improvement of the access road to the warehouse site with traffic control modifications

The construction sequence will be in logical steps beginning with the foundations. The project will be carried out by experienced civil contractors with sufficient supervision from the engineering consultants.

2.10 Management and Organizational Structure

The proposed project will employ a total workforce of about 50 comprising managerial, technical and non-technical support staffs. The organization structure is illustrated below:

Fig 4.0 Organogram for Takoradi Renewable Energy Ltd.



2.11 Description of Extraction Process

TREL core responsibilities under this project will be to fell the trees in the plantation, drag the felled trees to the roadside for de-limbing, chipping of trees into awaiting trucks. This cycle will constitute the extraction phase. There is the possibility of local community involvement in this process as a way of supporting local charcoal producers, carpenters and firewood dealers as a social responsibility project.

Table 7.0: Estimated Extraction Capacity

Felling of Trees	Chipping of trees to Open storage facility	Quantity of wood loaded to open storage facility
Over 600 hectares /year	600MT/day	219,000MT/year

2.12 Description of transport and Storage Process

The initial step in the extraction of rubber trees is the planning of access routes and determination of loading stations for intake of products. The harvesting excavators and Grappler skidder machines will need access into the plantations to cut and drag the trees to a central loading station to feed the mobile chipper equipment. The Ghana Rubber Estates Ltd has been practicing selective re-plantation and TREL may incorporate this planning into its harvesting programme. The transport cycle begins as soon as the chipper fully loads an awaiting truck in the loading station. Transportation is via the Takoradi–Tarkwa alp halt road which is about 40km to the open storage facility. The transported material is dumped at the open warehouse located at Apowa pending delivery to available vessel at the port.

Fig.5.0: Environmentally based extraction process flowchart indicating pollutant sources.

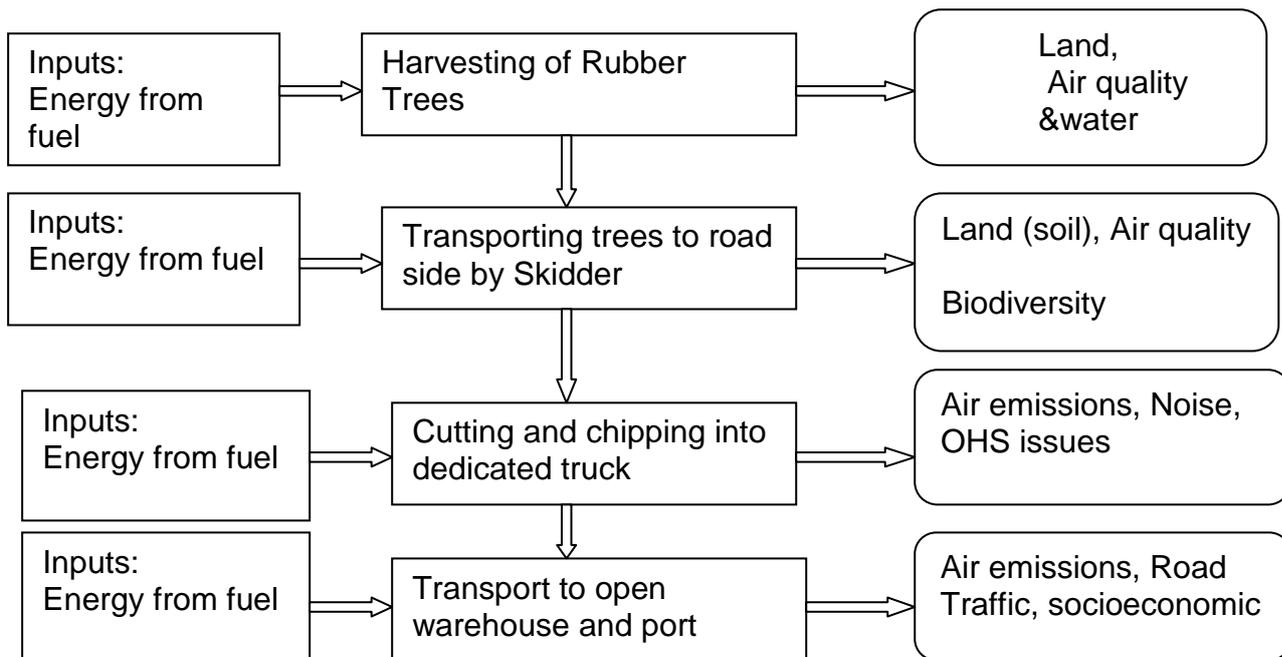


Fig. 6.0 Supply Chain Process Flow Diagram.

The main unit operations at the supply chain line are depicted in the flow chart below



Harvesting of Rubber trees



Transportation to road side by skidder



Road side de-limbing and cutting
Road side chipping into dedicated truck



Transport of wood chips to dedicated storage

3.0 BASELINE INFORMATION

3.1 Existing environment

The rubber plantation is currently accessed via the Takoradi-Bonsaso-Tarkwa asphalt road. Ghana Rubber Estates Ltd plantation is located within the Abura-Ahanta West, Tarkwa/Nsuaem, Mpohor Wassa and Nzema East districts of the Western Region

The baseline information on the project site was obtained through the adaptation of the following methodology:

- Determination of the characteristics of the various wastes, emissions and operations of plantations development through interviews
- Site assessment and desktop research on harvesting of plantations
- Consultations with stakeholders including government data collecting agencies and utility service providers

The baseline information covered here includes:

Site topography for warehouse, geology and soils, climate, vegetation, land use zoning, ambient air quality, ambient noise, traffic, waste generation (solid, gaseous and liquid)

3.2 Physical Environment

3.2.1 Geology

The soil is loamy and is good for the cultivation of palm fruit, coconut, maize, vegetables, citrus and rubber trees.

3.2.2 Topography and Drainage

The land is generally low-lying and it is underlain with rocks rich in gold, diamonds, manganese and some takes of clay.

3.2.3. Vegetation

The District falls largely within the High Rain Forest Vegetation Zone, capturing several hectares of plantation of the rubber trees. To a large extent, this contributes significantly to reducing the problem of global warming, since a chunk of CO₂ emissions by the automobile especially, are absorbed.

Due to human activities, all the forest except Cape Three Points Forest Reserve which occupies an area of 51.02 square kilometers has been reduced to secondary forest.

3.2.4 Flora and Fauna

The terrain of the plantation area is undulating and the main vegetation of the area consists of rubber plantations (raw material), grass, and weeds. The fauna evident in the project area are lizards, butterflies, bees, grasshoppers and birds of several species.

3.2.5 Climate

The climatic conditions of the project area are within the South-Western Equatorial Climatic Zone of Ghana the highest mean temperature is 34°C which is recorded between March and April, while the lowest mean temperature of 20°C is experienced in August. The rainfall is tropical with a double maxima pattern. It experiences a double maxima rainfall of over 1,700 millimeters. This abundant rainfall supports agrarian activities in the District. However, due to the high number of third class roads in the district, accessibility to most parts of the district is thwarted during the rainy season. Relative humidity is very high averaging between 75% to 85% in the rainy season and 70% to 80% in the dry season. The District is located within the wettest region in Ghana.

3.2.6 Ambient Air Quality

Data on the quality of air in the area is lacking mainly due to the vast land reserved only for plantation development. Only few settlement camps exist for the workers of the Ghana Rubber Estates limited and very little activities are done to disturb the air quality equilibrium.

The area for the warehouse facility is presently located on an industrialized zone, environmental monitoring with regards to air quality has not been conducted yet but a monitoring programme will be put in place to check the contribution of the proposed project on the ambient air quality of the area.

3.2.7 Ambient Noise

Noise nuisance in the plantation areas could be influenced by activities of the chainsaws and vehicular traffic on the access road. Otherwise, the area is very quiet. Daytime ambient noise levels are primarily due to intermittent chainsaw operators, small forest birds and road side traffic.

EPA Permission Noise Levels for Zoning of residential and industrial areas has no relevance in the plantation setting, but can be applicable at the warehouse facility. Currently, only intermittent activities of the General Development Company impact the acquired land site for the construction of warehouse. Data on existing noise level are absent, but will in general not exceed 70Db (A)– heavy industrial areas.

3.3 Meteorological Information

3.3.1 Rainfall

The climate of the area falls mainly within the wet equatorial forest region with two rainfall maxima. The main season is from March to July with the wettest month in June and the minor season is from September to November. A short dry spell occurs in August and the major dry season is from December to February.

3.3.2 Temperature

The mean daily minimum and maximum temperatures are 23.3⁰C and 30.2⁰C with a mean daily temperature of 26.8⁰C. The mean annual temperature is 26⁰C. The highest mean monthly temperature of about 32⁰C occurs between March and April of the year and the lowest of about 21.5⁰C occurs in August.

3.4 Total Energy Requirement for the Project

There will be two main sources of energy used in the extraction, transport and storage process: electrical energy from national grid for storage facility lighting requirements at the warehouse and fuel to power the machinery engaged in the harvesting and transportation phases.

In addition there will be a 100 KVA standby generator to supply electricity to the warehouse facility in case of power outage.

3.5 Water Requirement for the proposed open storage facility project

An estimated 200,000 litres water tank capacity is incorporated in the warehouse facility design to store water either from rain harvest sources or underground abstraction. There is also the intention of connecting to the city water supply system to support the warehouse water requirements but this will be expected to have limited impact on GWCL capacity to supply water to the entire area. The possibility of ground water abstraction is being discussed but this will be in limited volumes making its assessment less significant.

3.6 Consultations

Consultations have been carried out with the following organizations:

- ❖ Sekondi Takoradi EPA office in respect of the submission of a completed Form EA1 with attachments and to arrange for the screening visit to the proposed project site.
- ❖ Management of General Development Company for land acquisition and determination of accessibility to the site.
- ❖ ECG to verify whether demand by the proposed project can be supplied without affecting the general power supply
- ❖ GWCL to find out whether the proposed project will adversely affect the water supply situation in the area.
- ❖ STMA for collection and disposal of solid waste from the proposed project facility
- ❖ The company is in the process of applying for a free zones status from the GFZB
- ❖ Ghana Ports and Harbour Authority to assess impacts of this new industry on port operations

4.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS

Environmental concerns identified with the proposed project may be categorized into the constructional phase and the operational phase impacts. Whereas the operational phase of the extraction of the plantation is a well known activity only limited to small scale businesses of fire wood traders, charcoal producers and carpenters, the industrialized harvesting using heavy machinery and equipment will create impacts on the plantation resources. The constructional phase impacts are varied depending upon the scale of the project, the geographical location, land use of the vicinity, materials used for the construction and the demands of the local authority.

4.1 Constructional Phase Impacts

These will involve the preparation of the land and the construction of infrastructure for the open storage facility located at Apowa. The impacts associated with this phase will be:

- Loss of vegetation cover
- Change of landscape from the massive cutting of hilly portion to fill the low lying areas.
- Noise nuisance from the operation of earth-moving equipment and from the hammering, compacting machines and the use of small implements
- Generation of dust from soil disturbance during land clearing, tipping of sand, aggregates and the use of cement as well as the movement of vehicles through untarred surfaces.
- Occupational safety and health hazards
- Construction waste management
- Traffic management at the roadside and entrance to construction site
- Socioeconomic benefits from employment generation and its multiplier effect for the people of the Ahanta West district and the western region

4.2 Operational Phase Impacts

Potential operational phase impacts will be the following:

- Aerial emissions from machinery engaged in the harvesting of the rubber trees,
- Solid waste (particularly wood off cuts and leaves) generation and management
- Fuel spillages from the refueling activities
- Occupational safety & health hazards (Noise, fire, stress, heat exposure, etc)
- Biodiversity impact
- Socioeconomic benefits
- Community relations
- Traffic management

4.3 Socio-Economic Impact

The project would create a positive impact through employment generation for about 50 Ghanaians and help improve their standard of living and their families and the multiplier effect on relations. Employment in terms of equipment operation, haulage of industrial by-product to storage shed and port will create direct employment opportunities for the indigenous people. Out of the annual target of over 600 hectares of rubber plantations to be harvested, more than 8% of this would be available for local communities involved in charcoal production, carpentry and wood arts, and domestic firewood for household use. The export of the biomass by-product will generate foreign exchange from payment on exported quantities as well as generate revenue through the tax exemptions under the free zone enterprise regulations.

4.4 Assessment of Impacts

The constructional, operational and socio-economic impacts are discussed and evaluated with respect to:

- i) Their nature, magnitude and effect on human health and general environment.
- ii) Residuality, that is, impacts that might remain after mitigation measures have been applied and may therefore require monitoring.

4.4.1 Assessment of Constructional Phase Impacts

4.4.1.1 Dust Generation

The dust generated can affect the aesthetics of the settlements around and affect the vegetation as well leading to foliage loss. Dust can also impact on the workers on the project site as well as inhabitants of the settlements in the leeward direction of the wind. Ailments such as asthma and respiratory tract infection will increase with excessive dust generation.

4.4.1.2 Noise Nuisance and Vibration

All aspects of the construction activities will generate noise which can cause sleeplessness with its complications such as headache, migraine, tiredness etc. Hearing loss impairment will result from the noise associated with the project particularly the workers using the implements and machinery. Noise will equally come from the concrete mixer, compacters, the use of motorized implements as well as the horns of project vehicles. There will be no blasting of any sort but ground vibration will be caused by the operation of the earth-moving machinery and foundation compactors.

The level of vibration will however be too small to cause any damages to properties of adjoining land. Also, the effects of noise and dust from the construction activities will be inevitable, intermittent and of short-term in nature and duration and if not controlled, may lead to varying degrees of chronic and acute situations.

4.4.1.3 Construction Waste

Constructional waste here will mainly include excavated overburden, debris, concrete, broken blocks, cement bags, paint cans, roofing/other metal trimmings & pieces of wire, wood and plastic pipes. The fact that the impact in this category can be turned into economic positives makes its overall evaluation as less significant.

4.4.1.4 Occupational Safety and Health Hazards

Accidents occurring during construction works have the potential to cause serious injury, permanent disabilities or even death to workers. Accidents may also occur off the construction site involving haulage trucks that may result in fatalities, loss of materials, protracted court cases, loss of time and money. The construction firms contracted for the proposed project must develop safety plans in line with the company's policy whose implementation must constitute steps, activities and measures to ensure proactive steps are taken to guarantee safety and health of workers at all times. Strict adherence to the plan may reduce the incidence of accidents and injury to workers. TREL has contracted an experienced and reputable company, K+H Limited, which has such safety and health policies in place for this work.

4.4.1.5 Traffic Situation

Currently, the entrance to the construction site is directly facing the Takoradi-Agona-Tarkwa road and hence has the potential of creating traffic go-slow when trucks will be entering and exiting. It also has the potential of causing accidents if not properly managed. A traffic count at the road side of the trunk road is about 600 vehicles per hour, most of which are saloon cars, pick-up trucks and commercial mini buses. There are currently few heavy-duty trucks plying this route but this might change depending on upsurge of companies in logistics and transport services to Tarkwa, Axim and Elubo areas.

4.4.2 Assessment of Operational Phase Impacts

4.4.2.1 Solid Waste

Solid waste from the extraction process, administrative offices will be generated. However, the major waste whose management will be a significant concern is predominantly wood off cut originating out of the harvesting activities.

Solid waste if properly harnessed will also be economic resource particularly for the small local charcoal producers, fire wood traders and carpentry and wood carving opportunities. Improper disposal of all solid wastes will affect land-use; choke drains leading to flooding during torrential rain falls.

4.4.2.2 Air Quality

The sources of energy for the operating equipment to be used are environmentally clean generating no flue gases. Maintenance schedule will be strictly adhered to and coupled with the fact that complete combustion of diesel/petrol may not always be achieved, some adverse impacts on air quality is likely to be present but very minimal. The main possible source of air pollution will come from the dust generated during construction of open warehouse, movement of trucks involved in the construction, exhaust emissions of trucks and machinery from diesel consumption of machinery involved in mechanically harvesting of trees.

4.4.2.3 Noise Nuisance

Harvesting machinery operation will generate noise. Takoradi Renewable Energy Ltd cognizant of impacts associated with equipment operation has undertaken to buy only brand new high technology equipment or at worst used equipment with small operating hours from Europe and the USA. However, the work environment noise due to the operation of these machines may be of less concern because there are no inhabitants living in close proximity to both the plantations and also the storage area.

4.4.2.4 Fire Hazards

Fire outbreak may result from inadvertent handling of wood waste, leaves and dry sticks when activities of charcoal producers are not controlled. This could lead to widespread fires in the surviving plantations and nearby forest. There is also the potential of fires from the storage shed due to faulty electrical connections and wood chipping storage. The wood products stored in the warehouse are very combustible and would readily serve as fuel in case of fire.

4.4.2.5 Occupational Health and Safety

This project may pose occupational health and safety risks to the workers. These will include:

- traffic safety at the road side and the main gate
- accidents, abrasions, cuts from moving and unguarded machines
- electrical shocks from machines, chainsaw machines and warehouse facilities
- improper operation and handling of equipment and tools such as harvesters, chainsaws machines, haulage trucks

However, preventive/mitigation measures will be adopted where necessary.

4.5 ANALYSIS OF SIGNIFICANCE OF IMPACTS

Impact magnitude will be determined by assessing the extent, duration, severity and probability of occurrence and reversibility of impact.

Table 8.0 Criteria for Predicting Impact Magnitude

Criteria	Low Impact (1-4)	Medium Impact (5-8)	High Impact (9-12)
Extent	Restricted to Site	Restricted to project stakeholders	Beyond the project partners affect local communities or public
Duration	At a particular activity	During project life	Beyond project
Severity	Small changes	Small & incurable losses	Substantial losses
Probability of occurrence	Possible	Will most likely occur	Will definitely occur
Reversibility	Can be reversed	Possibly reversible	Reversibility highly unlikely

Scale Index	1 – 20	Low (L)
	21 – 40	Medium (M)
	Above 40	High (H)

Table 9.0 Impact Assessments – Magnitude of Impacts

Impact	Extent	Duration	Severity	Probability	Reversibility	Total	Significance
<u>Construction phase</u>							
Vehicular Traffic at Road side	4	7	4	4	5	24	M
Compacting of soil	4	1	8	6	11	30	M
Landform change & earthworks	3	2	10	10	12	37	M
Ambient Noise Levels	4	6	3	7	3	23	M
Ambient Air Quality	8	3	5	5	3	24	M
Construction waste generation	2	4	6	8	1	21	M
Drainage	3	5	3	4	5	20	L
Socioeconomic benefits	11	8	4	12	6	41	H

<u>Operational phase</u>							
Traffic management	4	7	4	4	5	24	M
Ambient Air Quality	8	6	6	5	3	28	M
Workplace air quality	2	6	4	4	2	18	L
Workplace temperature	1	5	5	4	2	17	L
Employment	12	8	5	12	11	48	H
Increased Noise	4	6	5	5	5	25	M
Increased Risk of Fire	6	8	9	3	1	27	M
Sanitary waste disposal	1	5	2	8	1	17	L
Solid Waste Mgt (refuse)	9	6	3	4	3	25	M

<u>Harvesting phase</u>							
Traffic Management	4	4	3	1	5	17	L
Ambient Air Quality	4	5	5	6	2	22	M
Climatic Conditions	8	9	8	2	2	29	M
Increased Noise Level	4	6	5	5	6	26	M

4.5.1 Analyses of impacts

High Impacts

There are positive high impacts across the project phase basically due to the socio economic influence on local charcoal production, carpentry, fire wood traders and employment generation for some Ghanaians.

Construction phase

- Socioeconomic benefits which are positive

Operational phase

- Employment opportunities

Medium Impacts

The magnitude of impacts here was rated medium.

Construction Phase

- Vehicular traffic at the road side
- Vegetation loss
- Landscape changes and earthworks
- Ambient Noise Level
- Ambient Air Quality
- Construction Waste Generation
- Compacting of soil

Operation Phase

- Traffic management
- Ambient air quality
- Increased level of noise
- Increased risk of fire
- Occupational health and safety issues
- Solid wastes (wood /dirt/refuse) management

Harvesting Phase

- Ambient Air Quality
- Climatic Conditions
- Increased Noise Level

Low Impacts

The magnitudes impacts were rated low.

Construction Phase

- Construction waste management
- Drainage alterations and increased land invert levels relative to low land
- Occupational health and safety issues

Operational phase

- Workplace air quality
- Wetland siltation and contamination
- Sanitary waste and process wastewater disposal
- Increase in ambient temperature & work environment temperature leading to stress of workers

5.0 ENVIRONMENTAL IMPACT MITIGATION MEASURES

5.1 Introduction

The various strategies evolved in this study to mitigate the possible negative environmental impacts associated with the development and operation of the project are derived from consultants experience in best management practices and recommendation of ISO 14001 management systems. Some of the construction controls to minimize adverse effects are described below:

- Condoning off of the construction site to eliminate trespassing by pedestrians and to avoid accidents involving passers-by
- Ensuring all construction activities are limited to the day time to avoid noise disturbances at night
- Training of workers in their respective work assignments to implement cleaner operations techniques and reduce waste, pollution and work-related accidents
- Purchasing of low noise producing machinery, equipped with silencers/mufflers
- Ensure the provision of personal protective gears and accessories to construction workers (helmets, safety boots, gloves overalls etc) and the appropriate attire for the workers
- Implementation of a solid waste management, prioritizing economic waste to maximizing profit and employing STMA approved contractors to collect and dispose undesirable wastes
- Installation of fire equipment including fire extinguishers, fire hydrants, smoke detectors and fire alarms systems
- Implementation of an elaborate risk and emergency response plan to curtail, minimize, eliminate and appropriately respond to actual emergency situations,

5.2 Constructional Phase

5.2.1 Vegetation loss and landscape alteration

The scanty vegetation of grass, shrubs and trees will be removed, collected to waste disposal sites and part given as firewood to the local community to allow for the construction of the open storage facility. The overburden will be stockpiled for backfilling whilst the refuse carted away by the STMA approved dealer.

All the backfilling will be compacted, landscaped and the northern border stone pitched or butted to prevent any future collapse or excessive erosion. This arrangement is according to best practice and will allow gravity drainage of warehouse premises and the immediate environs into the designed drains.

5.2.2 Generation of Dust

Tarpaulin will be used to cover sand, gravel and chippings when being transported to the site. All vehicles transporting construction materials in the project area will move at a mandatory speed of 40 km/h or less so as to prevent spilling transported construction materials leading to dust generation. Water sprinklers/dowers will also be used to suppress dust on untarred and active working surfaces of the construction site and sand tipping points when the need arises.

5.2.3 Waste Generation

Excavated soil will be used to backfill the foundation and excess used in landscaping. Broken blocks and slabs will also be used for foundation backfilling or for concrete work. Empty cement bags, pieces of wire, wood, plastic pipes and paint cans will be picked up by approved waste contractor for disposal.

5.2.4 Occupational Health and Safety

The contractor(s) on the project will observe occupational health & safety plan(s) and procedures including commitments to work hours to ensure minimal workplace accidents. The workers will be provided with crash helmets, plain safety goggles (but where welding is involved, the appropriate goggles), nose masks, overalls, reflective jackets and safety boots. First Aid items will be provided at the site for minor cuts

whist serious injuries shall be treated at the district hospital or the Effia-Nkwanta Hospital. The project site will be fenced to ward off intruders.

5.2.5 Construction Noise

These are identified in section 4.4.2.3 and though short in duration will be inevitable and sometimes annoying for this phase. To avoid any noise nuisance and disturbing the sleep of neighbours, contractors are to schedule and ensure all construction activities start in the morning (7.00am) and close at 6.00pm daily with no night construction activities.

5.2.6 Traffic Management

The proposed project is currently under construction and the entrance used is main gate of the General Development Company. Though the construction vehicles are restricted to the site, traffic wardens wielding green and red flags have to control traffic. Though this affects traffic flow temporarily, it is the best arrangement to avoid accidents.

5.2.7 Socioeconomic issues and Corporate Social Responsibility

The employment figures for the warehouse construction activities stand at about 60 who will earn income to improve the living standards of their families. These workers are made up of local and national engineers, supervisors, and artisans of various trades of the construction industry.

5.3 Operational Phase

5.3.1 Solid Waste Generation.

- The company shall source and select an approved STMA waste collecting agency to handle all types of solid waste which cannot be used economically.

5.3.2 Air Quality

- To avoid air pollution, emissions from machinery should be environmentally clean fuel devoid of the normal flue gases.
- Construction activities shall be planned to avoid inadvertent dust generations

5.3.3 Noise

- Workers manning noisy machines will be provided with earmuff
- Regular maintenance will be carried out on all equipment and machinery to reduce their noise levels and also improve upon their efficiency.
- The numbers of vehicles entering the premises to load and off-load goods and supplies will be limited and controlled to eliminate rampant reversing in the yard.
- Horn blowing will be prohibited and the speed limits will be 40kph

5.3.4 Fire

In order to prevent fire outbreak, the company will embark on good housekeeping, provision of adequate and suitable fire extinguishers, fire hydrant points with adequate reels/hoses, smoke detectors and fire alarm in accordance with the recommendations of the Ghana National Fire Service protection and prevention report.

5.3.5.1 Guarding of Dangerous Machinery

Exposed parts of dangerous machinery and moving parts shall be guarded to prevent access to dangerous parts and hence injuries to workers and visitors.

5.3.5.2 Statutory Examination of Lifting Equipment

A competent Engineer-Surveyor approved by the Chief Inspector of FID to rectify faults shall statutorily examine all forms of lifting equipment

5.3.5.3 Protective Clothing and Appliances

All workers shall be provided with prescribed personal protective clothing and gears overalls, head covers, earmuffs and Wellington boots to protect them against injuries and their use shall be enforced as well as motivate workers to use them all time

5.3.5.4 Electric Shock

To prevent electric shock, electrocution or fire outbreak, electrical circuits shall be insulated, earthed and properly fused. Sockets and plugs shall be of the correct specifications.

5.4 Resource Use per Unit Production

One of the objectives of the TREL will be the judicious use of resources as shall be set out annually in the resource per unit production analysis set against best practice industry benchmarks to assist TREL Management in making business decisions and keeping cost and risks associated with resource use and production in mind. This will also make TREL Management aware that optimizing resource use and preventing and managing wastes can result in opportunities for business gains.

Analyzing resource use will provide a base to ensure that TREL resources will be used to their maximum advantage and will be an essential element of an effective resource management plan with enhanced ability to track and monitor their resource use. This will help to:

1. confirm savings from any efficiency investments and identify new opportunities for savings
2. set up a database for cost control and benchmarking and

3. check billing accuracy in the case of water, energy (electricity), telephone and any other billable resource.

TREL will benefit significantly by moving towards effective resource management practices. Effective resource management does more than reduce costs and increase profitability; it can drive the whole business to improved performance through its effect on, operations, maintenance and environmental issues.

6.0 ENVIRONMENTAL MONITORING PLAN

Monitoring plans shall be developed for the company as follows:

6.1 Environmental Monitoring

The monitoring criteria will ensure that sound environmental management practices are adhered to at all stages of the project.

As much as possible noise monitoring programme will be put in place and recommendations formulated to management for improvement measures to ensure compliance with EPA and FID standards. The monitoring regimes for the above parameters, additional parameters and regularity of report submission shall be discussed with the regional EPA when the project is operating.

6.2 Occupational Health and Safety Management

Monitoring will also cover housekeeping, noise, equipment operation, efficiency and maintenance. Documentation and records shall be kept to reflect periodic review and corrective action plans. The in-house capabilities available within local consultants would be used to monitor air and noise quality.

6.3 Medical Monitoring

Workers will undergo pre-employment medical examination and thereafter be subjected to thorough medical examination periodically to determine any occupation induced sickness.

7.0 Emergency Response Plan

The management of Takoradi Renewable Energy Ltd proposes the following emergency response plan that will be modified when the project eventually comes into operation. The plan to train all categories of workers on kinds/types of emergencies will include but not limited to accidents, oil or diesel spillage, lightening and storms and bush fire . This will cover:

- ❖ How to raise alarm and what actions to take
- ❖ The organization of mock drills to test workers' response to alarms.
- ❖ How and who to call emergency services, e.g. Fire Service, Police, etc.
- ❖ Where to go to reach safety or get rescue equipment.
- ❖ Who will control the incident and the names of other key staff such as first aiders.

The proposed project will be equipped with the following:

- ❖ First –aid boxes,
- ❖ Alarm systems
- ❖ Emergency services e.g. shut down systems
- ❖ Fire extinguishers approved by the Ghana National Fire Service
- ❖ Water hydrants located at vantage positions

8.0 CONCLUSION

The operations proposed by TREL has a series of environmental impacts as identified in this report as well as important socio-economic benefits to the communities. The management is cognizant of the necessary measures to mitigate the environmental impacts of the project and will put in place the necessary plans. TREL is also expecting to be recognized as a free trade zone company.