MIRO-FORESTRY (GHANA) LIMITED

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE PROPOSED REFORESTATION OF 4,428 HECTARES OF DEGRADED FOREST LANDS IN CHIRIMFA AND AWURA FOREST RESERVES, IN THE MAMPONG MUNICIPAL AND SEKYERE CENTRAL DISTRICT OF THE ASHANTI REGION

(Expansion of the Buomfuom

Draft ESIA Report

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EXECUTIVE SUMMARY

Background

Miro Forestry (Ghana) Limited is a sustainable and commercially focused forestry company with established and expanding plantations of fast growing timber for local and international markets. The Company is centered in West Africa.

The Company currently operates on about 5,000 hectares (ha) of degraded forest lands within the Boumfuom Forest Reserve, located about 8 km from Agogo, 20km from Kumawu and 3km from Ananekrom community. The current operational area was leased from traditional landholders and the Forestry Commission of Ghana.

In order to expand its operations, the company has acquired about 4,428ha of land in the Chirimfa and Awura Forest Reserves in the Mampong Municipal and the Sekyere Central District respectively from the Forestry Commission and the traditional landholders. Miro Forestry (Ghana) Ltd (MFGL) intends to develop the 4,428-hectare plantation with mainly Teak *(Tectona grandis),* Eucalyptus (Eucalyptus spp), Acacia and indigenous species such as Ceiba *(Ceiba pentandra)* and Wawa *(Triplochiton scleroxylon).*

The proposed development will involve nursing of seedlings, land preparation, creation of conservation management areas, planting of fast growing Teak and Eucalyptus tree species, sustainable selective harvesting. Infrastructural activities will include upgrading and maintenance of old logging roads.

The project will create employment opportunities for locals in Mampong, Nsuta and neighbouring communities, development of modern agro-forestry initiatives, collaboration with key stakeholders to support local good causes and distribution of financial benefits from plantation outputs for stakeholders. The company aims to plant 1,500 ha per annum going forward.

The acquired area in the Chirimfa and Awura Forest Reserves has suffered vast deforestation due to valuable hardwood harvesting, slash and burn agriculture and the harvesting for charcoal production. Consequently, the areas proposed for development is degraded and these activities have adversely affected the flora and fauna of the area.

According to a study undertaken by the Government of Ghana, as reported in Hawthorne and Abu-Juam's1995 IUCN book *Forest Protection in Ghana*, to the classify forest reserves into six condition categories, and upon consultations with the Mampong Forest Service Division, the level of degradation of the Awura and Chirimfa Forest Reserves is attributed to a condition score of 4-6. Scores 4-6 are applied to forests that have suffered slight degradation over more than half the reserve or heavy degradation over more than one-quarter of. it. Very often significant parts of the forest mosaic have poor regeneration of timber trees and other forest plants, generally because of lack of 'good' parts of nearby forest mosaics.

The Project is a reforestation intervention intended to rehabilitate degraded forest reserves by the development of fast growing commercial plantations and to restore the supply of timber for export and national development.

SAL Consult Limited, an environmental & water consulting firm based in Accra, Ghana was contracted by Miro Forestry Ghana in August 2017 to carry out the Environmental and Social Impact Assessment (ESIA) and the Public Consultation for the proposed Chirimfa & Awura lands for the Project.

In line with environmental permitting requirements as provided under the Environmental Assessment Regulations of 1999, Legislative Instrument (LI) 1652, Miro Forestry (Ghana) Limited registered the proposed Project with the Environmental Protection Agency (EPA). The EPA in a response letter of EPA letter) classified the proposed project as one which requires an Environmental Impact Assessment (EIA) to be carried out to help understand the likely implications of the proposal in order to inform the environmental permitting decision-making prior. A Scoping Report has been submitted.to the Agency for review.

Policy and Legal Framework for the Project

The following policies relevant environmental laws and regulations to guide Miro Forestry from the conceptualization stage of the project to implementation and monitoring include the following:

- Ghana Shared Growth and Development Agenda, 2010;
- National Environmental Policy, 2013;
- National Land Policy, 1999;
- National Water Policy, June 2007;
- Forest and Wildlife Policy, 2012;
- National Climate Change Policy, 2013;
- Riparian Buffer Zone Policy, 2014;
- National Employment Policy, 2014; and
- National Gender Policy, 2015

The relevant national environmental and other statutory laws and legislation particularly relevant to the project include the following:

- The 1992 Constitution of the Republic of Ghana;
- Ghana Investment Promotion Centre Act 1994, Act 478;
- Forestry Commission Act of 1999 (Act 571);
- The Companies Code, 1963 (Act 179);
- The Concession's Act (Act 124) 1962;
- The Forest Ordinance (Cap 157) 1927;
- Timber Resource Management (Amendment) Act (Act 617), 2002;
- The Forest Protection (Amendment) Act (Act 624), 2002;
- Wildlife Conservation Regulations (L.I. 685), 1971;
- Wild Animals Preservation Act,1961 (Act 43);
- The Forest and Plantation Development Act (Act 583), 2000;
- The Trees and Timber Act 493 (1994);
- Environmental Protection Agency Act 1994, Act 490;

- Environmental Assessment Regulations 1999, LI 1652;
- Fees and Charges (Amendment) Instrument 2015, LI 2228;
- National Environmental Quality Guidelines (EPA) 1995;
- Water Resources Commission Act 1996, Act 522;
- Office of the Administrator of Stool Lands Act 1994, Act 481;
- Local Governance Act 2016, Act 936;
- The Labour Act 2003, Act 651;
- Workmen's Compensation Law, 1987, PNDCL 187;
- Ghana National Fire Service Act 1997;
- The Fire Precaution (Premises) Regulations 2003, LI 1724;
- Factories, Offices and Shops Act 1970, Act 328;
- Control and Prevention of Bush Fires Act 1990; and
- Control of Bush Fires Law of 1983 (PNDCL 46).

Relevant International Conventions

Ghana is a signatory to some of the international conventions that are relevant to the proposed project such as *United Nations Convention on Biological Diversity; United Nations Framework Convention on Climate Change (UNFCCC); International Plant Protection Convention (IPPC) and African convention on the conservation of nature and natural resources (Revised) - ACCNNR*

Relevant International Safeguard Policies

The World Bank's environmental and social safeguards policies covering ten (10) key categories in a form of Operational Policies (OPs) as well as the International Finance Corporation (IFC) Performance Standards covering eight (8) key categories are operationalised when triggered by the proposed project's scope. The policies/procedures are to ensure the safe development of projects and to prevent and mitigate unintended adverse effects on third parties and the environment in the development process.

The Forest Stewardship Council (FSC) Principles and Criteria for Forest Stewardship

Miro Forestry has initiated the process to get its Ghana operations certified by the Forestry Stewarship Council (FSC). Certification is achieved by passing an assessment carried out by an FSC-accredited certification body, with forest management conformity assessed against the FSC Principles and Criteria.

Project Description

Miro Forestry (Ghana) Ltd (MFGL) proposes to develop a 4,428-hectare plantation comprising mainly Teak (*Tectona grandis)*, Eucalyptus (*Eucalyptus spp*), Acacia and indigenous species such as Ceiba (*Ceiba pentandra*) and Wawa (*Triplochiton scleroxylon*), as expansion development to add to the already existing 5,000 ha of plantation development at Boumfoum.

The proposed development will involve nursing of seedlings, land preparation, creation of conservation management areas, planting of fast growing Teak and Eucalyptus tree species, upgrading and maintenance of old logging roads, Thinning and Maintenance of tree plantations, sustainable selective harvesting, and Forest Fire Mitigation Management.

Pest control will be by means of Integrated Pest Management approach that employs a range of preventative and control methods to combat pests and diseases. Pesticides as well as cultural management strategies will be explored. Pesticides that will be used will be registered with the EPA as required by law.

The creation of employment opportunities for locals in Mampong, Nsuta, and other close communities, development of modern agro-forestry initiatives, collaboration with key stakeholders to support local good causes and distribution of financial benefits from plantation outputs for stakeholders. Miro's production site will be located in Mampong.

It is anticipated that raw water will be abstracted from the Drobon and Afram Rivers within the Chirimfa and Awura Reserves respectively, for storage prior to application of tree seedlings at the early stages of planting. Water distribution will be done by pressurized systems using pumps.

Project construction is likely to take 7 -8 years. About 20-30 management and administrative support staff will be recruited in the project during the construction and the operation phase. About 140-150 workers will be recruited to support plantation development objectives during the construction phase. The project will engage both skilled and unskilled people for various roles within the management of the project.

Baseline Environmental Conditions

The project area lies within the Afram Plains portion of the Forest-Savannah Agro-ecological zone of Ghana, characterized by pronounced wet and dry seasons.

The relief of Awura and Chirimfa Forest Reserves are gently undulating topography with slope gradients of 1–5% from summits to the edge of lowlands. Locally, areas where some rock outcrops occur have steep slopes (5–8%). A soil survey carried out in 2017 in the project area identified and mapped five major soil types within the Awura Reserve and include; Bediesi series (Dystric Nitisol); Sutawa series (Gleyic Arenosol); Kaple series (Umbric Gleysol); Bejua series (Dystric Gleysol); Volta series (Eutric Gleysol). Five soil types were also identified in the Chirimfa Reserve and include: Damongo series (Ferric Luvisol); Murugu series (Haplic Luvisol); Kintampo series (Lithic Leptosol); Techiman series (Ferric Acrisols); Tanoso series (Eutric Gleysol)

With the exception of the valley bottom soils (e.g. Volta series) and shallow rocky soils (e.g. Kintampo series), all the major soils are generally good for tree plantation establishment.

The quality of the ambient air within the area is good. No industries exist in the project area. Dust levels may be elevated in the area during harmatan periods.

The major surface water body existing in the project area are the Atonso and Drobon Rivers in the Chirimfa forest which flows into the big Afram River. The Afram stream flows through the Awura forest. Tributaries include the Asuonwunu and Nankonoma streams in the Chirimfa and Awura reserves respectively.

Water quality assessment carried out on the river bodies at both upstream and downstream points indicated that generally, the physico-chemical parameters were within acceptable limit except Total Phosphorus which was above WHO guideline for surface waters. Trace metals such as lead were below detectable limits. Communities near the river uses the water for domestic activities including drinking.

The vegetation of the area is basically made of trees, shrubs, and herbs. The most frequent tree species in the project area are *Tectona grands; and Gmelina arborea.*

Species spotted during the faunal survey in the Awura reserve Tortoise include (*Kinixys belliana*); Agama lizard (*Agama Africana*); Butteries; Ground squirrel (*Euxerus erythropus*); Groundcutter (*Thryonomys swinderianus*)**;** African hornbill (*Tockus nasutus*); Blue-billed Roller (*Coracias cyanogaster*); Weaver birds (*Ploceidae* spp); Partridge (*Pternistis ahanten*)**;** Royal python (*Python regius*); Black cobra (*Naja melanoleuca*)**;** Green mamba (*Dendroaspis angusticeps*) (

Species found in Chirimfa Reserve include Agama lizard; Butteries; Ground squirrel (*Euxerus erythropus)*; Ground cutter (*Thryonomys swinderianus);* African hornbill (*Tockus nasutus)*; Blue-billed Roller (*Coracias cyanogaster);* Weaver birds *(Ploceidae spp);* Partridge (*Pternistis ahanten);* Stone partridge (*Ptilopachus petrosus);* Puff adder *(Bitis arietans);* Black cobra *(Naja melanoleuca);* and Green mamba *(Dendroaspis angusticeps)*

The aquatic study revealed insignificant macrophyte community. The phytoplankton community observed is dominated by the Bacillariophyta, (35%), Chlorophyta (29%) and Cyanophyta (16%). The Flagellates and the Rhodophyta recorded 10% each, compares favourably with freshwater systems occurring in West Africa.

The major communities close to the project area (Miro's allocated compartment) and with interest in the reserves are Bunusu, Esereso, and Asuonwunu. Other fringe community of interest is Mframabuom, which shares boundary with Chirimfa reserve but on Kwaman stool land.

There are no of cultural heritage resources identified within the project areas. There is no cemetery at the project sites. The major occupation of the local communities is farming and some minor activities are fishing, hunting and charcoal processing. Some project affected farmers have been identified at the project sites.

Engagement of Stakeholders

Stakeholder participation during project planning, design and implementation has now become universally recognised as an integral part of environmental and social impact assessment process. Local communities, their representatives, government, and non-governmental organisations (NGOs) may all be able to contribute to (and benefit from) dialogue directed at identifying and resolving key project-related issues. Stakeholder consultation has been a two-way flow of information and dialogue between project proponents and stakeholders. Stakeholders consulted include the following:

- Local communities at or near of the project site;

- Environmental Protection Agency (EPA), Head Office, Accra;
- Environmental Protection Agency (EPA); Ashanti Regional Office;
- Water Resources Commission, Kumasi – Ashanti Regional Office -Pra Basin Secretariat;
- Forestry Commission, Kumasi/ -Ashanti Region;
- Forest Services Division of the Forestry Commission, Mampong-A/R;
- Office of the Administrator of Stool Lands (OASL) Kumasi/ Mampong A/R;
- Factories Inspectorate Department; Kumasi
- Ghana National Fire Service, Mampong & Nsuta
- District Health Directorate, Mampong/ Sekyere Central District –A/R;
- Timber Industry Development Division (TIDD), Kumasi;
- Department of Feeder Roads- Kumasi
- Ashanti Mampong Municipal Assembly, Mampong;
- Sekyere Central District Assembly, Nsuta
- Mampong Traditional Council, Mampong;
- Nsuta Traditional Council, Nsuta; and.
- Kwaman Traditional Council

Potential Positive Impacts

- Employment and job opportunities during project implementation;
- Improvement in the local and national economy;
- Improvement in the revenue base of key institutions and regulatory bodies such as the FC from sales from forest products;
- Improvement in income and standard of living of beneficiary farmers through inter-cropping;
- Improvement in amenities and social infrastructure of local and fringe communities;
- Transformation of reserve landscape and development of micro climates as well as carbon credits from sequestration;
- Limiting illegal farm allocations/activities and improvement in reserve management; and
- Protection of biodiversity habitats and indigenous tree species
- Improvement in Social Amenities; and
- Regional Effects.

Potential Adverse Impacts and Mitigation Measures Proposed

The significant adverse impacts (rated as moderate or major) identified from the analysis and evaluation of the potential impacts are presented in the table below with the suggested mitigation measures.

Mitigation Measures Proposed for Anticipated Negative Impacts and Enhancement of Positive Impacts

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
Preparatory Stage				
Acquisition of farm lands and impact on livelihood of farmers	Land/forest compartments acquisition	Land owners and migrant land users/farmers	Major	▪ MFGL has proposed to allow short-term inter-cropping of certain crops alongside the planting of tree seedlings by local legitimate farmers. Affected farmers will have the option to participate in the scheme as farmers to improve their livelihoods. This will be under strict conditions for inter-cropping activities to ensure control of use of herbicides by farmers, choice of crops, preparation of soil beds to minimise soil erosion and run-off into water bodies ▪ Project affected farmers have been identified, and will be considered first in the intercropping scheme and/or employment by Miro before other interested persons for the reforestation project. ▪ All farmers will be allowed to harvest their crops before the commencement of work.
Occupational Health & Safety Issues	Soil testing and field investigations	Staff/experts	Local/ Moderate	▪ Staff and experts and contractors involved in land and field investigations will be made to follow the health and safety policy of Miro Forestry. The adoption of a health and safety policy at site during field investigations will serve as a precautionary measure to prevent/minimize the possibility of accidents and reduce health risks. ▪ Workers will also be provided with the necessary protective gadgets /PPEs and enforced. its use ▪ All ailments will be referred to the nearest health facility for treatment.
Social Conflict with local community/migrant settlers and farmers	Education and sensitization of local farmers/ communities	Local farmers/ Community and identifiable groups	Major	▪ Community sensitization programs will continue and will include among other things: o Holding of meetings at the community level to further explain the project and its socio-economic benefits to the people. o Facilitate the formation of a consultative group with selected representatives from the communities to meet periodically with Miro and plan for peaceful co-existence; and o Build capacity for Community relations work to ensure successful implementation of project. ▪ The program will help avoid unnecessary tension between misinformed communities and Miro and establish a better rapport between the parties. ▪ Sensitization and training to Local and migrant Farmers specifically, to acknowledge their illegal entry into the reserve for farming activities and the need to preserve the reserve through plantation development. Miro Forestry will make known to them their intent of allowing farming to co-exist alongside the establishment of plantations whilst observing the rules and regulations governing the reserve. Farmers will be well educated on modern farming practices including the use of agrochemicals, land preparation and conservation techniques.

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
Constructional Stage				
Public/ Community Safety	Transportation of construction materials and equipment to the project site	Local communities /general public	Moderate	▪ Communities along the haulage route may suffer from elevated traffic, dust and noise levels during the transportation of construction materials and equipment. The following mitigation measures will be implemented to reduce these nuisance and health concerns: o Use of regularly serviced and well-maintained vehicles to prevent frequent breakdowns on the roads. o All temporary traffic controls will be done in consultation with the Department of Urban Roads (DUR) and the Police Motor Transport and Traffic Division (MTTD); o Adherence to traffic and road regulations including speed limits, warning signs, flags. mandatory speed limit of 50km/hr when moving through the human settlements; and Speed ramps would be provided at 50m intervals within human settlements; o A code of conduct for drivers on the road would be developed and implemented; o Community complaints handling arrangements would be instituted. o Additionally, alternative haulage routes will be considered where necessary. o Any accidents on the road involving trucks and humans or domestic animals would be investigated immediately and corrective actions taken to avert re-occurrence
Loss of vegetation and impact on terrestrial life/biodiversity (flora and fauna)	Land preparation (land clearing, Soil preparation, ripping, ploughing)	Terrestrial habitat Flora, and fauna	Moderate	▪ Significant ecological areas such as patches of remnant semi-deciduous forest vegetation and indigenous species, swamps, and riparian strips and habitats within the concession of the Chirmfa and Awura Forest reserves have been identified and mapped out to ensure the preservation of original plant and animal species within the project area. All Rare, Threatened Endangered ecosystems and habitats will be protected as part of the companies Conservation Management plans. ▪ The project will not carry out total mass clearance of vegetation in one phase. Phasing of development activities will allow some time for mobile fauna to seek refuge in adjacent and similar habitats or establish new ones nearby. ▪ Critical habitat such as the gallery forest along the banks of the river will be left undisturbed and further enhanced through tree planting. ▪ Patches of remnant forest and areas with indigenous species will be left undisturbed and protected. enrichment planting will be encouraged to restore and enhance such species ▪ Buffer zones and strips of vegetation will be created along riparian areas to reduce impact on habitat and threatened fauna/ wildlife as well as for the promotion of soil stability and climate change adaptability ▪ There will be minimal cutting of trees unless it is very necessary. ▪ Miro will consult Forestry Services Department to plant and nurture trees at suitable locations.

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
Surface run-off and material transport into water-bodies	Land preparation/ road construction	Soil / Surface water bodies, aquatic flora /fauna	Moderate	▪ Clearing will be limited to the area required for the reforestation project to reduce exposure of bare soil to agents of erosion and deposits of debris in water systems; thus affecting aquatic life. ▪ Clearing will be by slashing and the cleared material (thrash) will be left on the surface to decompose and used as mulch or plough and then mixed into the soil to act as soil nutrient, so as not to leave the soil completely bare. ▪ The use of heavy machinery for clearing will be limited as much as possible. ▪ Miro Forestry will establish and maintain a vegetative buffer zone of 30 metres from the water bodies of to reduce the risk of pollution of the water systems ▪ Culverts and drains will be constructed along access roads to check erosion and control any run-off. ▪ Seasonal streams will be identified during road planning stage. ▪ Access roads will be well compacted to minimise erosion.
Clearing of Illegal settler farms and impact on livelihoods	Land preparation (land clearing, Soil preparation, ripping, ploughing)	Migrant and settler farmers	Major	▪ MFGL will allow short-term inter-cropping of certain crops alongside the planting of tree seedlings by local legitimate farmers. Affected farmers will have the option to participate in the scheme as farmers to improve their livelihoods. ▪ MFGL will consider in future employment opportunities to farmers. Project affected farmers will be considered first in the intercropping scheme and any employment by MFGL before other interested persons for the reforestation project. ▪ Farmers will be allowed to harvest their crops before the commencement of work. ▪ MFGL will collaborate with landowners and stakeholders in educating illegal settlers and local farmers to desist from future encroachment of the reserve.
Air quality impact/noise nuisance	Transportation of construction materials Land clearing Road construction	Workers; Community	Minor	▪ MFGL will ensure that noise abatement devices such as earphones and earplugs are worn by all operatives who operate machinery. ▪ Work involving forest machinery will be intermittent and be restricted to day time to minimise noise nuisance, particularly in settlement located just on the Boundary of Miro's compartment. ▪ Reasonable speed limits and frequency of use of forest machinery will be ensured to minimize dust emissions. ▪ Burning of large biomass or cleared vegetation will not be encouraged as reasonably practical. ▪ Equipment will be serviced regularly to avoid excessive noise generation.
Occupational health and safety issues	Land clearing and preparations	Workers; Contractors	Moderate	<u>Adoption of Health and Safety Policies</u> ▪ All workers will be required to adopt MFGL's Health & Safety Policy to guide the construction phase activities. The adoption of the health and safety policy at site will serve as a precautionary measure to prevent/minimise the possibility of accidents and reduce health associated risks.

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				▪ A health and safety officer will be appointed to ensure compliance with the Health and Safety Policy. <u>Provision and Use of Personal Protective Equipment (PPE)</u> ▪ MFGL will provide and enforce the use of appropriate personal protective equipment (PPE) such as safety boots, reflective jackets, hand gloves, earplugs and nose masks. Sanctions will be implemented where workers do not use the PPEs provided. <u>Use of Road Worthy Vehicles</u> ▪ MFGL will regularly maintain and service its bulldozers, excavators and tractors to ensure they are in good condition. Good conditioned and well maintained equipment will reduce frequent breakdowns, noise nuisance and smoke emissions which could affect the operator's and other workers' health and safety. <u>Use of Qualified Personnel</u> ▪ MFGL will employ only qualified machine operators with requisite skills and experience to operate the machines. ▪ MFGL will carry out regular training on standard operational procedures and health & safety will be provided for machine operators. <u>First Aid</u> ▪ MFGL will provides first aid training for its workers and provide first aid kits at the project site during land preparation and construction activities to treat minor ailments. However, major cases will be referred to the nearest hospital or health post (Mampong Municipal Hospital)
Generation of biomass and fire risk	Land clearing (slashing)	Entire plantation/forest	Moderate	<u>Biomass</u> ▪ Salvaging of useable biomass will be encouraged to significantly reduce the volume of waste that has to be disposed of. ▪ Burning of large biomass or cleared vegetation will be avoided as reasonably practical. ▪ In the event burring is required, controlled burning according to well-designed protocols will be employed. ▪ MFGL will ensure workers are properly trained in slash burning protocols and observe favourable weather conditions for burning of slash and ensure proper disposal <u>General waste</u> ▪ MFGL will ensure the contractor(s) provide bins on site for collection and disposal of plastic waste and polythene materials such as lubricant containers, drinking water sachets and carrier bags which will be regularly emptied at approved dump site.
Sanitation issues	General constructional	Local communities	Moderate	▪ The Contractor will provide places of convenience at the site to discourage free-range defecation among workers. In addition, field workers will be encouraged to use places of convenience

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
	phase activities	/workers		available at nearby communities. ▪ The project will collaborate with the Municipal/District Assemblies in the provision of additional toilet facilities in the affected communities to help prevent health threat. ▪ Waste bins will be provided at appropriate and convenient places to minimize littering of the site. Wash rooms and changing rooms will also be provided for construction workers.
Demographic and Population Change Impacts	Marketing	Local communities	Moderate	▪ The project will ensure close collaboration with the local police personnel and traditional authorities to minimise the incidence of crime in the project area and its immediate environs. ▪ Rigorous awareness-raising and campaigning against HIV/AIDS and other Sexually Transmitted Diseases (STIs) which is likely to go high as a result of the presence of migrant workers and increased income that tends to encourage liberal sexual behaviour. Workers will be encouraged during regular meetings to practice safe sex. ▪ MFGL will ensure the contractor(s), together with opinion leaders such as the Assembly member and traditional leaders, sensitise migrant workers on societal norms, taboos and other cultural practices in the area
Operational Stage				
Impact of agrochemical on soil and contamination of water bodies and aquatic life	Application of agrochemicals for weed control and fertilization	Soil, Terrestrial flora and fauna; Surface waters and groundwater Aquatic species	Moderate	▪ As practicable as possible, mechanical weed control will be adopted to minimize the use of weedicides, in accordance with the Forest Stewardship Council (FSC) Pesticides Policy (2005)) ▪ MFGL will ensure that only EPA approved agro-chemicals, from licensed agrochemical shops, will be purchased and used. All agrochemicals on the FSC list of 'highly hazardous' pesticides will be avoided. ▪ MFGL will control the application of weedicides and fertilizers by adhering to limits and recommended dosage in order avoid overspills and over concentrations. ▪ Miro Forestry will, preferentially, use selective pesticides with low environmental impact quotient (EIQ) where appropriate, rather than broad-spectrum products, to minimize impacts on non-target species ▪ Application of agrochemicals will follow an integrated pest management approach. ▪ Ensure workers and farmers for intercropping scheme are properly trained in the use and disposal methods for chemicals. ▪ Avoid using weedicides in areas close to water bodies and avoiding using on steep slope areas near water bodies. ▪ Limit on the application of fertilizer to farmland that may subsequently leach/seep into underground water

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
Sedimentation run off into water bodies	Land /soil preparation (Ripping, Ploughing)),	Surface water bodies	Moderate	▪ Soil preparation on steep slopes close to water bodies will be avoided. ▪ MFGL will create vegetative buffers alongside water bodies to protect them from soil sedimentation. ▪ Regular visual inspections of water bodies will be conducted to ascertain any sedimentation of water bodies ▪ Riparian vegetation will be maintained to sieve off sediment from runoff from the plantation. ▪ Planting will be between contour bunds. ▪ Ploughing without harrowing will be encouraged. ▪ Planting of seedlings will be done on ridges across slope. ▪ Planting will be done in contour strips.
Occupational health and safety issues	Planting of tree seedlings and handling of agrochemicals;	Workers; farmers	Moderate.	▪ The Project will institute an occupational health and safety policy and strictly enforce its regulations. The adoption of a health and safety policy at site will serve as a precautionary measure to prevent/minimize the possibility of accidents and reduce health risks. ▪ MFGL will ensure machinery and equipment hired are in good condition and (right tool for right job) to prevent accidents and injury. ▪ Workers and farmers will be given adequate training on health and safety as well as on the job training and ensure adherence to health and safety procedures to minimize accidents. ▪ Workers will also be provided with the necessary protective gadgets /PPEs and their use will be enforced ▪ The project will provide, train and equip selected members of the workforce on first aid administration. ▪ MFGL will ensure that any pesticides used are applied according to the FSC Pesticides Policy (2005)) ▪ MFGL will ensure all pesticides listed in WHO Hazard Class II (moderately hazardous), will be avoided unless appropriate controls established with respect to the manufacture, procurement, or distribution and/or use of these chemicals are in place. These chemicals would not be accessible to personnel without proper training, equipment, and facilities in which to handle, store, apply, and dispose of these products properly. ▪ MFGL will educate its workers and farmers on the safe use of agrochemicals and safe disposal of chemical containers. ▪ All agrochemicals on the FSC list of 'highly hazardous' pesticides will be avoided. ▪ MFGL will ensure that pesticides that fall under the World Health Organization's (WHO)

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				Recommended Classification of Pesticides by Hazard Classes 1a (extremely hazardous) and 1b (highly hazardous), or Annexes A and B of the Stockholm Convention are not purchased, stored or used.
Alteration of landscape aesthetics	Harvesting and felling	workers	Moderate	▪ MFGL will avoid contiguous harvesting of large areas to minimise disruptions to landscape and ensure proper disposal and management of slash material.
Noise Pollution from forest machinery		Workers/farmers	Moderate.	▪ Ensure all workers use noise protective gear such as earplugs and headphones to minimise noise from harvesting machinery. ▪ Avoid prolonged operation of machinery.
Damage to corridors used by fauna and loss of flora		Flora and fauna	Moderate	▪ Miro Forestry has identified significant ecological areas such as patches of remnant semi-deciduous forest vegetation and indigenous species, swamps, and riparian strips and habitats areas within the concession of the Chirmfa and Awura Forest reserves.to ensure the preservation of original plant and animal species within the project area. ▪ MFGL has prepared a forest management plan which will be implemented to guide tree harvesting; ▪ MFGL will maintain a 15 m buffer along the streams to maintain riparian vegetation and lifeforms they support. ▪ Specimens of indigenous trees occurring naturally will be retained for regeneration purposes, and provide den and nesting sites, food sources, cover, and travel corridors for wildlife. ▪ Ensure directional felling by trained personnel to minimize canopy damage and distance to skid trails ▪ Ensure that large canopy holes are avoided by limiting proximity of trees to be harvested;
Impact of Fuel/Oil Handling and Spillage on Soil	Project implementation	Soil/land, water	Moderate	▪ Waste oil and used lubricants will be collected by third party agents certified by appropriate authority (EPA) to collect and dispose of wastes (e.g. Oil Marketing Companies)
Public health/ traffic safety issues	Harvesting and marketing	Local communities	Local Moderate	▪ Communities along the haulage route may suffer from elevated traffic, dust and noise levels during the harvesting. The following mitigation measures will be implemented to reduce these nuisance and health concerns: o Reckless tooting of horns would be an offence within the settlements; o Use of regularly serviced and well maintained vehicles to prevent frequent breakdowns on the roads. o Adherence to traffic and road regulations including speed limits, warning signs, flags. mandatory speed limit of 50km/hr when moving through the human settlements; and Speed ramps would be provided at 50m intervals within human settlements; o A code of conduct for drivers on the road would be developed and implemented;

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				○ Community complaints handling arrangements would be instituted. ○ Alternative haulage routes will be considered where necessary. ○ Any accidents on the road involving trucks and humans or domestic animals would be investigated immediately and corrective actions taken to avert re-occurrence
Environmental/social threats	Project implementation	Forest plantations	Major	<u>Buffer Zones/Fire Belts</u> ▪ Buffer zones/fire belts will be provided between and around planting units within the plantation to prevent possible threats resulting from bushfire from the surrounding communities/activities. A well-demarcated boundary of about 10-m width will be provided and also will serve as access routes within the plantation. ▪ Compartment roads, external boundary roads, and valley bottom cut-off roads will also serve as fire breaks. Slash /vegetation will also be well managed to reduce the risk of fire spread ▪ Some green belts will also be established which are extended further into other high-danger areas at strategic locations along the perimeter of the reserve. ▪ Fire response teams will be established and trained on site to detect emergency fire out breaks as well as to liaise with the Ghana National Fire Service to combat fire.
				<u>External Nomadic herdsmen</u> It is reliably informed that nomadic cattle herdsmen invade the forest and are sometimes the cause of wildfires. The project will liaise with the traditional authorities and the district security personnel (forest guards)to tackle the nomadic herdsmen menace.
				<u>Illegal logging activities</u> The Project will ▪ liaise with traditional authorities, District assemblies and the FC to discourage illegal logging in the reserve ▪ Interested illegal loggers may be encouraged to participate in the reforestation project as a more sustainable income generation/ livelihood venture

Environmental Monitoring Plan

Environmental monitoring is an essential component of a post project review phase following Environmental Assessment to confirm any predicted impact or otherwise made during the environmental impact assessment study. The major monitoring activities to be undertaken will cover the following with an estimated amount of **GH₵109,000**:

- Aquatic biodiversity of surface waters;
- Surface water quality;
- Groundwater quality;
- Soil fertility and other properties in general;
- Soil erosion;
- Fire risk and management;
- Significant ecological areas;
- Invasive species;
- Occupational health and safety; and
- Road monitoring and maintenance.

Provisional Environmental Management Plan

A provisional Environmental Management Plan (EMP) is developed for the project in line with the Environmental Assessment Regulations of 1999, LI 1652 to ensure that the operations of the proposed reforestation development are carried out in an environmentally safe and sound manner. The actual EMP will be prepared eighteen (18) months after project implementation and it will follow the EPA format.

About **GH₵ 269,000.00** is required annually for the implementation of the proposed management measures. The proposed major programs required under the EMP include the following:

- Corporate Commitment and Environmental and Health/Safety Policies;
- Establishment of an Environmental, Health and Safety Committee;
- Appointment of an Environmental Officer and Engagement of Environmental Consultants;
- Staff Information and Training;
- Environmental Monitoring Programs;
- Emergency Preparedness and Response Planning;
- Field Visits and Inspections;
- Digital Management system;
- Stakeholder Engagement;
- Community Liaison and Grievance Management/Conflict Resolution
- Environmental Audit and Reviews; and
- Public Participation.

Conclusion

The benefits to be derived from the project are immense. The implementation of the proposed project will improve the socio-economic life of the people in and around the Mampong Municipal and Sekyere Central District, particularly the local communities. There will be employment opportunities for people who hitherto had insufficient source

of income. The degraded forest cover will be restored and will generate revenue to the Forestry Commission, district assemblies, and traditional authorities/landowners.

The stakeholder consultations show that the stakeholders are in full support of the Project and are committed to help ensure that the project is implemented to the benefit of the people of the area, and the country as a whole.

1.0 INTRODUCTION

1.1 Project Background

Miro Forestry (Ghana) Limited is a sustainable and commercially focused forestry company with established and expanding plantations of fast growing timber for local and international markets. The Company is centered in West Africa.

The Company currently operates on about 5,000 hectares (ha) of degraded forest lands within the Boumfuom Forest Reserve, located about 8 km from Agogo, 20km from Kumawu and 3km from Ananekrom community. The current operational area was leased from traditional landholders and the Forestry Commission of Ghana.

In order to expand its operations, the company has acquired about 4,428ha of land in the Chirimfa and Awura Forest Reserves in the Mampong Municipal and the Sekyere Central District respectively from the Forestry Commission and the traditional landholders. Miro Forestry (Ghana) Ltd (MFGL) intends to develop the 4,428-hectare plantation with mainly Teak *(Tectona grandis),* Eucalyptus (Eucalyptus spp), Acacia and indigenous species such as Ceiba *(Ceiba pentandra)* and Wawa *(Triplochiton scleroxylon).*

The proposed development will involve nursing of seedlings, land preparation, creation of conservation management areas, planting of fast growing Teak and Eucalyptus tree species, upgrading and maintenance of old logging roads, sustainable selective harvesting, creation of employment opportunities for locals in Mampong, Nsuta and neighbouring communities, development of modern agro-forestry initiatives, collaboration with key stakeholders to support local good causes and distribution of financial benefits from plantation outputs for stakeholders. The company aims to plant 1,500 ha per annum going forward.

The acquired area in the Chirimfa and Awura Forest Reserves has suffered vast deforestation due to valuable hardwood harvesting, slash and burn agriculture and the harvesting for charcoal production. Consequently, the areas proposed for development is degraded and these activities have adversely affected the flora and fauna of the area.

According to a study undertaken by the Government of Ghana, as reported in Hawthorne and Abu-Juam's1995 IUCN book *Forest Protection in Ghana*, to the classify forest reserves into six condition categories, and upon consultations with the Mampong Forest Service Division, the level of degradation of the Awura and Chirimfa Forest Reserves is attributed to a condition score of 4-6. Scores 4-6 are applied to forests that have suffered slight degradation over more than half the reserve or heavy degradation over more than one-quarter of. it. Very often significant parts of the forest mosaic have poor regeneration of timber trees and other forest plants, generally because of lack of 'good' parts of nearby forest mosaics.

The Project is a reforestation intervention intended to rehabilitate degraded forest reserves by the development of fast growing commercial plantations and to restore the supply of timber for export and national development.

SAL Consult Limited, an environmental & water consulting firm based in Accra, Ghana was contracted by Miro Forestry Ghana in August 2017 to carry out the Environmental and Social Impact Assessment (ESIA) for the proposed Chirimfa & Awura Project.

In line with environmental permitting requirements as provided under the Environmental Assessment Regulations of 1999, Legislative Instrument (LI) 1652, Miro Forestry (Ghana) Limited registered the proposed Project with the Environmental Protection Agency (EPA). The EPA in a response letter dated September 22, 2017 and referenced *CF: 58/02/10* (see **Annex 1** for copy of EPA letter) classified the proposed project as one which requires an Environmental Impact Assessment (EIA) to be carried out to help understand the likely implications of the proposal in order to inform the environmental permitting decision-making prior to project implementation.

The EPA advised in the said letter that a scoping exercise be carried out in order to generate the relevant terms of reference to guide a satisfactory ESIA study and also a scoping notice must be published (see **Annex 2a** for the scoping notice publication) to facilitate stakeholder and public involvement. **Annex 2b** shows the EPA response on the Scoping Report dated January 15, 2018 and referenced CF 58/02/23.

In Ghana and for the EPA, an EIA also means an ESIA because the law interprets 'environmental assessment' to encompass the assessment of the biophysical and the socio-economic and cultural as well as public health environment and therefore the abbreviations EIA and ESIA used in this document refer to the same assessment.

1.2 Terms of Reference for the EIA Study

The terms of Reference (TOR) for the Environmental Impact Assessment (EIA) study is briefly described under:

- Aim/purpose of the EIA study;
- Scope of work for the EIA study; and
- Approach and Methodology for the EIA study and reporting.

1.2.1 Aims and purpose of the EIA Study

The aim of the study is to satisfy both legal and institutional obligations specified under the Environmental Protection Agency Act 1994 (Act 490) and the Environmental Assessment Regulations 1999 (LI 1652). The purpose of the EIA study is to address possible direct and indirect significant adverse environmental and social impacts of the proposed project for its acceptability and sustainability.

1.2.2 Scope of Works for the EIA Study

The scope of work for the EIA study includes among other things:

- Provide adequate description of the proposed project and identify all activities of environmental/social concern;
- Establish the existing environmental and socio-economic baseline conditions of the project area of influence;
- Predict and examine all the significant environmental impacts on the surrounding communities and the general environment during implementation of the proposed project and advise on appropriate mitigation and abatement measures against potential adverse impacts;
- Provide an environmental monitoring program for predicted impacts;
- Provide a provisional Environmental Management Plan (EMP); and
- Document the socio-economic and environmental benefits associated with the proposed project for stakeholders to make an informed decision on the level of environmental compromise and permitting.

1.2.3 Approach and Methodology for the EIA Study and Reporting

The approach and methodology adopted for the study included:

- Field inspections and Trekking;
- Baseline studies comprising:
    - Air quality and noise monitoring;
    - Terrestrial flora and fauna studies;
    - Land use studies;
    - Aquatic biology studies;
    - Water quality monitoring; and
    - Socio-economic studies.
- Stakeholder consultations;
- Review of project documents and literature; and
- Reporting.

<u>Field Inspections and Trekking</u>

Surveys and observation of the project sites were carried out to confirm relevant baseline environmental issues and conditions to be affected or are likely to develop from the proposed project implementation.

<u>Baseline studies</u>

Air Quality and Noise Monitoring

Assessment of the baseline ambient air quality and noise levels at selected locations.

Terrestrial Flora and Fauna Studies

The methods employed include:

- A walk-through of the entire project area proposed for the reforestation project to observe and identify the various tree and plant species and traces of animal life by the use of transects;

- Review of relevant documents on previous works carried out in the affected area; and
- Interviews with some residents/hunters in close by communities as well as some farmers from these communities

Land Use Studies
Methods employed include:
- Observations and assessment of land uses; and
- Use of the 1:50,000 topographical map of the area to demarcate the project area of influence and development of 1: 17,000 map of the project site for further analysis.

Aquatic Biology Studies
The approach adopted for the studies involve:
- Sampling of nekton, aquatic macrophytes and their associated fauna, at selected points on the Drobon and Atonsu Rivers which runs through the Chirimfa Forest reserve and Afram River which passes through the Awura Forest reserve;
- Interviews with some community members living in and around the project site for confirmation of the productivity of the water system in terms of fish resources; and
- Review of relevant research documents.

Socio-economic Studies
The methodology used for the socio-economic studies include:
- Observation of social issues in the project area;
- Interviews with project affected farmers within close communities; and
- Interviews with some chiefs and opinion leaders of communities and staff of the District Assembly.

Stakeholder Consultations
Consultations have been held with relevant stakeholders and interested groups. Concerns/issues raised are presented in this report and evidence of consultation with these groups are provided in **Annex 3.** Stakeholders and other interested groups consulted include:

Government Institutions
- Environmental Protection Agency (EPA), Head Office, Accra;
- Environmental Protection Agency (EPA); Ashanti Regional Office;
- Water Resources Commission – Ashanti Regional Office;
- Forest Services Division of the Forestry Commission, Kumasi/Mampong-Ashanti Region;
- Lands Commission /Office of the Administrator of Stool Lands (OASL) Kumasi- Ashanti Region;
- Factories Inspectorate Division;
- Ghana National Fire Service, Mampong & Nsuta
- District Health Directorate, Mampong-Ashanti Region;
- Timber Industry Development Division (TIDD), Kumasi; and
- Department of Feeder Roads- Kumasi

District Administrators

Ashanti Mampong Municipal Assembly, Mampong; and

- Sekyere Central District Assembly, Nsuta

Traditional Authorities/Councils

- Mampong Traditional Council, Mampong; and
- Nsuta Traditional Council, Nsuta; and.
- Kwaman Traditional Council

Local Communities Close to the Project Sites (Forest Reserves)

- Bunuso community;
- Esereso Community;
- Asuonwunu Communities;
- Project Affected Persons /Farmers; and
- Cattle Herdsmen Representative

Other Fringe Community

- Mframabuom

Review of Available Literature

Literature/ documents from various sources have been reviewed including relevant laws and other strategic planning documents at the national and sector levels and also at the international level especially, with reference to project financing.

Policies and legal framework documents reviewed cover:

- Relevant sector policy/plan documents and regulations;
- Environmental Protection Agency Act, 1994 (Act 490);
- Environmental Assessment Regulations, 1999 (LI 1652);
- Ghana EIA Procedures; and
- Relevant international conventions and safeguards.

A number of project related documents have been reviewed including:

- EIA Report- Final Environmental Impact Statement for Proposed Reforestation of 5000 hectares of Degraded Forest Lands in Boumfuom Forest Reserve, Near Agogo, Ashanti July 2014;
- Rapid Environmental Assessment Checklist of the Chirimfa Reserve-Miro Forestry (Ghana) Limited- 2017;
- Terrain Observation in Both Chiremfa and Awura Forest Reserves, September 29th, 2017;
- Reforestation Management Plan- Sustainable Plantation Forestry on a Portion of the Bomfoum, Chirimfa and Awura Forest Reserve;
- Scope of Works- Environmental and Social Impact Assessment for a Forestry Project in Chirimfa and Awura Forest Reserves, Ghana;
- Report on Rapid Assessment of Compartments Available in the Awura and Chirimfa Forest Reserves-December 2016;

- Socio Economic Survey and Livelihood Study Report-Community Consultation Meeting, October, 2017; and
- Chirimfa Reserve Pre-Land Preparation Interview Questionaire-2017.

Other relevant documents/literature reviewed include:

- 1:50,000 topographical maps of the project area (Awura and Chirimfa Forest Reserves); and
- Medium Term Development Plans of the Mampong Municipal and Sekyere Central District Assemblies.

Data Analysis and Reporting

The data obtained from the desk and field studies were analysed and have been presented in this Environmental Impact Assessment Report and follows the EPA's approved format. Major headings of the report comprise:

- Table of Contents;
- List of Figures, Table, Plates and Annexes;
- Executive Summary;
- Introduction;
- Policy, Institutional and Legal Framework;
- Proposed Project Description;
- Description of Baseline Environmental and Social Conditions;
- Potential Impact Identification, Prediction and Evaluation;
- Proposed Mitigation Measures;
- Environmental Monitoring Plan;
- Provisional Environmental Management Plan;
- Conclusion;
- References; and
- Annexes.

2.0 POLICIES, LEGISLATIVE AND ADMINISTRATIVE REQUIREMENTS

Miro Forestry is committed to adhering to the requirements of all applicable legislation and associated regulations in the design and development of the project. The relevant policies, laws and regulations to guide Miro Forestry from the conceptualization of the project to implementation and monitoring as well as decommissioning are discussed below.

2.1 Policy Framework

The following national policies with bearing on the proposed project have been reviewed as part of the study:

- Ghana Shared Growth and Development Agenda, 2010;
- National Environmental Policy, 2013;
- National Land Policy, 1999;
- National Water Policy, June 2007;
- Forest and Wildlife Policy, 2012;
- National Climate Change Policy, 2013;
- Riparian Buffer Zone Policy, 2014;
- National Employment Policy, 2014; and
- National Gender Policy, 2015.

Table 1: Policy Framework

Relevant Policies	Key Requirements/Objective	Relevance to the Reforestation Project of MFGL /Comments
Ghana Shared Growth and Development Agenda, 2010	It provides for the Vision for the Agricultural, Environment and Natural Resource Sectors in Chapter four. Section 4.2.2 provides for the vision for the Environment and Natural Resource Sector. The key objectives of the sector for the future are as follows: • Improved cross-sectoral environmental management, including the consideration of global issues such as climate change and loss of biodiversity, as well as the opportunities of initiatives such as REDD+, VPA/FLEGT; • Strategic Environmental Assessment (SEA) applied to inform decision-making and mainstream environment into all sectors of the economy, especially as regards the cost of environmental degradation; • Improved Environmental and Social Impact Assessment (ESIA) processes and compliance; • Decentralized environmental management, including the enforcement of laws on waste, illegal mining and chain-saw logging at the local level; • Improved environmental monitoring and reporting; and • Strengthened functional partnership and participation in environmental management with civil society, development partners, industry, and research bodies.	The reforestation project is in line with the sustainable management of natural resources as identified in the Ghana Shared Growth and Development Agenda (GSGDA) and is essential to deliver the medium term national development agenda. The intervention of fast growing commercial plantations will restore degraded forest and the supply of timber for export and national development
National Environmental Policy, 2013	The ultimate aim of the Policy is to improve the surroundings, living conditions and the quality of life of the entire citizenry, both present and future. It seeks to promote sustainable development through ensuring a balance between economic development and natural resource conservation. The policy thus makes a high quality environment a key element supporting the country's economic and social development. The specific objectives of the policy include: • Ensuring sound management of natural resources and the environment; • Protecting human, animals and plants and their biological communities and habitat; • Guiding development in accordance with quality requirement to prevent, reduce and as far as possible eliminate pollution and nuisance; and • Integrating environmental considerations in sectorial, structural and socio-economic planning at all levels.	The project will promote sustainable development by including economic, social and environmental considerations in the various interventions and activities.
National Climate Change	The vision of the National Climate Change Policy is to ensure a climate-resilient and	The reforestation project as part of its

Policy, 2013	climate-compatible economy while achieving sustainable development through equitable low-carbon economic growth for Ghana. The three objectives of the NCCP are (1) effective adaptation, (2) social development and (3) mitigation. Four thematic areas have been identified to address the adaptation issues in Ghana. These are (1) energy and infrastructure, (2) natural resources management, (3) agriculture and food security, and (4) disaster preparedness and response. On mitigation, Ghana has responded positively to various international mechanisms on enhanced mitigation actions, including low carbon growth, REDD+, etc.	objectives, to Support government efforts in achieving climate change mitigation through the sequestration of carbon from trees via the Reduced Emissions from Deforestation and Degradation (REDD+) initiative.
National Land Policy, 1999	Key aspects of Section 4.4 (Ensuring Sustainable Land Use) of the Policy relevant to the ERP include but not limited to: (a) The use of any land in Ghana for sustainable development, the protection of water bodies and the environment and any other socioeconomic activity will be determined through national land use planning guidelines based on sustainable principles in the long term national interest. (b) All lands declared as forest reserves, strict nature reserves, national parks, wildlife sanctuaries and similar land categories constitute Ghana's permanent forest and wildlife estates, and are "fully protected" for ecosystem maintenance, biodiversity conservation and sustainable timber production. (c) Fully protected land areas as well as timber and wildlife protected areas may be used for the purposes of education, research, recreation and tourism, provided that such uses are compatible with the conservation of the environment. (d) Land categories outside Ghana's permanent forest and wildlife estates are available for such uses as agriculture, timber, mining and other extractive industries, and human settlement within the context of a national land use plan. (i) Unless approved by the appropriate public authority, no land use change of any kind will be countenanced. (m) All land and water resources development activities must conform to the environmental laws in the country and where Environmental Impact Assessment report is required this must be provided. Environmental protection within the 'polluter pays'	The reforestation project covers degraded lands in the Awura and Chirimfa Forest Reserves near Mampong in the Ashanti Region. The various intervention will occur in on-reserve /protected areas. The FSD of the FC will ensure that the interventions and activities under the project on on-reserve will comply with the environmental laws of the country as required in the National Land Policy.

	principle will be enforced.	
Forest and Wildlife Policy, 2012	The objectives of the policy are to manage and enhance the ecological integrity of Ghana's forest, savannah, wetlands and other ecosystems; to promote the rehabilitation and restoration of degraded landscapes through plantations development and community forestry; to promote the development of viable forest and wildlife based industries and livelihoods; and to promote training, research and technology development that supports sustainable forest management. The policy aims to provide for the maintenance of environmental quality and perpetual flow of optimum benefits to all segments of society. It also encourages local stakeholder participation in forestry and highlights the need for reforestation of the country's degraded forest reserves. Forestry Development Master Plan was developed in 2016 and it seeks to implement the goal, objectives, and strategies of the 2012 Forest and Wildlife Policy.	The reforestation project will enhance the forest integrity by development of plantation as well as minimising deforestation especially in the protected areas of the forest reserves MFGL has conducted a number of consultations with the local communities and Traditional Authorities to gain proper understanding of their needs, interests and concerns and how these impact on the project.
National Water Policy, 2007	The National Water Policy, approved in June 2007, provides for a framework for the sustainable development of water resources in Ghana. The overall goal of the policy is to "achieve sustainable development, management and use of Ghana's water resources to improve health and livelihoods, reduce vulnerability while assuring good governance for present and future generations." The relevant principles for climate variability and change include: (i) recognizing water as a finite and vulnerable resource, given its multiple uses; (ii) coordinating water resources planning with land use planning; and (iii) adopting the river basin (or sub-basin) as a planning unit. The policy objectives are: (i) to minimize the effects of climate variability and change; and (ii) to institute measures to mitigate the effects of, and prevent damage caused by extreme hydrological occurrences (floods and droughts).	The policy proposes integrating water resources management and development with environmental management in order to ensure the sustainability of water resources in both quantity and quality. The project by its growing of plantation trees in conservation areas and along streams and rivers, in order to enrich the forest cover along the water bodies and provide maximum protection to the various water courses in the reserve from depletion through excess evaporation due to lack of trees/forest cover.

Riparian Buffer Zone Policy, 2014	This policy lays down prescriptions for the effective management and protection of water systems. In particular, the policy provides guidelines and recommendations for the establishment of buffers nearby water systems. Within forest areas, the policy makes recommendations of establishing a minimum of 10 meter buffers near water systems and riparian areas. The following are provided in the riparian buffer zone policy document: <u>Recommended Design Standards for Riparian Buffer Zones</u> The recommended buffer widths are: • Municipal reservoir shoreline protective buffer: 60 to 90 meters (e.g. Weija Dam and Lake Bosomtwe); • Major perennial rivers/streams: 10 to 60 meters (e.g. Volta, Tano, and Offin); • Minor perennial streams: 10 to 20 meters; • Important seasonal streams: 10 to 15 meters; • Streams within forest reserves: 10 to 50 meters; and • Wetlands: 30-meters around the perimeter as defined from the high water elevation.	The degraded areas and compartments in the Awura and Chirimfa reserves have some important rivers/streams such as Afram, Drobon, Asuonwunu, and Atonso. The FC and the WRC recommends that MFGL ensure that the required buffer around the various rivers/streams traversing the forest reserves under the project are maintained.
National Employment Policy, 2014	The goal of the NEP is to create gainful and decent employment opportunities for the growing labour force to improve their living conditions and contribute to economic growth and national development within the framework of equity, fairness, security and dignity. The key objectives to be pursued in order to achieve the overall goal are: 1. To create more decent jobs to meet the growing demand for employment. 2. To improve the quality of jobs for those who are employed. 3. To increase labour productivity. 4. To strengthen governance and labour administration. There are 23 strategic actions developed to achieve Objective 1. However, three major ones which are of importance to the ERP include: • Mainstream job creation in national development planning and strategy at all levels as a major goal of development and make employment outcomes key development indicators. • Adopt community-driven employment strategies through local participation and community owned interventions. • Identify and promote investment in strategic sectors of the economy that have the greatest potential for job creation, such as modernised agriculture, industry, tourism, and ICT. • Promote and support initiatives for the creation of green jobs in energy and industrial efficiency, energy supply, transportation, biodiversity, conservation and ecosystem restoration, soil and land management, and waste management.	The fringe communities in the project area will benefit from diverse employment opportunities that will be offered by the project. The project interventions are expected to generate alternative employment opportunities through support for tree planting to local farmers The project will encourage agro-forestry and inter-cropping practices which will contribute to income generation in and around the project area and ultimately lead to improved welfare and generally a reduction in poverty.

National Gender Policy, 2015	The National Gender Policy aims at mainstreaming gender equality concerns into the national development processes by improving the social, legal, civic, political, economic and socio-cultural conditions of the people of Ghana. It also seeks to empower the vulnerable groups particularly women, children, and people with special needs such as persons with disabilities and the marginalized.	MFGL is committed to ensuring that women play an active role in its plantation project as far as is practically possible. It is well known that women are best suited for undertaking certain plantation forestry tasks such as preparing seedlings and transplanting in the field. This is a positive move in promoting gender balance and equality; as well as improving the incomes and livelihoods of women.

2.2 National Regulatory and Administrative Framework

The relevant national regulatory and administrative laws relevant to the project include the following:

- The 1992 Constitution of the Republic of Ghana;
- Ghana Investment Promotion Centre Act 1994, Act 478;
- Forestry Commission Act of 1999 (Act 571);
- The Companies Code, 1963 (Act 179);
- The Concession's Act (Act 124) 1962;
- The Forest Ordinance (Cap 157) 1927;
- Timber Resource Management (Amendment) Act (Act 617), 2002;
- The Forest Protection (Amendment) Act (Act 624), 2002;
- Wildlife Conservation Regulations (L.I. 685), 1971;
- Wild Animals Preservation Act,1961 (Act 43);
- The Forest and Plantation Development Act (Act 583), 2000;
- The Trees and Timber Act 493 (1994);
- Environmental Protection Agency Act 1994, Act 490;
- Environmental Assessment Regulations 1999, LI 1652;
- Fees and Charges (Amendment) Instrument 2015, LI 2228;
- National Environmental Quality Guidelines (EPA) 1995;
- Water Resources Commission Act 1996, Act 522;
- Office of the Administrator of Stool Lands Act 1994, Act 481;
- Local Governance Act 2016, Act 936;
- The Labour Act 2003, Act 651;
- Workmen's Compensation Law, 1987, PNDCL 187;
- Ghana National Fire Service Act 1997;
- The Fire Precaution (Premises) Regulations 2003, LI 1724;
- Factories, Offices and Shops Act 1970, Act 328;
- Control and Prevention of Bush Fires Act 1990; and
- Control of Bush Fires Law of 1983 (PNDCL 46).

Table 2: Regulatory and Administrative Framework

The 1992 Constitution of the Republic of Ghana	The Constitution is the parent law upon which all other national laws derive their authority and legality. The 1992 Constitution covers a whole range of issues that are relevant to the ERP implementation. Some major ones include: • Safeguarding the national environment for posterity provided in Article 36 (() • Lands and Natural Resource issues as provided in Articles 258, 266, 267, 268 and 269. • Article 258 establishes a Lands Commission and prescribes the functions of the Commission. • Article 267 stipulates that "All stool lands in Ghana shall vest in appropriate stool on behalf of and in trust for the subjects of the stool in accordance with customary law and usage". In practice, all stool lands belong to paramount chiefs who are the Traditional Heads of Paramount Stools • Chieftaincy, as provided in Article 270 which recognizes the institution of chieftaincy, together with its traditional councils as established by customary law and usage. • Property rights of spouses, as provided in Article 22 The Constitution also includes some provisions to protect the right of individuals to private property, and also sets principles under which citizens may be deprived of their property in the public interest (described in Articles 18 and 20). Article 18 provides that "Every person has the right to own property either alone or in association with others."	The 1992 Constitution is very relevant to the reforestation project implementation Under this Article, MFGH cannot claim title to the stool lands allocated for the reforestation project but may lease lands in agreement with the stool landowners and the Forestry Commission. Land leases and PPP agreements have already been signed between MFGH and the Forestry Commission. It is anticipated that further PPP agreements will be signed for additional Forest Reserve land; all the leases will be endorsed and registered at the Regional Lands Commission.
Ghana Investment Promotion Centre Act, 1994, Act 478	The Ghana Investment Promotion Centre Act of 1994, Act 478 requires that the Ghana Investment Promotion Centre, the Government Agency responsible for the encouragement, promotion, co-ordination of private investment in the Ghanaian economy, must in its appraisal of proposed investment projects or enterprises, "…have regard to any effect the enterprise is likely to have on the environment and the measures proposed for the prevention and control of any harmful effects to the environment".	MFGL acknowledges that the proposed interventions may have some level of environmental/social impacts. Appropriate mitigation measures are included in the ESIA report to guide implementers to address these concerns.
The Companies Code, 1963 (Act 179)	This Act provides for business entities to register their firms with the Registrar-General of Ghana for the issuance of business registration certificates and commencement of business certificates	MFGL has complied with this Act; as the Company has been registered as a limited liability Company, with registration number CS693502015.
The Forestry Commission Act	This Act established the Forestry Commission as a semi-autonomous body responsible	By virtue of this Act, MFGH is obliged to

1999 (Act 571)	for all the forestry sector agencies implementing the functions of protection, development, management and regulation of forest and wildlife resources in the country. The Commission is responsible for the regulation of the utilization of forest and wildlife resources, the conservation and management of those resources and the co-ordination of policies related to them. The Commission through its Wildlife Division regulates the utilization of forest and timber resources, manages the nation's forest reserves and protected areas by proper planning for the protection, harvesting and development of forest and wildlife resources in a sustainable manner.	collaborate with the Forestry Commission on all matters pertaining to the establishment of its plantations on lands leased to it by the Forestry Commission. The main division of the Forestry Commission to be actively involved in the project is the Forest Services Division. The Forestry Commission is fully represented in Kumasi, and there is a District Forest Services Division at Mampong, which is directly in charge of the project area.
The Forest Ordinance (Cap 157) 1927	The Forest Ordinance (Cap 157), 1927 section 18(1) provides "*that the ownership of land is not altered by its declaration as a forest reserve"*. The stool landowners therefore have the right to a share of the benefits from the development of plantations in forest reserves	The Benefit Sharing Agreement signed by MFGL and the Forestry Commission in May 2009 for Commercial Forest Plantation Development states that the "*Landowner is entitled to 6% of the standing tree value (STV) of thinning and final harvest, the Forestry Commission is entitled to 2% of standing tree value of thinning and final harvest, the Local community shall also receive 2% of standing tree value of thinning and final harvest. The balance of 90% shall accrue to the plantations investor.*
The Concession's Act (Act 124) 1962	The Concession's Act (Act 124), 1962 indicates that "*the timber and land in forest reserves or subject to timber concessions (both within and outside the reserved forests) are vested in the State in trust for the landowning communities"*. The exploitation of the production forest reserves is administered by central government through the Ministry of Lands and Natural Resources (MLNR) and the Forestry Commission. Under this arrangement the landowners have a right to a share of revenue from both natural timber harvesting and forest plantation development within the forest reserves.	To ensure compliance with this Act, MFGL has entered into benefit sharing agreements with stool landowners and other stakeholders for the existing land holdings under the Commercial Plantation Developers scheme.
Timber Resource Management (Amendment) Act (Act 617),	The function of this Act provides for incentives and benefits applicable to investors in forestry and wildlife and to provide for matters related to these. This Act amended the original Act, 547, to exclude from its application the granting of timber rights on lands	This therefore protects MFGL from having any of its allocated lands being subjected to any future competitive bidding for

2002	with private forest plantations or lands with any timber grown or owned by individuals or groups of individuals	timber rights. MFGL is also registered with the Ghana Investments Promotion Council and therefore entitled to investment incentives as outlined by the GIPC.
The Forest Protection (Amendment) Act (Act 624), 2002	This Act relates to forest reserves and defines the offences and corresponding penalties that may be imposed by the Forestry Commission in the event of unauthorized setting of fires which run out of control, obstruction of rivers and waterways, erection of buildings, moving or destroying a forest reserve boundary pillars etc.	This Act therefore imposes strict guidelines on how MFGL should operate in the Chirimfa and Awura forest reserves with particular regard to management of fires, erection of permanent structures and use of water bodies. MFGL has developed good fire prevention and risk management procedures for managing fires in its plantations.
Wildlife Conservation Regulations (L.I. 685), 1971	This Legislative Instrument places restrictions on the hunting of game, the need to apply for game licences and permits for export of game.	MFGL has no intention to hunt any game. However, by its presence in the reserve, the Company has a responsibility to inform the Forestry Commission of any persons that may be in contravention of this regulation.
The Forest and Plantation Development Act (Act 583), 2000	The Act establishes a fund for plantation development in Ghana. The aims of the Fund are to provide: • financial assistance for the development of forest plantation on lands suitable for timber production, and • for research and technical advice to persons involved in plantation forestry	As the project evolves, MFGL will embark on research in soils, water and tree species and may wish to apply to the Forestry Commission for technical assistance in these areas
The Trees and Timber Act 493 (1994)	This Act defines the level of export levy attributable to different processed and unprocessed timber products for export. Under schedule 1 of the Act, Teak (logs and billets) attract a special levy of 10% of FOB value	Any future exports of teak logs or billets by the Company will be subject to the levy.
Environmental Protection Agency Act, 1994 Act 490	This Act establishes and mandates the EPA to seek and request information on any undertaking that in the opinion of the Agency can have adverse environmental effects and to instruct the proponent to take necessary measures to prevent the adverse impacts. The EPA Act, 1994 (Act 490) gave mandate to the Agency to ensure	The reforestation project may require some clearance from the EPA with regard to impact assessment and permitting. Both public and private entities to be

	compliance of all investments and undertakings with laid down Environmental Assessment (EA) procedures in the planning and execution of development projects, including compliance in respect of existing ones. The EPA is the responsible for issuing environmental permits for operations/developments likely to impact on the environment subject to EPA review. Part II of the Act 490 deals with pesticides control and management. This section of Act 490 provides the rules for registration, pesticides classification, approval, clearance, using, disposing of and non-disclosure of confidential information, the granting of license, labeling and pesticides inspections. It requires that any person who wishes to use pesticides must register and obtain a license from the Agency.	involved with provision of pesticides under the project will have to engage with the EPA.
Environmental Assessment Regulations, 1999, LI 1652	The Environmental Assessment Regulations of 1999, LI 1652 enjoins any proponent or person to register an undertaking with the Agency and obtain an Environmental Permit prior to commencement of the project. It indicates the EIA process and provides list of environmentally sensitive areas as well as possible undertakings requiring EIA. Schedule 1 of LI 1652 provides for undertakings requiring registration and environmental permit from the EPA.	The preparation of this ESIA to obtain the EPA Permit for project implementation is in compliance with this regulation.
Fees and Charges (Amendment) Instrument, 2015, LI 2228	The Fees and Charges (Amendment) Instrument 2015 (L.I. 2228) provides comprehensive rates, fees and charges collectable by Ministries, Department and Agencies (MDAs), such as the Environmental Protection Agency, for goods and services delivered to the public.	MFGL, in obtaining an environmental permit from the EPA for the project intervention, will pay all necessary fees and charges as prescribed by LI 2228 or negotiate with the EPA as appropriate.
National Environmental Quality Guidelines	EPA Environmental Quality Guidelines that are relevant to any environmental impact assessment study or implementation of an activity include: • Environmental Quality Guidelines for Ambient Air provide advice on maximum permissible levels of a variety of air pollutants; • Environmental Quality Guidelines for Ambient Noise provide advice on the maximum permissible noise levels; and • Effluent Quality Guidelines for Discharges into Natural Water Bodies provide maximum permissible effluent discharge concentrations for a number of parameters. The Guidelines are general and sector specific. Details are addressed in Section 2.2.1	Water pollution concerns may arise from use of pesticides and fertilizers on large scale. Therefore, periodic sampling of affected or nearby rivers/ streams in the reserves may be required to ascertain level of pollution and presence of pesticides to help implement appropriate mitigation measures.

Water Resources Commission Act 1996, Act 522	The Water Resources Commission Act, 1996 (Act 522) establishes and mandates the Water Resources Commission (WRC) as the sole agency responsible for the regulation and management of the utilization of water resources and for the co-ordination of any policy in relation to them. Section 13 prohibits the use of water (divert, dam, store, abstract or use water resources or construct or maintain any works for the use of water resources) without authority. Section 16 empowers the Commission to grant Water Rights (water use permits) to prospective users. The Act states under Section 24 that any person who pollutes or fouls a water resource beyond the level that the EPA may pre-scribe, commits an offence and is liable on conviction to a fine or a term of imprisonment or both.	The WRC will be involved where water pollution concerns arise from use of pesticides etc and where Miro Forestry intends to use any surface water body for irrigation of tree seedlings.
Office of the Administrator of Stool Lands Act 1994, Act 481	The OASL Act 1994, Act 481 establishes the Office of the Administrator of Stool Lands as enshrined in Article 267 (2) of the 1992 Constitution and it is responsible for establishment of stool land account for each stool, collection of rents and the disbursement of such revenues. The Administrator is charged with the management of stool lands and in accordance with the provisions in the 1992 Constitution, 10% of the gross revenue goes to the Administrator of Stool Lands for administrative expenses whilst the remainder is disbursed as follows: • 25% to the stool through the traditional authority for the maintenance of the stool; • 20% to the traditional authority; • 55% to the District Assembly, within the area of authority of which the stool lands are situated.	A stampage fee is paid to the Forestry commission by Miro Forestry upon harvesting. A percentage of the stampage fee is also paid to OASL by the Forestry Commission as annual rents for land use for disbursement to the relevant beneficiaries including the traditional authorities and the district assemblies as stipulated under the Constitution.
Local Governance Act 2016, Act 936	This Act establishes and regulates the local government system and gives authority to the RCC and the District Assembly to exercise political and administrative power in the Regions and District, provide guidance, give direction to, and supervise all other administrative authorities in the regions and district respectively. The Assembly is mandated to initiate programmes for the development of basic infrastructure and provide municipal works and services as well as be responsible for the development, improvement and management of human settlements and the environment in the district.	The FC and MFGL will work closely with the Mampong Municipal Assembly and the Sekyere Central District Assembly in the implementation of the reforestation project

The Labour Act 2003, Act 651	Section 118(1) of the Labour Act 2003 (Act 651) stipulates that it is the duty of an employer to ensure that every worker employed works under satisfactory, safe and healthy conditions. Act 651 contains a number of specific provisions relating to an employer's duty of care to its workers. These include providing and maintaining "at the workplace, plant and system of work that are safe and without risk to health" and taking "steps to prevent contamination of the workplaces by, and protect the workers from, toxic gases, noxious substances, vapours, dust, fumes, mists and other substances or materials likely to cause risk to safety or health", Trade Unions and Collective Bargaining Arrangements, as well as the employment of women. A worker is required to report situations that he believes may pose "an imminent and serious danger to his or her life, safety or health".	MFGL will ensure that the welfare of workers and the safety and health of workers engaged in any subproject activity are protected through the provision of a safe working environment and use of appropriate personal protective gears.
Workmen's Compensation Law 1987	The law holds employers responsible for the payment of compensation to workmen for personal injuries caused by accidents arising out and in the course of their employment.	The law is applicable to the forestry sector as provided under Section I of the Law. The forestry sector is an area which exposes its workers to a lot of occupational health and safety risks and accidents do occur as well.
Ghana National Fire Service Act 1997	The Act re-establishes the National Fire Service to provide for the management of undesired fires and to make provision for related matters. The objective of the Service is to prevent and manage undesired fire. For the purpose of achieving its objective; the Service is to organise public fire education programmes to create and sustain awareness of the hazards of fire, heighten the role of the individual in the prevention of fire and provide technical advice for building plans in respect of machinery and structural layouts to facilitate escape from fire, rescue operations and fire management. The GNFS has a rural fire department responsible for the control and management of bushfires.	The FC and MFGL currently collaborates with the GNFS with regard to providing education, awareness creation and training of forest fringe communities to prevent, control and manage fires.
The Fire Precaution (Premises) Regulations 2003, LI 1724	The Fire Precaution (Premises) Regulations 2003 (LI 1724) requires all premises intended for use as workplaces to have Fire Certificates and confers enforcement powers on the Ghana National Fire Service (GNFS) to demand a fire certificate for premises that are put to use as a place of work.	The Regulation requires MFGL to obtain a Fire certificate for the operation of offices, warehouse associated with the reforestation and its subprojects.

Factories Offices and Shop Act, 1970, Act 328	The Factories, Offices and Shops Act of 1970 (Act 328), as amended by the Factories Offices and Shops (Amendment) Law 1983 PNDCL 66, the Factories Offices and Shops (Amendment) Law 1991 PNDCL 275 s.1 (a), requires all proponents to register every factory, office and shop with the Chief Inspector of Factories Inspectorate Department. The Act requires all factories, offices and shops to among other things, notify the Chief Inspector of accidents, dangerous occurrences and industrial diseases, post in a prominent position in every factory the prescribed abstract of the act and other notices and documentations, as well as outlines the regulations to safeguard the health and safety of workers.	During the reforestation project implementation, MFGL will ensure that warehouses, and offices constructed under the project are registered with the Factories Inspectorate Department, and ensure that other relevant requirements are met during the implementation of the programme.
Control of Bush Fires Law of 1983 (PNDCL 46)/Control and Prevention of Bush Fires Act 1990	Control of Bush Fires Law of 1983 (PNDCL 46) seeks to control the setting of bush fires by criminalizing the intentional, reckless, or negligent causing of such fires and holding the offender liable for all consequences of the fire. Section 2 of the Control and Prevention of Bushfire law, PNDCL 229, defines "starting of a bushfire". A person starts a bushfire if an action of that person results in the uncontrolled burning of a farm, forest or grassland. The Chief Conservator of Forests or the Chief Game and Wildlife Officer may authorize staring of fires by authorized officers in Conservation Areas under section 4. Other sections concern duties of private parties and the National Fire Service in respect of bushfire control. The National Fire Service is responsible, on the coming into force of this Act, for the training of town, area and unit fire volunteer squads.	These laws are very important to the sustainability of the reforestation project because bushfire is a risk to the project. Bushfires have been identified as major causes of forest degradation and deforestation. The threat of fires becomes more evident in the dry seasons (December – April). Efforts will be put in place to protect plantation sites from the threat of fires.

2.3 Environmental Quality Guidelines

The guideline provides for permissible levels for ambient air quality, noise levels and effluent quality guidelines for discharge into natural water bodies. The environmental guidelines issued in 1997 include:

- National Ambient Air Quality Guidelines;
- National Ambient Noise Level Guidelines; and
- National Effluent Quality Discharge Guidelines.

National Ambient Air Quality Guideline Values

The guideline provides for permissible guideline values for a variety of air pollutants as shown in **Table 3.**

Table 3: National Ambient Air Quality Guideline Values

Substance	Time Weighted Average (TWA)		Averaging Time
Sulphur Dioxide (SO_2)	900 µg/m^3 700 µg/m^3 150 µg/m^3 100 µg/m^3 80 µg/m^3 50 µg/m^3	Industrial Residential Industrial Residential Industrial Residential	1 hr 1 hr 24 hr 24 hr 1 yr 1 yr
Nitrogen Oxides (measured as $N0_2$)	400 µg/m^3 200 µg/m^3	Industrial Residential	1 hr. 1 hr.
	150 µg/m^3 60 µg/m^3	Industrial Residential	24 hr 24 hr
Total Suspended Particulate	230 µg/m^3 150 µg/m^3 75 µg/m^3 60 µg/m^3	Industrial Residential Industrial Residential	24 hr 24 hr 1 yr 1 yr
PM_{10}	70 µg/m^3		24 hr
Smoke	150 µg/m^3 100 µg/m^3 50 µg/m^3 30 mg/m^3	Industrial Residential Industrial Residential	24 hr 24 hr 1 yr 1 yr
Carbon Monoxide	100 mg/m^3 60 mg/m^3 30 mg/m^3 10 mg/m^3		15 min 30 min 1 hr 8 hr
Hydrogen Sulphide	150 µg/m^3		24 hr
Mercury	1 µg/m^3		1 yr
Lead	2.5 µg/m^3		1 yr
Cadmium	10 - 20 ng/m^3		1 yr
Manganese	1 µg/m^3		24 hr
Dichloromethane (Methylene Chloride)	3 mg/m^3		24 hr
1,2-Dichloroethane	0.7 mg/m^3		24 hr
Trichloroethane	1 mg/m^3		24 hr
Tetrachloroethene	5 mg/m^3		24 hr

Substance	Time Weighted Average (TWA)		Averaging Time
Toluene	8 mg/m^3		24 hr
Arsenic	30 ng/m^3	Industrial	24 hr
	15 ng/m^3	Residential	24 hr
Fluoride	10 µg/l		24 hr

National Ambient Noise Level Guideline (NANLG)

The guideline provides for permissible night and day noise levels for variety of settings ranging from residential areas with negligible or infrequent transportation to predominantly heavy industrial areas as shown in **Table 4**.

Table 4: National Ambient Noise Quality Guideline Values

ZONE	DESCRIPTION OF AREA OF NOISE RECEPTION	PERMISSIBLE NOISE LEVEL IN dB(A)	
		DAY 0600 - 2200	NIGHT 2200 - 0600
A	Residential areas with low or infrequent transportation	55	48
B1	Educational (school) and health (hospital, clinic) facilities	55	50
B2	Areas with some commercial or light industry	60	55
C1	Areas with some light industry, places of entertainment or public assembly, and places of worship located in this zone	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

National Effluent Quality Guidelines

The national effluent quality discharge guideline levels as administered by the EPA are as provided in **Table 5**.

Table 5: General Effluent Quality Guidelines for Discharge into Natural Water Bodies- Maximum Permissible Levels

Parameter	EPA Recommended Guideline Value
pH	6 – 9
Temperature Increase	<3oC above ambient
Colour	200 TCU
Turbidity	75 NTU
Conductivity	1500 uS/cm
Total Suspended Solids	50 mg/l
Total Dissolved Solids	1000 mg/l
Oil/Grease	5.0 mg/l
Sulphide	1.5 mg/l
Total Phosphorus	2.0 mg/l
Biochemical Oxygen Demand (BOD_5)	50 mg/l 250 mg/l
Chemical Oxygen Demand (COD)	50 mg/l
Nitrate	1.0 mg/l
Ammonia as N	150 mg/l
Alkalinity as $CaCO_3$	2.0 mg/l
Phenol	0.005 mg/l

Mercury	1.0 mg/l
Total Arsenic	0.1 mg/l
Soluble Arsenic	0.1 mg/l
Lead	0.5 mg/l
Total Pesticides	10 mg/l
Fluoride	250 mg/l
Chloride	200 mg/l
Sulphate	400 MPN/100ml
Total Coliforms	0 MPN/100ml
E. coli	0.1 mg/l
Cadmium	0.1 mg/l
Chromium (+6)	0.5 mg/l
Total Chromium	5.0 mg/l
Copper	0.5 mg/l
Nickel	1.0 mg/l
Selenium	10.0 mg/l
Zinc	5.0 mg/l
Silver	5.0 mg/l
Tin	5.0 mg/l
Aluminum	5.0 mg/l
Antimony	0.05 mg/l

(Source: Environmental Protection Agency, Accra 1997)

2.4 Relevant International Conventions

Ghana is a signatory to some of the international conventions that are relevant to the proposed project and it is imperative to analyze the project in light of the commitments made under such conventions.

United Nations Convention on Biological Diversity

The three goals of the CBD are to promote the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. Ghana being a signatory of this convention is supposed to work towards the achievement of the three goals.

The convention calls for the adoption of national strategies, plans and programmes for the conservation and sustainable use of biological diversity into their relevant sectoral and cross-sectional plans, programmes and policies. One of the tools that are prescribed for the management of biodiversity is environmental assessment. Article 14 of the convention deals with impact assessment and minimization of adverse impacts.

United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change (UNFCCC) provides the basis for global action to protect the climate system for present and future generations.

The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other

emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 189 countries having ratified.
The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Under the Convention, governments:

- Gather and share information on greenhouse gas emissions, national policies and best practices.
- Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
- Cooperate in preparing for adaptation to the impacts of climate change

International Plant Protection Convention (IPPC

The International Plant Protection Convention (IPPC) is a 1951 multilateral treaty overseen by the Food and Agriculture Organization that aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products. The Convention extends beyond the protection of cultivated plants to the protection of natural flora and plant products. It also takes into consideration both direct and indirect damage by pests, so it includes weeds.

The Commission of Phytosanitary Measures of the IPPC has developed a strategic framework with the objectives of:

- protecting sustainable agriculture and enhancing global food security through the prevention of pest spread;
- protecting the environment, forests and biodiversity from plant pests;
- facilitating economic and trade development through the promotion of harmonized scientifically based phytosanitary measures, and:
- developing phytosanitary capacity for members to accomplish the preceding three objectives.

African convention on the conservation of nature and natural resources (Revised) - ACCNNR

The objectives of the Convention are (i) to enhance environmental protection; (ii) to foster the conservation and sustainable use of natural resources; (iii) to harmonize and coordinate policies in these fields with a view to achieving ecologically rational, economically sound, and socially acceptable development policies and programs. In achieving the above objectives, the right of all people to a satisfactory environment favorable to their development should be ensured.

2.5 Relevant International Safeguard Policies

2.5.1 IFC Performance Standards and it relation to the Proposed Project

Table 6: IFC Performance Standards

No	IFC Performance Standards	Summary of core requirements	Potential for Trigger under the proposed project	Remarks or recommendation for proposed project
1	***Assessment and Management of Environmental and Social Risks and Impacts***	Identify and evaluate environmental and social risks and impacts of the project and adopt measures anticipate, avoid and when avoidance is not possible, minimise and or compensate Project Affected People/Communities and Environmental Area of Influence. The achievement of the above, Clients should established an effective ESMS, which ensures stakeholders/community participation and grievance redress mechanisms.	Triggered as project will impact on both biophysical environment, and socio-cultural and livelihood of some community members.	ESIA will identify and assess expected impacts and devise workable ESMS to address identified issues
2	***Labor and Working Conditions of workers***	Management of projects should ensure workers safety promote the fair treatment, non-discriminatory and equal opportunity of workers and establish, maintain and improve the worker-management relationship, and comply with national employment and labour laws of host country.	Triggered as project will involve considerable labour force. Worker's safety and congeniality of workers condition will be very cardinal in the successful project execution and acceptability	The project will take into consideration appropriate worker interest, welfare and safety measures during implementation
3	***Resource Efficiency and Pollution Prevention***	Avoid or minimise adverse impacts on human health and the environment through avoidance or minimisation of pollution including release of greenhouse gases from project and promote sustainable use of resources such as energy and water. Clients are also expected to ensure the use of efficient pollution abatement machinery to reduce pollution.	Triggered as surface water resources runs through the allocated compartments of the reserve and possible pollutants from fertilizer and agrochemical usage activities and its impact on surface water bodies and human health	Mitigation measures in ESIA to address various pollutants from agro-chemical use and disposal of agrochemical waste containers and among others
4	***Community Health, Safety and Security***	To evaluate the risks and impacts to the health and safety of the Affected Communities during the project lifecycle and establish preventive and control measures consistent with Best International Practices and commensurate with their nature and magnitude of impacts.	Triggered as anticipated impacts and risk from the operations of the reforestation project will affect local communities nearby	Potential community risk impacts will be assessed and addressed in the ESIA studies
5	***Land Acquisition and Involuntary***	As much as possible project siting and activities should not displace people. However, where avoidance is not possible, displacement	Potentially triggered but the company has been duly informed by Forestry	It is worth noting that the reserve lands are under the

	Resettlement	should be minimised by alternative project design considerations. No force eviction should be undertaken by client. Land acquisition should be done in a manner as to minimise adverse social and economic impacts through the provision of compensation packages and to ensure a humane resettlement procedure, disclosure of information, consultation and participatory of PAPs. It should be the client's duty to ensure the physical and economic wellbeing of displaced people are not worst of than their pre displaced lives.	Commission that all those working in the reserves are there illegally and therefore anyone affected by Miro's activities, will not receive any compensation from Miro Forestry.	management and control of the Forestry Commission; who have not allocated any reserve lands to any of the local farmers.
6	***Biodiversity Conservation and Sustainable Management of Living Natural Resources***	All clients should identify both direct and indirect project related impacts that could potentially threaten biodiversity and ecosystem services. The following indicators should be used as a guide: habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution.	Triggered as both aquatic and terrestrial ecosystems are involved in the project.	Both terrestrial and aquatic ecology studies will be carried out as part of the ESIA studies and appropriate biodiversity preservation /conservation measures recommended.
7	***Indigenous People***	Indigenous People are defined as a social group with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population.	Not triggered as there are no indigenous people on the project lands or within the project communities of influence.	Not applicable
8	***Preservation of Cultural Heritage***	Client must protect cultural heritage from the adverse impacts of project activities and support its preservation. Clients should also promote the equitable sharing of benefits from the use of cultural heritage.	Further studies required to determine whether it is triggered or not. No international or national cultural or natural heritage site of importance identified yet. It is possible for local cultural heritage sites to exist in the project area.	Cultural heritage sites shall be identified during the ESIA studies

2.5.2 The Forest Stewardship Council (FSC) Principles and Criteria for Forest Stewardship

Miro Forestry has initiated the process to get its Ghana operations certified by the Forestry Stewarship Council (FSC). Certification is achieved by passing an assessment carried out by an FSC-accredited certification body, with forest management conformity assessed against the FSC Principles and Criteria.

The evaluation process consists of an in-depth review of forest management processes and their environmental, social, and economic impact. A certificate will be issued, depending on the number and scale of any non-conformities discovered. FSC forest management certification is valid for five years, subject to annual checks that FSC requirements are continuously met.

The FSC Principles and Criteria for which Miro Forestry is putting in measures to ensure full compliance to achieve certification in the short-term are provided below.

- Principle 1 (Compliance with Laws): The Organization shall comply with all applicable laws, regulations and nationally- ratified international treaties, conventions and agreements.
- Principle 2 (Workers' Rights and Employment Conditions): The Organization shall maintain or enhance the social and economic wellbeing of workers.
- Principle 3 (Indigenous Peoples' Rights): The Organization shall identify and uphold Indigenous Peoples' legal and customary rights of ownership, use and management of land, territories and resources affected by management activities.
- Principle 4 (Community Relations): The Organization shall contribute to maintaining or enhancing the social and economic wellbeing of local communities.
- Principle 5: (Benefits from the Forest): The Organization shall efficiently manage the range of multiple products and services of the Management Unit to maintain or enhance long term economic viability and the range of environmental and social benefits.
- Principle 6: (Environmental Values and Impacts): The Organization shall maintain, conserve and/or restore ecosystem services and environmental values of the Management Unit, and shall avoid, repair or mitigate negative environmental impacts.
- Principle 7 (Management Planning): The Organization shall have a management plan consistent with its policies and objectives and proportionate to scale, intensity and risks of its management activities. The management plan shall be implemented and kept up to date based on monitoring information in order to promote adaptive management. The associated planning and procedural documentation shall be sufficient to guide staff, inform affected stakeholders and interested stakeholders and to justify management decisions.
- Principle 8 (Monitoring and Assessment): The Organization shall demonstrate that, progress towards achieving the management objectives, the impacts of management activities and the condition of the Management Unit, are monitored and evaluated

proportionate to the scale, intensity and risk of management activities, in order to implement adaptive management.

- Principle 9: (High Conservation Values): The Organization shall maintain and/or enhance the High Conservation Values in the Management Unit through applying the precautionary approach.
- Principle 10 (Implementation of Management Activities): Management activities conducted by or for The Organization for the Management Unit shall be selected and implemented consistent with The Organization's economic, environmental and social policies and objectives and in compliance with the Principles and Criteria collectively.

3.0 PROPOSED PROJECT DESCRIPTION

3.1 The Need for the Project

Timber demand in West Africa is growing with booming economic growth and construction. This is against a backdrop of decreasing timber supply, as stocks of standing timber continue to be depleted with unsustainable harvesting. These macro factors provide an economic opportunity on which to build a profitable and hence sustainable and economically secure plantation forestry business. Construction timbers (for poles, sawn timber and wood based panels) represent the largest and fastest growing segment of the timber market in West Africa. Ghana is currently experiencing serious shortages in good quality timber and therefore, it is recognised within the Forestry Commission and industry that fast rotation growing plantations is the future for rehabilitation of forest reserves and improving the supply of timber to the domestic market.

It is also Government policy to promote private sector participation in commercial forest plantation development in order to sustain the supply of timber and timber products to the timber and wood-based industries. For these and other reasons extensive areas of sustainably managed forest plantations are needed in the country to meet the growing demand for industrial timber.

The project seeks to impact positively in terms of economic, environmental and social benefits. The project will ultimately contribute to increased supply of timber and timber products as well as revenue to the Forestry Commission derived from local and export levies that would accrue from harvesting, processing and export of timber products. Small and medium-scale support businesses are also likely to spring up to boost economic activities; particularly at Mampong, Nsuta, Kumawu, Kwaman and other surrounding villages close to the project area.

The environmental benefits expected from the project will include the improvement of the protective function of the forest cover within the project area. The project will adopt best practices to ensure sustainable forest management and contribute to the establishment of a vegetative cover to improve soil and water conservation; as well as the reduction in the loss of soil nutrients through erosion. The project's plan to develop conservation areas and protect areas of environmental sensitivity will contribute greatly to environmental conservation in the reserves.

The fringe communities in the project area will benefit from diverse employment opportunities that will be offered by the project. The project will encourage agro-forestry and inter-cropping practices which will contribute to income generation in and around the project area and ultimately lead to improved welfare and generally a reduction in poverty.

The current degraded nature of the project sites does not offer any significant benefits to the stool landowner, local community and the Forestry Commission. However, the benefit sharing arrangements from the implementation of the project will bring economic benefits

to the stool landowners, local communities and the Forestry Commission, as they will benefit from the 10% of standing tree value (STV) of thinning and final harvest of the plantation.

In summary, the development of the proposed 4,428 hectares of Awura and Chirimfa Forest Reserves in addition to the already existing plantation of about 5000 ha at Buomfoum is aimed at the restoration of degraded reserves, employment generation and skills development, capacity building, boosting local economy as well as national development, mitigating climate change, protecting water sheds, improving timber supply, minimizing soil erosion, enhancing soil nutrients, improving local food production, and improving biodiversity in such degraded areas.

3.2 Project Location and Accessibility

The proposed project will be implemented in the Awura and Chirimfa Forest Reserves, which is an extension of the existing plantation at Boumfoum Forest Reserve. The Awura and Chirimfa Forest Reserves fall within the Mampong Municipal and Sekyere Central District respectively, and under the Mampong District Office of the Forest Service Division (FSD) all in the Ashanti Region of Ghana. The Awura project site is accessible through Ejura –Aframso Road whilst Chirimfa site can be access via Aframso –Mampong road. The location maps for the Forest Reserves are shown in **Figures 1** and **2.**

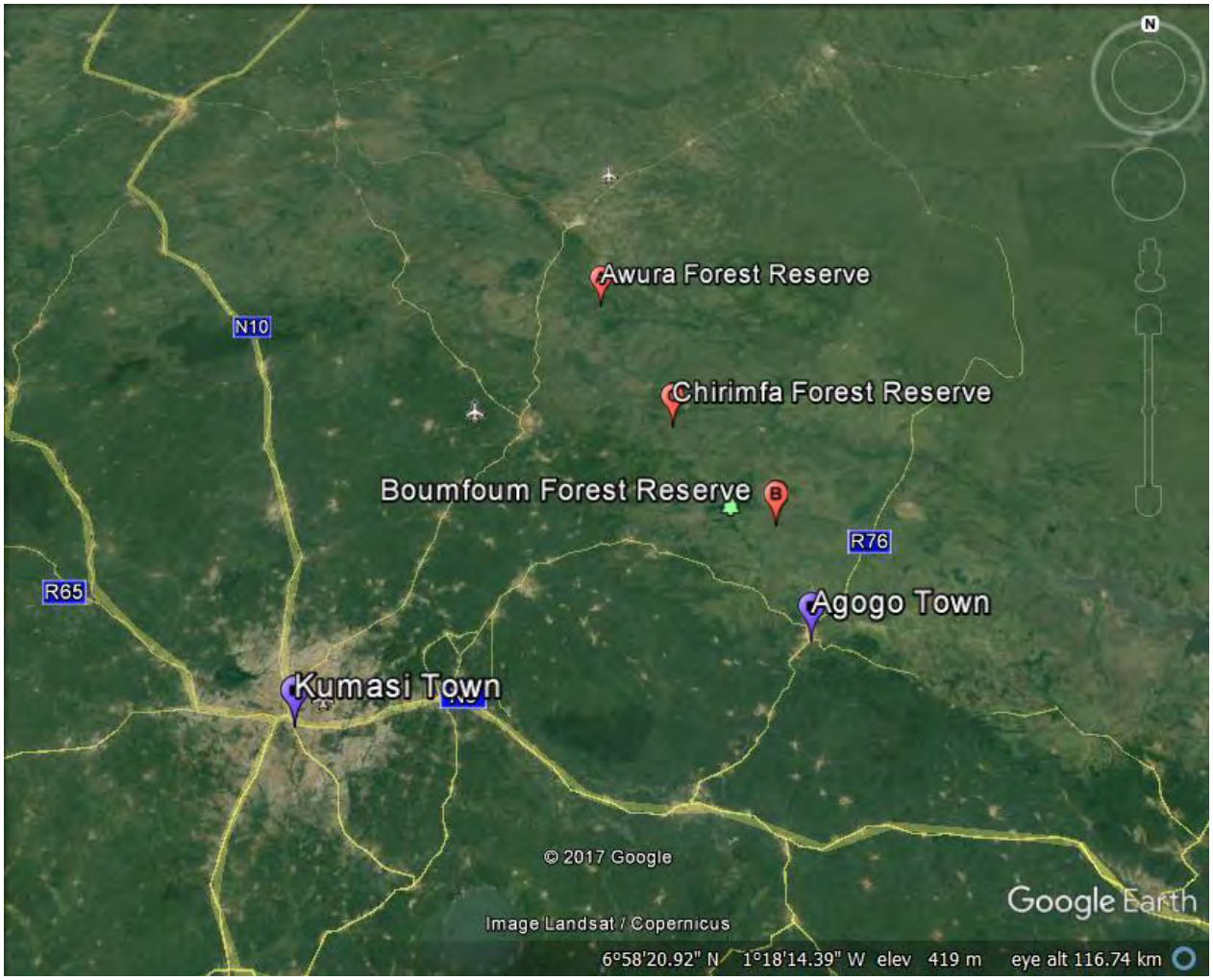

Figure 1: Location of Boumfoum, Chirimfa and Awura Forest Reserves in the Ashanti Region of Ghana

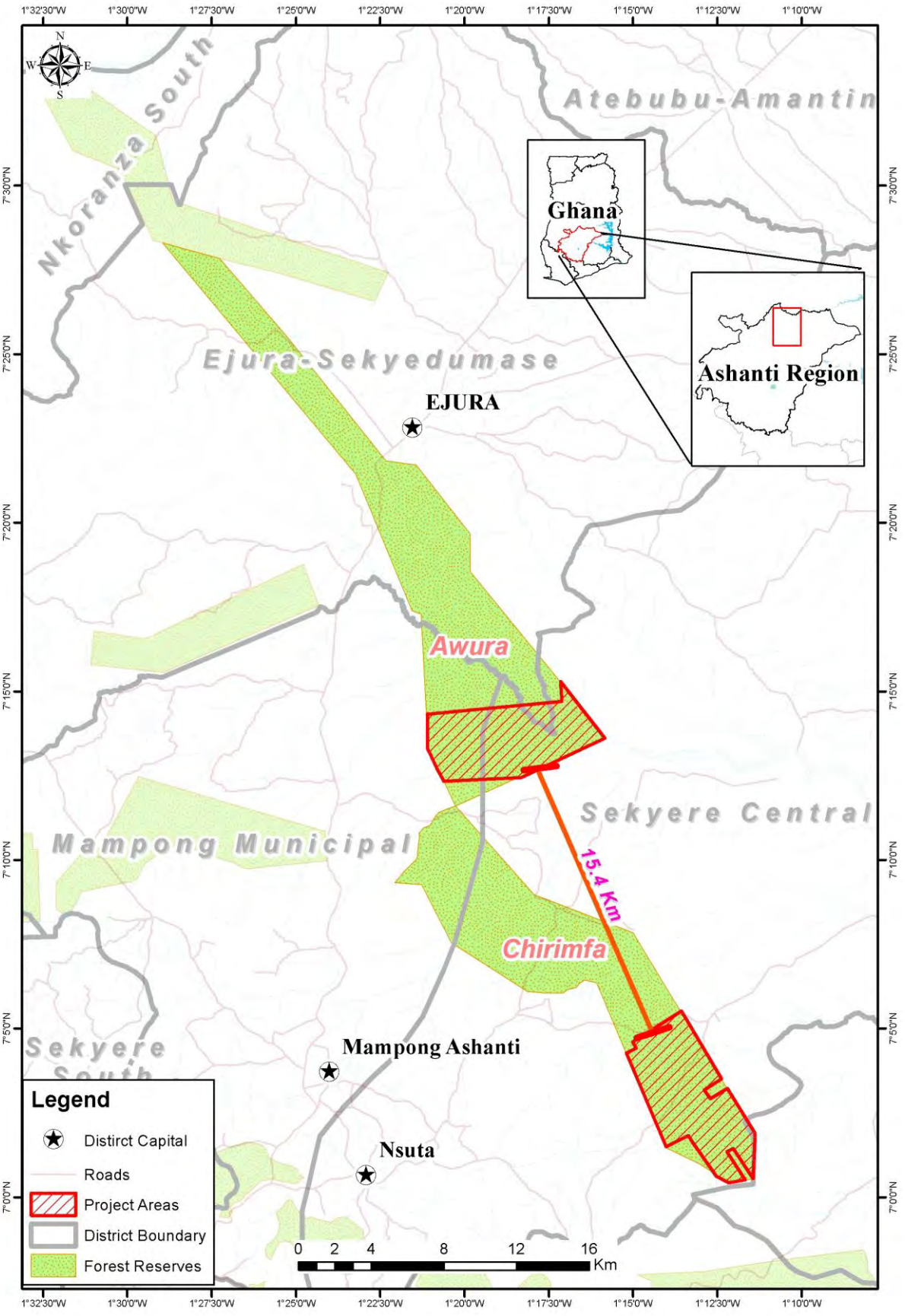

Figure 2: District Map showing Location of Chirimfa and Awura Forest Reserves

3.3 Project Concept

Based on literature and a detailed soil and land suitability study carried out, soils in the reserves generally have developed over sandstone and are predominantly sandy loam soils with between 10% - 15% clay content, an indication of their suitability for forest tree plantation establishment.

Miro Forestry (Ghana) Ltd (MFGL) proposes to develop a 4,428-hectare plantation comprising mainly Teak (*Tectona grandis)*, Eucalyptus (*Eucalyptus spp*), Acacia and indigenous species such as Ceiba (*Ceiba pentandra*) and Wawa (*Triplochiton scleroxylon*), as expansion development to add to the already existing 5,000 ha of plantation development at Boumfoum.

Under the broad project scope, the key project stages and timelines for the MFGL proposed development are as follows:

a) 2017 – 2018 - Scoping and EIA Approvals Stage
b) 2018 - 2024 – Holding nursery establishment and seedling development
c) 2017 – 2024 – Land Preparation
d) 2018 – 2024 – Planting of Teak and Eucalyptus trees (and other trial species)
e) 2017 – 2024 - Road maintenance and construction
f) 2017 – 2024 – Creation of conservation areas and Buffer Zones/Riparian strips
g) 2020 – 2024- Thinning and Maintenance of tree plantations
h) 2020 – 2024 - Selective Harvesting
i) 2018 – 2020 – Additional labour and staff recruitment
j) 2017 – 2024 - Forest Fire Mitigation Management
k) 2018 - 2024 - Annual Social Responsibility Commitments/Agreements

The proposed development will involve nursing of seedlings, land preparation, creation of conservation management areas, planting of fast growing Teak and Eucalyptus tree species, upgrading and maintenance of old logging roads, sustainable selective harvesting, creation of employment opportunities for locals in Mampong, Nsuta, and other close communities, development of modern agro-forestry initiatives, collaboration with key stakeholders to support local good causes and distribution of financial benefits from plantation outputs for stakeholders. Miro’s production site will be located in Mampong.

3.4 Main Components of the Proposed Project

The main components of the project are discussed below.

3.5 Land Mapping

As part of the initial project activities, MFGL and the Forestry Commission have mapped out the boundaries and Compartments of the proposed development for Chirimfa and Awura reserves using Geographical Information Systems (GIS) and field verification of boundary pillars as shown in **Figure 3** and **Figure 4.**

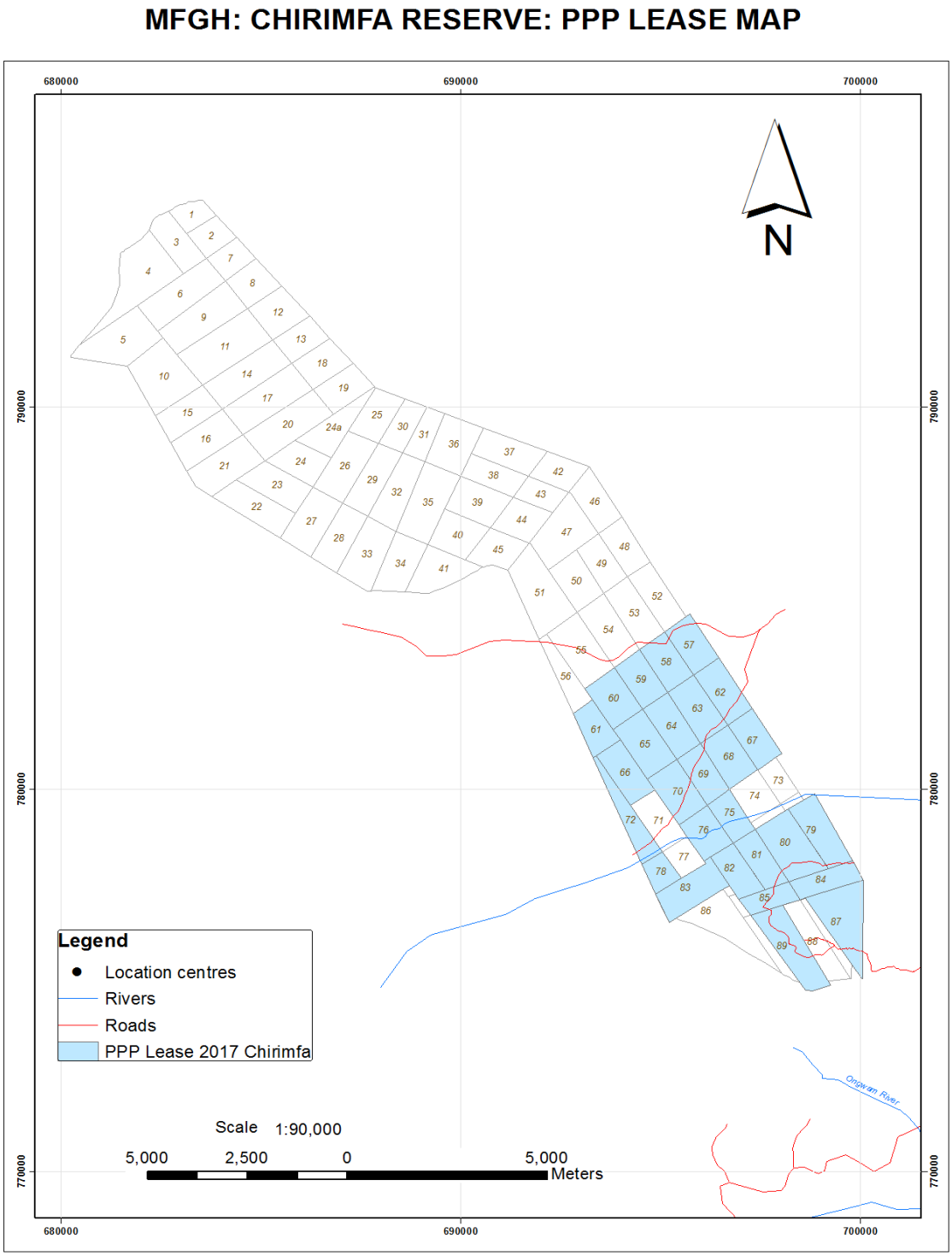

Figure 3: Land Mapping of Chirimfa Forest Reserve of MIRO Compartments

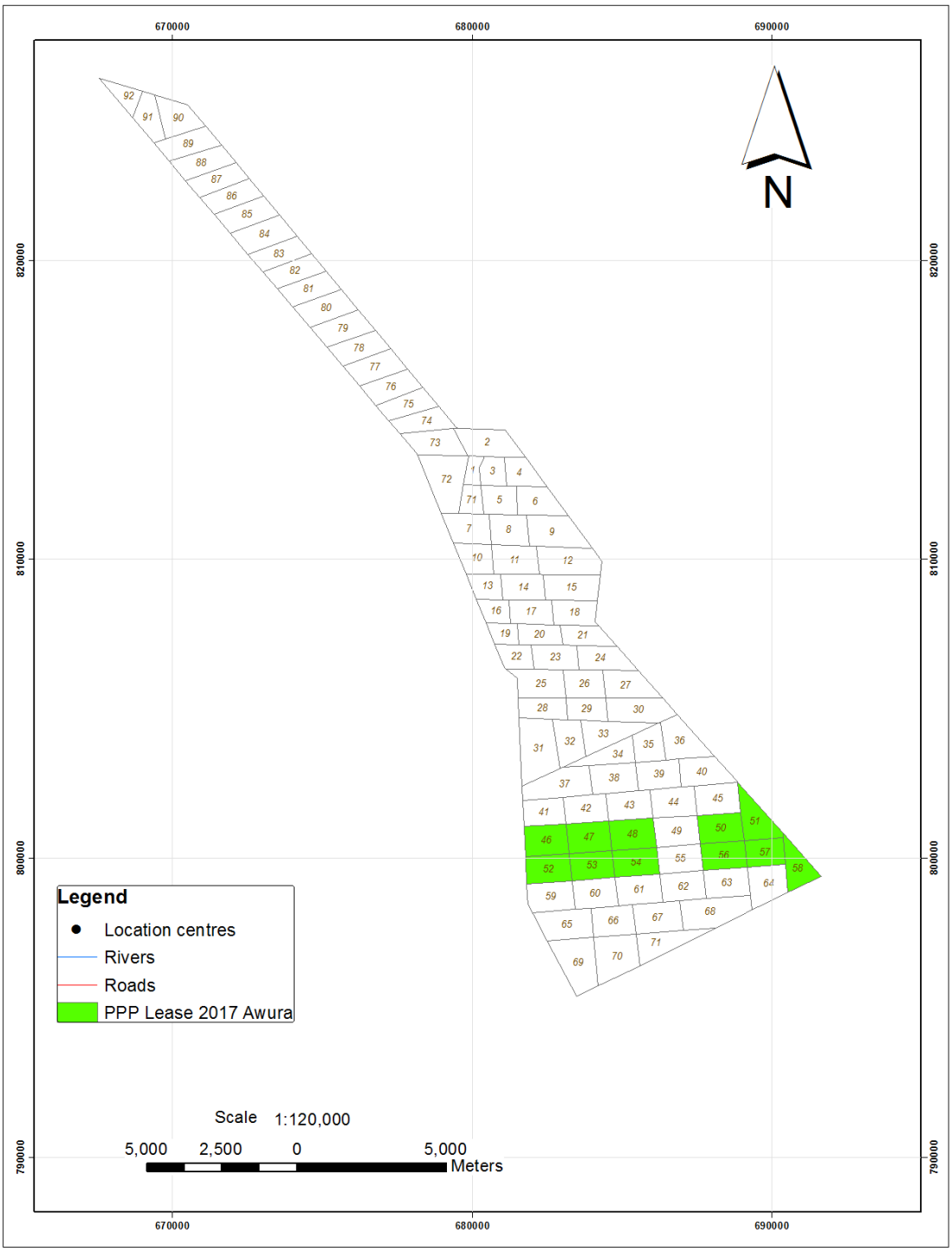

Figure 4:Land Mapping of Awura Forest Reserve of MIRO Compartments

3.6 Species to be selected

The following tree species are more likely to be cultivated under the plantation development following from the success of its use in many parts of the country by private plantation developers and the Forestry Commission:

- Teak; and
- Eucalyptus.

Planting of indigenous species in conservation areas such as Ceiba (*Ceiba pentandra*) and Wawa (*Triplochiton scleroxylon*) is also considered as a prime option to provide a rich mix of plantation and indigenous species in its allocated areas. Other commercial species the Company will be trialling in the project area include Pine, Corymbia spp, and Cedrela.

3.7 Plantation Establishment

Land Preparation: Various mechanical land preparation techniques will be employed by Miro Forestry including the use of large mechanical chopper-rollers, roam disc harrows, tractor and bulldozer-drawn rippers, ploughs and other land preparation implements. Where such mechanical systems are difficult manual methods will be used

Land preparation will involve appropriate soil preparation (such as stumping, windrowing, cleaning up) and soil testing and analysis. This will ensure optimisation of the site as soil preparation, to a large extent, determines the success of the planting.

Marking and Pitting: Out the planting points at the desired spacing for planting is to lay out a line, marked at intervals with the desired spacing, along the edge of the area to be planted.

Planting: The Company plans to establish 1,500 hectares per annum including up to 80% fast growing industrial timber. Planting is targeted between April – October annually depending on the weather during that period. All planting materials will be transported from the nursery using flat-bed trucks and brought to the planting site only on the day of planting in order to limit the transplantation shock to the plants. The project will adopt a general spacing of 2.5m x 3m for Eucalyptus *spp*. and other fast growing species (1,333 stems per hectare) and 3m x 3m for Teak (1,111 stems per hectare) in each planting unit except for areas requiring the planting of indigenous species where a spacing of 4m x 4m will be used. This activity will be completed by the end of April of each planting year depending on the weather.

In the case of Eucalyptus, the seedlings are removed from the seedling tray and placed upright in the planting hole deep enough to cover the root plug and a short portion of the stem. Soil is then placed around the roots, ensuring that the seedling remains in a vertical position and firmed down using the fingertips. A water-retention gel is then used that will

assist the seedling by providing access to water in the event that there is a break in rainfall during the early days of establishment.

Survival Survey and Blanking: Where the planting has been done on schedule between April and October, survival surveys will be carried out within 2 weeks following planting to determine the need for blanking which, if necessary, is completed within 3 weeks to prevent an uneven stand. Blanking is then carried out where seedling mortality turns out to be more than 10% or concentrated at various spots. A second assessment is then carried out in March/April of the following year to determine any casualties following the dry season. In all cases blanking is done using large healthy nursery stock.

3.7.1 Weeding/Maintenance

Most common weeds grow faster than newly-planted trees and unless the weeds are controlled effectively, the plantation investment suffers seriously and may even fail completely. Weeding will be performed either manually, mechanically or by hand, to remove weeds that have germinated. Seeds will continue to germinate and follow-up inspections and weeding will always be required. Weeding will therefore be done before the weeds are able to seed in order to be effective. Weeding is done to prevent or to minimize any competition to the planted seedling.

The aim of the operation is to create a weed-free zone of 50cm radius around each newly-planted seedling. This operation is best carried out using a hoe and care will be taken not to hoe right up to the stem, as this causes soil to be removed from the base of the stem which can lead to the seedling falling over. Tractors will be used where appropriate, towing a disc, plough, rotavator or flail mower to slash down weeds. When necessary chemical weeding will be undertaken using Glyphosate (herbicide) to kill undesired weeds. When used in post-planting weed control, measures will be taken to prevent it coming into contact with the planted trees.

3.7.2 Fertilizing

As part of the land preparation activities, an NPK and trace element mix fertilizer will be applied. Any inter-cropping of trees with leguminous crops such as cowpeas, soya and onions by farmers can contribute to improving the nitrogen content in soils and will be pursued.

3.7.3 Pruning

Pruning is carried out to provide a knot-free timber from the growing tree. Branches that develop up to, at least, a third of the tree height are removed during the first, second, third, fourth and fifth years of establishment approximately. Intensive pruning of buds and branches is also undertaken regularly after the first pruning operation. As a cost saving measure this operation will be run concurrently with singling where necessary.

3.7.4 Thinning

Thinning is undertaken to reduce total stems per hectare. This allows the trees greater space to increase girth and enhance its eventual end timber use and value. The thinning operation is carried out on the young seedlings that develop multiple shoots on the main stem after planting. The shoots of undesirable qualities (the smallest or worst stem form) are removed to maintain one stronger and healthier shoot to develop into good pole size or small size timber. The first round of singling is done in the year following the year of planting. The thinning operation is completed using hand bow saws and chain saws as applicable. Thinning will be carried out in each annual coupe to ensure that the final crop develops under conditions that will maximize volume increment.

3.7.5 Harvesting

MFGL is in the early stages of its plantation development and will not be commencing clear-fell harvesting proper until 2024 for the Chirimfa and Awura reforestation project.

3.8 Forest Protection

MFGL considers fire protection a key issue since fire poses the greatest physical risk to the Company's biological assets as well as to the already heavily-degraded reserve. Fire protection therefore will focus on fire prevention, fire risk reduction and fire preparedness and suppression.

Fire prevention measures require the active engagement with the local community. Most fires are man-made, often started to clear land or for the purposes of hunting. Agricultural methods using fire to clear land are less efficient in terms of retaining nutrients and organic matter in the soil, and efforts will be made through education programmes to re-educate local farmers who clear land in this way.

Fire risk reduction methods will focus on physical methods of preventing fires from occurring or reducing the potential severity of fires. Weed control methods will aim not only at preventing competition with young trees but also at reducing the volume of combustible material that builds up beneath the trees. Intensive weed control methods will be used for both purposes. Fire breaks are a further tool that will be used to reduce the impact of fires and aid in the ability to fight them. Fire breaks 10 metres wide will be created around planting units within the plantation and also serve as access routes within the plantation. Some green belts will be established in high-danger areas at strategic locations along the perimeter of the reserve. Local farmers will be encouraged to plant groundcover crops within the green belts to further enhance their capacity to retard the spread of fire.

Fire preparedness is of high importance during the fire season (December – April). MFGL has fire equipment to manage fire outbreaks. Field vehicles fitted with high-pressure, water deployment devices for rapid firefighting interventions are available.

Roaming security guards will be employed and deployed on 24-hour patrol of the plantation during the dry season. The guards will be provided with transport and communication gadgets to facilitate communication between the groups for rapid response to manage fire outbreaks. The company has introduced a fire index system that takes temperature, wind speed and humidity into account and all staff will be alerted every morning as to the current index and the fire risk for the day. In support of its firefighting efforts, MFGL also proposes to partner with locals for effective fire management support.

3.9 Pest Control

Pest and disease issues can include fungal, bacterial and biological pathogens. The impact of pests and diseases vary, but can lead to reduced growth rates, reduced yields, lower quality timber and total crop failure – all of which have a significant financial impact.

Pest control will be by means of Integrated Pest Management approach that employs a range of preventative and control methods to combat pests and diseases. Pesticides as well as cultural management strategies will be explored. Pesticides that will be used will be registered with the EPA as required by law.

The Company aims to maintain a diversity of planting stock, to ensure that the genetic base of the plantation is wide and varied. Currently, it has a dedicated research and development department that tests new commercial species for deployment, continuously evaluates its planted material, and engages with leading research institutions including FABI in South Africa, to ensure that it is abreast of the latest information on pests and diseases.

3.10 Inter- cropping schemes

In line with the company's objective of introducing alternative livelihood schemes to the local farmers the project will allow selected registered farmers to intercrop the tree seedlings with selected seasonal food crops (preferably vegetables, legumes and non-woody fruit plants). The inter-cropping schemes will be developed in close collaboration with Traditional Councils and local stakeholders after land preparation activities have been completed and trees planted.

3.11 Labour and Staff Recruitment

MFGL will recruit workers for its field operations from within the Mampong community and surrounding areas. These workers will complement and support plantation development managers who will oversee the implementation of the project. It is estimated that about

140-150 additional workers will be recruited to support plantation development objectives; together with 20-30 management and administrative support staff.

3.12 Materials and Equipment

During the first five establishment years of the project, MFGL estimates the use of the following key inputs:

Seedlings

- Teak Seedlings
- Eucalyptus Seedlings
- Other Hardwood Species (Gmelina arborea, Acacia mangium, Corymbia spp.)
- Reusable seedling trays and inserts

Consumables

- Water-retention gel for planting
- Glyphosate for weed control
- Other weed control products (Alion, Triclopyr, Silhouette)
- Termicide (Imidacloprid)
- Fertilisers - SK10, Urea, DAP

Heavy Equipment and Vehicles

- Tractors, tractor ploughs, ridger, ripper
- Bulldozer for land clearance and ripping
- Savannah Ripper-Ridger
- Compactor Roller
- Tipping Trailers
- 3-Wheel Telelogger
- Pickup vehicles for management staff travel
- Labour trucks for staff travel
- Road Grader
- Motorbikes
- Fire Trucks

Small Tools and Equipment

- Chainsaws for land clearance, stump removal and harvesting
- Assorted hand tools and equipment
- GPS devices and other planning equipment
- Firefighting water pumps, drums and hoses

3.13 Infrastructure

Road Construction and Maintenance

Many of the old logging roads in the reserves were poorly constructed and as such require maintenance to bring them up to modern forestry standards. MFGL will therefore rehabilitate old logging roads; where they occur within its allocated compartments.

The planning, construction and maintenance of the forest road network, depots, landings and extraction routes are referred to as access development. This is necessary to enable equipment and personnel to gain access to the standing tree to remove products from the forests. Tactical planning is a necessary step in road planning and construction and will be a function of the time frame of the tactical harvesting plan. MFGL therefore aims to achieve an optimal balance between forest roads, extraction routes, depots and landings to maximise the profitability of the forest estate. As part of its road planning activities, MFGL will consider the following during the planning and construction of roads:

- Size of corridor to be cleared;
- Soil properties, topography and terrain;
- Prevailing climate;
- Availability and type of harvesting methods to be used; and
- Volume of timber to be transported.

To facilitate proper planning and construction of roads and mitigate against some of the possible impacts identified above, the Company also will employ the use of GIS techniques to map its landed areas as well as field surveys to ensure proper slope and gradient alignment of road construction to planting areas.

3.14 Construction Period

Project construction will take 7-8 years to reach the full scale of the project. The plantation development of 4,428 ha is expected to start in 2018 from land preparation activities through to harvesting in 2024.

3.15 Project Ownership and Management

Miro Forestry (Ghana) Limited has signed a Land Lease and Benefit Sharing Agreement with the Forestry Commission of Ghana to undertake the development of a commercial forest plantation project within the Awura and Chirimfa Forest Reserves. The reserve land is owned by the people of Mampong and Nsuta Traditional areas and managed by the Mampong Forestry District

Miro Forestry (Ghana) Limited will be responsible for the overall development and management of the plantation development scheme. MFGL has implemented an operating structure that is headed by the General Manager and supported by the Business Operations

Manager, Environmental Officer, Community Liaison Officer and other experienced professionals in key positions, to oversee the operations of Miro Forestry and the entire project.

4.0 PROJECT ALTERNATIVE ANALYSIS

4.1 Project Development Options

A number of options are under consideration in the development of the proposed reforestation project, and these are as summarised in **Table 7** below**.**

Table 7: Options Considered for the Development of the Proposed Project

No	Issue	Alternative options	Analysis of options	Preferred alternative/ Remarks
1	Location for Plantation development	On reserve/forest plantation development	- Plantation development in degraded areas of protected forest zones. - Miro Forestry and FSD has direct responsibility of monitoring and ensuring that there is a balance on tree exploitation and sustainable forest management of on-reserves. - The plantation development model proposed by MFGL to the Forestry Commission is one that allows for controlled community inter-crop farming alongside plantation tree species within the lands allocated to the company	To support the Forestry Commission's goal of promoting tree plantation development as a means of re-afforesting degraded forest reserves, and the development of a sustainable plantation venture that will generate high returns. On –reserve plantation development is the preferred option. .
		Off reserve plantation development	• Plantation development of land outside of a protected forest zone interspersed with patches of naturally occurring tree species of economic or non-economic value and also consists of mosaics of intact forests. • Fresh land acquisition from land owners/traditional authorities is required in such cases and could generate land disputes/litigation affecting project development. • The primary use of the land in the off-reserve is agriculture which makes it difficult for any form of sustainable forest management to be ensured. • Possible disagreements over off-reserve Benefit Sharing Arrangement under the reforestation project between FSD, MFGL and Land owners	
2	Type of tree species	Exotic non-invasive species (Eucalyptus, teaks)	• Predominantly Eucalyptus and Teak will be planted as well as Acacia • Teak and Eucalyptus species can grow on a variety of soils. General soil conditions are suitable for both Teak and Eucalyptus The quality of its growth, however, depends on the depth, structure, porosity, drainage and moisture holding capacity of the soil. They normally develop best on deep, well drained and fertile soils. • Plantation Teak is a fast growing tree species that provides lumber in 12-15 years	In view of the seriously degraded nature of the reserves and the need to have it restored as quickly as possible, plantation species of Teak and Eucalyptus are the preferred option to rapidly

No	Issue	Alternative options	Analysis of options	Preferred alternative/ Remarks
			from planting. • Fast growing plantation trees that will rapidly contribute to the development of a much needed micro climate capable of supporting wildlife, flora and biodiversity in the reserve and good economic returns • Teak is well suitable to soil and ecological conditions and there is much local knowledge in silviculture about the species as well as its great economic importance • Teak is well adapted to the tropical climate of Ghana • Eucalyptus to be planted are mainly hybrids designed to suit varied environmental conditions of climate, soils, rainfall and temperature. • Eucalyptus is a versatile timber, of high density and close grain formation, high growth rates, fire and drought resistance, good stem form, and resistance to pests/diseases • It is currently the major source of pulp-wood for the international paper industry and is the major timber used for transmission poles across the tropics because of its high bending strength and natural durability characteristics. • Eucalyptus is a highly adaptive species and will adjust its growth to suit the levels of water available. Poorly drained sites in the reserve, if planted with Eucalyptus will improve on the drainage conditions of such sites.	restore the reserve. The choice of Teak and Eucalyptus by MFGL as a plantation species for use in the reserve is adequate and will provide a rich green texture to the reserve landscape as well as offer the needed economics of scale.
		Indigenous species	• A minimum of 5% of planting areas will be dedicated to indigenous species such as Ceiba (Ceiba pentandra) and Wawa (Triplochiton scleroxylon). • Fast growing, high survival rates, low incidence of pests. • Ceiba is a multipurpose tree valued for its fibre, but also supplies foods, medicines and many commodities and as an ornamental tree. • The fibre of Ceiba is irritating to the eyes, nose and throat, and workers exposed to Ceiba dust for long periods may develop chronic bronchitis. • The trees have vigorous rooting systems and are known to cause damage to buildings and roads if planted too close. • The tree is an important habitat for honey bees and is also suitable for soil erosion control and watershed protection.	Miro Forestry will incorporate the planting of indigenous species in significant ecological areas as part of its operational plans. This will provide a rich mix of plantation and indigenous species in its allocated areas. Sensitive ecological areas and along streams and rivers will receive conservation and protection interventions to encourage the survival and regeneration of indigenous species.

4.2 No Project or Action Option

The no action option will mean maintaining the status quo. This option would mean that the goal of the Forestry Commission of promoting tree plantation development as a means of re-afforesting degraded forest reserves and the needed support from Miro Forestry to be given cannot be realised. This would result in further degradation of the reserves due to increased encroachment of the reserves by illegal migrant settlers seeking lands for maize, plantain development and cattle grazing. Following discussions with local farmers and the chiefs, it was identified that continued encroachment by illegal migrant farmers could lead to undesirable social conflicts. It also exposes the reserves to increased risks from fire and fire spread; usually caused by migrant farmers attempting to clear grassland for farming.

The opportunity to introduce agro-forestry to provide alternative means of livelihood to communities currently farming the Forest Reserve, as well as to subsidize establishment and weed control costs would be lost. Job and local employment as well as economic empowerment opportunities in the rural communities would also be lost.

This alternative was found to be contrary to the wishes and interests of the Stool landowners and the Forestry Commission, who have a very keen desire to maintain the area as a forest reserve. It is also counter-intuitive to the Forestry Commission's mandate of overseeing the management and development of the reserve as a forest on behalf of the traditional stool landowners.

5.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

The forest reserve sites for the proposed project cut across two main (2) municipalities/districts listed as follows:

- Mampong Municipality; and
- Sekyere Central District.

A baseline survey of the biophysical and social environment of the project area was undertaken, and some secondary data from literature and local knowledge were gathered to support the ESIA study as described below for the project affected districts. The baseline information is useful to predict and monitor any residual impacts to be associated with the proposed plantation development /reforestation project.

5.1 Physical Environment

The physical environment is described as below:

5.1.1 Climatic Conditions

Awura and Chirimfa Forest Reserves lie within the Afram Plains portion of the Forest-Savannah Agro-ecological zone of Ghana. The area experiences equatorial climate characterized by two rainfall regimes, high and nearly uniform temperatures throughout the year. Climatic considerations are very important for successful plantation establishment. It is therefore necessary to assess the climatic requirements of eucalyptus and teak against the prevailing conditions within the forest reserves.

Rainfall (mm)

The rainfall pattern is bimodal, characterized by two rainy seasons, which are separated by two dry seasons. The main rainy season starts between March and July with a peak in May/June. August experiences a short dry spell. The minor rainy season starts from mid-September to the end of November. A long dry period is experienced from November to the end of March with possibilities of occasional rains. During this period, there is severe drought accentuated by the desiccating harmattan weather conditions. At this time, most plants shed their leaves and some tributary rivers and streams of the Afram River dry up completely or appear in discontinuous pools. Some months of this period are rainless and bushfires are rampant. It should be noted that the start and ending of rainfall events are not clear-cut and great variations exist in the total monthly and annual rainfall amounts. The total annual rainfall amounts for Awura and Chirimfa Forest Reserves are in the neighbourhood of 1,370 mm at Ashanti Mampong and 1,444 mm at Ejura.

Temperature (°C)

Temperatures within the study area are uniformly high throughout the year with yearly average around 33.2°C maximum and 20.2°C minimum **(Table 8)** below**.** The highest mean temperatures usually occur just before the onset of the rains at the end of February or early March. Temperatures are relatively low during the wet months, from April to

July. The lowest minimum temperatures, however, occurs during the harmattan months of December and January. December, January and February also have the greatest daily ranges in temperature with the nights being very cold and the afternoons being very hot.

Relative Humidity (%)

Recorded relative humidity values are generally highest between mid-nights and early mornings (0900 hrs) and lowest in the early afternoons (1500 hrs). During the rainy months of June to September, the mean monthly figures may be around 90% at mid-days and are lowest in the harmattan months, recording about 70% in the mornings and 40% at mid-days. (**Table 8**).

Table 8: Mean monthly temperatures (°C) and RH (%) for Mampong (Ashanti) and Ejura

Station	Main Dry Season			Main Wet Season					Minor Dry Season	Minor Wet Season		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mampong (°C)	24.9	25.2	26.8	26.6	26.3	23.6	24.9	23.6	23.6	24.1	24.7	25.2
Ejura (°C)	26.3	26.4	21.6	21.8	27.9	26.3	19.7	25.4	25.2	25.4	26.1	26.6
Mampong (%) RH (0900 hrs.)	86.0	78.1	79.1	82.5	82.7	84.4	86.1	88.5	89.2	89.2	88.1	84.0
Ejura (%) RH (0900 hrs.)	74.1	69.9	71.8	85.5	77.1	80.3	82.5	81.9	80.2	83.3	82.4	77.5

Compiled from Ghana Annual weather summaries, Ghana Meteorological Services, Accra

5.1.2 Geology

The study area falls within the Afram Plains portion of the Voltaian Basin with the underlying geology consisting entirely of sedimentary rocks, mainly coarse-grained sandstones which is massive, thin-bedded, flaggy, impure, ferruginous or feldspathic and locally interbedded with shale and mudstones. These sedimentary formations are of Devonian or early Carboniferous age (Junner and Hirst, 1946).

5.1.3 Relief and Drainage

The relief of Awura and Chirimfa Forest Reserves are gently undulating topography with slope gradients of 1–5% from summits to the edge of lowlands. Locally, areas where some rock outcrops occur have steep slopes (5–8%). The altitude ranges between 137 m to 162 m above sea level. During the peak rainy seasons in June/July and September/October, the low-lying areas may be waterlogged. The Afram River and its tributary streams drain the study area **(Figure 5).**

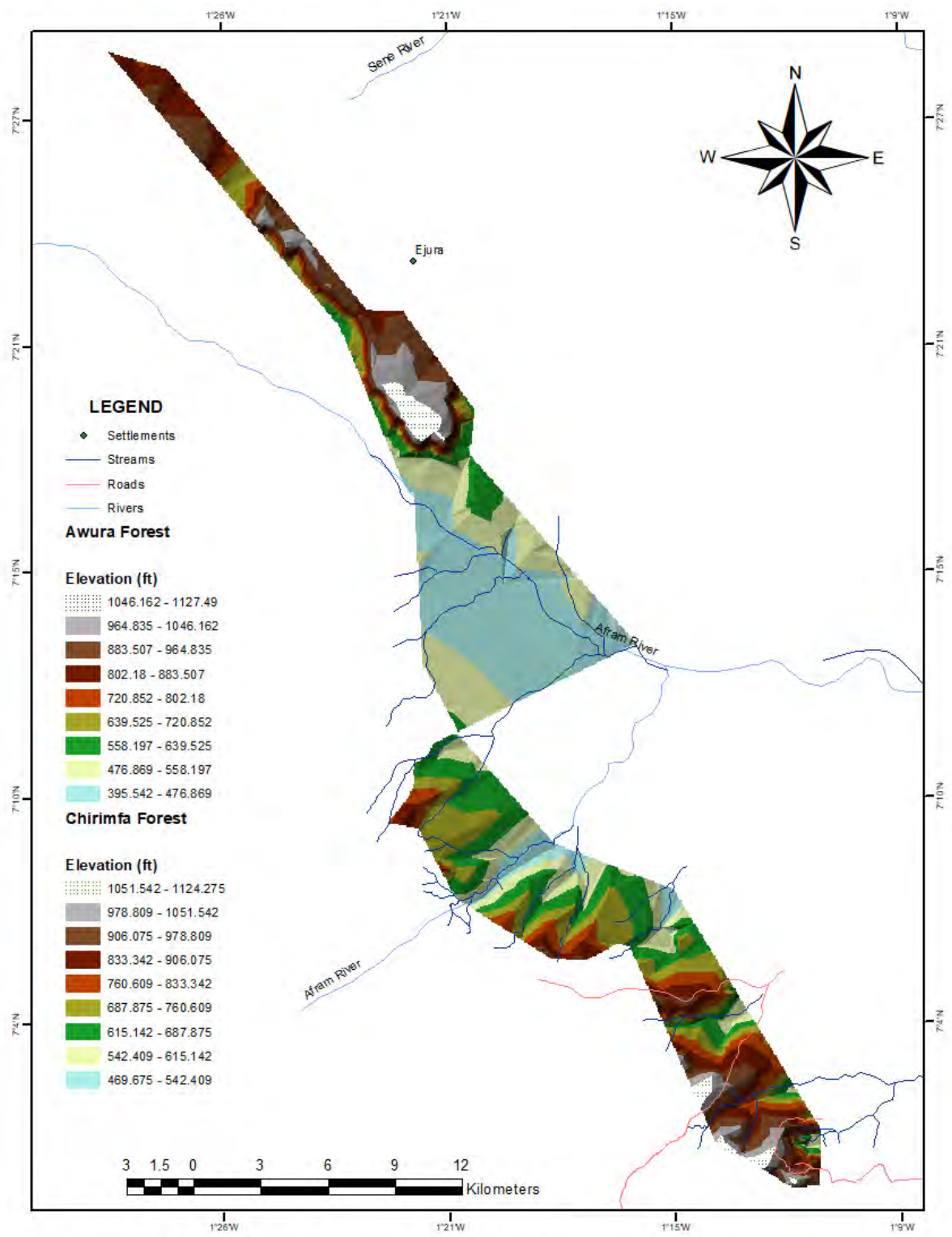

Figure 5:Relief and Drainage for Awura and Chirimfa Forest Reserves

5.1.4 Soils

A soils survey has been carried out in the project area by Centre for Scientific and Industrial Research (CSIR)-Soil Research Institute, Accra in November 2017 according to procedures for conducting reconnaissance soil surveys by the free survey method. The most recent available satellite imagery of the area has also been studied to appreciate the lie of the land, major topographic features of the land, boundaries, roads drainage and current land use.

Methodology/Field Surveys

Field soil examination was carried out in some selected compartments. The free survey method (random observations) was adopted (Dent and Young, 1981). Five compartments within Awura Forest Reserve were examined. Out of the twenty-one allocated compartments within Awura Forest Reserve, those selected for the study were compartment 56, 62, 66, 67 and 68 **(Figure 6).** Similarly, out of the twenty-five allocated compartments within Chirimfa Forest Reserves, those selected for the study were compartments 62, 70, 75, 79, 81, 85 and 87 **(Figure 7).**

Generally, three observation points were sampled in a compartment. At each observation point, an auger bore was dug in order to describe soil parameters such as color, depth, texture, drainage and coarse-fragment content. Composite samples were taken from the selected observation points at pre-determined depths of 0-20cm and 20-50cm for laboratory analysis. Two soil profiles (one for each forest reserve) were excavated on the major soils, described and sampled for laboratory analysis. Additionally, GPS coordinates of various sampling points were recorded for GIS analysis and map production. Moreover, map layers of the selected compartments showing boundaries, roads, rivers and streams were provided by the Planning Forester for Miro Forestry (Ghana) Ltd. Finally, soil observation points were plotted and used for the production of soil units of the selected compartments within the forest reserves.

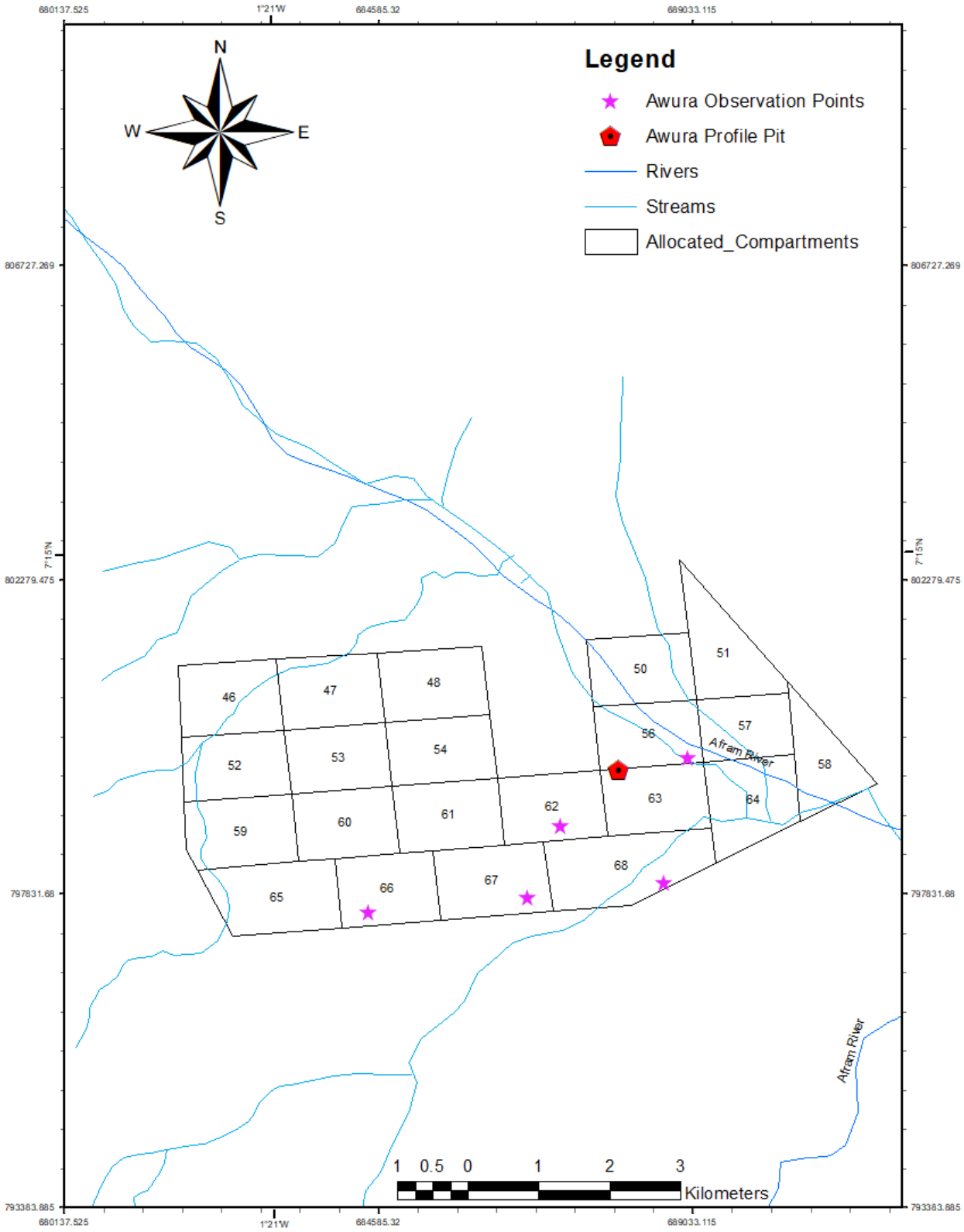

Figure 6: Soil Profile and Composite Sampling Points Of The Selected Compartments In Awura Forest Reserve

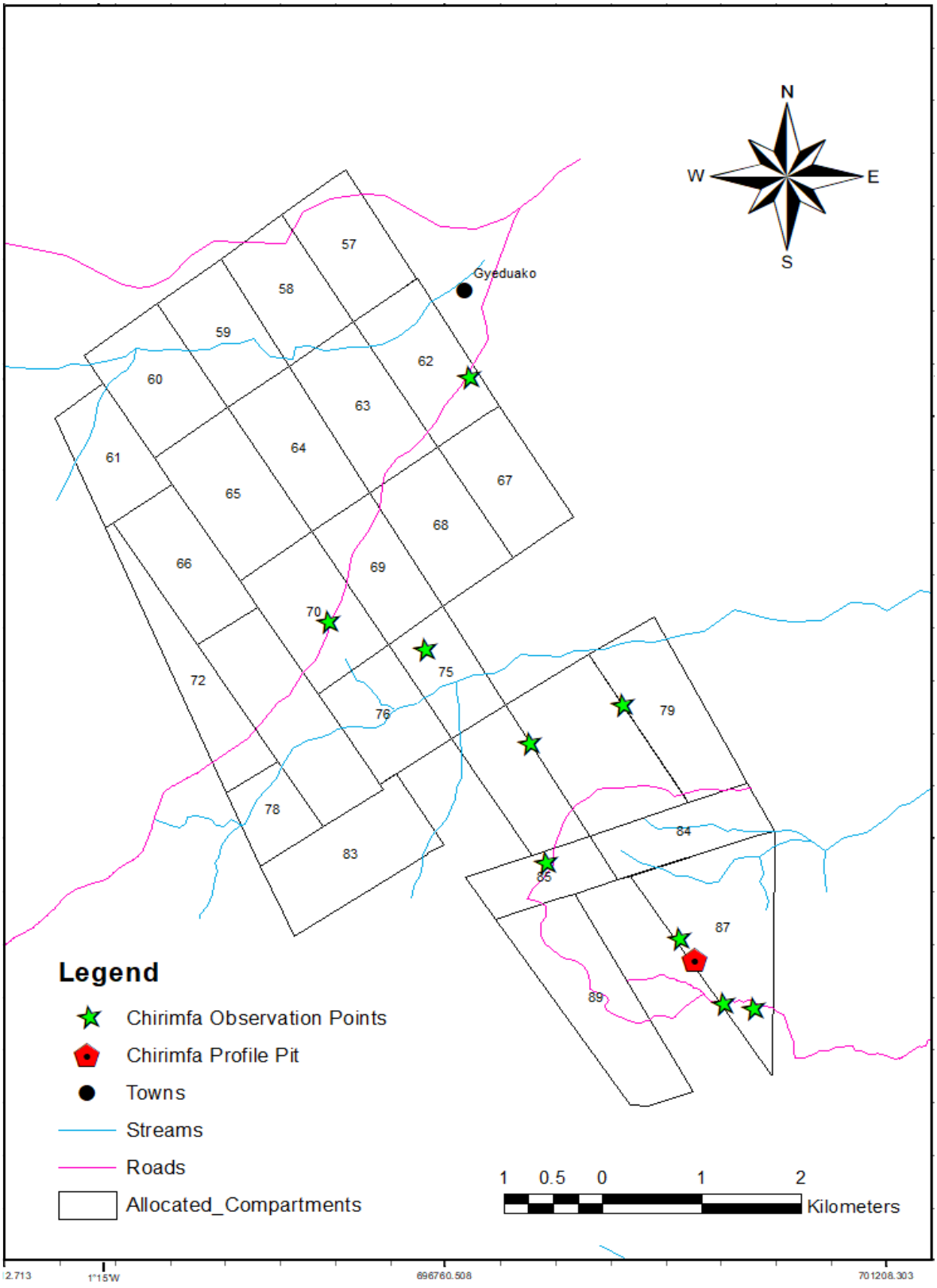

Figure 7: Soil Profile And Composite Sampling Points Of The Selected Compartments In Chirimfa Forest Reserve

Main Soil Types of Selected Compartments within Awura Forest Reserve

The soils in both Awura and Chirimfa Forest Reserves are largely (> 90%) developed over Voltaian Sandstone with a small area developed over Voltaian Clay Shales. The river and stream valley bottoms are occupied by alluvial deposits (Adu and Mensah-Ansah, 1995).

From the field survey, five main soil types were identified on the basis of their characteristics as observed from the field. Summary descriptions of these soil types are presented below, supported by soil profile description, soil laboratory analysis data for representative pits.

Bediesi series (Dystric Nitisol)

Bediesi series include the most important soils developed over Voltaian sandstone. These are deep to very deep (>150cm), well drained, dark reddish brown to dusky red, non-gravelly, sandy clay over sandstone on summits (2-5%) and upper slopes of gentle topography. The top soils are thick 20–30 cm, dark brown to reddish brown humus, loam, very friable fine granular, over red to dusky red, sandy clay to clay, non-gravelly, weak fine sub angular blocky, friable to firm, slightly sticky subsoils.

Sutawa series (Gleyic Arenosol)

These are moderately well drained, brownish yellow drift soils on middle slopes (2%) of gently undulating topography below Bediesi series. They are deep to very deep (>150cm), brownish yellow to yellowish red sandy loam to loamy sand. The topsoil consists of brown, sandy loam, weak fine granular, very friable, non-gravelly, non-sticky non plastic, porous, humus with many rootlets underlain by brown to reddish brown, loamy sand, weak fine and medium subangular blocky, gradual smooth boundary, porous, non-stony and non-gravelly subsoil.

Kaple series (Umbric Gleysol)

Kaple series comprise seasonally imperfectly drained, pale coloured sands on gentle lower slopes (< 2%) and developed in slope wash derived from Bediesi and Sutawa series. They consist of 0-30cm of grey brown fine sandy loam grading downwards into very pale brown loamy sand to sandy loam which become mottled with brownish to reddish yellow colouration. The layer may extend to a depth of 145cm or more. Towards its base there is a stone-line consisting of ironstone and pebbles, which overlie a mottled weathered substratum of sandstone.

Bejua series (Dystric Gleysol)

The series comprise the lower slope towards valley bottom soils. Normal profiles consist of about 30cm of dark grey, loose, sandy loam over 30-60cm of light yellowish brown loamy fine sand which is loose, porous and crumbly. The layer extends downwards to 140-160cm and consists of pale grey strongly mottled brown sandy loam. It is possible to encounter seepage iron pan at this depth.

Plate 1: Bejua series

Volta series (Eutric Gleysol)

Volta series is a major valley bottom soil developed over clay shale formation along the Afram River. These alluvial soils have a simple profile consisting of grey brown slightly mottled yellow, porous, silty loam with a thin dark grey slightly humus surface layer over, 120-180cm or more of, grey and orange or red mottled silty clay loam. The profiles have well-developed sub-angular blocky structure. The texture in some profiles tends to lighten below about 120cm, whilst in others the tendency to develop ground water laterite is indicated by the presence of soft iron concretions. The light texture of the profiles at depth is characteristic of Volta series.

Soils Types of Compartments within Chirimfa Forest Reserve

Damongo series (Ferric Luvisol)

The *Damongo series* consists dark reddish brown, humous, loamy sand topsoils developed over fine-grained Voltaian sandstone. Damongo soils are characteristically deep to very deep, well-drained, medium textured and gravel-free. The subsoils are red sandy loam or sandy clay loam extending downwards to a depth of about 120cm. It may be underlain by iron pan or sandstone. The series occur on upper slopes to summit positions on gently sloping topography (2-5%). They possess good tilth and permit easy root- development. They have developed under savannah and transitional savannah vegetation consisting of tall grass and savannah tree species, and in the transitional zone with some forest tree species and less grass.

Plate 2: Damongo Series

Murugu series (Haplic Luvisol)

The series occur as a colluvium on the lower slopes of Damongo, and there is little difference between Murugu and Damongo series in profile morphology. Murugu series are deep, going downwards to 150 cm to well over 200 cm. Surface horizons range from dark brown to brown whilst subsurface horizons have colours ranging from bright reddish brown to yellowish red. Textures do not vary much; surface horizons are sandy loams whilst subsurface ones are fine sands. Murugu series is characteristically sandy throughout the profile. It has few dark red ironstone concretions.

Kintampo series (*Lithic Leptosol*)

Kintampo series comprise grayish brown to reddish brown, very shallow, eroded, excessively drained skeletal soils occurring on summits of rocky scarps and inselbergs developed over sandstone. Kintampo series my also occur as rock outcrops on upper, middle and lower slopes in eroded areas The depth of soil to rock varies from 10 cm to 30 cm. These shallow soils are mainly colonized by very short grasses and stunted trees.

Techiman series (Ferric Acrisols)

Techiman series comprises moderately shallow, slightly humous, well-drained, reddish brown, ironstone concretionary soils. The concretionary layer may overlie sandstone rock or ironpan. They are usually found in association with *Kintampo series*.

Tanoso series (Eutric Gleysol)

Tanoso series occur as alluvium in valley bottoms. They are deep and poorly drained and generally-inextensive. The depth of the alluvium ranges between 140 cm to 220 cm. Textures vary from loamy fine sand to sandy loam. Subsurface horizons occur in bands of varying textures because of the deposits that come along with every seasonal flooding.

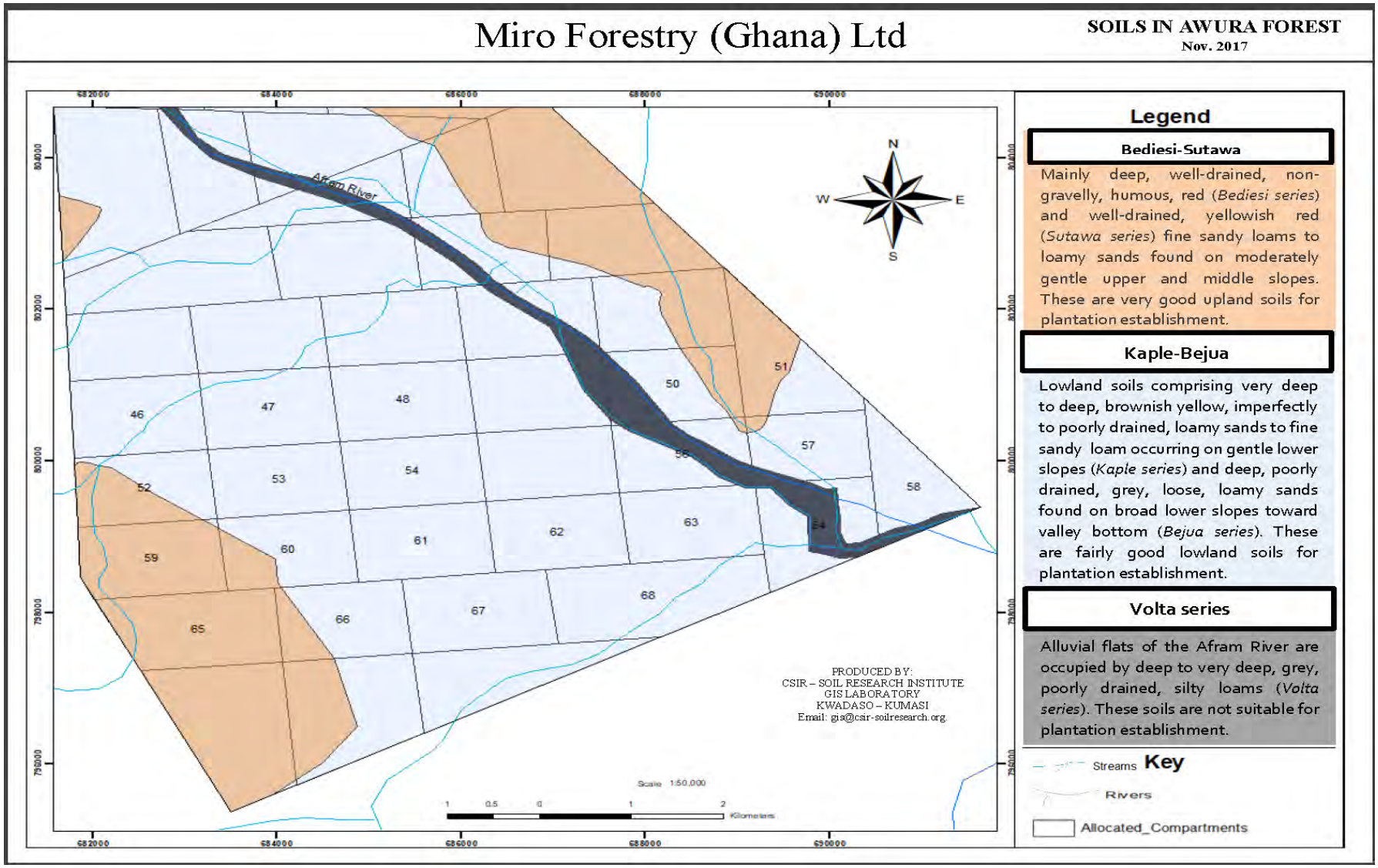

Figure 8: Soil Map Of Selected Compartments In Awura Forest Reserve

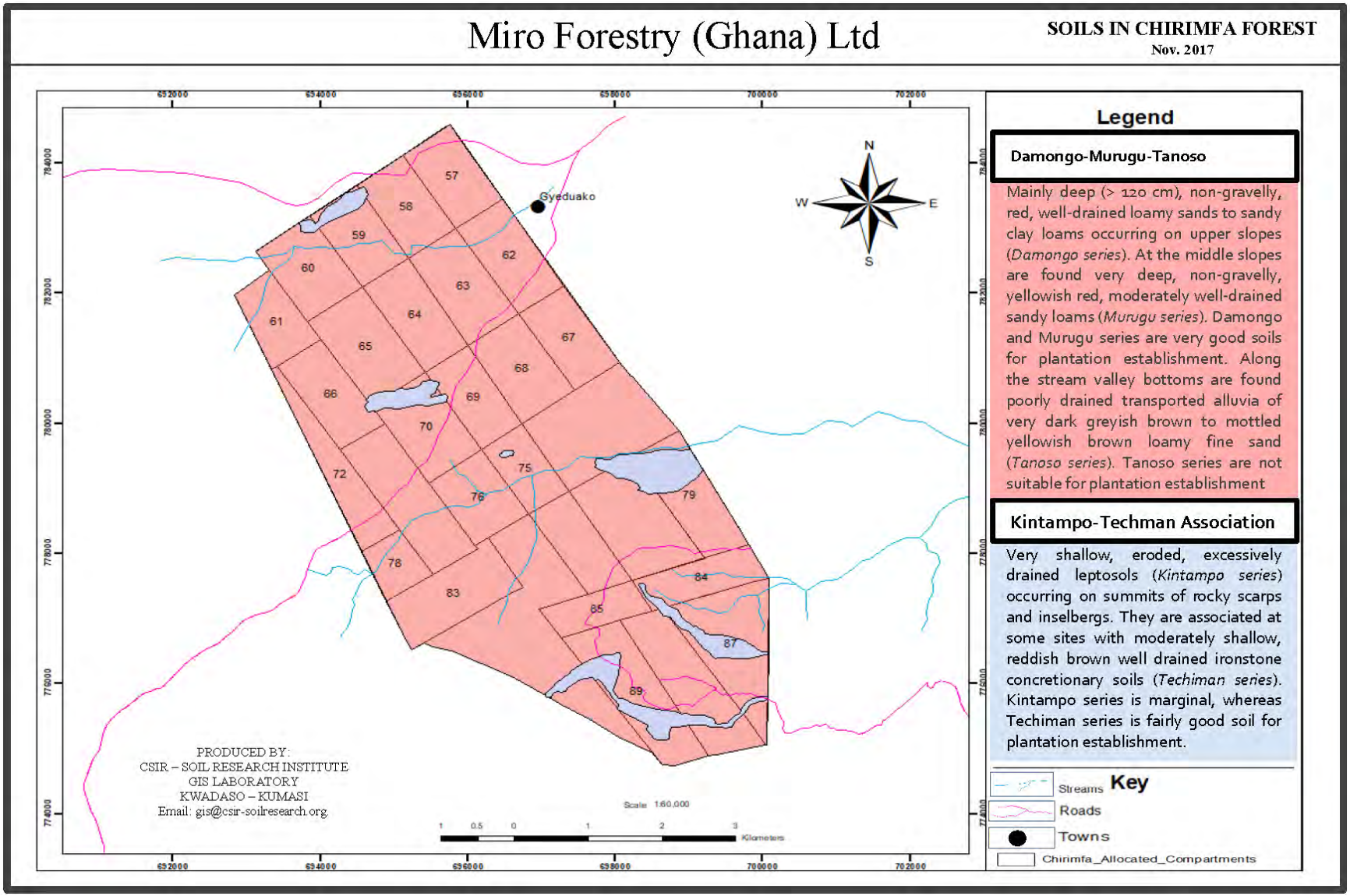

Figure 9: Soil Map Of Selected Compartments In Chirimfa Forest Reserve

Soils Observations in Selected Compartments within Awura Forest Reserve

Table 9: Soil characteristics and location of observed points at Awura Forest Reserve

Compartment	Characteristics of observed points				Location Coordinates	
	Soil Series	Texture/structure		Gravel Content	Lat (N)	Long (W)
		Top soil	Sub soil			
56	Volta	SiL,	SiCL	NIL	07 13 55.387	01 17 18.227
62	Bejua	SL	SL	NIL	07 13 23.965	01 18 17.543
66	Sutawa	LS	SCL	NIL	07 12 44.447	01 19 46.354
67	Kaple	SL	LS	Rare	07 12 50.974	01 18 32.824
68	Kaple	SL	LS	Rare	07 12 57.707	01 17 29.656

Texture: SiL – *silty loam*, SiCL – *silty clay loam*, SL – sandy loam, LS – *loamy sand*, SCL – *sandy clay loam*

Soils Observations in Selected Compartments within Chirimfa Forest Reserve

Table 10: Soil characteristics and location of observed points at Chirimfa Forest Reserve

Compartment	Characteristics of observed points				Location Coordinates	
	Soil Series	Texture/structure		Gravel Content	Lat (N)	Long (W)
		Top soil	Sub soil			
87	Kintampo	Concretionary	Sandstone	Common	07 00 52.987	01 11 26.663
87	Damongo	SL	SCL	NIL	07 00 54.501	01 11 36.642
87	Murugu	SL	S	Few	07 01 17.192	01 11 51.346
85	Damongo	LS	SCL	NIL	07 01 43.173	01 12 34.813
81	Damongo	SL	SCL	NIL	07 03 06.351	01 13 46.065
79	Kintampo	Concretionary	Sandstone	Common	07 02 37.401	01 12 09.322
75	Kintampo	Concretionary	Sandstone	Common	07 02 56.484	01 13 14.521
70	Damongo	LS	SCL	NIL	07 02 24.490	01 12 40.062
62	Murugu	SL	SCL	Few	07 04 30.181	01 12 59.568

Notes: ***Concretionary*** - moderately shallow soil occurring on upper slopes with very few ironstone concretions ***Sandstone*** – sandstone rock underlying shallow soils LS – *loamy sand*, SL – *sandy loam*, S C L – *sandy clay loam,* S – *sand (unspecified)*

Assessment of Suitability of Soils and physical environment for tree plantations Development

Suitability assessment is carried out to match the various soil units with the tree species they can support well. The soil units are assessed for tree plantation establishment by matching the soil depth, topography, drainage, etc. against ecological/growth requirements of the tree species as summarized and presented in **Table 11.**

Table 11:Ecological requirements of selected tree species

Growth requirements	Tree Species	
	Eucalyptus	**Teak**
Climatic parameters	Mean Annual rainfall: 500 - 1,200 mm Mean annual temperature: 10 - 32°C Altitude: 30-500 metres	Mean Annual rainfall: 1,250 - 3,750 mm Mean annual temperature: 13 - 43°C Altitude: < 1,000 meters
Tolerance of extremes in climate	Drought: eucalyptus is known to be moderately drought tolerant	Drought: at least four months of less than 60 mm precipitation
Soil Factors	Texture: loam, clay loam, sandy loam, sandy clay loam or sand. Soil pH: acidic (< 6.5) or neutral (6.5-7.5) Soil depth; moderate to deep (30-100 cm or greater) Drainage: well-drained to seasonally waterlogged. Salinity: Slightly to moderately saline or non-saline	Factors Texture: loam, clay loam, sandy loam, sandy clay loam. Soil pH: neutral (6.5 - 7.5) Soil depth; moderate to deep (> 60 cm) Drainage: well-drained soils
Tolerance of adverse soil conditions	Extremes in soil pH: acidity Extremes in soil texture: clayey or sandy Salinity: moderate (-8 dS m-1), nil-sensitive to saline soils or slight (2-4 dS m-1) Waterlogging: can withstand some periods of waterlogging	Nutrients: Calcium content of the soil is a very important factor for satisfactory growth of teak. Waterlogging: Teak plantations have failed completely when they have been established on low-lying, poorly drained clay soils.

Discussion of the Suitability Assessment

Based on the growth requirement of eucalyptus, the tree can grow well on all the soils in Awura and Chirimfa Forest Reserves with the exception of the river and stream valley bottom soils (Volta series and Tanoso series). On a lighter note, eucalyptus plantations have been implicated in drying-up of river bodies, and this reason suggests the need to avoid planting eucalyptus in riverine soils. In terms of the climatic conditions, Awura and Chirimfa Forest Reserves are located in the Forest-Savannah agro-ecological zone of Ghana. The total annual rainfall is generally over 1,300 mm and the mean monthly temperature ranges from 20 to 33°C. These are optimal climatic conditions for establishing eucalyptus tree plantations.

In the case of teak plantation establishment, the tree develops best on deep, well-drained and fertile soils. The quality of its growth, however, depends on the depth, structure, porosity, drainage and moisture-holding capacity of the soil. Teak plantations have failed completely when they have been established on compacted, low-lying, poorly drained and waterlogged soils (Seth and Yadav, 1959). Additionally, the species performs very poorly, in terms of growth and stem form, on dry sandy soil, shallow soil

(hard pan soil or lower water table soil), acidic soil (pH < 6.0). The optimal soil pH is between 6.5 and 7.5.

Good soil for establishing teak plantation is relatively fertile with high calcium (Ca), phosphorus (P), potassium (K), nitrogen (N) and organic matter (OM) contents. The calcium content of the soil is a very critical factor to be monitored at all times. Several studies indicate that teak requires relatively large amounts of calcium for its growth and development, and teak has been named as a calcareous species (Seth and Yadav, 1958; Kaosa-ard, 1981; Tewari, 1992). Calcium deficiency in the soil results in stunted growth of teak trees (Kaosa-ard, 1981). Teak grows best when the minimum monthly temperature is above 13oC and the maximum monthly temperature is below 40oC. Optimal rainfall for teak ranges between 1,250 and 3,750 mm per year; however, for the production of good-quality timber the species requires a dry season of at least four months with less than 60 mm precipitation (Kaosa-ard, 1981). As noted earlier, these climatic requirements prevail within the study areas and will benefit established teak plantations.

The soil study revealed that, the dominant soils of the selected compartments in Awura Forest Reserve are Kaple and Bejua series with minor inclusions of Sutawa series. On the other hand, the soils of the selected compartments in Chirimfa Forest Reserves are dominated by Damongo and Murugu series with occasional rock outcrops of Kintampo series.

With the exception of the valley bottom soils (e.g. *Volta series*) and shallow rocky soils (e.g. *Kintampo series*), all the major soils are generally good for tree plantation establishment.

5.1.5 Ambient Air Quality Assessment of the Project Area

Air quality assessment was conducted from 11th to 19th October 2017 at a location each of the Chirimfa forest and Awura forest reserves within the 4,428-hectare land development for the proposed project as shown in **Figure 10**.

The main objective of the air quality assessment was to determine the ambient levels of Total Suspended Particulate (TSP), Particulate Matter (PM_{10}), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon monoxide (CO) to provide a basis for determining the impacts on human health and the environment as a result of the future operation of the reforestation project.

Sampling Equipment and Methodology Employed

An internationally recognised practices based on ISO, US EPA, NIOSH or APHA methods were adopts for air quality monitoring and reporting. The methodology employed in this monitoring meets the national and international requirements.

Total Suspended Particulates (TSP) and Particulate Matter (PM10)

TSP and PM10 sampling was conducted using a portable ambient air sampler called MiniVol Tactical Air Sampler. The equipment was set at a low flow rate of 5 L/min over a pre-weighed 0.8-micron filter paper. The General methods for the determining of Total Suspended Particulate Matter in the atmosphere by ASTM D 4096-91(2009) was modified and used. The sampling technique used by the Minivol TAS is a modification of the PM10 referenced method described in the U.S. code of federal regulations (40 CFR part 50, Appendix J). Measurement was done for a period of 24 hours at each location.

Dust concentration is computed as follows:

$$Dust\ Conc\ (\text{mg/m3}) = \frac{Net\ dust\ weight\ (mg) x\ 1000}{Flow\ Rate\ (L/s)\ x\ Sample\ Time(\text{s})}$$

Carbon monoxide (CO)

The concentration of Carbon monoxide was measured using a direct reading device with electrochemical probes (TSI IAQ-CALC Air Quality Meter) in accordance with UNE standard 100011:1991. The equipment provides a CO measuring range of 0 - 2,000 ppm with a resolution of 2 ppm and was set to sample for 15 minutes according the Ghana EPA standards for ambient air quality guidelines.

SO2 and NO2 Monitoring

Nitrogen dioxide (NO2) and Sulphur dioxide (SO2) was sampled using RadielloTM passive tubes consisting of a blue diffusive body, a supporting plate, vertical adapter and a chemi-adsorbing cartridge. The cartridge is made of microporous polyethylene coated with triethanolamine (TEA). Nitrogen and Sulphur dioxides are chemi-adsorbed selectively as nitrite and sulphite or suphate ions. Nitrite is quantified by visible

spectrophotometry, while sulphite and sulphate are analysed by ion chromatography. NO2 and SO2 can be analysed together by Ion Chromatography.

Nitrogen Dioxide (NO2) and Sulphur Dioxide (SO2) was sampled for 7 days at each location, with results reported as a 7-day average concentration.

Analysis of Dust Samples

In order to calculate the organics concentration per cubic meter of air (µg/m3) for each sample, the following formula is used:

$$C = \frac{m}{tQ}$$

Where Q is the sampling rate and has the dimensions of a gaseous flow (if m is expressed in µg, t in minutes and C in µg/l, Q is expressed in l/min).

Noise Measurement

Noise levels measurements were conducted at the various locations using a calibrated 3M Quest SoundPro SP DL-1- 1/3 integrated Sound Level Meter. Noise levels were recorded for 24 hours (Day and Night time) duration according to the World Bank/International Finance Corporation (WB/IFC) guidelines and, ISO standards 1996-2:2007. The sound level meters were calibrated prior to and after each monitoring and was mounted to about 1.5 meters above ground level. The following statistical indices were computed:

- Leq;
- L90;
- Lmin and;
- Lmax.

Sample Location (GPS Coordinates)

Table 12 shows precise coordinates for monitoring locations at Chirimfa and Awura forest reserves.

Table 12: Table of GPS coordinates

Point Name	Location	Easting	Northing
Air/ Noise Monitoring Point 1	Chirimfa Forest	695449	779791
Air/ Noise Monitoring Point 2	Awura Forest	688363	799693

Sampling points and sampling parameters for the two locations monitored (Chirimfa Forest and Awura Forest) are indicated in **Figure 10** below.

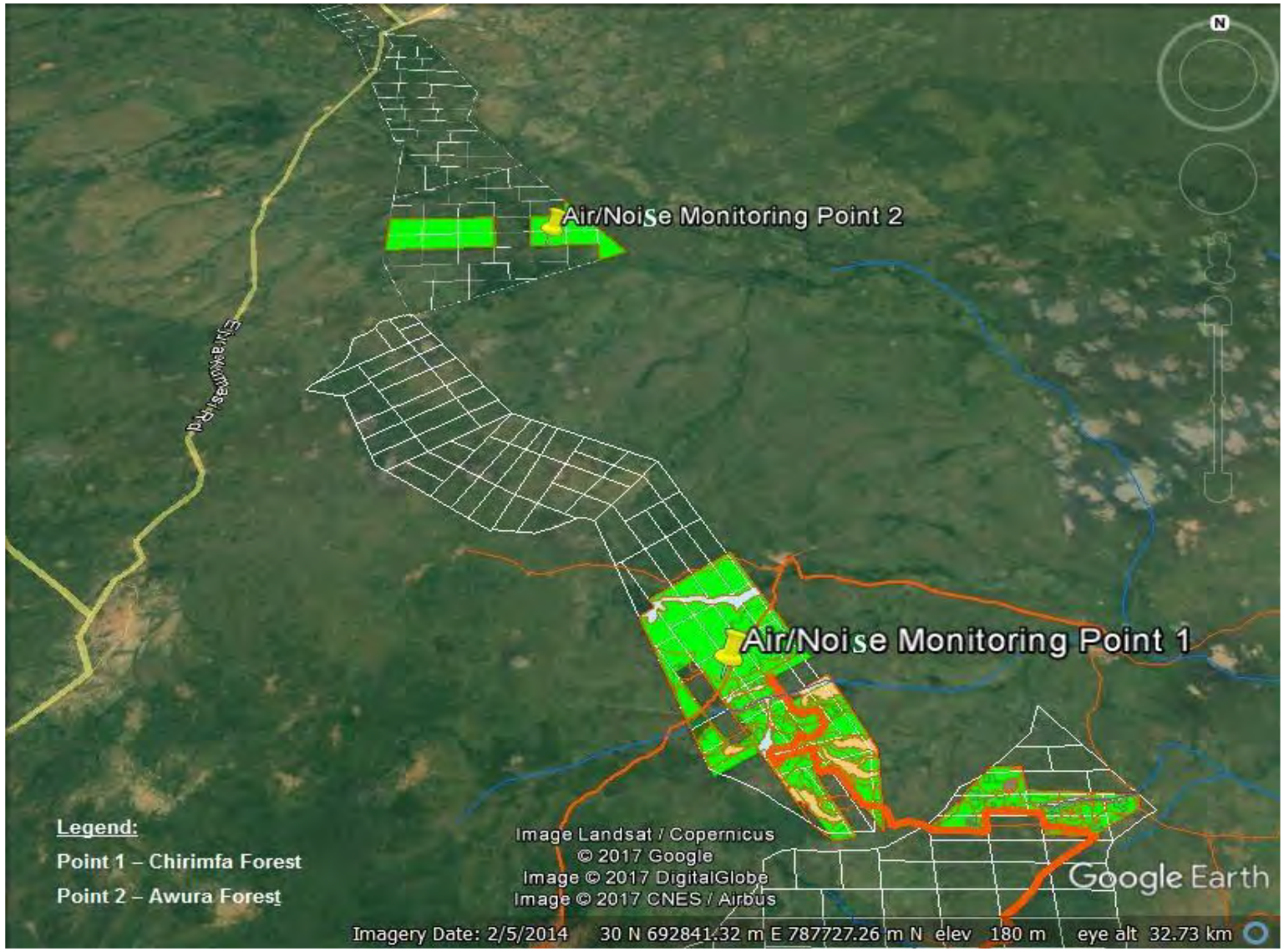

Figure 10: Map showing Monitoring Site for Air Quality and Noise Level Measurements

Result of Air Quality Measurement/ Assessment

The results of the air quality assessment are as shown in **Table 13.**

Table 13*: Results of Air Quality Assessment*

No	Sample Location	TSP μgm^{-3}	PM_{10} μgm^{-3}	SO_2 μgm^{-3}	NO_2 μgm^{-3}	CO mgm^{-3}
1	Chirimfa Forest	40.1	27.8	<0.2	4.9	0.34
2	Awura Forest	22.2	20.8	2.1	<0.5	0.23
EPA Ambient Air Quality Guidelines Values over 24 hours		**230**	**70**	**150**	**150**	**100 (15mins)**

The following observations can be made from the results in **Table 13** above:

Chirimfa Forest

- Ambient concentrations of TSP (40.1µg/m^3) and PM10 (27.6 µg/m^3) were below their Ghana EPA guidelines of 230 µg/m^3 and 70 µg/m3 respectively;
- Carbon monoxide concentration (0.34 mg/m^3), Nitrogen dioxide (4.9 µg/m^3) and Sulphur dioxde (< 0.2 µg/m^3) were below their respective Ghana EPA guidelines of 100 mg/m^3 and 150 µg/m^3.

Awura Forest

- Ambient concentrations of TPS (22.2 µg/m3), PM10 (20.8 µg/m3) were below their Ghana EPA guidelines of 230 µg/m3 and 70 µg/m3 respectively;
- Carbon monoxide concentration (0.23 mg/m3), Nitrogen dioxide (<0.5 µg/m3) and Sulphur dioxde (2.1 µg/m3) were below their respective Ghana EPA guidelines of 100 mg/m3, and 150 µg/m3.

Results of Ambient Noise Measurement

The results of the noise level measurements are summarized in **Table 14** below.

Table 14 : Results of Noise Level measurement result

No	Sampling Site	Period	Leq	Lmax	Lmin	L_{90}
1	Chirimfa Forest	Daytime	50.5	88.3	31.9	32.4
		Night-time	53.4	81.6	34.4	44.2
2	Awura Forest	Daytime	49.1	79.0	46.3	46.2
		Night-time	46.8	63.0	46.3	46.2
EPA Guideline Value for Residential areas with some commercial or light industry for day = 60 dB (A) and night = 55 dB (55						

Legend

Leq - Integrated noise level during the measurement period L_{90} - Background noise level

Lmax - Maximum noised level

Lmin - Minimum noise level

It can be observed from **Table 14** that the noise levels were within EPA's permissible noise limits for both day and night.

Plate 3: TSP & PM10 monitoring at Chirimfa Forest

Plate 4:Noise measurement at Chirimfa Forest

Plate 5:CO measurement at Chirimfa Forest

Plate 6: TSP & PM10 monitoring at Awura Forest

Plate 7:Noise measurement at Awura Forest

Plate 8"NO_2 & SO_2 measurement at Awura Forest

5.1.6 Water Environment

Hydrology and Surface Water Resources

Major streams and rivers flowing through the project catchment are the Atonso and Drobon Rivers in the Chirimfa forest which flows into the big Afram River. The Afram stream flows through the Awura forest. Tributaries include the Asuonwunu and Nankonoma streams in the Chirimfa Awura reserves respectively.

A water quality and aquatic study was carried out for the surface water bodies at upstream and downstream points as well as groundwater from boreholes within the project's catchment.

The main objective of the study was to determine the baseline quality of these water resources and to assess the impact of the reforestation project on the surface water and groundwater resources within the project catchment.

Water Quality

Surface water quality is affected during the rainy season where storm water picks up potential pollutants that may include sediment, nutrients and other constituents particularly from agrochemical use, and carried into surface water bodies affecting its quality .There is the need to do further monitoring and water quality assessment during project operations and to assess if any impact (positive or negative) has occurred that could be attributed to the development and this will be compared to the baseline quality of the water resources to determine any change in its quality.

The water quality of the project area waters was carried out on 6th October,2017. The samples were taken from the upstream and downstream points of the Atonso, Drobon, Afram and Nankonoma Rivers using standard sampling techniques. Groundwater were sampled from boreholes in the Bunusu and Esreso communities in the Awura and Chirimfa forests respectively

The samples were analysed at the environmental quality laboratories of the KNUST-Department of Civil Engineering. Specified methods as laid in "Standard Methods for the Examination of Water and Wastewater" published jointly by the American Water Works Association (AWWA), American Public Health Association (APHA) and the Water Environment Federation (WEF) 20th Edition, 1998 were followed, and the results are as s shown in **Table 15** below.

Table 15: Surface and Groundwater Sample Results

Parameters	*G/lines	1	2	3	4	5	6	7	8	9	10
pH	6.5-8.5	6.31	6.45	6.27	6.58	5.48	6.96	6.77	6.81	6.74	5.25
Turbidity	0-5	3.96	2.86	111	40.8	4.1	106	76.9	43.4	49.5	0.5
Conductivi	0-2000	111.8	100.3	80.1	87.3	59.2	57	57.5	51.9	34.3	73.9

ty											
Colour	0-15	80	69	89.2	326	5	158	106	146	134	5.0
Total Dissolved Solids	0-1000	55.9	50.1	40.1	43.6	30.1	28.5	28.5	29.5	17.7	37
Total Suspended Solids	0	4	0	53.6	28.3	1	83	57	40	27	2
Alkalinity	0-150	28	22	20	20	14	12	12	13.9	14	13
Chemical Oxygen Demand	0-250	22	21	22	19	19	60	21	31	35	19
Biochemical Oxygen Demand	0-50	5	4	5.2	3.5	3.5	16	4	7.5	8.1	3.2
Oil and Grease	0-5	0	0	0	0	0	0.002	0	0	0	0
Total Phosphorous	0-2	10.35	5.03	7.65	3.08	2.55	3.35	1.5	3.83	3.38	1.2
Nitrate	0-10	6.2	0.8	17.5	4.5	7.6	2.4	1.3	-	-	11.3
Iron	0-0.3	0.48	0.52	2.62	1.5	0.02	0.38	0.31	0.34	0.38	0.26
Chloride	0-250	10.9	17	10.9	8.9	14	14.9	5	5.9	6	12
Fluoride	0-1.5	0.34	0.35	0.06	0.13	0.11	0.29	0.28	0.38	0.29	0.01
Lead	0-0.1	0.011	0.009	0.01	0.011	0.011	0.099	0.099	0.001	0.009	0.017
Sulphide	0-1.5	0	0	0.022	0	0	0	0.094	0.021	0.01	0.005
Zinc	0-5	0.029	0.022	0.02	0.023	0.008	0.023	0.024	0.001	0.001	0.035
Total Coliform	0/100	$112*10^2$	$58*10^2$	$124*10^2$	$116*10^2$	120	$84*10^2$	$112*10^2$	$160*10^2$	$411*10^2$	112
Faecal Coliform	0/100	$13*10^2$	$28*10^2$	$86*10^2$	$45*10^2$	14	$48*10^2$	$52*10^2$	$20*10^2$	$22*10^2$	16

*WHO/GWCL

Legend: (Sample numbers and names)

Awura Forest Reserve

1.Nankonoma upstream

2.Nankonoma Downstream

3.Afram Upstream

4.Afram Downstream

5.Bunuso Borehole

Chirimfa Forest Reserve

6.Drobon Upstream

7.Drobon Downstream

8.Atonsu Upstream

9. Atonsu Downstream

10.Esreso Borehole

The results indicate waters of good pH, low Electrical Conductivity (Salt load) and Lead levels; it is neither saline nor sodic nor heavy metals present and therefore suitable as irrigation water for seedlings.

The results showed that:

- Typical freshwater quality regime with low concentration of anions and cations except iron which exceeded the WHO Guideline Value in all surface waters except borehole sample. This may be due to the presence of Iron that exists naturally in rivers since there are no major human activities occurring;
- pH values for all the samples were within the WHO guideline range of 6.50 – 8.50; and
- Lead was ≤ 0.1mg/l in all samples;

- Conductivity and Total Dissolved Solids values for all samples were within the WHO guideline range of 0-2000 and 0-1000 respectively;
- Total Phosphorous concentration for downstream and upstream samples all WHO Guideline range of 0-2 except borehole sample. High phosphorous levels in surface water samples may be attributed to the use of fertilizer on crops by farmers as these compartments have been converted to agricultural lands rending it highly degraded.

5.2 Biological Environment

5.2.1 Terrestrial Ecology Study

The general fauna and floristic composition of the proposed Project, covering an area of 4,428 hectares have been studied. Distinguishable land use and vegetation cover types of the study area were:

- Cropped fields with seasonal crops
- *Gmelina* and *Tectona* plantations

Vegetation/ Flora

A total of 4 hectares (2 points distributed in each of the concession area) were assessed using transects of 500m x 20m. The transects locations were determined using the GPS points which was placed at random on the concession area. Four sampling locations (Miro T1 – T4) in Awura and Chirimfa reserve were studied during the survey.

Each transect was subdivided into 5 subplots at a distance of 100m for the assessment of trees and shrub presence. At the end of every 90m and 10m points, (thus beginning of new subplot) 20m x 20m plot size was established using the GPS as a guide to determine the distance on the ground. The plot was used to assessed grasses, climbers, herbs, shrubs as well as regeneration of tree species presence This process was repeated for all other subplot as well as quadrats in the transects. Conscious efforts were made to identify areas of ecological importance such as streams or rivers.

Data on tree species names were recorded during the field inventory. Field botanist identified and assigned unique names to trees, where trees were not identified at the spot, Hawthorne & Jongkind, (2006) I, Okezie Akobundu and C. W. Agyakwa (1987), Michel Arbonnier (2004), was used as reference to identify all specimens taken. Within each transect, all trees species where identified, counted and recorded. Where a tree has multiple stem, (forked below 1.3m P.OM), the stems were counted and recorded.

Star Rating Definitions

Black Star species:	Species rare internationally and at least uncommon in Ghana; urgent attention to conservation of populations needed
Gold Star species:	Fairly rare internationally and/or locally

Blue star species:	Widespread internationally but rare in Ghana or vice-versa
Scarlet star species:	Common, but under serious pressure from heavy exploitation
Red Star species:	Common, but under pressure from exploitation
Pink Star species:	Common and moderately exploited. Also non-abundant species of high potential value
Green Star species:	No particular conservation concern, common in Ghana

The proportions of species in the various categories were estimated and used in commenting on the ecological significance of the area.

General Vegetation of the Project Area

The project areas lie in the dry semi-deciduous forest vegetation zone of Ghana where both high forest and savannah species are shared. Secondary vegetation is characterized by shrubs and continuous tall grassy ground layer with open canopy tree stratum and scattered remnant of trees from the old forest depicting the natures of a degraded forest. The vegetation is thus open in several places and some parts appears to be wetlands or waterlogged. The ground layer is annually or periodically burnt during the dry season.

The vegetation of this zone is characterised by trees such as *Mangnifera indica, Elaeis guineensis, Borassus aethiopum, Ceiba pentandra, Albizia spp, Anogeissus leiocarpus, Parkia biglobosa, Khaya senegalensis, Khaya grandifoliola, Ficus spp, Tectona grandid, Morinda lucida, Antiaris toxicaria, Cola gigantean, Bombax buonopozense, Carica Papaya, Spathodia campanudata, Anacardium occidentale, Vitellaria paradoxa, Pycnanthus angolensis, Persea Americana, Triplochiton scleroxylon, Cola gigantea*

Structure and Floristic Composition of Vegetation of the Project Site

The original vegetation has been degraded through intensive human activities such as settlement, agriculture, lumbering, fuelwood harvesting, charcoal production and annual bush fires, which have resulted in only a little of the original true climax vegetation remaining.

Farms with crops such as maize, rice, okro, yam etc exist within compartments allocated to Miro Forestry Ghana. The farms have given the vegetation a characteristic patchy appearance. The vegetation is largely open due to the effects of frequent fires, cultivation and grazing. It is uniform in structure (3 vertical layers of plants i.e. tree, shrub and herb) and composition over large distances in the project site.

Plate 9: open gallery vegetation in a typical compartment

Plate 10: Maize Farm in the Project Area

Plate 11: charcoal burning within the reserve

General Floristic Composition

The results of the flora survey indicated that a total of 1159 individual trees of 73 species belonging 26 plant families were recorded during the field inventory. Out of these numbers, the total number of shrubs was 25, climbers were 4, and tree species was 44 along all the four transect can be identified in the study area. The family represented by the greatest number of species was *Malvaceae* with 8 species, *Papilonaceae, Mimosaceae*, *Caesalpiniaceae*, *Apocynaceae,* with 5 species, followed by *Verbernaceae, Sapindaceae and Meliaceae* with 4 species*.* All other families recorded were represented by less than 2 species.

ANNEX 4a shows the floristic and species composition of the project site and the species frequencies. It shows that *Tectona grands* is the most frequent tree species in the project site followed by *Gmelina arborea* plantations sparsely distributed in both forest reserves.

Fauna of Project Area at Awura and Chirimfa Reserves

Species spotted during the faunal survey in the Awura reserve are presented below. **Annex 4b** shows the fauna species identified and Butterflies survey carried out.

Awura Forest Reserve

1) Tortoise (*Kinixys belliana*) (Least Concern, LC)
2) Agama Lizard (*Agama Africana*) (LC)
3) Butteries (Annex 5 Butterflies survey)
4) Rodents
    - Ground squirrel (*Euxerus erythropus*)
    - Groundcutter (*Thryonomys swinderianus***)**
5) African hornbill (*Tockus nasutus*) (LC)
6) Blue-billed Roller (*Coracias cyanogaster*)
7) Weaver birds (*Ploceidae* spp)
8) Partridge (*Pternistis ahanten***)**
9) Snakes
    - Royal python (*Python regius*)
    - Black cobra (*Naja melanoleuca***)**
    - Green mamba (*Dendroaspis angusticeps*)

Chirimfa Forest Reserve

1) Agama lizard
2) Butteries
3) Rodents
    - Ground squirrel (Euxerus erythropus)
    - Groundcutter (*Thryonomys swinderianus)*
4) African hornbill (*Tockus nasutus)*
5) Blue-billed Roller (*Coracias cyanogaster)*
6) Weaver birds *(Ploceidae spp)*
7) Partridge (*Pternistis ahanten)*
8) Stone partridge (*Ptilopachus petrosus)*
9) Snakes
    - Puff adder *(Bitis arietans)*
    - Black cobra *(Naja melanoleuca)*
    - Green mamba *(Dendroaspis angusticeps)*

Conclusions and Recommendations of Terrestrial Ecology Studies of the Project Area

The results of the assessment indicated that species of national conservation concern (GD-Gold, R-Red, BU-Blue, S-Scarlet, and P-Pink star species) and globally endangered or threaten species were identified in the concession areas. Twelve (12) species including shrubs (2), climber (1), herb (1) and trees (12) of national conservation concern were identified. Eighteen (18) plant species of global conservation concern were recorded in the project area, and are listed in the IUCN Red Data book under Vulnerable and Least concern categories. *Afzelia africana*, *Albizia ferruginea*, *Khaya senegalensis*, and *Khaya grandifoliola* were four main tree species identified to be listed on the Red List as Vulnerable. The tree densities of the concession area were relatively low due to unsustainable farming practices in the concession area

The project would lead to loss of vegetation and consequently habitats for the abundant wildlife in the area during the constructional phase. It is recommended that these species should be considered when the area is being cleared.

There will be significant loss of livelihood support since crop farming and charcoal making collection would decline as a result of vegetation clearance. Provision of a viable alternative is imperative.

Results of the faunal study suggests that the most species that populate the project area are of Least Concern according to the IUCN categorization for endangered species. This indicates that the proposed project would not significantly affect the fauna of the project site.

Efforts should be made to avoid animal kills during vegetation clearance in case they are encountered.

5.2.2 Aquatic Biology

As part of the EIA study of the proposed project, a baseline study of the aquatic habitats of the project area has been carried out. Specifically, the report studies the baseline condition of the aquatic ecosystem and predicts the likely impacts of the proposed project on the aquatic environment within the catchment of the project. **Figure 11 and 12** shows the location map of study site on the Afram, Atonsu and Drobon Rivers in the Awura and Chirimfa forest reserves. The detailed aquatic study report is attached as **Annex 5.**

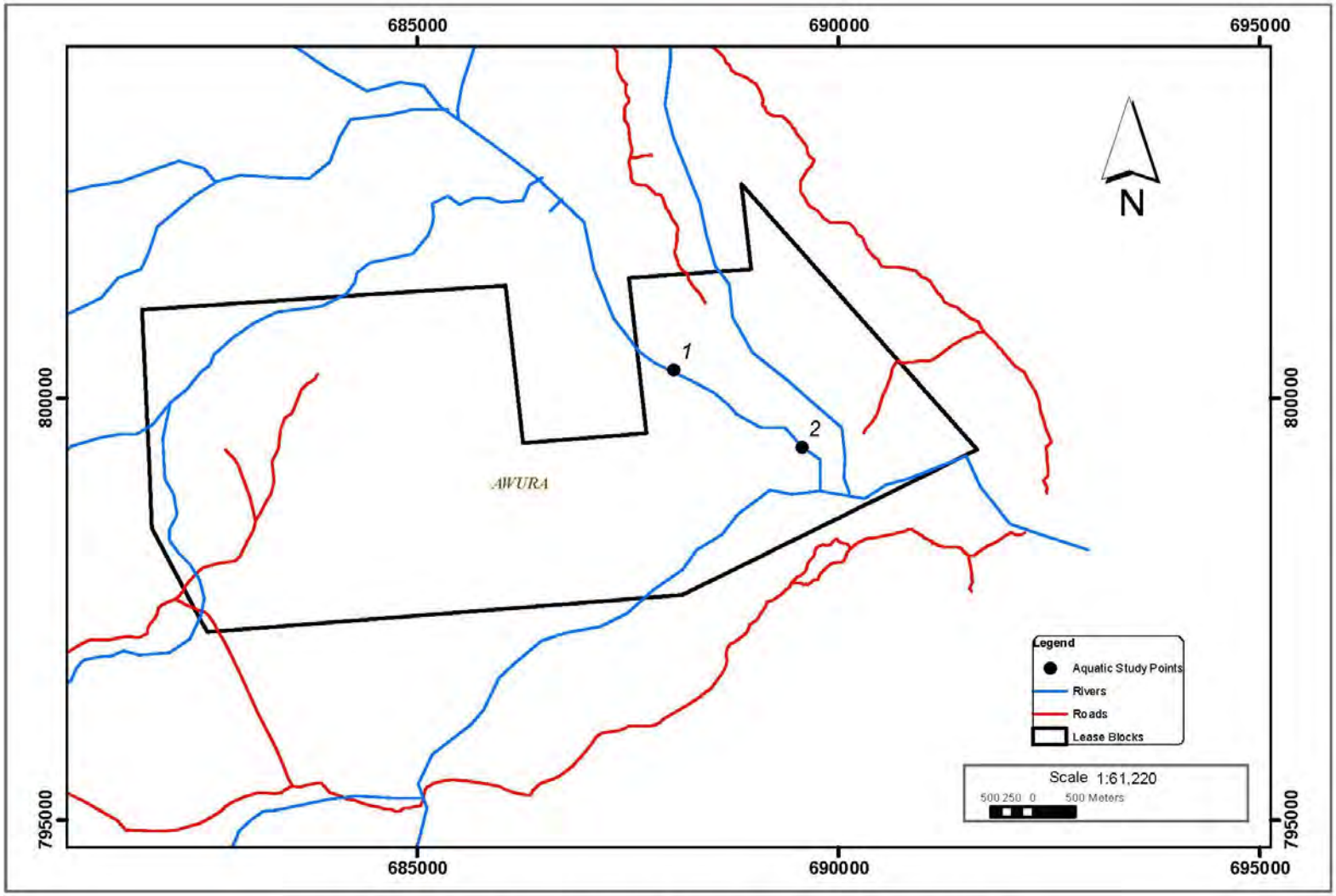

Figure 11: Map showing Locations of the Study Sites on the Afram River In the Awura Reserve

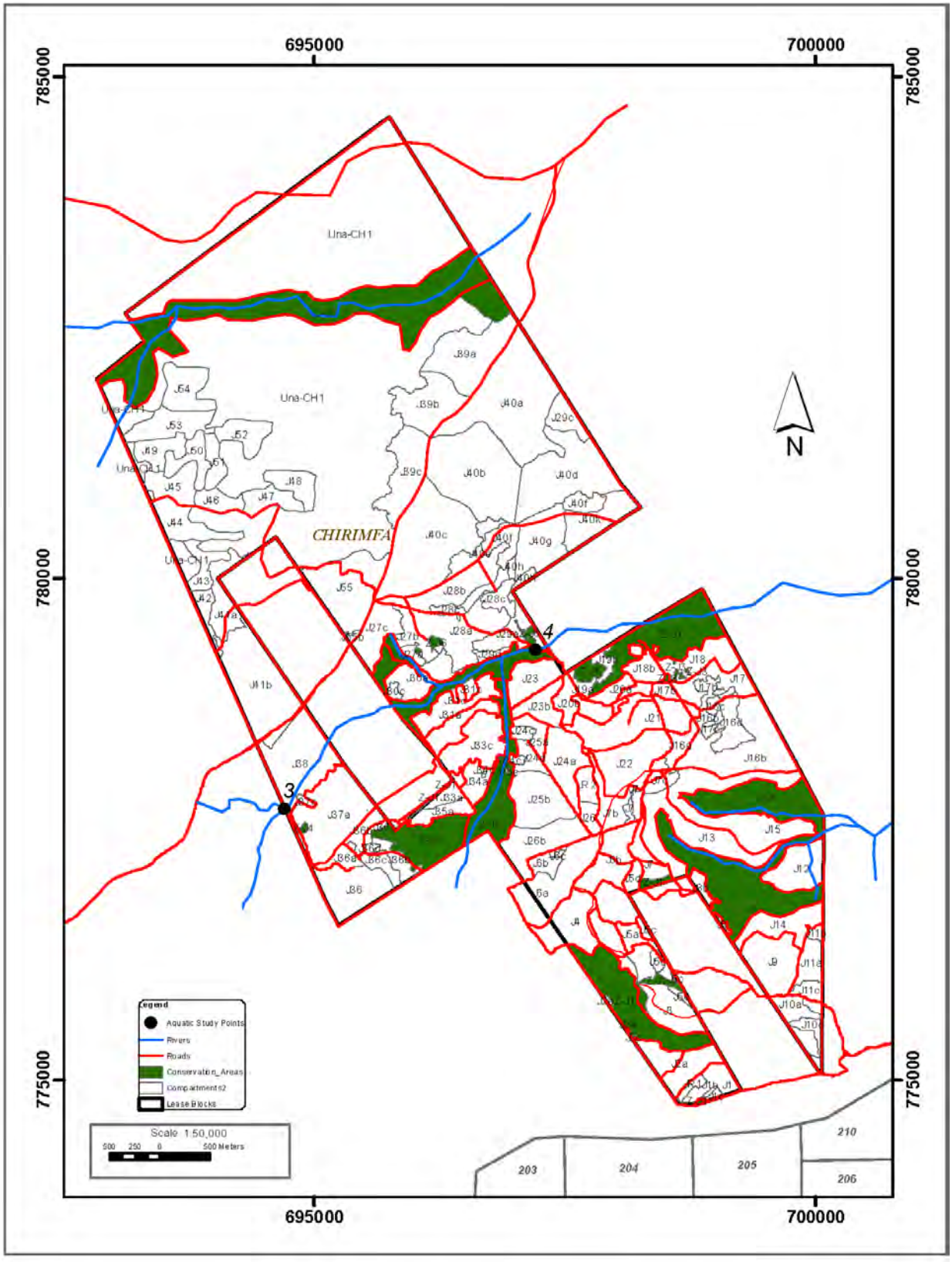

Figure 12: Map showing Locations of the Study Sites on the Atonsu River in Chirimfa Forest

Macrophytes and Phytoplankton Diversity and Aquatic Community Structure

The water bodies in the project area are generally poor in macrophyte community structure, with composition list of very few members The species composition and community structure of the various indicators are not unique to the project area but a representation of similar habitats. The plants appear in quantities that could conveniently be described as serving basic ecosystem functions.

The diversity of the macrophyte vegetation is quite poor, with very few emergent and near non-existent free floating types, with only *Lemna* sp., only observed at the Afram sites. The structure of the macrophyte community can therefore be described as ordinary with marginal numbers of components, and without any unique species. The macrophyte community observed in the survey is not in any disturbing quantities. Caution should however be exercised by monitoring the vegetation to prevent proliferating during the operation phase of the project, possibly through impounding the rivers water abstraction. However, in case of low water yield by the rivers at certain times of the year which could call for blocking to collect water or create standing water conditions, the presence of any aquatics should be targeted for monitoring. These macrophytes also have the ability to reduce water levels through increased evapo-transpiration. Therefore, a massive aquatic vegetation level would invariably mean a higher rate of water loss through this means.

The absence of any submerged macrophyte should be appreciated as some of these plants serve as host of agents/vectors of water related disease like Bilharzia. The presence of any submerged plant should be monitored to prevent entry and proliferation during the operation phase of the project to keep the project area disease-free. This is also in view of the presence of some macro-invertebrate agents in the area, and the likely regulation of the flow rate of the rivers by the project, which condition favours the vectors.

The phytoplankton community is typical of freshwater systems and pan-tropic and no species of special ecological interest were found. The various phytoplankton groups were fairly distributed in the project area. Though the distribution followed no particular trend, diatoms recorded relatively high numbers probably due to low water levels in the rivers and rocky substratum of these. This microfloral species assemblage is typical of the Volta system. Generally, none of these species of aquatic vegetation observed in the study area are considered rare or of conservation concern and would face no threats from the project.

Generally, this project will not impose any ecological threats to the biological structure of the area but it is expected that best practices measures will be employed in the project operations.

Conclusions and Recommendations of Aquatic Ecology Studies of the Project Area

The study revealed that the area where the forest reserves targeted for rehabilitation is generally devoid of any significant macrophyte community, as about 7 emergent macrophytes were observed in marginal quantities. *Lemna* sp. was the only free-

floating macrophyte observed in the study. This phytoplankton community observed and dominated by the Bacillariophyta, (35%), and followed by the Chlorophyta (29%) and Cyanophyta recording 16%. The Flagellates and the Rhodophyta recorded 10% each, compares favourably with freshwater systems occurring in West Africa.

It is recommended that a strict monitoring exercise should be followed for the macrophyte community to prevent proliferation during the operation phase of the project, which might involve impoundment and water collection to ensure environmental compliance of the project.

5.3 Social Environment

5.3.1 Brief Profile of the Host Districts

The forest reserve sites for the proposed project cut across two main (2) municipalities/districts listed as follows:

- Mampong Municipality; and
- Sekyere Central District.

Mampong Municipality

Location and size

The Awura Forest Reserve lies geographically within the Mampong Municipality and under Mampong District office of the Forest Service Division of the Forestry Commission. Mampong Municipality is located north -east of Kumasi in the the Ashanti Region of Ghana as shown in **Figure.2** above. It is bounded to the north by Atebubu District in the Brong Ahafo Region, east by Sekyere Central, south by Sekyere South and Ejura-Sekyedumasi to the West. It is also located within longitudes $0^0$05''W and $1^0$30''W and latitudes $6^0$55''N and $7^0$30''N.

The Municipality covers a total land area of 23.9km^2 with 79 settlements, 61% being rural, with Mampong as the capital. The rural areas are mostly found in the northern part of the Municipality where communities with an average of less than 50 people live in dispersed patterns. The major towns within the Municipality are Mampong, Krobo, Dadease, Asaam, Kofiase, Adidwan and Apaah.

Demographic Characteristics

The population of the Municipality was 88,051 according to the 2010 PHC as against 78,056 in 2000 (GSS, Population and Housing Census, 2000). Over a decade, the Municipality experienced a population increase of about 9,995, which represents 12.8 percent increase with an annual growth rate of 1.3 percent.

Social and Cultural Structure

Settlements within the Municipality are made up of various ethnic groups from across the country and the sub region. Each group has a unique culture in terms of building styles, physical appearances and the type of food.

The population is however dominated by Akans who constitute 92.6 percent and the other ethnic groups constitute 7.4 percent. Christians constitute about 87.6 percent of the population whilst Muslims and traditionalists constitute about 10.9 percent and 1.1 percent respectively. The Mampong Traditional Area is famous for the celebration of the Kontonkyi Adaekesie, which traces the migration of the Mampong people to their present location

Economy

Agriculture is the main economic activity within the Municipality and employs about 67.3 percent of the entire labour force. However, production is at the subsistence level, which needs to be improved to ensure higher agricultural productivity for local consumption and export to generate income and foreign exchange for the inhabitants and the country as a whole. Major crops cultivated are carrots and groundnuts.

The Service Sector is the second economic industry and absorbs about 17.2 percent of the population while Commerce constitutes 8.5 percent. Manufacturing however absorbs about 8.9 percent while 3.2 percent are absorbed by other income generating activities.

Land Tenure and Land Use

Stools, families or clans control land in the Municipality. The acquisition of such land is normally done through the chief. Majority of the farmers are tenants who pay rent, 12% of them are involved in the share cropping system (ie. The “abusa” system). Land is used for crops / livestock farming, tree planting (afforestation), game /forest reserves (Wildlife), road and building construction.

Farming System

Farmers in the district generally practice shifting cultivation and mixed cropping with a few of them adopting mono cropping and crop rotation. Similarly, livestock and poultry keeping are on extensive system (free range) with a margin keeping to the semi–intensive and intensive system.

Tourism

Tourism as an activity is poorly developed. However, the Municipality can boast of a number of attractive natural resources with tourism potential. There are also a number of hospitality industries and services such as Hotels, Guest Houses and Restaurants. Currently, there is one radio station called New Mighty FM.

Sekyere Central District

Location and Size

The Chirimfa Forest Reserve lies geographically within the Sekyere Central District and under Mampong District office of the Forest Service Division of the Forestry Commission. Sekyere Central District is located on the northern part of the region, and shares boundaries with Mampong Municipal, Atebubu District, Sekyere East, Sekyere South, and Ejura Sekyedumasi. The land size of the District is 1,631.1 sq. km and it is located within longitudes 0.05 degrees and 1.30 degrees west and latitudes 6.55 degrees and 7.30 degrees north. It has about 150 settlements with about 70 percent being rural. The rural areas are mostly found in the Afram Plains portion of the District where communities with less than fifty (50) people are largely located. The district capital is Nsuta. Major settlements are Kwaman, Nsuta, Beposo, Atonsu, Jeduako, Birem, Kyebi and Bonkrong.

Demographic Characteristics

The population of the District is 71,232, distributed as 35,225 males (49.5%) and 36,007 females (50.5%). Majority of the population reside in the rural areas (48,666) than urban areas (22,566). More than half (52.3%) of the population in the District are in the age category 0-19 years.

Social and Cultural Structure

Traditional Set-Up

There are three (3) paramountcies namely, Nsuta, Kwamang, and Beposo. There is a strong clan relationship between the Nsuta, Beposo and Kwamang Stools and these belong to the Oyoko, Agona and Aduana clans respectively.

Ethnicity

Almost every ethnic group in the country can be found in the District. Of more significance is the interrelationship among the various ethnic and clan groupings. Each one is proud to be identified as “Nsutani”, “Kwamangni” and “Beposoni”, except in times of a peculiar situation that calls for a real identification.

From the 2010 Population and Housing Census (PHC) data, the District is dominated by the Akans who constitute about 64.1 percent followed by Mole-Dagbani 17.9 percent, Gurma 12 percent, Grusi 4.1 percent, Mande 0.4 percent, Ewe and Guan are both 0.3 percent, Ga Adangbe 0.1 percent and other tribes 0.8 percent.

Festivals

The people in the District take special pride in the celebration of festive days like the Akwasidae, Kwasidae, Wukudae and Fofie. The Akwasidae is the most adored festive celebration of the various paramount seats. There are no known identified negative cultural practices that hamper social cohesion in the District

Economy

Agriculture

Farming is the predominant economic activity and employs about 75 percent of the economically active labour force. The District has a vast arable land; however, farming is at subsistence level. The geographical location of the District and its closeness to other districts enhances trade activities. Market days in the various districts experience inflow and outflow of both agricultural and manufactured goods. The result is that the Assembly's revenue is enhanced and traders' income improved because of the large market.

The vast land in the north-eastern part of the District is a potential source of agricultural land for modernized agricultural development. The rainfall pattern of the District support two cropping seasons

Small scale manufacturing and the services industries

Small-scale industries in the District can be categorized into 5 groups, namely, agro-based forestry, textiles, metal works, and services. Fifty-Six percent of all these industries are agrobased. These include Akpeteshie distilling, pito brewing, baking, corn milling, cassava and gari processing, oil palm extraction and soap making.

The next major groups are forestry-based industries. They include carpentry and charcoal burning. This group accounts for 15 percent of all establishments. Mechanics and blacksmiths are considered as metal-based industries and both account for 3 percent of all establishments. The service industry includes recreation (hotels, chop bars, beauty salons and barbering shops). The district can boast of sand and stone deposits.

Tourism

The Atwea Mountain, with its beautiful scenery has a high potential in the hospitality and tourism industry. In addition, the relatively high nature of the area results in cool temperature whiles the rivers and streams serve as source of drinking water for most of the communities. Again, people make living from the rivers through fishing. The bigger rivers especially Afram and Sene are potential sources of irrigation farming in the Afram Plains. The fact that there is no litigation on land is a plus for developing a potential for tourism. Chiefs who are custodians of the land are also collaborators with the District Assembly and therefore acquisition of land for development by the Assembly and foreign investors is not a problem.

5.3.2 Profile of Project Affected Communities

The major communities close to the project area (Miro's allocated compartment) and with interest in the reserves are Bunusu, Esereso, and Asuonwunu. Other fringe community of interest is Mframabuom, which shares boundary with Chirimfa reserve but on Kwaman stool land.

Bunuso Community

Bunuso Community is located near the Awura Forest Reserve. The Chief of the Community is Nana Adade Brenya. During the 2010 population census, the Community recorded about 5,000 members and the current estimated population is 6,500.

Ethnicity.

The community is dominated by Konkombas and Dagaates. Other minority ethnic group include Dagomba, Chokosi, Mossi, Frafra, Kotokori, Bussanga, Gruma, Sisaala, Asantes. Apart from the Asantes who are indegenes, all the other ethnic groups have migrated as settlers migrated from the northern part of Ghana. The language spoken are Konkoba, Dagaare, Mossi, Kusaase, Busanga, Sisaala, Frafra, Asante Twi

Structures

Bunuso has Houses about 800 households and are typically of mud and wood roofed with thatch and a few of them roofed with iron sheets (tin). Bunuso is not connected to the national electricity grid although power cables have been erected. All the households use dry cell batteries in torch lights as lightening source at night. Fuel wood is the main source of energy for cooking with few using charcoal.

Land tenure and Land Use Rights

Individuals owing lands give them out for rent for a particular period and others do share cropping. However, reserve lease holders give portions out for hiring and the agreement is one acre for one bag in the case of maize. Cocoa farming is on sharecropping basis.

Those using land for sharecropping such as cocoa pay for a token called 'drink fee'. One can also cultivate both cash and food crop on the same piece of land. The farmer takes the food crop and takes care of the cash crop for the landowner. Reserve lease holders rent portions of the forest out to those interested.

Occupation

Major economic activity is farming. Food crops grown include: Maize, rice, yam, beans, groundnut, plantain. Cash crops are cultivated by these farmers include Cocoa, Palm tree, Teak on the same piece of land.

Water and sanitation

The residents of the community have access to boreholes as their source of water The Community can boast of 3 boreholes. There is no designated waste dump and so household refuse are mostly burnt or thrown into bushes. There are also no household or community toilet which has led to open defecation system by the community.

Education and Health
The educational facility is from the nursery to Basic nine (9). Health facility is under construction but currently they access healthcare at Bosomkyekye Clinic and Mampong Government Hospital

Religion and Culture
No festival is observed but churches and mosque are found. There is cemetery and a shrine is located outside the forest reserve. Tuesdays are taboo days and libation is sometimes poured at the shrine site to invoke the spirit of the ancestors to protect them against any strange diseases.

Market
Market days are Tuesdays and Fridays.

Esereso Community

This Community is located near the Chiremfa Forest Reserve and the head of the Community is Opanin Kwadwo Anane. Esereso Community has an estimated population of about 200 people. About 98% of the inhabitants are believed to have come from the northern part of Ghana The community pays allegiance to Kwaman Traditional Council.

Ethnicity.
The community is dominated by the Baaseres Other minority ethnic group include Konkomba, Dagaate, Asante. Apart from the Asantes who are indegenes, all the other ethnic groups have migrated as settlers migrated from the northern part of Ghana. The language spoken are Baasare, Konkomba, Dagaare, Asante Twi

Structures
Esreso has Houses about 70 households and are typically of mud and wood roofed with thatch and a few of them roofed with iron sheets (tin). Esreso is not connected to the national electricity grid. All the households use dry cell batteries in torch lights as lightening source at night. Fuel wood is the main source of energy for cooking with few using charcoal.

Land tenure and land use rights
The Asantes own lands through inheritance and some also buys their own lands and give them out on sharecropping in the case of cash crops. Others also give lands to some individuals for food crops whiles those individuals plant cash crops for the land owners. Land is also given out on rental basis. Majority in this community depend on the forest reserve for food crops.

Women are allowed to own lands without any limitation or restrictions. There are no issues associated with people farming on forest land however for the individuals' lands, one is obliged to pay a token as 'drink fee' in the case of sharecropping. land

use on rent basis, would have to be payed according to the number of acres and period of use.

Occupation
Major economic activity is farming. Food crops grown include: Maize, rice, yam, beans, groundnut, plantain. Cash crops are cultivated by these farmers include Cocoa.

Water and sanitation
The residents of the community have access to boreholes as their source of water The Community can boast of 1 borehole. The Drobon and Yadodo rivers are also water sources by the community. There is no designated waste dump and but almost every household has toilet facility.

Education and Health
There is no constructed educational facility. The only existing is a Kindergarten School but has no classroom block. Lessons are being taken in the open under trees. There is no health facility existing. The community access healthcare at Kwaman and Nsuta.

Culture and Religion
There are no Church building or mosque existing. Community members worship at Kwaman. There is no festival to observe. No festival is observed but churches and mosque are found.
Tuesdays are taboo days and libation is poured at the village shrine to appease the river goddess. There is cemetery and community shrine is located on the banks of river Drobon but outside the forest reserve.

Market
There are no market days in the community. They go to Nsuta on Thursdays to buy and sell

<u>Asuonwunu Community</u>

Asuonwunu is a community located close to Chiremfa Forest Reserve with an estimated population of about 130 people made up of about 85 being Konkombas and 50 Dagaates. The head of the Community is Nantwum Biiba and the people pay allegiance to Kwaman Traditional Council. It has about 35 households and all the residents in this Community originated from the northern part of the country. All the community members (both men and women) rent or hire land from lease holders in the reserve.

Ethnicity.
The community is dominated by Konkombas. Minority ethnic group is the Dagaate. Both Konkombas and Dagaates are believed to have migrated as settlers. The language spoken is Konkomba and Dagaare.

Structures
Houses are typically of mud and wood roofed with thatch. Asuonwunu is not connected to the national electricity grid. All the households use dry cell batteries in torch lights as lightening source at night. Fuel wood is the main source of energy for cooking with few using charcoal.

Occupation
Major economic activity is farming. Food crops grown include: maize, yam, cassava and vegetables No cash crops are cultivated by these farmers.

Water and sanitation
Their source of water is a stream by name Asuonwunu which joins the big river Atonsu. No boreholes exist in the community. There is no designated waste dump and so household refuse are mostly burnt or thrown into bushes. There are also no household or community toilet which has led to open defecation system by the community.

Education and Health
The community have no School nor health facility in the community. Pupils and students school in Kwaman. Healthcare is accessed at Kwaman and Nsuta.

Culture and Religion
There is no church or mosque but worship at Kwaman. There is no cemetery nor shrine existing in the community. Tuesdays are taboo days. No rituals practised.

5.3.3 General Socio- economic Considerations in the Project Area

Land Rights at the Project Site
The land of the Awura and Chirimfa Forest Reserves are owned by the people of Mampong and Nsuta, traditional areas respectively; each represented by their stool leader or Chief. The implication is that these two stools have the title to the land and all benefits accruing from the land are due to them. It is of interest to note that the people of the two traditional areas are from common ancestral backgrounds and indeed see themselves as cousins. As a result of this blood-relation, there are no physical stool land boundaries in the Reserve for the identifiable owners.

Desk studies have revealed a number of legislative instruments pertaining to land tenure and use. Article 267 of the 1992 Constitution stipulates that "*All stool lands in Ghana shall vest in appropriate stool on behalf of and in trust for the subjects of the stool in accordance with customary law and usage*". In practice, all stool lands belong to paramount chiefs who are the traditional heads of paramount stools. Ownership is often hierarchical with paramount divisional, town or village stools all having an interest in the land according to the mode of acquisition.

The Forestry Commission is the mandated custodian of the reserve lands and has been entrusted by the stool landowners to manage and maintain the reserve as a forest on behalf of the stool landowners.

Traditional Rights and Land Use

Local communities have traditionally used the Awura and Chirimfa Forest Reserves as a means of providing key inputs to support their livelihoods and subsistence. These include hunting for game, collection of dead wood for fuel and collection of medicinal plants. However, the degraded state of the reserve, due to illegal logging, slash and burn agriculture and over-hunting has resulted in some negative effects for communities. For example, the degraded areas in the reserve have resulted in less tree stands being available for fuelwood and animal game have migrated to more protective forested areas. Mampong and Nsuta are predominantly an agro-forestry and fishing community and it is therefore important that these traditional rights are protected and continuously contribute to the lives of local communities.

There is no registered leasehold of any part of the project land. Both farms and settlements exist on the land based on the informal customary arrangement. Other associated land use currently existing is agriculture. Vast portions of the reserve have been converted into agriculture lands by farmers inhabiting these settlements. Farming is done on subsistence basis, under shifting cultivation where farms are abandoned after some years of cultivation and new farms are cultivated on another land. Majority of the farmers are engaged in mixed farming and cultivate annual food crops like yam, maize, beans, and groundnuts. In addition to farming, they also engage in fishing as a second economic activity.

Agro-based Industries

There are no agro-based industries in the study area. The inhabitants of the area concentrated on their primary activities like farming, fishing, hunting and charcoal processing.

Livestock

The Fulani dwell in certain areas in the project area, and most often than not send their cattle to graze on the concession. Farmers from settler communities on the project land also keep domestic animals such fowls, goats and sheep.

5.4 Environmentally /Culturally Sensitive Sites

The key environmentally sensitive features are water resources including stream and wetlands and riparian strips running through the reserves, which is the main recipient of any impact from the reforestation project. All stream/rivers/ wetlands will be mapped out of production area.

No archaeological sites or sacred groves as well as cemeteries have been identified. Sensitive ecological areas will receive conservation and protection interventions to

encourage the survival and regeneration of indigenous species. There is no cemetery on the proposed project sites.

Plate 12: A typical View of a Settlement on the Chirimfa Forest Concession (Asuonwunu Community)

6.0 STAKEHOLDER CONSULTATIONS AND PUBLIC INVOLVEMENT

6.1 Objectives of Stakeholder Engagement

Stakeholder participation during project planning, design and implementation has now become universally recognised as an integral part of environmental and social impact assessment process. Local communities, government, and nongovernmental organisations (NGOs) may all be able to contribute to and benefit from dialogue directed at identifying and resolving key project-related issues.

Stakeholder consultation has been a two-way flow of information and dialogue between project proponents and stakeholders. It is specifically aimed at developing ideas that can help shape project design, resolve conflicts at an early stage, assist in implementing solutions and monitor progress.

Specifically, the stakeholder engagement seeks to achieve the following objectives:

- To provide information about the proposed reforestation project to stakeholders;
- To educate stakeholders on the need for the proposed project;
- To provide opportunities for stakeholders to discuss their opinions and concerns;
- To enhance the project designs and implementation by learning from, and incorporating the expertise of individuals, professionals, communities and organisations;
- To provide and discuss with stakeholders, alternatives considered to reduce anticipated impacts and risks;
- To manage expectations and misconceptions regarding the project;
- To discuss the significance of environmental, social and health impacts and risks identified;
- To inform the process of developing appropriate mitigation, monitoring and management measures; and
- To facilitate and maintain dialogue with key stakeholders throughout the project implementation phase.

6.2 Stakeholders Consulted

SAL Consult and Miro Forestry (Ghana) Ltd held various levels of consultations with relevant stakeholders comprising:

Regulatory Institutions

- Environmental Protection Agency (EPA), Head Office, Accra;
- Environmental Protection Agency (EPA), Kumasi, Ashanti Regional Office;
- Water Resources Commission, Kumasi, Ashanti Regional Office – Pra Basin Secretariat;
- Ghana National Fire Service, Mampong & Nsuta; and
- Factories Inspectorate Department, Kumasi.

Local Government Body

- Ashanti Mampong Municipal Assembly, Mampong; and
- Sekyere Central District Assembly, Nsuta.

Other Government Institutions

- Office of the Administrator of Stool Lands- Kumasi/Mampong-A/R;
- Forestry Commission (FC) Kumasi- Ashanti Region;
- Forest Services Division of the Forestry Commission, Mampong-A/R;
- Ministry of Food and Agriculture (MoFA)- Mampong Municipal/Sekyere Central District;
- Timber Industry Development Division (TIDD)-Kumasi;
- Department of Feeder Roads, Kumasi; and
- District Health Directorate, Mampong Municipal/Sekyere Central District.

Traditional Authorities/Councils

- Mampong Traditional Council, Mampong;
- Nsuta Traditional Council, Nsuta; and
- Kwaman Traditional Council.

Local community close to the project sites (Forest Reserves)

- Bunuso community;
- Esereso Community;
- Asuonwunu Communities;
- Other Fringe Community - Mframabuom;
- Project Affected Persons /Farmers; and
- Cattle Herdsmen Representative.

6.3 Outcome of Consultations

Consultations have been established with different interest groups and individuals and concerns/ issues raised are presented in **Table 16.** Evidence of consultations is presented in **Annex 3.**

Table 16: Summary of Concerns Raised by Stakeholders

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
Regulatory Institutions					
Forestry Commission/ Forest Services Division- Regional Office, Kumasi	Thomas Okyere	Regional Manager	0244739359	24/11/2017	• The FC earmarks highly degraded compartments/areas in the reserves and leases it to private developers/ investors for plantation development. • There is the need to protect catchment areas in the reserve by creating a buffer around these water bodies. • Indigenous species already existing in the reserve should be left standing. • The FC in collaboration with Miro Forestry should select and train fire wardens in fire protection and management. • The developers can however, employ forest guards to assist the existing ones so they can provide intense security in the reserves. • All traditional norms such as taboos, preservation of sacred grooves, etc. in the reserves should be complied with. • All conditions stated in the Benefit Sharing Agreement should be followed. • Miro and FC to take on board security issues on the Fulani menace by instituting private forest guards.
Water Resources Commission (WRC)- Pra Basin Secretariat, Kumasi	Yaw Boateng	Asst. Basin Officer	0203169737	24/11/2017	• The proponents should apply for a water use permit from the Commission if it intends to abstract or use surface/ground water. Documents to be provided to the commission include a Water Demand Management Plan, EPA permit, documents from FC, Certificate to commence business. • Information on the species to be planted, frequency and use of water (spraying/fertilization), dependents of the water should also be provided to the Commission. • Water Quality analysis and Soil analysis should be conducted as part of the baseline studies and subsequently on a monthly basis to be able to detect changes in the soil and water quality.

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					• The use of water for watering of the trees will decrease as the years go by. • The water use permit issued is subject to renewal after every 3 years but not transferrable. However, the conditions attached to the permit have to be duly followed by the proponents.
Timber Industry Development Division (TIDD), Kumasi	Anthony A. Eshun	Area Manager	0208142192	24/11/2017	• The Forestry Commission is made up of the Wildlife Division, Forest Services Division and the TIDD. • The TIDD is involved in the transportation of timber from the forest gate through the road network to the final processing point. ie. the sawmill. • There are checkpoints along the transportation networks. The relevant documentations are checked at each of these checkpoints to ascertain if they are up to date. Otherwise products are confiscated. • The buyer/ seller of the timber and companies involved in exportation as well as purchases at the forest gate have to register with TIDD. • TIDD also supervises the processes and grading of timber at the sawmill before issuing a certificate to cover them. • A contract of sale which is an agreement between the buyer and seller of the timber is signed. The agreement includes information on the dimensions of the timber, species, grade/quality of the timber, export price. • The agreed price should be within the Timber Industry price range. • TIDD ensures that the timber processed is based on the specifications stated in the contract. • A commission. i.e. 1.5% of the agreed contract amount is paid to TIDD. However, TIDD uses 0.5% of this amount for plantation and industry development. • TIDD uses the conditions stated in the contract and permit to ensure that all regulations are adhered to.
Factories Inspectorate	Baffour Asamoah	Regional Director	0277479523	23/11/2017	• Noise levels and Air quality assessments should be carried out for operations of future facilities such as sawmill and timber treatment plant

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
Department, Kumasi					• A certificate should be acquired for materials that will be used for in the case of Timber Treatment Plant. • In the case of establishment of a wood treatment plant facility which mostly uses a boiler, therefore, FID will outsource an engineer to determine the appropriate specifications of the boiler. • The block plan of all facilities should be made available to the FID. • The proponents have to conduct a pre- employment medical examination for all employees (kidney, liver). • Each of the offices should also have a minimum height of 9 feet. • The office premises should have an emergency assembly point. • The investors have to purchase a registration form from FID to enable them acquire a certificate for their operations. The certificate is subject to renewal annually. • FID will make a visit to the site to determine the conditions of the site. • There should a safety policy for the project. • FID carries out monitoring quarterly as well as organizing safety training for the employees. • Material Safety Data Sheet for chemicals such as Arsenic which is used for treatment of timber should be strictly adhered to.
Office of the Administrator of Stool Lands, Kumasi	Goergina Rockson	Principal Stool Lands Officer	0204753262	23/11/2017	• OASL deals with revenue mobilization from stool lands. • A stampage fee is paid to the Forestry Commission (FC) by the private investor upon harvesting. A percentage of the revenue generated is ceded to the OASL as annual rents for land use and to the District Assembly. • OASL is mandated for the disbursement of funds based on the 1992 constitution which is 10% as administrative charges on the overall stampage fee given to OASL by FC. However, the remaining 90% is treated as 100% and disbursed as follows;

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					✓ 25%- For the Traditional stools ✓ 20%- For the Traditional authority ✓ 55%- For the assemblies • The lease agreement between the investors and traditional authorities should be registered with the Public and Vested Lands Management Division of the Lands Commission. This helps the project to get the Government concurrence i.e. the backing of the Government. • Any compensation issue triggered should be well tackled. • All agreements signed should also be duly followed.
Ghana National Fire Service, Mampong-Kumasi	Selasie P. Avevor	Municipal Fire Commander	0208447241	21/11/2017	• Bush burning is rampant in the district. However, the by-laws have been gazetted to regulate the levels of bush fires in the district. • The GNFS are enforcers of anti- fire laws. Hence, the activities of the developers will not conflict with the laws and regulations of the GNFS because their activities do not include bush fires. • The developers should ensure the activities are in conformity with the PNDC Law 229 and the bylaws of GNFS. • By implementing these by-laws on bushfires, help protect the vegetative cover as well as empowers GNFS to arrest culprits of bush fires. • Floater i.e. group hunting is a localized activity in the district which involves hunting for bush animals using fire as a bait. This activity is a major cause of bush fires in the district. • There are fire volunteers who represent the GNFS in the rural communities and also help enforce the bylaws. • Bush fires are persistent mainly in the dry seasons which peaks in January. Records indicate that bush fires were intense during the 2015 and 2016 harmattan seasons in the district. • GNFS has the mandate to render services to educate communities around their

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
					concession about the bylaws as well as measures to prevent bush fires. • The investor needs to furnish GNFS with the project details so they can fully understand the project and assist when called upon. • The GNFS recommend that the watersheds are preserved so the rivers do not dry up as a result of evaporation. • The GNFS has a fire tender and personnel to tackle fire when called upon, but usually fall on the assembly if they need to organize any educational programme due to inadequate funds.
Department of Agriculture, Mampong Municipal	Emmanuel Baah	Agriculture Desk Officer	0242305467	22/11/2017	• Majority of the farmers in the municipal are into Teak plantations. • A major problem in the district is land fragmentation i.e. the lands of farmers are scattered apart and not sizeable enough for farming. • Bush burning as a method of land preparation is also a problem in the district. • The Fulani herdsmen (nomads) may pose a problem to the project because they set the land on fire in order to get grazing areas for their cattle. • The chiefs/ traditional council should be involved in the project implementation to ensure the smooth running of the project. • MoFA works with farmers regarding the best agriculture methods to be practiced, and are willing to offer their support. • MoFA recommends that only approved chemicals (for both pesticides and fertilizers) are used during the reforestation project.
Department of Agriculture- Sekyere Central District, Kumasi	Rashad Shaibu Charles Appiah	Monitoring and Evaluation officer Agric. Extension Agent	0249571780/ 0208258953 0243061686/	22/11/2017	• The department has limited funds for its operations, therefore, the developers has to resource them to be able to provide extension services in the reserve. • The department does not have oversight of forest activities. However, if FSD collaborates with them in relation to the taungya system, it will enable them educate the farmers as to how to operate the system very effectively. • MoFA has the mandate to organizes awareness creation programmes to educate farmers on topics such as not felling trees, planting across slopes and planting

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
			0505140391		trees along water bodies. • Communication and co collaboration between MoFA and FSD is very poor.
Department of Feeder Roads- Kumasi	Mr. K.B. Amoako	Dep. Regional Officer	0244472990	23/11/2017	• The department will be involved for quantity survey works to identify the scope of works. This will help estimate the cost of road construction. • The department will outsource a contractor to construct the access road, under their supervision. • Provisional money (contingency) will be included in the estimate to cater for any uncertainties.
Mampong Municipal Assembly	Hon. Appiah Kubi Thomas Charles Oteng	Mun. Chief Exec. Mun. Coordinating Dir.	0244943579 0208198379	21/11/2017	• The FSD and the developers should formally inform the assembly about the details of the project. • The Environmental Department of the University of Winneba, Mampong campus proposed to donate tree seedlings to be planted in certain reserves but the assembly is not certain as to whether the Chirimfa and Awura forest reserves are included. • It is expedient that quarterly reports of the FSD should be submitted to the assembly for it to be discussed later. This will enable the assembly to be aware of the activities on going in the reserves found in the district.
Sekyere Central District Assembly	Asare Bediako T.K. Donkor	Mun. Coordinating Dir. Planning officer	0243436958	22/11/2017	• The district has not been informed about the ongoing project. • They will like to know the details of the project especially with regards to the project benefits.
Mampong Municipal Health Directorate- Mampong	Kwao Dorothy Frankie Otchere	Public Health Nurse Admin. Manager Snr. Accounts	0249628294 0546286569	21/11/2017	• The top ten diseases recorded in the area include malaria, anaemia, upper respiratory tracts, urinary tract diseases, etc. • The project design can incorporate the construction of boreholes for some communities around the reserves. This could form part of their corporate social responsibilities.

Stakeholder/ Institution/ Location	Contact Person	Role	Contact No.	Date	Concerns Raised/ Information Received
	Agbewu Prince	Officer	0266787658		• There are 69 communities in the municipal which have been divided into five sub districts by the directorate. These include Krobo sub, Mampong sub, Kofi Ase sub, etc. • The activities carried out at the directorate include adolescent health service, maternal services, outreach programmes and family planning services.
Sekyere Central District Health Directorate	Danso Yeboah Agyei Kwaku	Health Director Health Info. officer	0506205937 0247576596	22/11/2017	• Buruli ulcer is currently being recorded in the district. • Provided the annual health report for the year 2016 for consideration

Summary of Interest and Concerns of Project Affected Farmers and Local Communities

- The community members indicated that they do not know who falls within the concession and where it covers and hence the boundary line should be clearly demarcated;
- It was noted that some plantation developers under the previous Modified Taungya System had used the farmers to assist in planting tree crops in the reserve and refused to pay them. Therefore, they needed the surety that it will not be repeated by Miro Forestry if they are given the opportunity to be part of the project;
- The community members intimated that, farming in the reserve was their major source of livelihood and do not have any other means of survival. They enquired what alternative was for those who are going to be affected by the land take;
- The farmers made request to the developers to exclude the areas where the farmers are working and move to other areas within the reserves;
- It was requested that, the affected farmers be allowed to continue farming on their respective lands in the reserve whilst Miro Forestry provide them with tree seedlings to plant and take care of the plantation to be developed;
- Will Miro Forestry pay compensation to farmers who will be affected by Miro's activities?
- The grazing of cattle in the reserve has been a major source of local discontent as this has resulted in damage to crops. It was enquired how Miro was going to deal with the Fulani issues; and
- It was noted that the people of the communities are law abiding and peaceful people and are willing to cooperate fully with Miro Forestry for the development of the project, and hence, the developers should do likewise.

7.0 IMPACT IDENTIFICATION, PREDICTION AND EVALUATION

7.1 Introduction

A key activity under the environmental impact assessment is to clearly indicate the potential environmental and social issues and concerns, both positive and negative, to be elicited by the project. These formed the basis for the design of the baseline data collection program and subsequent impact analysis of the proposed. This part of the study has been greatly facilitated by the earlier description of the project scope, as well as the extensive stakeholder consultations already carried out in the proposed project area.

This section therefore identifies the geographical and socio- economic areas of influence by the project, and enumerates various government and non-governmental institutions likely to be interested or affected by the project vis-à-vis their statutory functions.

The local communities are clearly identified and their potential concerns are highlighted. The bio-physical environment to be impacted is also described through the magnitude of impact.

The environmental and social concerns are raised for the different phases of project life comprising the preparatory, constructional and operational stages

7.2 Project Area of Influence

The areas to be affected foremost have been identified and grouped under:

- Geographical;
- Environmental;
- Socio-economic;
- Institutional/organizational; and
- Community level.

7.2.1 Geographical Area of Influence

The immediate geographical area of influence of the project covers the 4,428 hectares of land area for the plantation development and its ancillaries and the access routes through different compartment s of the entire Awura and Chirimfa Forest reserved, in the Mampong Municipal and Sekyere Central District of the Ashanti Region respectively. The immediate political districts to be influenced include the Mampong Municipal and Sekyere Central District.

7.2.2 Environmental Media of Influence

The main environmental media to be impacted are ambient air at the project sites, water resources and wetlands, fauna & vegetation at the project sites, farms within the project sites, and soil resources. The Afram stream, Drobon and Asuonwunu streams

will be the main recipient of any water impact and wastewater to be generated from the project.

Erosion problems during farm development and subsequent effects on water quality are important. Pesticide usage and fuel/oil handing could be potential pollutant sources in addition to sediment transport and these could have adverse effects on the water resources.

The ambient air environment will be influenced during the construction phase especially during land preparation activities and vehicular movement especially during the dry season. Fumes and exhaust of equipment/machinery usage may also impact on ambient air quality.

7.2.3 Socio-economic Influence of the Project

The proposed plantation development project will greatly impact on the socio-economic condition of farmers farming at the project sites, local communities on and around the project sites, Mampong Municipal and Sekyere Central District as a whole. It is anticipated that social facilities, income levels and economic wellbeing, infrastructure (roads, education, and health) will be greatly improved.

The project will attract all manner of persons to the area (migrant farmers, market, timber dealers, truck drivers and their mates etc) and will require good planning to keep pace with this influx including such facilities to adequately take care of public law and order.

The social structures to be improved would include the various classes or groups identified in the project area such as chieftaincy, farmer groups, women groups, timber dealers, religious leaders and ultimately the local government system.

Improvements in the social structure variables viz., pattern of relationships, size of institution, income distribution, and concurrency of social relationships resulting from improved and increased plantation development and socioeconomic activities in the project area is expected to positively affect the social structure/ classes in the project area.

The increased socioeconomic activity is expected to improve economic fortunes of the district assembly increasing the size of the local government system at Mampong and Nsuta while the importance of the chieftaincy and family hierarchy will also become prominent when issues of land leasing come into play. The recognition of the hierarchy in the social structures and the role to be played by each class in the society of the project area will definitely cause an improvement in communities such as Bunusu, Esreso an Asuonwunu.

7.2.4 Institutional and Organisational Influence

There are many institutions which will share interest in the proposed project in various capacities including promotional, regulatory and monitoring purposes, and which must be adequately informed and engaged in the entire life of the project. The major institutions

to be involved and influenced by the project in accordance with their statutory mandates include:

- Environmental Protection Agency;
- Forestry Commission (FC);
- Water Resources Commission (WRC);
- Mampong Municipal and Sekyere Central District Assembly;
- Ministry of Food and Agriculture (MoFA);
- Ghana National Fire Service;
- Department of Factories Inspectorate;
- Office of the Administrator of Stool Lands;
- Department of Feeder Roads;
- Health Directorate;
- Timber Industry Development Division (TIDD);
- Mampong Traditional Council;
- Nsuta Traditional Council; and
- Kwaman Traditional Council

7.2.5 Community/Settlement Influence

The local communities or settlements of concern are:

- Bunuso community
- Esereso Community;
- Asuonwunu Communities; and
- Other Fringe Community- Mframabuom

7.3 Specific Project Activities of Environmental/Social Concern

The project activities are grouped into three phases as follows:

a) Preparatory phase;
b) Constructional phase; and
c) Operational phase

7.3.1 Preparatory Phase Activities

The preparatory phase is described by the following sets of activities to be carried out to execute the project, and which could impact on the biophysical and social environments:

- Land/forest compartments acquisition;
- Soil testing to determine the best areas for tree planting;
- Field determination and creation of Special Management Zones (such as securing of water resource/wetlands/riparian strips/indigenous species); and
- Education and sensitization of local farmers/communities about the reforestation project

7.3.2 Constructional Phase Activities

The constructional phase activities to potentially impact on the environment include:

- Transportation of construction materials and equipment to the project site.
- Land clearing such as stumping,
- Site and tree species matching; and

- Road construction/access development.

7.3.3 Operational Phase Activities

The operational activities that will potentially impact on the environment include the following:

- Land/soil preparation (weed control, fertilization, ripping, ploughing) for tree planting and forest development;
- Planting of tree species;
- Application of fertilizer and agrochemicals;
- Maintenance activities such as weeding around newly-planted trees;
- Pruning activities;
- Thinning and maintenance of tree stands;
- Harvesting and felling activities;
- Slash generation, disposal /management; and
- loading and transportation.

7.4 Evaluation of the Significance of Impacts

The impact significance is determined using the following criteria:

- Impact magnitude;
- Sensitivity and value of the receptor;
- Compliance with relevant laws, regulations and standards;
- Concerns and views of stakeholders;
- Overall worker comfort; and
- Likelihood of an occurrence.

Additionally, the impacts significance has been determined based on:

- Spatial coverage/Area of influence: this is to determine whether the impact will affect the local environment or will extend to other regions or national.;
- Duration/persistence of impact: whether it is temporal in nature or permanent; and
- Reversibility or otherwise: whether the impact is reversible or irreversible in nature.

The impacts are rated according to the following categories:

a) An impact of ***Low Significance*** hereafter referred to as a '**Minor Impact**' is one where an effect is experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value;
b) An impact of Medium Significance hereafter referred to as a '**Moderate Impact'**, is one which is within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor, up to a level that might be just short of breaching an established (legal) limit; and
c) An impact of High Significance hereafter referred to as a '**Major Impact'** is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resources/receptors.

7.5 Evaluation of Impacts at Preparatory Stage

The significant environmental and social issues, which could arise from preparatory phase activities include:

Acquisition of farm lands and impact on livelihood of farmers

Due process has been followed to lease the compartments from the Forestry Commission and traditional authorities (Mampong and Nsuta Traditional authorities) concerned. MFGL has therefore entered into benefit sharing agreements with stool landowners and other stakeholders. Communication strategy has been established with migrant settler farmers to move out of the project sites. The allocated MFGL compartments however contain farmlands (mainly plantain and maize) illegally established by both locals and migrant settlers. The implementation of the proposed project without adequate consultation of the affected farmers will create tension between the farmers, Forestry Commission and MFGL. Land clearing in these compartments to make way for the plantation development will inevitably result in the destruction of these illegal farms and affect the livelihoods of the affected farmers.

The impact is of major environmental significance.

Occupational Health & Safety Issues

Staff and experts and contractors involved in land and field investigations such as soil testing could be exposed to injury from accidents, reptile attacks and insect bites during field survey. The implementation of standard operational and safety procedures by experienced staff and experts will minimise the impact on flora and risk of injury.

The impact is of minor environmental significance.

Social Conflict with local community/migrant settlers and farmers

Poor communication strategy by Miro during the Education and sensitization of local farmers/ communities may give rise to misinterpretation and misunderstanding leading to tension and/conflicts especially if the communication strategy does not show respectful for the culture, traditions and concerns of the people.

The impact is of moderate environmental significance.

7.6 Evaluation of Impacts at Constructional Phase

The potential significant environmental issues associated with the construction phase activities are described below.

7.6.1 Positive Constructional Phase Impacts

The potential positive impacts to be derived from the implementation of the project include:

- Employment and job opportunities during project implementation; and
- Improvement in the local economy.

Employment and Job Opportunities

The project is expected to engage local people during the constructional phase as both skilled and unskilled labour. The current profile of the community would suggest that most of the youth may be taken on to undertake unskilled work. About 140-150 workers will be recruited to support plantation development objectives. The local community will be considered in the first instance before migrants in the provision of casual labour. This is a positive impact of the project and will go to affect the local communities directly.

Regular monthly earnings of labourers and artisans during the construction period will give a boost to the local economy.

The impact is of major environmental significance.

Improvement in the local economy

The local and national economy will be boosted through the following:

- Direct and indirect job creation;
- Increased income for workers;
- Increase in business activities in the communities; and
- Payment of taxes will improve the revenue base of the economy.

The impact will be regional and permanent, lasting throughout the duration of the project.

The impact is of major significance.

7.6.2 Adverse Constructional Phase Impacts

The potential adverse impacts likely to occur during the construction phase are identified and assessed below.

Public/Community Safety

The transportation of construction materials, waste generated and the movement of heavy equipment to the project site may pose risk to inhabitants along the affected routes. Any unattended mechanical breakdown of such cargo trucks on the roads can induce traffic and serious accidents.

The impact is of moderate environmental significance.

Loss of vegetation and impact on terrestrial life/biodiversity (flora and fauna)

Land clearing will lead to removal of existing vegetation cover to pave way for the plantation establishment. This leaves clear land surface for land zoning and land planning activities. Some plant material in the form of trees, shrubs and herbs as well as grasses will be removed in some areas through slashing, lopping and stumping. There may be a potential loss of eeconomic and representatives of important plant species occurring on the cleared site. However, the project will not carry out total mass clearance of vegetation in one phase. Trees will be removed only when it is necessary to do so.

Terrestrial ecological studies carried out during the baseline studies did not identify any plants of conservation significance, hence no major biodiversity challenges exist from land clearing.

Even in its degraded form, the trees, shrubs, herbs and grasses in the Chirimfa and Awura reserves form important source of food for the wildlife found in and around the project site. Even though most of the wildlife has migrated to the more forested conditions nearby, clearing of the vegetation is likely to limit the diet variability available to the small quantities of wildlife that remain or occasionally visit the project sites for food. This disturbance can result in changes to fauna behaviour patterns (dwelling, feeding, breeding, daily and seasonal movements etc.). The aggregated effects could result in decline in fauna population or permanent absence of species very sensitive to habitat disturbance.

The progressive clearing of vegetation across the landscape gradually affects the frequency and distribution of species between cleared and areas not cleared and consequently the biodiversity over time. The impact is long-term and limited to the project area.

This impact of loss of vegetation and terrestrial life/biodiversity is of moderate environmental significance.

Surface run-off and material transport into water-bodies

Construction and land clearance activities such as vegetation clearance, road construction or maintenance works to create access into the forest compartments and excavation works, will inevitably result in loosening of the topsoil and exposure of the soil surface to direct rainfall.

Excavated or exposed soil surface may be washed and deposited in nearby Drobon, Atonsu and Afram Rivers as a result of surface runoff during rainfall. Compacted road surfaces for access roads are also at risk of erosion from surface runoff. The transported materials from runoff may consist of soil particles, organic debris and chemical elements contained in the soil.

During the erosion process, soil particles (topsoil) are removed by run-off and transported down slopes and deposited in the lowlands, thereby creating rills and gullies. The deposited material ending up in streams and rivers may increase turbidity in the surface water bodies and raise the bed of the affected rivers. Plant or organic debris transported into the streams will decompose to add dissolved organic matter into the water bodies. Decomposition of vegetative materials in the rivers tends to reduce oxygen content for aquatic organisms through the process of eutrophication and ultimately undermine species survival. Appropriate measures will need to be put in place to forestall such impact.

The potential impact from surface run-off and material transport into water-bodies is of moderate environmental significance.

Impact on Aquifer Recharge

Land clearing is normally carried out during the dry months. MFGL activity will expose the soil to increased evaporation if the vegetative cover acting as mulch is removed for seedling planting. Initial rains cause surface sealing and thus reducing soil permeability. The reduced surface water infiltration, increased surface runoff and dryness of the soil increase the soil and artesian moisture deficit between monthly precipitations. Subsequently, groundwater recharge is reduced, increasing surface runoff to valleys and streams. MFGL proposes to give the plant lines a 2m secondary tillage to reduce surface sealing of soils and thus allow for improved soil permeability.

The impact on aquifer recharge is of minor significance.

Clearing of illegal farm lands and impact on livelihood

The allocated MFGL compartments contain farmlands (mainly plantain and maize) illegally established by both locals and migrant settlers. This has been the source of some tensions between the farmers, Forestry Commission and MFGL. Land clearing in these compartments to make way for the plantation development will inevitably result in the destruction of these illegal farms and affect the livelihoods of the affected farmers.

The potential impact on livelihood of affected farmers is of major environmental significance.

Noise Nuisance/Pollution

Sources of noise will include movement of vehicles, operation of forest machinery and power tools and movement of construction materials during construction activities such as land clearing and road construction. These will generate some noise and may result in temporary inconvenience to settlements along the haulage route and workers who operate such machinery. Noise nuisance is expected to be of local extent, intermittent and temporary, occurring only during active construction period.

The potential impact on noise nuisance/pollution is of minor environmental significance.

Air Quality Deterioration

Dust generation is expected from the excavation works, access road construction and the movement of materials/equipment over dusty surfaces. Large scale earth moving equipment such as road graders, caterpillars and tipper trucks used in the construction of access roads and are likely to generate more dust than equipment for land clearing by slashing as well as a small tractor plough used to prepare land. Dust levels will be elevated during the dry season. Dust is expected to be generated from the project activities are intermittent and in small quantities. They are therefore not expected to pose any significant health risk and impact on communities along the materials and equipment haulage routes. Road construction will not be an all year round activity and will be carried out in the early stages (1-3 years) of the project; after which a less intensive road programme will be adopted to maintain the roads. The impact is of local extent and temporary, lasting during the constructional phase. The application of standard dust suppression measures will assist to ensure that these issues are minimised.

The potential impact on air quality deterioration is minor environmental significance.

Occupational Safety and Health Issues

Workers will be exposed to noise, vibrations and dust during the construction activities. Additionally, there is high risk of accidents and injuries from the use of equipment and machinery and from animal/insect bites or threats during land clearing. Occupational health and safety issues are highly probable throughout the construction phase.

The impact Occupational Safety and Health Issues is of moderate environmental significance.

Generation and disposal of solid waste

Large scale clearance of vegetation will generate large amount of biomass, which will require proper management and disposal.

Servicing and maintenance of machinery will generate significant amounts of metal scrap, worn tyres and spent lubricating oil, empty lubricant containers, rubber seals, etc. which must be disposed of properly to avoid adverse impact on the environment. Poor housekeeping during construction works may also generate waste such as used polythene bags, food wastes, used water sachets and bottles, etc.

The potential impact from generation and disposal of solid waste is of moderate environmental significance.

Sanitation Issues

Open defecation may be promoted amongst the construction workers if adequate toilet facilities are not provided during construction. Facilities required will include toilets, bathrooms as well as potable water supply to avoid health challenges. The potential impact from sanitation is temporary and of local extent.

The potential impact from sanitation is of moderate environmental significance.

Demographic and Population Change Impacts

The proposed project is expected to induce an influx of migrant workers into the nearby communities during the construction period. The local population may increase during construction activities and may further stress local amenities. Influx of people and human migration into project area can disrupt the cohesion of small, stable communities, which can lead to an increase in criminal activities such as fraud, theft, rape and other social ills and anti-social behaviour.

Promiscuity may lead to the spread of Sexually Transmitted Infections (STIs) including HIV/AIDS. Migrant workers and increased incomes tend to encourage liberal sexual behaviour. Community members and workers will be sensitized and educated on such social vices.

The potential impact of demographic and population change is of moderate environmental significance.

7.7 Evaluation of Impacts at Operational Phase

Impacts anticipated from the operational phase of the project include the following positive and negative/ adverse impacts:

7.7.1 Positive Operational Phase Impacts

Direct positive impacts of the reforestation project include:

- Employment and job opportunities during project implementation;
- Improvement in the local and national economy;
- Improvement in the revenue base of key institutions and regulatory bodies such as the FC from sales from forest products;
- Improvement in income and standard of living of beneficiary farmers through inter-cropping;
- Improvement in amenities and social infrastructure of local and fringe communities;
- Transformation of reserve landscape and development of micro climates as well as carbon credits from sequestration;
- Limiting illegal farm allocations/activities and improvement in reserve management; and
- Protection of biodiversity habitats and indigenous tree species

Employment and Job Creation

There will be job creation and increased employment opportunities for the local communities on the reforestation project. It is expected that, poverty will be reduced as family incomes will be enhanced and wealth generated.

About 20-30 management and administrative support staff will be recruited for the project during the construction and the operational phase. It is also worth noting that subject to the company meeting its plantation goals and securing appropriate land. It is also anticipated that these developments will lead to the establishment of support industries and the resultant employment that could arise and benefit the local populace.

The scale of impact is local and the duration is permanent. The degree of significance is therefore rated Major.

Improvement in Local Economy

Hundreds of thousands of Ghana Cedis is expected to be injected into the local economy in the form of regular monthly earnings of labourers, artisans, engineers, technicians among others, thereby boosting their income levels and alleviating poverty levels of the project area. Small and medium-scale support businesses are also likely to spring up to boost economic activities, particularly at Mampong, Nsuta and other surrounding villages close to the project area. The impact on local economy will last throughout the operational phase of the project.

The Project may catalyse further development in the region by presenting business opportunities to local and external entrepreneurs. Other services (transport, telecommunications etc.) will be required to support the reforestation project and these may be provided by these entrepreneurs, who will create job opportunities and wealth for the locals and others beyond.

The potential improvement of the local economy is of major environmental significance.

Increase in Institutional and National Revenue

There will be significant revenue generation from the project to benefit local communities, the district and the nation as a whole through its exportation of timber. Revenue will accrue to the State in the form of corporate tax deductions and from wages of workers. Government agencies such as the Forestry Commission will generate revenue from local and export levies that would accrue from harvesting, processing and export of timber products. The EPA will also generate revenue through charging processing and permit fees for environmental permitting of the current project.

The potential increase in institutional and national revenue is of major environmental significance.

Limiting Illegal allocation of forest lands to migrant farmers

Field visits and discussions with locals and stool landowners have revealed that some timber companies and individuals who acquired portions of the degraded forest with the objective of establishing private commercial plantations, rather engaged in the illegal practice of allocating portions of the reserve lands to migrant settlers and farmers for financial reward. This explains the presence of abandoned and poorly managed mosaics of old Teak plantations; as well as the presence of illegal plantain and maize farms within the reserve. Therefore, the allocation of some of these lands to MFGL for plantation development will limit the presence of illegal migrant farmers on the reserve and bring back the degraded area into forest production. This will achieve the desired objective of the stool landowners and the Forestry Commission.

This impact is of local and regional extent, lasting throughout the duration of the operational phase**. The potential impact on illegal allocation of forest lands is of major significance.**

Carbon sequestration

Trees and forests are well known to be very efficient carbon storage systems. According to the UN Convention on Climate Change, fast growing tree plantation forests can store approximately 19-20 tons of carbon per hectare per year. With 4,428 hectares of plantations to be established, the MFGL plantations can potentially sequester about 88,560 tons of carbon per annum.

The scale of the impact is local and lasting throughout the operational phase of the project. **The degree of significance is therefore rated as Major.**

Inter-cropping by local farmers

MFGL has proposed to allow short-term inter-cropping with include onions, water melons, and peas. However, there shall be strict conditions for inter-cropping activities to ensure control of use of herbicides by farmers, choice of crops, preparation of soil beds to minimise soil erosion and run-off into water bodies. This arrangement will also encourage the exchange and sharing of inter-cropping information, provides income generation opportunities for local farmers and strengthen the working relationships between MFGL and local farmers for the duration of the operational phase and beyond.

The potential impact of intercropping by local farmers is of major environmental significance.

Improvement in Social Amenities

A major positive impact expected from the project is an improvement in facilities such as health care centres, schools, potable water supply, electricity and transportation (roads) for the communities within the project area. Such amenities and infrastructure will be provided by the project proponents as part of their corporate social responsibilities in close consultation with Ghana Government and for the effective management of the reforestation project

The potential impact from improvement in social amenities is of major environmental significance.

7.7.2 Negative Operational Phase Impact

Soil Erosion and Transport of Sediment into Water Bodies

Soil preparation activities such as ripping and ploughing tend to loosen the soil and make it more susceptible to erosion. Soil particles (topsoil) could be removed by run-off emanating from rains and the material transported down-slope and deposited in surface water bodies and lowlands. The deposited material ending up in the Drobon, Atonsu and Afram Rivers that drain the concession and could result in siltation and consequently facilitate the drying up of water in the channels, if left unchecked.

The potential impact from soil erosion and transport of sediment into water bodies is of moderate environmental significance.

Open Animal Grazing and Impacts on Tree Seedlings

The nomadic cattle herdsmen (popularly known as the Fulani) use the reserve as a grazing area for their cattle. The grazing of cattle in the reserve is a major source of local discontent as this has resulted in damage to crops of communities currently farming the reserves as well as its anticipated destruction to tree seedlings during planting of seedlings. Appropriate measures will need to be put in place to forestall such impacts.

The potential impact of animal grazing on tree seedlings is of major environmental significance

Impact of Agrochemical use on soil, water bodies and aquatic life

Agrochemical such as glyphosate used for weed control is administered by spraying and contains phosphorus which is beneficial to the soil. However, poor application and control of use may result in applying high concentrations of the chemical and in some cases accidental spillage. Some nutrients such as nitrates and phosphorus may be dissolved during rains and be transported through runoff into rivers and streams used for fishing by the small local communities in the project area. High nutrient content in the surface water bodies could facilitate eutrophication, thereby threatening the health and survival of aquatic life and fish species.

Insufficient or inappropriate use of agrochemicals and inorganic fertilizers may result in soil pollution and elevated levels of some soil nutrients. The continuous application of ammonium-based inorganic fertilizers may result in soil acidification and failure to correct changes in soil pH could affect the ability of soil to support life. Nutrient depletion may occur through continuous cropping of the land without adequate replenishment of soil nutrients. Impact is local and may be long lasting even after the project ends.

The potential impact agrochemical uses on soil, water bodies and aquatic life is of moderate environmental significance.

Sedimentation run off into water bodies

Land preparation activities such as ripping and ploughing will inevitably result in loosening of the topsoil and exposure of the soil surface to direct rainfall. The loose or exposed soil surface, especially on steep slopes, may be washed and deposited into the nearby Drobon, Atonsu and Afram Rivers as a result of surface runoff during rainfall. The transported materials from runoff may consist of soil particles, organic debris and chemical elements contained in the soil.

During the erosion process, soil particles (topsoil) are removed by run-off and transported down slopes and deposited in the lowlands, thereby creating rills and gullies. The deposited material ending up in streams and rivers may increase turbidity in the surface water bodies and raise the bed of the affected rivers. Plant or organic debris transported into the streams will decompose to add dissolved organic matter into the water bodies. Decomposition of vegetative materials in the rivers tends to reduce oxygen content for aquatic organisms through the process of eutrophication and ultimately undermine species survival. Appropriate measures will need to be put in place to forestall such impact.

The potential impact from surface run-off and material transport into water-bodies is of moderate environmental significance.

Impact on Soil (*Effects of soil compaction and erosion)*

Activities involved in thinning and maintenance of tree stands and harvesting will include the use of heavy haulage trucks, tractors and harvesters. The continuous use of these equipment could lead to soil compaction. Soil compaction may adversely affect soil porosity, reduce infiltration and increase in surface run-off and soil erosion. MFGL has

prepared Forest Logging Manual guidelines to guide harvesting and promote low impact harvesting methods, which will reduce soil compaction and erosion. This impact could last throughout the duration of operational phase and beyond.

The potential impact on soil is of minor environmental significance.

Occupational Health and safety Issues of Workers

The use and handling of equipment and implements during soil preparation and tree planting activities will require appropriate training, and provision of requisite PPEs workers as well as equipment operators will minimize the incident of injury and accidents in general.

Inappropriate control and use of agrochemicals can affect the health and safety of the workers via inhalation and/or direct contact with the body. To ensure proper control and use of such chemicals, there should be provision of protective clothing such as nose masks, boots, helmet and overalls for all staff likely to come into contact with agro-chemicals.

Improper washing or cleaning of used agrochemical containers could lead to harmful consequences where containers are reused as food or drink containers. The population groups at risk include women, children, elderly and local farmers who are mostly illiterate and principal users of empty containers without proper treatment. An increase in pesticide containers in the project area is expected during project implementation and proper collecting system and disposal is required to minimize reuse of containers for domestic activities.

The potential impact on occupational health and safety is of moderate environmental significance.

Landscape aesthetics

Harvesting and felling practices will have an effect in defining the characteristics of the reserve landscape by opening up certain compartments for harvesting. MFGL proposes to limit widespread harvesting of trees by adopting landscape planning, selective harvesting techniques and ensuring that the forest landscape is maintained as far as is practically possible. The impact is of local extent and temporary.

The potential impact on landscape aesthetics is of moderate environmental significance.

Noise Nuisance and Gaseous /Fumes Emissions

Noise and exhaust gases will be generated from equipment/ machinery used for land preparations. Local air quality deterioration concerns and noise nuisance may arise and workers/farmers will be mostly affected. Air quality and noise nuisance issues will be very local and temporary.

The potential impact from noise nuisance and gaseous /fumes emissions is of moderate environmental significance.

Damage to corridors used by fauna and Loss of flora

The reforestation project will result in the creation of desired habitats and corridors for fauna. However, there will be some harvesting of some of the trees to realise the economic value of the project. Harvesting and felling activities will require harvesting equipment like harvesters and chain saws. This activity will interrupt the corridors used by fauna occasionally and also result in some loss of flora from the forest floor.

The potential impact on corridors used by fauna and loss of flora is of moderate environmental significance.

Impact of Fuel/Oil Handling and Spillage on Soil

The storage, transport and use of lubricants and fuel should be well managed. Proper containment need to be provided around fuel storage facilities to prevent oil spills from contaminating the soil. The project will generate waste oil from servicing of mechanical equipment which should also be well taken care of. Fuel service points and mechanical workshops must be planned to ensure best practices and prevent oil spills. This impact will last for the entire project duration.

The potential impact of fuel/oil handling and spillage on soil is of moderate environmental significance.

Public / Traffic Safety Issues

The current low traffic regime in a typical rural setting will give way to frequent movements of various classes of vehicles and heavy duty equipment during harvesting and marketing of timber produce. Appropriate measures will have to be put in place to regulate the movement of both private and commercial vehicles/ trucks on site to safeguard public life and property.

The potential impact on public/ traffic safety is of moderate environmental significance.

Environmental/Social Threats

The likely environmental and social threats to the project which needs to be considered include Bushfires/wildfires, and, illegal logging activity/charcoal production, and open animal grazing.

Bush fires

Traditionally, farming land in the reserve is created by torching the vegetation. Human activities of bush/wild fires in the reserves usually caused by migrant farmers as well as cattle herdsmen attempting to clear grassland for farming and regeneration of new fodder for cattle respectively. This has resulted in severe degradation of the reserve. Bush fires become serious especially during the dry season from December to March and prior to the farming season in April and May, where it is mainly used as a land clearing means.

Uncontrolled bushfires may pose serious threat to the reserve, affecting biodiversity, and property

Illegal logging/charcoal production

Even though commercial logging activities does not seem to exist currently in the reserves, illegal logging activity in the reserves is a source of concern to the project. The consequences of such a development are dire and could have serious environmental and socio-economic consequences and these activities needs to be curtailed.

The potential impact from environmental/social threats is of moderate environmental significance.

Dust inhalation by workers and community health

Harvesting and felling activities are likely to generate dust from use of harvesting machinery within compartments and log transport machinery using logging roads. This is inevitable and the extent to which roads are properly constructed and compacted will influence the amount of dust generated. The dust may affect the health of workers and operators of forest machinery as well as nearby farmers. Apart from a community on the boundary, the distances (4-5km) from the project area to the other communities are such that there is no anticipated effect on any community.

The potential impact from dust inhalation by workers and on community health is of minor environmental significance.

8.0 PROPOSED MITIGATION MEASURES

Mitigation measures have been proposed in the ensuing paragraphs based on the analysis of the environmental consequences of the proposed reforestation Project. The measures have been provided in **Table 17.** These mitigation measures are expected to reduce all potentially significant effects of the preferred alternative to less than significant levels.

The general rules followed in designing these measures are:

a) Avoidance of major impacts: major impacts are impacts where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resources/receptors.
b) Reduction of major and moderate impacts: moderate impacts are impacts within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor, up to a level that might be just short of breaching an established (legal) limit.
c) Minor impacts occur where effects are experienced, but the impact magnitudes are sufficiently small and well within accepted standards, and/or the receptors are of low sensitivity/value.

8.1 Forms of Mitigation Measures

The mitigation measures adopted may be placed under three major forms which comprise:

- Preventive measures;
- Control measures; and
- Compensatory measures.

8.1.1 Preventive Measures

These are measures to be incorporated during pre-development phase and these include:

- Education programmes with farmers and local communities on fire prevention;
- Establishment of vegetative buffers around water bodies to prevent erosion; and
- Exclusion of areas identified as high environmental risks – e.g. high soil erosion;
- Phasing of development

8.1.2 Control Measures

These are measures to be adopted during development and operational phases. These mitigation measures are related to sustainable plantation development and environmental working practices and these include among others:

- Promotion of land/soil conservation practices;
- Maintenance of indigenous tree species;
- Application of integrated pest management methods; and
- Establishment of fire breaks to reduce impact of fires

8.1.3 Compensatory Measures

These measures will be adopted for impacts which will result in direct losses to neighbouring communities. These include:

- Intercropping schemes for farmers; and
- Community sensitization programs.

Table 17: Mitigation Measures Proposed for Anticipated Negative Impacts and Enhancement of Positive Impacts

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
Preparatory Stage				
Acquisition of farm lands and impact on livelihood of farmers	Land/forest compartments acquisition	Land owners and migrant land users/farmers	Major	▪ MFGL has proposed to allow short-term inter-cropping of certain crops alongside the planting of tree seedlings by local legitimate farmers. Affected farmers will have the option to participate in the scheme as farmers to improve their livelihoods. This will be under strict conditions for inter-cropping activities to ensure control of use of herbicides by farmers, choice of crops, preparation of soil beds to minimise soil erosion and run-off into water bodies ▪ Project affected farmers have been identified, and will be considered first in the intercropping scheme and/or employment by Miro before other interested persons for the reforestation project. ▪ All farmers will be allowed to harvest their crops before the commencement of work.
Occupational Health & Safety Issues	Soil testing and field investigations	Staff/experts	Local/ Moderate	▪ Staff and experts and contractors involved in land and field investigations will be made to follow the health and safety policy of Miro Forestry. The adoption of a health and safety policy at site during field investigations will serve as a precautionary measure to prevent/minimize the possibility of accidents and reduce health risks. ▪ Workers will also be provided with the necessary protective gadgets /PPEs and enforced. its use ▪ All ailments will be referred to the nearest health facility for treatment.
Social Conflict with local community/migrant settlers and farmers	Education and sensitization of local farmers/ communities	Local farmers/ Community and identifiable groups	Major	▪ Community sensitization programs will continue and will include among other things: o Holding of meetings at the community level to further explain the project and its socio-economic benefits to the people. o Facilitate the formation of a consultative group with selected representatives from the communities to meet periodically with Miro and plan for peaceful co-existence; and o Build capacity for Community relations work to ensure successful implementation of project. ▪ The program will help avoid unnecessary tension between misinformed communities and Miro and establish a better rapport between the parties. ▪ Sensitization and training to Local and migrant Farmers specifically, to acknowledge their illegal entry into the reserve for farming activities and the need to preserve the reserve through plantation development. Miro Forestry will make known to them their intent of allowing farming to co-exist alongside the establishment of plantations whilst observing the rules and regulations governing the reserve. Farmers will be well educated on modern farming practices including the

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				use of agrochemicals, land preparation and conservation techniques.
Constructional Stage				
Public/ Community Safety	Transportation of construction materials and equipment to the project site	Local communities /general public	Moderate	▪ Communities along the haulage route may suffer from elevated traffic, dust and noise levels during the transportation of construction materials and equipment. The following mitigation measures will be implemented to reduce these nuisance and health concerns: o Use of regularly serviced and well-maintained vehicles to prevent frequent breakdowns on the roads. o All temporary traffic controls will be done in consultation with the Department of Urban Roads (DUR) and the Police Motor Transport and Traffic Division (MTTD); o Adherence to traffic and road regulations including speed limits, warning signs, flags. mandatory speed limit of 50km/hr when moving through the human settlements; and Speed ramps would be provided at 50m intervals within human settlements; o A code of conduct for drivers on the road would be developed and implemented; o Community complaints handling arrangements would be instituted. o Additionally, alternative haulage routes will be considered where necessary. o Any accidents on the road involving trucks and humans or domestic animals would be investigated immediately and corrective actions taken to avert re-occurrence
Loss of vegetation and impact on terrestrial life/biodiversity (flora and fauna)	Land preparation (land clearing, Soil preparation, ripping, ploughing)	Terrestrial habitat Flora, and fauna	Moderate	▪ Significant ecological areas such as patches of remnant semi-deciduous forest vegetation and indigenous species, swamps, and riparian strips and habitats areas within the concession of the Chirmfa and Awura Forest reserves have been identified and mapped out to ensure the preservation of original plant and animal species within the project area. All Rare, Threatened Endangered ecosystems and habitats will be protected as part of the companies Conservation Management plans. ▪ The project will not carry out total mass clearance of vegetation in one phase. Phasing of development activities will allow some time for mobile fauna to seek refuge in adjacent and similar habitats or establish new ones nearby. ▪ Critical habitat such as the gallery forest along the banks of the river will be left undisturbed and further enhanced through tree planting. ▪ Patches of remnant forest and areas with indigenous species will be left undisturbed and protected. enrichment planting will be encouraged to restore and enhance such species ▪ Buffer zones and strips of vegetation will be created along riparian areas to reduce impact on habitat and threatened fauna/ wildlife as well as for the promotion of soil stability and climate

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				change adaptability ▪ There will be minimal cutting of trees unless it is very necessary. ▪ Miro will consult Forestry Services Department to plant and nurture trees at suitable locations.
Surface run-off and material transport into water-bodies	Land preparation/ road construction	Soil / Surface water bodies, aquatic flora /fauna	Moderate	▪ Clearing will be limited to the area required for the reforestation project to reduce exposure of bare soil to agents of erosion and deposits of debris in water systems; thus affecting aquatic life. ▪ Clearing will be by slashing and the cleared material (thrash) will be left on the surface to decompose and used as mulch or plough and then mixed into the soil to act as soil nutrient, so as not to leave the soil completely bare. ▪ The use of heavy machinery for clearing will be limited as much as possible. ▪ Miro Forestry will establish and maintain a vegetative buffer zone of 30 metres from the water bodies to reduce the risk of pollution of the water systems ▪ Culverts and drains will be constructed along access roads to check erosion and control any run-off. ▪ Seasonal streams will be identified during road planning stage. ▪ Access roads will be well compacted to minimise erosion.
Clearing of Illegal settler farms and impact on livelihoods	Land preparation (land clearing, Soil preparation, ripping, ploughing)	Migrant and settler farmers	Major	▪ MFGL will allow short-term inter-cropping of certain crops alongside the planting of tree seedlings by local legitimate farmers. Affected farmers will have the option to participate in the scheme as farmers to improve their livelihoods. ▪ MFGL will consider in future employment opportunities to farmers. Project affected farmers will be considered first in the intercropping scheme and any employment by MFGL before other interested persons for the reforestation project. ▪ Farmers will be allowed to harvest their crops before the commencement of work. ▪ MFGL will collaborate with landowners and stakeholders in educating illegal settlers and local farmers to desist from future encroachment of the reserve.
Air quality impact/noise nuisance	Transportation of construction materials Land clearing Road construction	Workers; Community	Minor	▪ MFGL will ensure that noise abatement devices such as earphones and earplugs are worn by all operatives who operate machinery. ▪ Work involving forest machinery will be intermittent and be restricted to day time to minimise noise nuisance, particularly in settlement located just on the Boundary of Miro's compartment. ▪ Reasonable speed limits and frequency of use of forest machinery will be ensured to minimize dust emissions. ▪ Burning of large biomass or cleared vegetation will not be encouraged as reasonably practical. ▪ Equipment will be serviced regularly to avoid excessive noise generation.

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
Occupational health and safety issues	Land clearing and preparations	Workers; Contractors	Moderate	Adoption of Health and Safety Policies ▪ All workers will be required to adopt MFGL's Health & Safety Policy to guide the construction phase activities. The adoption of the health and safety policy at site will serve as a precautionary measure to prevent/minimise the possibility of accidents and reduce health associated risks. ▪ A health and safety officer will be appointed to ensure compliance with the Health and Safety Policy. Provision and Use of Personal Protective Equipment (PPE) ▪ MFGL will provide and enforce the use of appropriate personal protective equipment (PPE) such as safety boots, reflective jackets, hand gloves, earplugs and nose masks. Sanctions will be implemented where workers do not use the PPEs provided. Use of Road Worthy Vehicles ▪ MFGL will regularly maintain and service its bulldozers, excavators and tractors to ensure they are in good condition. Good conditioned and well maintained equipment will reduce frequent breakdowns, noise nuisance and smoke emissions which could affect the operator's and other workers' health and safety. Use of Qualified Personnel ▪ MFGL will employ only qualified machine operators with requisite skills and experience to operate the machines. ▪ MFGL will carry out regular training on standard operational procedures and health & safety will be provided for machine operators. First Aid ▪ MFGL will provides first aid training for its workers and provide first aid kits at the project site during land preparation and construction activities to treat minor ailments. However, major cases will be referred to the nearest hospital or health post (Mampong Municipal Hospital)
Generation of biomass and fire risk	Land clearing (slashing)	Entire plantation/forest	Moderate	Biomass ▪ Salvaging of useable biomass will be encouraged to significantly reduce the volume of waste that has to be disposed of. ▪ Burning of large biomass or cleared vegetation will be avoided as reasonably practical. ▪ In the event burring is required, controlled burning according to well-designed protocols will be employed. ▪ MFGL will ensure workers are properly trained in slash burning protocols and observe favourable weather conditions for burning of slash and ensure proper disposal General waste ▪ MFGL will ensure the contractor(s) provide bins on site for collection and disposal of plastic waste

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				and polythene materials such as lubricant containers, drinking water sachets and carrier bags which will be regularly emptied at approved dump site.
Sanitation issues	General constructional phase activities	Local communities /workers	Moderate	▪ The Contractor will provide places of convenience at the site to discourage free-range defecation among workers. In addition, field workers will be encouraged to use places of convenience available at nearby communities. ▪ The project will collaborate with the Municipal/District Assemblies in the provision of additional toilet facilities in the affected communities to help prevent health threat. ▪ Waste bins will be provided at appropriate and convenient places to minimize littering of the site. Wash rooms and changing rooms will also be provided for construction workers.
Demographic and Population Change Impacts	Marketing	Local communities	Moderate	▪ The project will ensure close collaboration with the local police personnel and traditional authorities to minimise the incidence of crime in the project area and its immediate environs. ▪ Rigorous awareness-raising and campaigning against HIV/AIDS and other Sexually Transmitted Diseases (STIs) which is likely to go high as a result of the presence of migrant workers and increased income that tends to encourage liberal sexual behaviour. Workers will be encouraged during regular meetings to practice safe sex. ▪ MFGL will ensure the contractor(s), together with opinion leaders such as the Assembly member and traditional leaders, sensitise migrant workers on societal norms, taboos and other cultural practices in the area
Operational Stage				
Impact of agrochemical on soil and contamination of water bodies and aquatic life	Application of agrochemicals for weed control and fertilization	Soil, Terrestrial flora and fauna; Surface waters and groundwater Aquatic species	Moderate	▪ As practicable as possible, mechanical weed control will be adopted to minimize the use of weedicides, in accordance with the Forest Stewardship Council (FSC) Pesticides Policy (2005)) ▪ MFGL will ensure that only EPA approved agro-chemicals, from licensed agrochemical shops, will be purchased and used. All agrochemicals on the FSC list of 'highly hazardous' pesticides will be avoided. ▪ MFGL will control the application of weedicides and fertilizers by adhering to limits and recommended dosage in order avoid overspills and over concentrations. ▪ Miro Forestry will, preferentially, use selective pesticides with low environmental impact quotient (EIQ) where appropriate, rather than broad-spectrum products, to minimize impacts on non-target species ▪ Application of agrochemicals will follow an integrated pest management approach. ▪ Ensure workers and farmers for intercropping scheme are properly trained in the use and disposal

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				methods for chemicals. ▪ Avoid using weedicides in areas close to water bodies and avoiding using on steep slope areas near water bodies. ▪ Limit on the application of fertilizer to farmland that may subsequently leach/seep into underground water
Open Animal Grazing and Impacts on Tree Seedlings	Planting	Tree seedlings	Major	▪ Miro Forestry will pro-actively work with the FC and the national security task force to prevent animal grazing within the Forest Reserve. Forest guards are currently employed to assist with security by patrolling of the reserve.
Sedimentation run off into water bodies	Land /soil preparation (Ripping, Ploughing)),	Surface water bodies	Moderate	▪ Soil preparation on steep slopes close to water bodies will be avoided. ▪ MFGL will create vegetative buffers alongside water bodies to protect them from soil sedimentation. ▪ Regular visual inspections of water bodies will be conducted to ascertain any sedimentation of water bodies ▪ Riparian vegetation will be maintained to sieve off sediment from runoff from the plantation. ▪ Planting will be between contour bunds. ▪ Ploughing without harrowing will be encouraged. ▪ Planting of seedlings will be done on ridges across slope. ▪ Planting will be done in contour strips.
Occupational health and safety issues	Planting of tree seedlings and handling of agrochemicals;	Workers; farmers	Moderate.	▪ The Project will institute an occupational health and safety policy and strictly enforce its regulations. The adoption of a health and safety policy at site will serve as a precautionary measure to prevent/minimize the possibility of accidents and reduce health risks. ▪ MFGL will ensure machinery and equipment hired are in good condition and (right tool for right job) to prevent accidents and injury. ▪ Workers and farmers will be given adequate training on health and safety as well as on the job training and ensure adherence to health and safety procedures to minimize accidents. ▪ Workers will also be provided with the necessary protective gadgets /PPEs and their use will be enforced ▪ The project will provide, train and equip selected members of the workforce on first aid administration. ▪ MFGL will ensure that any pesticides used are applied according to the FSC Pesticides Policy (2005))

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				▪ MFGL will ensure all pesticides listed in WHO Hazard Class II (moderately hazardous), will be avoided unless appropriate controls established with respect to the manufacture, procurement, or distribution and/or use of these chemicals are in place. These chemicals would not be accessible to personnel without proper training, equipment, and facilities in which to handle, store, apply, and dispose of these products properly. ▪ MFGL will educate its workers and farmers on the safe use of agrochemicals and safe disposal of chemical containers. ▪ All agrochemicals on the FSC list of 'highly hazardous' pesticides will be avoided. ▪ MFGL will ensure that pesticides that fall under the World Health Organization's (WHO) Recommended Classification of Pesticides by Hazard Classes 1a (extremely hazardous) and 1b (highly hazardous), or Annexes A and B of the Stockholm Convention are not purchased, stored or used.
Alteration of landscape aesthetics	Harvesting and felling	workers	Moderate	▪ MFGL will avoid contiguous harvesting of large areas to minimise disruptions to landscape and ensure proper disposal and management of slash material.
Noise Pollution from forest machinery		Workers/farmers	Moderate.	▪ Ensure all workers use noise protective gear such as earplugs and headphones to minimise noise from harvesting machinery. ▪ Avoid prolonged operation of machinery.
Damage to corridors used by fauna and loss of flora		Flora and fauna	Moderate	▪ Miro Forestry has identified significant ecological areas within the concession of the Chirmfa and Awura Forest reserves. to ensure the preservation of original plant and animal species within the project area. ▪ MFGL has prepared a forest management plan which will be implemented to guide tree harvesting; ▪ MFGL will maintain a 15 m buffer along the streams to maintain riparian vegetation and lifeforms they support. ▪ Specimens of indigenous trees occurring naturally will be retained for regeneration purposes, and provide den and nesting sites, food sources, cover, and travel corridors for wildlife. ▪ Ensure directional felling by trained personnel to minimize canopy damage and distance to skid trails ▪ Ensure that large canopy holes are avoided by limiting proximity of trees to be harvested;
Impact of Fuel/Oil Handling and Spillage on	Project implementation	Soil/land, water	Moderate	▪ Waste oil and used lubricants will be collected by third party agents certified by appropriate authority (EPA) to collect and dispose of wastes (e.g. Oil Marketing Companies)

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
Soil				
Public health/ traffic safety issues	Harvesting and marketing	Local communities	Local Moderate	▪ Communities along the haulage route may suffer from elevated traffic, dust and noise levels during the harvesting. The following mitigation measures will be implemented to reduce these nuisance and health concerns: o Reckless tooting of horns would be an offence within the settlements; o Use of regularly serviced and well maintained vehicles to prevent frequent breakdowns on the roads. o Adherence to traffic and road regulations including speed limits, warning signs, flags. mandatory speed limit of 50km/hr when moving through the human settlements; and Speed ramps would be provided at 50m intervals within human settlements; o A code of conduct for drivers on the road would be developed and implemented; o Community complaints handling arrangements would be instituted. o Alternative haulage routes will be considered where necessary. o Any accidents on the road involving trucks and humans or domestic animals would be investigated immediately and corrective actions taken to avert re-occurrence
Environmental/social threats	Project implementation	Forest plantations	Major	<u>Buffer Zones/Fire Belts</u> ▪ Buffer zones/fire belts will be provided between and around planting units within the plantation to prevent possible threats resulting from bushfire from the surrounding communities/activities. A well-demarcated boundary of about 10-m width will be provided and also will serve as access routes within the plantation. ▪ Compartment roads, external boundary roads, and valley bottom cut-off roads will also serve as fire breaks. Slash /vegetation will also be well managed to reduce the risk of fire spread ▪ Some green belts will also be established which are extended further into other high-danger areas at strategic locations along the perimeter of the reserve. ▪ Fire response teams will be established and trained on site to detect emergency fire out breaks as well as to liaise with the Ghana National Fire Service to combat fire.
				<u>External Nomadic herdsmen</u> It is reliably informed that nomadic cattle herdsmen invade the forest and are sometimes the cause of wildfires. The project will liaise with the traditional authorities and the district security personnel (forest guards)to tackle the nomadic herdsmen menace.

Impact issue	Project Activity	Receptor(s)	Impact Magnitude	Mitigation Measures Proposed
				Illegal logging activities The Project will ▪ liaise with traditional authorities, District assemblies and the FC to discourage illegal logging in the reserve ▪ Interested illegal loggers may be encouraged to participate in the reforestation project as a more sustainable income generation/ livelihood venture

9.0 ENVIRONMENTAL MONITORING PLAN

Environmental monitoring is an essential component of a post project review phase following environmental assessment. The monitoring of various environmental parameters will also help to confirm any predicted impact or otherwise made during the environmental impact assessment study. It will provide management with relevant data and information to any problems that may arise with specific solutions.

The major monitoring activities to be undertaken will comprise:

- Aquatic biodiversity of surface waters;
- Surface water quality;
- Groundwater quality;
- Soil fertility and other properties in general;
- Soil erosion;
- Fire risk and management;
- Significant ecological areas;
- Invasive species;
- Occupational health and safety; and
- Road monitoring and maintenance.

9.1 Aquatic Biodiversity of key Surface Water Bodies

Eutrophication from fertilizer materials such as nitrates and organic material will have a direct effect on fish and other aquatic organisms. The surface waters (Drobon, Atonsu and Afram Rivers) are important to the local communities and ensuring sustained flow and aquatic life in the Rivers downstream are serious social and environmental concerns to Miro Forestry. Miro will ensure that a programme is instituted to closely monitor the rivers and this will include water quality, sedimentation and changes in aquatic taxa diversity.

9.1.1 Parameters to be monitored

Changes in the occurrence, diversity and community structure of the aquatic organisms are indicative of the changing quality of the water. On this basis, biological inventory of the following aquatic organisms namely, bacteria phytoplankton, invertebrates, macro-invertebrates and macrophytes in the water body will be undertaken to document their;

- Occurrence;
- Population density;
- Diversity;
- Habitat structure; and
- Identification.

Monitoring will be carried out every two years. It will be ensured that the monitoring sites coincide with that of the baseline.

9.2 Surface Water Quality

The physical, chemical and bacteriological quality parameters of the river waters would be monitored biannually to coincide with the dry and wet seasons of the year. The monitoring sites will cover the same locations as was done for the baseline study. T

9.2.1 Parameters to be monitored

The major physico-chemical parameters that require monitoring include:

- pH
- Turbidity
- Conductivity
- Colour
- Total Dissolved Solids
- Total Suspended Solids
- Alkalinity
- Chemical Oxygen Demand
- Biochemical Oxygen Demand
- Oil and Grease
- Phosphate
- Nitrate
- Pesticides
- Iron
- Chloride
- Fluoride
- Lead
- Sulphide
- Zinc

The bacteriological quality parameters to be monitored include:

- Total Coliforms; and
- Faecal Coliforms.

Miro Forestry will ensure that sampling results are compiled in a good reporting format to stakeholders like the Environmental Protection Agency (EPA) and the Water Resources Commission (WRC).

9.3 Groundwater Quality

The quality of local groundwater will be determined bi-annually. Major parameters to be determined will include:

- pH
- Turbidity
- Conductivity
- Colour
- Total Dissolved Solids
- Total Suspended Solids
- Alkalinity
- Chemical Oxygen Demand
- Biochemical Oxygen Demand
- Oil and Grease
- Phosphate
- Nitrate
- Pesticides
- Iron
- Chloride
- Fluoride
- Lead
- Sulphide
- Zinc
- Total Coliform
- Faecal Coliform

Miro Forestry will ensure that sampling results are compiled in a good reporting format to stakeholders like the Environmental Protection Agency (EPA) and the Water Resources Commission (WRC).

9.4 Soil Fertility and other Soil Properties

The soil may undergo changes resulting in the loss of nutrients of the top soils through erosion and leaching. A monitoring program will be developed to assess the changes in soil fertility and other soil properties. The sampling sites will be such that it is a good representation of the project area studied. The annual monitoring will be carried out from the second year after project development. The project will embark on soil nutrient improvement measures to promote better tree growth.

9.4.1 Parameters to be monitored

The parameters to be determined include:

- Gravel content;
- Moisture content;
- Sand, silt and clay content;
- Texture;
- pH;
- Organic carbon;
- Organic matter;
- Total nitrogen;

- Total and available phosphorus;
- Exchangeable bases like Ca, Mg, Na; K
- Exchangeable acidity; and
- ECEC.

9.5 Soil Erosion

Soil erosion and its associated risk will be assessed annually based on topography and slope; ground cover; exposed and bare soil; evidence of sheet, gully, and/or rill erosion; siltation and drying up of water channels, and exposed plant roots.

This will be by direct field observation to find out traces of such erosion. Miro Forestry Ghana limited will occasionally engage the services of a Soil Scientist to undertake this assignment. Erosion control measures will be designed out to check erosion.

9.6 Monitoring of Significant Ecological Areas, Flora and Fauna

Monitoring of biodiversity in significant ecological areas will be done by local experts or in-house monitoring team and will be done in compliance with the Conservation Management prescriptions. On an annual basis MFGL will report on any change in fauna species identified over the year, and will report after the 5- year biodiversity studies on changes in flora composition.

9.7 Fire Risk Monitoring and Management

Miro Forestry Ghana Limited will develop and implement an effective fire risk monitoring system to reduce any fire incidence on the plantation. The preparation of a formal fire management and response plan, supported by the necessary resources and training will be designed out. This will include the training of workers in the use of fire suppression equipment and evacuation. Procedures may include coordination activities with the Forestry Commission and local authorities. Training programmes will be conducted for farmers/workers on fire prevention and control.

Fire prevention strategies to be employed will include ensuring fire belts/breaks 10m wide are created around planting units within the plantation and also serve as access routes within the plantation. It will be ensured that compartment roads, external boundary roads, crest roads, secondary roads and valley bottom cut-off roads which also serve as fire breaks, and vegetation management (weed control) is done to reduce the risk of fire spread. Some green belts will be established and extended further into other high-danger areas at strategic locations along the perimeter of the reserve. Records will be kept on all fire occurrences and investigations conducted at all operational areas.

9.8 Occupational Health and Safety and Air quality and Noise Level Monitoring

The health of project workers and the rate of accidents/ fatality will be recorded and analyzed with regard to the type, frequency of and the likely source of accident/injury/diseases and dangerous occurrences.

The monitoring of the health of workers and accident rate will confirm how effective workers adhere to safety and health policy and procedures use personal protective gears and equipment made available to them.

The air quality and noise levels will be monitored in the project area as part of the occupational health and safety parameters to be monitored.

9.9 Invasive species

MFGL will closely monitor the quality and source of its approved seedlings to ensure that only approved non-invasive Teak and Eucalyptus seedlings are used on the project; as invasive species are expensive to control and eliminate

9.10 Road Monitoring and Mmaintenance

All foresters and contractors working on plantation will monitor road conditions and drainage. Roads will be mowed annually where necessary, especially before the dry seasons. The fire risk assessment determines the road mowing priority and phasing. A practical monitoring and corrective action procedure for road maintenance is in place to ensure that negative impacts from roads are managed as soon as practically possible.

9.11 Monitoring Budget

Detailed cost analysis from prospective consultants and experts to be engaged as part of the monitoring program will be needed to confirm cost requirements. However, provisional budget to carry out the proposed monitoring program has been provided in **Table 18.**

Table 18: Environmental Monitoring Budget

No	Environmental Component	Monitoring Site	Monitoring Parameters	Frequency	Responsibility	Cost/Year (GH¢)
1	Aquatic Biodiversity study	Upstream and downstream of Drobon, Atonso and Afram Rivers	Biological inventory of bacteria phytoplankton, invertebrates, macro-invertebrates and macrophytes	Every two years	Aquatic Biodiversity Expert	10,000
2	Surface water quality	Upstream and downstream of surface waters (Drobon, Atonso and Afram,Nankonoma Rivers)	pH, Turbidity Conductivity, Colour, Total Dissolved Solids, Total Suspended Solids, Alkalinity Chemical Oxygen Demand, Biochemical Oxygen Demand; Oil/Grease; Phosphate; Nitrate; Iron; Chloride; Fluoride; Lead; Sulphide; Zinc Coliforms; Pesticides	Bi-annually	Environmental Consultant	24,000
3	Groundwater quality	Boreholes within the affected communities	pH, Turbidity Conductivity, Colour, Total Dissolved Solids, Total Suspended Solids, Alkalinity Chemical Oxygen Demand, Biochemical Oxygen Demand; Oil and Grease; Phosphate; Nitrate; Iron; Chloride; Fluoride; Lead; Sulphide; Zinc Coliforms; Pesticides	Bi-annually	Environmental Consultant	24,000
4	Soil fertility and other properties	Within the plantation development site	Gravel content, sand, silt and clay content, texture, pH, organic carbon, total nitrogen, total and available phosphorus, exchangeable bases like Ca, Mg, Na, exchangeable acidity and ECEC.	Annually	Soil Expert	15,000

5	Air Quality and Noise Assessment	In the communities	TSP, PM_{10}, Noise	Bi-annually	Air Quality Expert	16,000
6	Conservation Areas/ Flora and Fauna	Significant ecological and conservation areas within the Project sites	Biodiversity- flora and fauna	Annually	Biodiversity expert	20,000
7	Road facilities	Project sites	Accessibility/ motorability	Annually	Road contractor	(Part of project cost)
8	**Total**					**109,000**

10.0 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

10.1.1 Background and Outline of EMP

A provisional Environmental Management Plan (EMP) is developed for the project in line with the Environmental Assessment Regulations of 1999, LI 1652 to ensure that the operations of the proposed reforestation project are carried out in an environmentally safe and sound manner. The provisional EMP provides an environmental budget and training programs to be implemented for staff responsible for the operation and maintenance of the project and its associated works.

The actual EMP will be prepared eighteen (18) months after project implementation. The proposed content for the actual EMP will have the following main headings:

- Executive Summary
- Introduction
  - Background;
  - Environmental Legal Framework;
  - Company Profile;
  - Management Goals.
- Policy on Environment, Health and Safety
  - Environmental Policy; and
  - Occupational Health and Safety Policy
- Potential Impact, Identification and Assessment
  - Description of Plantation Activities, and Products;
  - Potential Releases into Environmental Media (Air, Water and Land);
  - Pollution Indicators Requiring Control; and
  - Potential Hazards in the Working Environment
- Current Environmental Management Practices
  - Material Handling and Storage;
  - Water Use and Management;
  - Agro-chemical Use and Management;
  - Soil Conservation Practices;
  - Slash management;
  - Soil erosion management practices
  - Post -Harvest Handling of timber products;
  - Forest Fire Protection and Biodiversity Conservation;
  - Management of small holder farmers intercropping scheme;
  - Energy Management; and
  - Transport Management
- Environmental Action Plan
- Occupational Health and Safety Action Plan
- Program to meet Requirements
  - Organizational Structure and Responsibilities;
  - Staff training and Awareness Creation; and
  - Engagement of Consultants.

- Implementation Program
  - Implementation Schedules;
  - Environmental Monitoring;
  - Environmental Budget; and
  - Environmental Audit and Reviews.

10.2 Program to ensure that Environmental Actions and Issues are Implemented

The programs proposed to ensure that the mitigation measures as well as the monitoring programs are implemented include:

- Corporate Commitment and Environmental and Health/Safety Policies;
- Establishment of an Environmental, Health and Safety Committee;
- Appointment of an Environmental Officer and Engagement of Environmental Consultants;
- Staff Information and Training;
- Environmental Monitoring Programs;
- Emergency Preparedness and Response Planning;
- Field Visits and Inspections;
- Digital Management system;
- Stakeholder Engagement;
- Community Liaison and Grievance Management/Conflict Resolution
- Environmental Audit and Reviews; and
- Public Participation.

10.2.1 Corporate Commitment and Environmental, Social and Health/Safety Policies

Miro Forestry has developed environmental, social and health/safety policies that affect its behaviour with respect to its environmental, social and health and safety responsibilities for its Ghana operations. The relevant corporate policies, which includes the following are provided in **Annex 6:**

- Occupational health and safety and labour policy
- Environmental and sustainability policy
- Community engagement and external stakeholder policy
- Land development policy
- Anti-corruption and whistleblowing policy
- Public relations, communications and media policy

Miro Forestry is committed to conducting the Chirimfa and Awura Reforestation Project in a manner that is transparent and in accordance with Ghanaian rules and regulations and the Company's own internal standards and policies. Miro Forestry commits to demonstrate leadership in safety, stewardship of the environment and social responsibility. The company is committed to responsible corporate citizenship in a way that builds on the foundation of trust that is integral to the success of the business.

10.2.2 Environmental Health and Safety Committee

Miro Forestry (Ghana Limited) has an existing Environmental, Health and Safety committee comprising staff at all levels (managers, supervisors and junior staff) that formulate policies and draw up programs to manage the environment from its various activities. To assure the commitment and support of management, the General Manager is the head of the committee. The functions of the committee among other things include:

- Responsibility for implementing the environmental policies of Miro Forestry (Ghana) Limited;
- Work closely with all staff and supervisors to co-ordinate all activities with bearing on the environment and occupational health and safety of workers;
- Process and manage environmental and health data that are generated with time to ensure easy appreciation and understanding by workers, the public and stakeholders;
- Liaise with and attend to complaints from the communities on all such matters of environmental concern arising from the operations of the reforestation project;
- Consult with Management to decide on the role of consultants/experts in assisting with the environmental management activities; and
- Implementing the environmental permit conditions and mitigation, monitoring and management measures in the ESIA

10.2.3 Environmental Officer

Miro Forestry Ghana has already recruited an Environmental Officer who ensures the implementation of all environmental actions. The functions of the Environmental Officer among other things include:

- Liaising with the General Manager who is head of the Environmental, Health and Safety (EHS) Committee to follow up on the implementation of environmental actions;
- Working closely with the General Manager and other staff and supervisors to ensure as far as reasonable practical, environmental protection, safe and healthy conditions and safe acts at all workplaces;
- Contributing to new projects or additional works to ensure that environmental and safety concerns are included in the planning stage;
- Liaising with the EHS committee to organise periodic meetings on environmental and safety awareness for all groups of workers;
- Liaise with the EHS committee to affirm which environmental concerns or reporting could be handled in-house and which ones will require external assistance;
- Daily recordings on Health and Safety information and reporting to the General Manager;
- Keeping and analyzing records of relevant environmental and safety data and processing them for stakeholder consumption as appropriate; and
- Maintaining a site environmental and safety incident and complaints log book.

10.2.4 Engagement of Environmental Consultants

As part of the measures to implement the plan, Miro Forestry may engage the services of qualified Environmental Consultants on retainer-ship basis to work closely with the General Manager as well as other personnel. The consultants will among others:

- Regularly train and create awareness on all aspects of environmental and safety issues for all units;
- Carry out periodic environmental monitoring as required under the permit conditions; and
- Undertake regular environmental management audits and reporting.

10.2.5 Staff Information and Training

The Project management will make available all operational manuals needed by personnel and organize on the job training programs for personnel where necessary on proper handling and application of pesticides, fertilizers and use of equipment; training in the use of fire suppression equipment and evacuation procedures. Also training in pest identification will be carried out.

Management is aware that a well-informed and trained personnel will contribute greatly towards environmental management through the judicious use of resources and the prevention of accidents that might damage equipment, personnel and the environment.

The objective of the environmental management plan will only be achieved if every worker is adequately informed on the impacts or effects of the activities or operations of the plantation development on the environment. Workers/ staff will be educated on the environmental/social impacts of the project through staff durbars, scheduled meetings, and workshops. Miro will ensure that contractors and consultants to be engaged or engaged on the various project activities are educated and well sensitized on environmental issues arising from its operations and activities.

10.2.6 Environmental Monitoring Programmes

Monitoring programs developed as part of this EIA for relevant parameters, which serve as indicators of pollution on environmental media like water, air land and biodiversity will be implemented. The EPA will also monitor the environmental impacts of the project to ensure that the Agency's environmental guidelines and permit conditions are followed.

10.2.7 Emergency Preparedness and Response Planning

An emergency response plan will be put in place to combat emergency situations such as risk of fire, flooding, accidents, and agrochemical spills.

10.2.8 Field Visits and Inspections

The Environmental Officer, Community Liaison Officer and Forest managers undertake periodic field visits to verify conformance to specifications. The General

Manager also carry out regular field visits to ensure conformance to Silviculture specifications and environmental objectives.

10.2.9 Digital Management system and Documentation

MFGL is currently developing a digital management system, stored on Dropbox, to enable the organisation manage all documents through an online system. Document control will be based on the online version, which will serve as the current applicable version. This system covers the following:

- Storing of information and document control;
- Information transfer and training;
- Corrective and preventative action;
- Operational Auditing and Compliance Monitoring; and
- Monitoring and Reporting.

Records on all environmental, worker health/safety issues including accident, fire and waste data at site will be kept.

10.2.10 Stakeholder Engagement

Miro Forestry is committed to engaging with stakeholders to ensure that the project takes into account the views and concerns of stakeholders. The existing stakeholder engagement plan for the Buomfuom project will be expanded to cover additional stakeholders under the Chirimfa and Awura projects. The stakeholder engagement plan includes:

- Stakeholder identification & mapping (interests, roles, etc.)
- Stakeholder contact register;
- Regular meetings/engagements
- Recording/reporting arrangements

Senior managers and Directors from the parent Company (Miro Forestry Developments Limited) periodically visit the Ghana operations to monitor progress; as well as meet with institutional stakeholders to identify and confirm urgent issues that need to be addressed. MFGL also work closely with the local community leadership in attending to environmental/social issues emanating from the affected communities/farmers and the need for effective conversation.

10.2.11 Community Liaison and Grievance Management/Conflict Resolution

A Community Liaison Officer is permanently employed to liaise directly with local communities regarding any concerns the communities may have and to manage community projects on behalf of the Company.

The Company's grievance mechanism provides employees and stakeholders with a mechanism to express grievances without fear of reprisal and ensure concerns are appropriately addressed in a timely manner. The grievance mechanism offers a set of approaches whereby the project affected person/complainant and the Company can find effective solutions together. The grievance redress process includes:

- Receive/ Accept Grievance;

- Acknowledge/Assess/Record;
- Investigate;
- Determine Resolution;
- Complaint Satisfied? (closed/pending); and
- Documentation management.

Notice boards have been erected in the communities surrounding the plantation operations, as well as the provision of suggestion box that is checked monthly. The Community Liaison Officer is responsible for hosting workshops on the grievance mechanism. A notice is published in all communities stating how to contact the Company and how the grievance will be dealt with.

10.2.12 Environmental Audit and Reviews

The monitoring program will form the basis for effective annual environmental auditing and reviews of all aspects of the project implementation. The Company will engage consultants occasionally to undertake safety/health/environmental/social audits of its operations in order to ensure compliance with required standards and recommend modifications to programme schedules, where necessary.

The audits and reviews will underpin the periodic update of the Environmental Management Plan (EMP) of the plantation development of the Awura and Chirimfa forest reserve project, (i.e. every three years as required by the EPA).

10.2.13 Public Participation

The doors of Miro Forestry are always opened to the general public for complaints, suggestions and advice on environmental related issues during project implementation through the Project Managers' Office, Environmental as well as the Community Liaison Officers.

10.3 Cost Estimate for Environmental Management

The environmental plans enumerated above require detailed cost analysis after project development to determine the budget needed for its implementation. Initial estimates for the environmental management program is **Two Hundred and Sixty-Nine Thousand Ghana Cedis (GH₵269,000)** as shown in **Table 19.**

Table 19: Cost Estimate for Environmental Management

No.	Program	Cost/year (GH₵)
1.	Environmental monitoring (*see Table 19 for details*)	109,000.00
2.	Implementation of mitigation measures/actions	(Part of project cost)
3.	Environmental, Health and Safety Training Programmes	20,000.00
4.	Occupational health and safety • Provision of PPE • Provision of fire-fighting/suppression equipment	20,000.00

5.	Environmental consultancy services	20,000.00
6.	Grievance redress and conflict resolutions	15,000.00
7.	Emergency Preparedness and Response Plan	10,000.00
8.	Environmental Auditing and Reporting • Annual environmental, health and safety audits • Quarterly returns of Monitoring Reports to EPA (in line with LI 1652) • Preparation of Annual Environmental Reports (in line with LI 1652) • Preparation of Environmental and Social Management Plan (in line with LI 1652)	60,000.00
9.	Management and Stakeholder Meetings	15,000.00
10.	**Total**	**269,000.00**

11.0 DECOMISSIONING PLAN

The land lease agreement from the Forestry Commission and traditional authorities (Mampong and Nsuta Traditional Councils) expires after 50 years. Any decommissioning activity will depend largely on the economic life span of the reforestation project. It is expected that the project will be successfully implemented culminating in the area being transformed into a sustainable forestry project with local community involvement.

In this regard, decommissioning may be an unlikely option. However, a decommissioning plan will have to be fashioned out should it become necessary at any point in time.

11.1 Basis for the Proposed Decommissioning Plan

In keeping with environmental regulations of the country including the Environmental Assessment Regulations 1999, LI 1652, a decommissioning or project closure plan will be discussed with the relevant regulatory authorities especially the Forestry Commission and the EPA if it becomes necessary that the project be abandoned or suspended or brought to a closure.

11.2 Objectives of the Proposed Decommissioning/Closure Plan

The decommissioning/closure plan will seek to achieve the following objectives:

- Ensure that the plantation development activities in the forest reserve and its immediate surroundings are left in safe conditions; and
- Rehabilitate and replant disturbed areas with indigenous tree species to acceptable standards.

11.3 Facilities/ Equipment and Forest Reserves

The Company will dispose of or remove all movable properties, equipment and machinery and temporary structures from the site. These properties will either be sent to new project sites or auctioned off to interested individuals or organisations.

Permanent or immovable buildings and structures which are currently outside the forest reserves will be left undamaged. These immovable structures will be handed over to the government – the relevant district assembly. However, there will be removal and disposal of all scrap metals and waste in general. Miro Forestry will hand over the forest reserve sites/plantations back to the Forestry Commission.

11.4 Financial Proposal for Decommissioning

Detailed analyses of costs will be carried out during the preparation of the actual decommission or closure plan to confirm the actual cost of the various activities involved

12.0 CONCLUSION

Miro Forestry Ghana Limited is fully aware of its responsibility to sound environmental management practices, and also the need to operate in accordance with the Environmental Protection Agency Act 1994, Act 1994 and Environmental Assessment Regulations 1999, LI 1652. In accordance with these laws, the major potential environmental and socio-economic issues and impacts associated with the proposed reforestation Project have been identified and duly assessed.

Mitigation and monitoring measures for the identified impacts have been proposed for implementation in order to minimise any potential adverse impacts to the bio-physical and human environment. The monitoring program will confirm the effectiveness of the proposed mitigation measures.

The benefits to be derived from the project are immense. The implementation of the proposed project will improve the socio-economic life of the people in and around the Mampong Municipal and Sekyere Central District, particularly the local communities. There will be employment opportunities for people who hitherto had insufficient source of income. The degraded forest cover will be restored and will generate revenue to the Forestry Commission, district assemblies, and traditional authorities/landowners.

The stakeholder consultations show that the stakeholders are in full support of the Project and are committed to help ensure that the project is implemented to the benefit of the people of the area, and the country as a whole.

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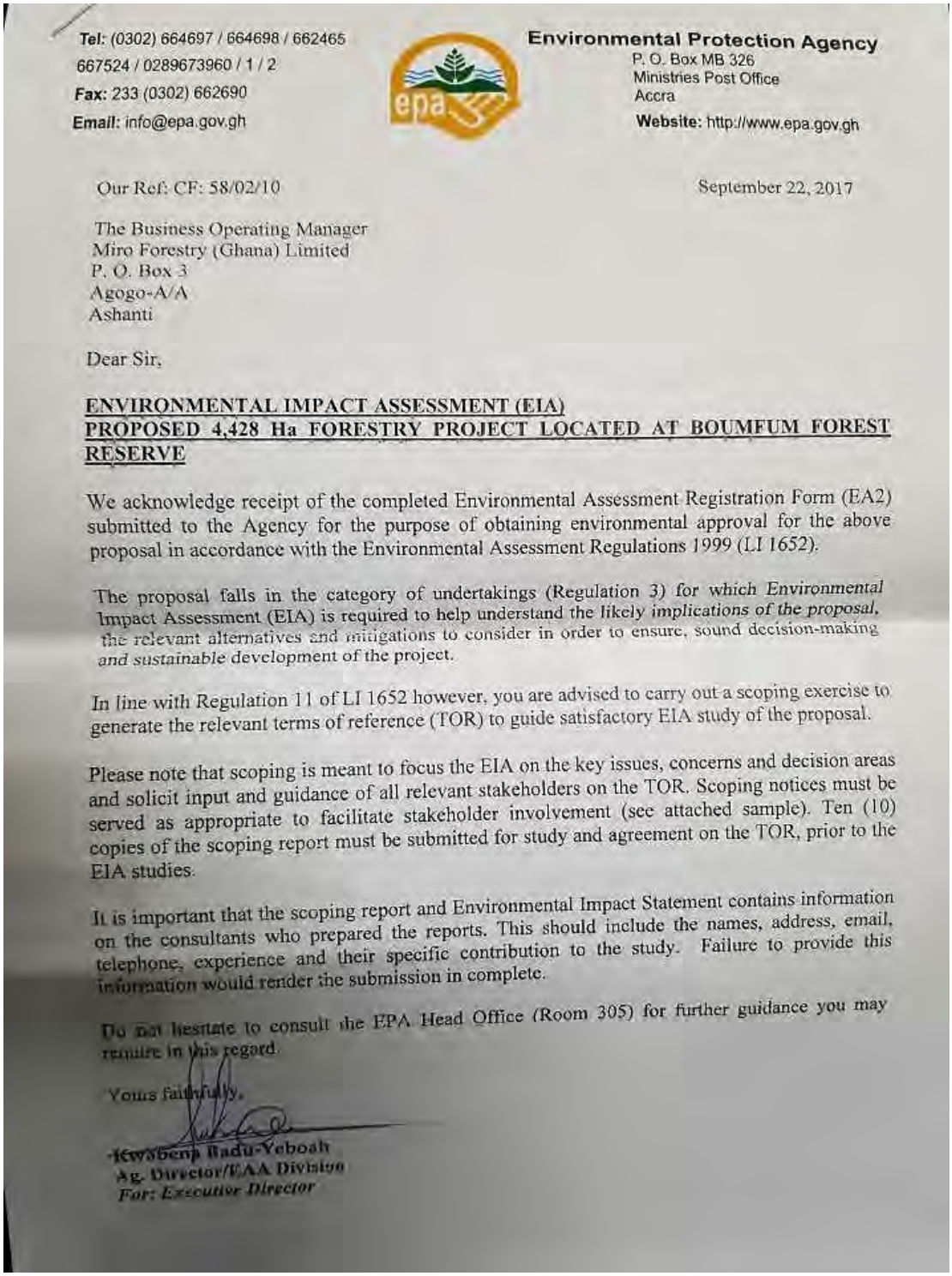
http://algaebase.org.

ANNEXES

Annex 1: EPA Response Letter on Project Registration



Tel: (0302) 664697 / 664698 / 662465
667524 / 0289673960 / 1 / 2
Fax: 233 (0302) 662690
Email: info@epa.gov.gh

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra
Website: http://www.epa.gov.gh

Our Ref: CF: 58/02/10

September 22, 2017

The Business Operating Manager
Miro Forestry (Ghana) Limited
P. O. Box 3
Agogo-A/A
Ashanti

Dear Sir,

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
PROPOSED 4,428 Ha FORESTRY PROJECT LOCATED AT BOUMFUM FOREST RESERVE

We acknowledge receipt of the completed Environmental Assessment Registration Form (EA2) submitted to the Agency for the purpose of obtaining environmental approval for the above proposal in accordance with the Environmental Assessment Regulations 1999 (LI 1652).

The proposal falls in the category of undertakings (Regulation 3) for which Environmental Impact Assessment (EIA) is required to help understand the likely implications of the proposal, the relevant alternatives and mitigations to consider in order to ensure, sound decision-making and sustainable development of the project.

In line with Regulation 11 of LI 1652 however, you are advised to carry out a scoping exercise to generate the relevant terms of reference (TOR) to guide satisfactory EIA study of the proposal.

Please note that scoping is meant to focus the EIA on the key issues, concerns and decision areas and solicit input and guidance of all relevant stakeholders on the TOR. Scoping notices must be served as appropriate to facilitate stakeholder involvement (see attached sample). Ten (10) copies of the scoping report must be submitted for study and agreement on the TOR, prior to the EIA studies.

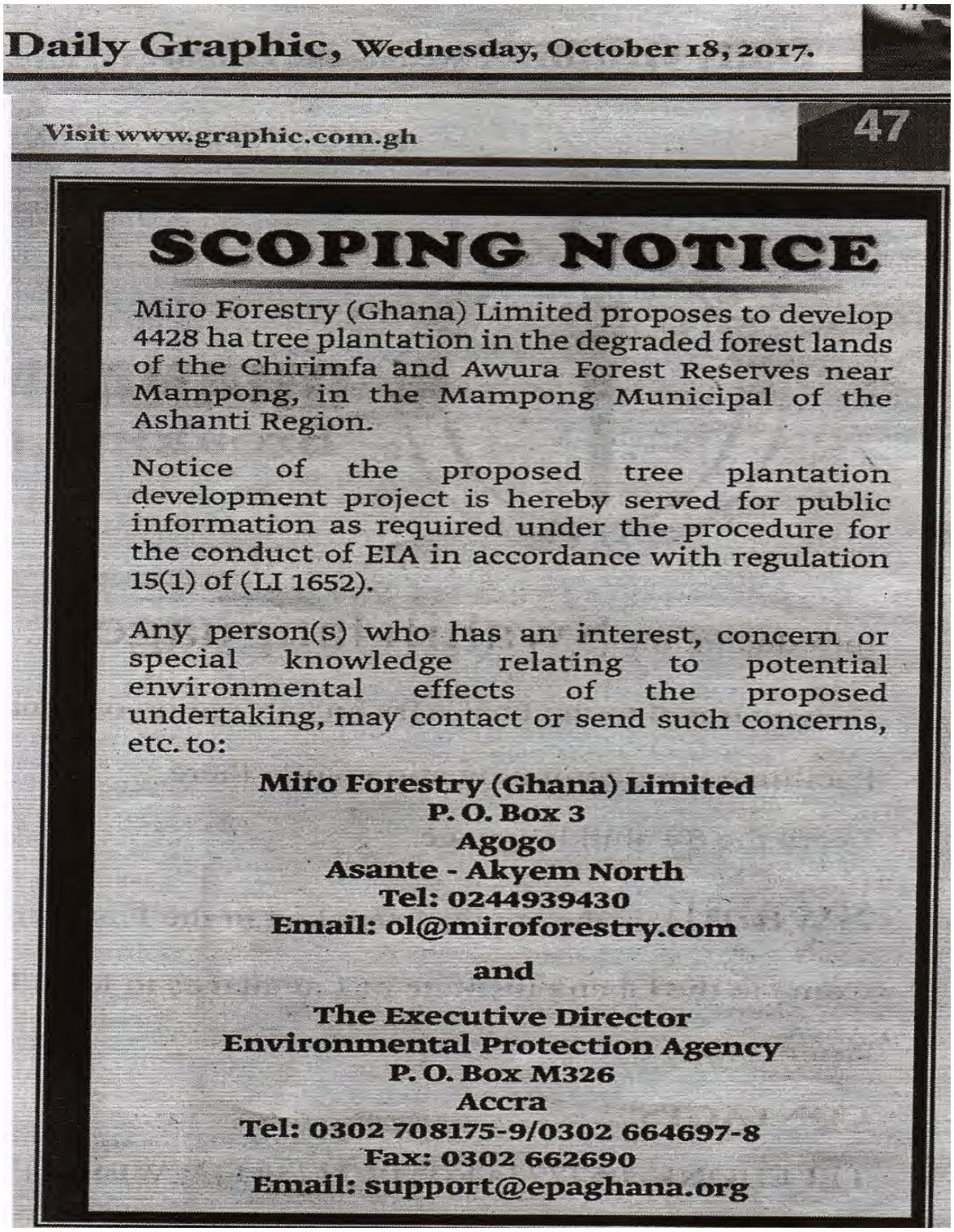
It is important that the scoping report and Environmental Impact Statement contains information on the consultants who prepared the reports. This should include the names, address, email, telephone, experience and their specific contribution to the study. Failure to provide this information would render the submission in complete.

Do not hesitate to consult the EPA Head Office (Room 305) for further guidance you may require in this regard.

Yours faithfully,

Kwabena Badu-Yeboah
Ag. Director/EAA Division
For: Executive Director

Annex 2a: Copy of the Scoping Notice Published



Daily Graphic, Wednesday, October 18, 2017.

Visit www.graphic.com.gh 47

SCOPING NOTICE

Miro Forestry (Ghana) Limited proposes to develop 4428 ha tree plantation in the degraded forest lands of the Chirimfa and Awura Forest Reserves near Mampong, in the Mampong Municipal of the Ashanti Region.

Notice of the proposed tree plantation development project is hereby served for public information as required under the procedure for the conduct of EIA in accordance with regulation 15(1) of (LI 1652).

Any person(s) who has an interest, concern or special knowledge relating to potential environmental effects of the proposed undertaking, may contact or send such concerns, etc. to:

Miro Forestry (Ghana) Limited
P. O. Box 3
Agogo
Asante - Akyem North
Tel: 0244939430
Email: ol@miroforestry.com

and

The Executive Director
Environmental Protection Agency
P. O. Box M326
Accra
Tel: 0302 708175-9/0302 664697-8
Fax: 0302 662690
Email: support@epaghana.org

Annex 2b: EPA Response on Scoping Report

Tel: (0302) 664697 / 664698 / 662465
667524 / 0289673960 / 1 / 2
Fax: 233 (0302) 662690
Email: info@epa.gov.gh

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra
Website: http://www.epa.gov.gh

Our Ref: CF 58/02/23

15th January, 2018

THE GENERAL MANAGER
MIRO-FORESTRY (GHANA) LIMITED
P.O.BOX 3
AGOGO

Dear Sir,

ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED FORESTRY PROJECT-CHIRIMA& AWURA FOREST RESERVES (SEKYERE CENTRAL DISTRICT &MAMPONG MUNICIPAL

We refer to your scoping report submitted for the purpose of obtaining environmental approval for the above-mentioned project in accordance with the Environmental Assessment Regulations, 1999 L.I 1652),

The report has been duly reviewed. The Terms of reference did not include key issues to be addressed in the EIA. These are attached for your consideration.

You may proceed to conduct the Environmental Impact Assessment (EIA) focusing on the key issues and submit six (6) copies to the EPA Head Office.

In line with the Fees and Charges (Amendment) Instrument, 2015 (L.I 2228),you are requested to pay a processing fee of ***Three thousand five hundred and twenty Ghana Cedis.(GH₵3,520.00).***Payment should be made at any ***Ecobank Limited*** and payable to the Environmental Protection Agency.

Please find enclosed an invoice for your attention.

Yours faithfully,

JEWEL KUDJAWU
CHIEF PROGRAMMES OFFICER/NATURAL RESOURCES
FOR: EXECUTIVE DIRECTOR

Cc: *The Regional Director, EPA Ashanti Region, Kumasi*
The Director, Environmental Assessment and Audit, Head Office, Accra
The Director, Field Operations, Southern Sector, Head Office, Accra

Attached:

MIRO-FORESTRY (GHANA) LIMITED (SCOPING REPORT) PROPOSED FORESTRY PROJECT-CHIRIMA& AWURA FOREST RESERVES (SEKYERE CENTRAL DISTRICT &MAMPONG MUNICIPAL)

GENERAL COMMENTS:

The following inadequacies not provided in the TORs should be taken into account in the EIA.

- Quality of water bodies traversing concession
- Admitted farms and how these are to be addressed
- Status of species to be cultivated and their long-term impacts on biodiversity
- Fire protection.
- Open animal grazing and impacts on tree saplings
- Pubic consultations

SPECIFIC COMMENTS:

The following should be captured in the EIS

i. Existing Baseline data on Aquatic life.

ii. Consultation with surrounding communities.

iii. The report should state the actual sate of degradation of the reserve.

iv. Page 28,Section 2.1 (The Need for the Project),Paragraph 6: An assertion was made earlier that all occupants of the degraded forest are illegal hence there will be no compensation or voluntary settle, however this paragraph indicates a benefit sharing of 10% standing tree value to landowners. Who are these landowners? Reconcile.

v. Page 30, Page Figure 1: A location map should be provided in relation to the communities

vi. Page 31, Figure 2, District map showing location of Chirimfa and Awura Forest Reserve: The district map shows some distance between the two proposed project sites. The actual distance should be given.

vii. Page 48, Section 3.6.1(Land Use): Parts of the reserve are being used by some locals for agricultural farming and settlements. Are these in your given concession and what would be the implication for the project?

viii. Page 33, Section 2.6 (Likely Species to be selected): Only two species have been mentioned, Eucalyptus was repeated.

ix. Page 61, Table 9 (Potential adverse impacts and issues during preparatory phase): Lease acquisition and impacts on farmers, communities which might lose their livelihood should be considered.

x. Page 61. Table 10 (Potential adverse impacts and issues during the construction phase): at what stage would the processing plant be installed? Impact of the processing plant should be considered at this stage if it is part of the project concept.

Annex 3: Evidence of Consultations with Stakeholders

SAL Engagement with Forestry Commission

Summary of key persons contacted

Stakeholder/ Institution/ Location	Contact Person/Role	Contact Number	Date of Consultations
Project implementers			
Miro Forestry	**Yaw Ofori Lartey** **Managing Director**	**0244939430**	**26/09/2017**
Government Regulatory Agency			
Forestry Commission **-Mampong Forest Service Division**	**Donkor Tweneboah** **(Manager)**	**0244467020**	**28/09/2017**

Evidence of Engagement with Local Communities by Miro Forestry

SOCIO ECONOMIC SURVEY AND LIVELIHOOD STUDY REPORT
COMMUNITY CONSULTATION MEETING
10TH OCTOBER, 2017

BACKGROUND

Miro Forestry Company is a profit driven, commercial plantation timber business. The Company's objective is to be a leading low-cost producer and supplier of sustainable timber operating to high management, social and environmental standards.

INTRODUCTION

Prior to the start of socio economic survey, in other words the livelihood study of Communities located around both Chiremfa and Awura forest reserves, we held consultative meetings with the Community members living in the areas aforementioned. Mention can be made of Bunuso near the Awura Forest Reserve, Esreso and Asuonwunu Communities near Chiremfa Forest Reserve

.

Chief of Bunuso with Staff

Miro staff at the meeting

Community members

COMMUNICATION OBJECTIVE

- To make Community members understand that Forestry Commission of Ghana has allocated a number of compartments in both Awura and Cherimfa forest reserves to Miro Forestry Ghana Limited.
- To let the Community members, understand that Miro Forestry will soon commence work in its allocated compartments in both reserves.
- To let Community members, appreciate the fact that Miro Forestry is socially responsible company and would operate to high management, social and environmental standards.

KEY MESSAGE

- Forestry Commission (F C) of Ghana has allocated a number of compartments in both Awura and Chiremfa forest reserves to Miro Forestry Ghana Limited for commercial plantation.
- Forestry Commission has accordingly informed the Company that all those working in the reserves illegally have been issued notice of warning to vacate the reserves.
- Miro forestry has also visited the compartments allocated in its name to observe the terrain and has identified a number of farms and other illegal activities in there.
- Miro Forestry Ghana Limited has met the leadership of the various Communities to declare its intention for their support to operate in the reserves so mentioned.
- In this regard, Miro forestry is informing all community members especially farmers in Awura and Chiremfa forest reserves that very soon work will begin in its allocated compartments.
- Miro Forestry has given farmers doing minor season farming in its allocated compartments up to the end of 2017 year to harvest their crops and vacate their respective areas.
- In January 2018 land preparation and planting of various tree species will commence.
- If one's farm land is within our compartments and happens to be taken over, he or she would be considered for employment.
- Miro Forestry will also allow intercropping where affected farmers would be given the opportunity to plant crops such as groundnut, beans and pepper in the inter –rows of our young trees.
- In the event of any complaint or grievance emanating from our operations, our grievance mechanism procedure (GMP) is in place to address every concern or grievance.

Bunuso Community Meeting

Esereso Community Meeting

Asuonwunu Community

ISSUES AND RESPONSES

ISSUE/QUESTION	COMMENTATOR	RESPONSE
Our community is surrounded by the forest therefore we are pleading with the Government to provide land for toilet facility.	KwadwoYeboah 	Mr. Yeboah, we thank you for the issue raised, however we are from a private institution therefore your issue can be channeled through the leadership of the community to the District Assembly for consideration.
As it stands now we do not know who falls within your concession and where it covers. How can we know?	John Bosco 	Mr. Bosco, the boundary line will be demarcated any time soon for everybody to see where we cover
A certain Company came here to use us to plant their trees but did not pay us. Are you sure you are not going to do same if you employ some of us?	KwakuAtu 	Kwaku, Miro Forestry is a responsible Company and cannot behave the way the other company did. Check from our workers in Asante AkimAgogo
All foreigners coming here are all targeting the forest and that is where we also depend for our survival. If all the forest land is taken over by them, how are we going to survive?	Abdulai Mummed 	Mr. Abdulai, as a matter of fact one cannot work in the forest reserve without permit from the Forestry Commission. So if you have a lease from them, your portion cannot be taken away.
What plans are there for those who will be affected by your operations?	IssahKwabena 	Issah, as I mentioned in my submission, all affected farmers would be considered for employment if they wish and also allow to intercrop with our trees.
Can't your Company exclude the areas where the farmers are working and move to other	Lambon Isaac	Isaac, thanks for your suggestion, however, we have to work within the areas allocated to us. By moving

areas to work there?		away to other areas, it means we are going out of our allocated compartments.
When is your boundary demarcation going to take place since some of us start land preparation early?	Lambon Isaac	Lambon, it will take place very soon even before the start of next farming season
What are you going to do about the Fulanis because the cattle are destroying our crops?	SeiduMahama 	Mahama, the Fulani issue is of national concern now. It has become a national security issue so we only have to manage them
Please, we here are law abiding people so when you are coming, come with peace	IssahKwabena 	Miro is a very peaceful Company and would not do anything to harm the Community. As I mentioned earlier, we have our grievance system in place to address every issue that emanates
We will be glad if your Company help deal with the Fulani issues	Charles Taylor 	Charles, I have said that the Fulani issue is of national security so let us leave it to the government to deal with it
You mentioned that if a farmer is affected by your operations, he or she will be considered for intercropping. How is the farmer going to get water to irrigate his farm since you are not going to allow people farm in your conservation areas?	Mohammed Ibrahim 	Ibrahim, to us working in a conservation area is highly illegal. However, you can still do the intercropping as it is being done elsewhere.
Is the Company going to pay compensation to farmers who will be affected by your activities?	EliasuGenge	Eliasu, please NO. As I explained to you earlier, Forestry Commission has informed the Company that

		all those working in the reserves are there illegally therefore if you are affected by our activities, you will receive no compensation from us.
Can you show us where you have been given the concession so that if my farm land is there, I look for a place somewhere to farm next year?	Maxwell Tawiah 	We deal with compartment names so if I mention the compartments you will not be able to know that is why I said the boundary line will be demarcated very soon so that you can see clearly where you fall into.
Please, I suggest you allow us to continue farming on our lands and you provide us with your seedlings to plant and take care for you.	NantwumBiiba 	Your suggestion is very good however you cannot do it to suit our planting plan and the maintenance of the trees
How big is the area given to you by the Forestry Commission?	KwadwoDaweh 	Currently, about eleven (11) compartments have been given out to us and there are plans to secure additional fifteen (15) or more to expand our project

CONCLUSION

The Communities were extensively consulted and engaged on Miro plans to begin work in the said forest reserves (Chiremfa &Awura). We had the support from the Community Chiefs and the residents also cooperated with us. The Community Chiefs have assured the Company of their unflinching support to carry out its operations in a very peaceful environment.

Minutes Prepared by Ntim-Adjei Opoku

(Community & Social Affairs)

ENGAGEMENT WITH MFRAMABUOM COMMUNITY NEAR CHIRIMFA FOREST RESERVE

MARCH 21, 2017

INTRODUCTION

AS part of activities marking our land preparation and planting processes, Environment, Social and Health Safety department would have to carry out Environmental and Social risks assessments survey to have an idea of the terrain and a number of settlements sitting right in the reserve allocated to the Company and that of adjourning Communities and also assess farms with crops in the compartments. By moving through the compartments 80, 81, 82, 84, 85, 86, 88 and 89, we could not identify any settlement but we noticed an adjourning Community by name Mframabuom which shares boundary with Chirimfa reserve but on Kwaman stool land.

OBJECTIVE

- To let Community members and farmers understand that Forestry Commission has leased eight compartments in the Chirimfa forest reserve to Miro Forestry Company to plant trees of different species.
-

KEY MESSAGE

Forestry Commission of Republic of Ghana has leased about eight (8) compartments to Miro Forestry (Ghana) Limited to establish tree plantation of different species and the Compartments involved are 80, 81, 82,84, 85, 86, 88, 89). As a result of this, Mampong District Forest Service Division have agreed to demarcate the said compartments to us and very soon work will begin in those compartments. We are pleading with every famer whose farm (s) is or are located in the Chirimfa forest reserve in the compartments aforementioned to put a stop to it or them because any further development might result into crop destruction by the company and the famer concerned would incur some debt.

However, after land preparation and planting, if anyone is interested with our intercropping mitigation measures, he or she can approach us for a piece of land to do intercropping. Crops allowed to intercrop with our trees are groundnut and cowpea (beans). If per our operations, you lose your farm, you can also be considered for employment if only you are interested.



ISSUES AND RESPONSES

ISSUES/COMMENTS	COMMENTATOR	RESPONSES
Please, some of us have already planted so what do we do?	Seidu Sambo	We shall discuss this with management and whatever comes out of it would be communicated to you as to whether

		you would be given some grace period or not
If someone comes later to tell us that the areas you are talking about belong to him, what do we tell him or her?	Kwadwo Owusu	Direct the person to contact us on 0209982288
Please, how do we know that we are farming in your compartments as we do not know the compartments names?	N-Langan Emmanuel	The boundary lines are being demarcated as we speak so by Friday you will get to know whether you are in or out.
Can you give us a letter or document to proof that you have taken over the land and that nobody should go there to farm?	Kofi Iddrisu	Kofi, for a proof of our ownership, please you can contact Mampong District Forest Service Division,
How / what is your total land size so we know whether we are in or out?	Kofi Duffour	As explained already, we have about eight compartments and currently the boundary lines are being demarcated as soon as we are done with it, everybody would know the land size.

RECOMMENDATION

From the interview conducted during the Social risk assessment, it was clear that the farmers were not aware of Miro coming to work on the compartments mentioned above so I therefore suggest that those who have prepared the land and planted their crops be given some grace period to harvest them whiles we map out their planted areas for future planting. This would go a long way to build a better relationship with them. The impact would be very great if we deny them the opportunity.

CONCLUSION

The meeting was well attended by the residents and about forty-seven (47) Community members were found to be present and thirty-one (31) of them have their farms located in the compartments.

Community members know the place does not belong to them and are aware of possible ejection by the Forestry Commission any time. They have also agreed to allow Miro to start its operations in the compartments allocated but pleaded for some grace period to be able to harvest their farm produce.

Minutes prepared by Ntim-Adjei

Annex 4a: Floristic Composition of the Project Site

List of species identified along the transect

TRANSECT NO.	TREE NO.	SCIENTIFIC NAME	FAMILY	LIFE FORM	FREQUENCY	CONSERVATION STATUS (Star Rating)
1	1	*Lippia chevalieri* (L.)	Verbenaceae	Shrub	1	NE
1	2	*Combretum glutinosum* (Perr. ex DC)	Combretaceae	Tree	5	NE
1	3	*Crossopteryx febrifuga* (Afzel. ex G. Don) Benth.	Rubiaceae	Tree	5	NE
1	4	*Terminalia avicennioides*(Guill.& Perr.)	Combretaceae	Tree	4	NE
1	5	*Manotes kerstingii* (Gilg)	Dipterocarpaceae	Shrub	1	NE
1	6	*Daniellia oliveri* (Rolfe) Hutch.& Dalz	Caesalpiniaceae	Tree	24	NE
1	7	*Flueggea virosa* (Roxb.ex willd.) Voigt	Euphorbiaceae	Shrub	2	NE
1	8	*Hymenocardia acida* (Tul)	Hymenocardiaceae	Tree	28	NE
1	9	*Annona senegalensis* (Pers.)	Annonaceae	Shrub	4	NE
1	10	*Burkea africana* (Hook.f.)	Caesalpiniaceae	Tree	6	NE
1	11	*Pterocarpus erinaceus* (Poir)	Papilionaceae	Tree	14	P
1	12	*Lophira lanceolata* (Van Tiegh. Ex keay)	Ochnaceae	Tree	5	NE
1	13	*Grewia villosa* (Willd.)	Tiliaceae	Shrub	9	NE
1	14	*Strychnos spinosa* (Lam.)	Loganiaceae	Tree	2	NE
1	15	*Trichilia emetica* (Vahl.)	Meliaceae	Tree	13	NE
1	16	*Ficus sur* (Forssk.)	Moraceae	Tree	7	GN
1	17	*Pericopsis laxiflora* (Benth.) Van Meeuwen	Papilionaceae	Tree	35	NE
1	18	*Combretum nigricans* (Lepr. Ex Guill & Perr)	Combretaceae	Tree	3	NE

1	19	*Combretum fragrans* (F. Hoffm.)	Combretaceae	Tree	2	NE
1	20	*Lannea velutina* (A. Rich)	Anacardiaceae	Tree	3	NE
1	21	*Gmelina arborea* (Roxb)	Verbenaceae	Shrub	4	NE
1	22	*Ficus sycomorus* (Miq). C. C. Berg	Moraceae	Tree	3	NE
1	23	*Bridelia ferruginea* (Benth)	Euphorbiaceae	Tree	4	NE
1	24	*Vitex doniana* (Sweet)	Verbenaceae	Tree	5	NE
1	25	*Lannea microcarpa* (Engl. & K. Krause)	Anacardiaceae	Tree	4	NE
1	26	*Tectona grandis* (L.f.)	Verbenaceae	Tree	274	NE
1	27	*Albizia adianthifolia* (Schumach.) W.F.Wight	Mimosaceae	Tree	2	GN
1	28	*Khaya senealensis* (Ders.) A.Juss.	Meliaceae	Tree	7	NE
1	29	*Anogeissus leiocarpus* (DC.) Guill. & Perr.	Combretaceae	Tree	9	GN
1	30	*Borassus aethiopum* (Mart.)	Palmae	Tree	1	NE
1	31	*Holarrhena floribunda* ((G.Don) T.Durand & Schinz.	Apocynaceae	Tree	4	GN
1	32	*Uvaria chamae* (P. Beauv.)	Annonaceae	Shrub	2	BU
1	33	*Markhamia tomentosa* (Benth.) K. Schum. ex Engl.	Bignoniaceae	Tree	2	GN
1	34	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	2	GN
1	35	*Cnestis ferruginea* (Vahl ex DC.)	Connaraceae	Climber	2	GN
1	36	*Saba senegalensis* (A. DC.) Pichon	Apocynaceae	Climber	1	NE
1	37	*Cola cordifolia* (Cav.) R.Br	Malvaceae	Tree	2	NE
1	38	*Malacantha alnifolia* (Bak.) Pierre	Sapotaceae	Tree	2	GN
2	39	*Terminalia macroptera* (Guill. & Perr.)	Combretaceae	Tree	2	NE
2	40	*Morinda lucida* (Benth.)	Rubiaceae	Tree	3	GN
2	41	*Holarrhena floribunda* ((G.Don) T.Durand & Schinz.	Apocynaceae	Tree	10	GN

2	42	*Albizia zygia* (DC.) J.F.Macbr.	Mimosaceae	Tree	30	GN
2	43	*Anogeissus leiocarpus* (DC.) Guill. & Perr.	Combretaceae	Tree	3	GN
2	44	*Afzelia africana* (Sm.)	Caesalpiniaceae	Tree	1	R
2	45	*Malacantha alnifolia* (Bak.) Pierre	Sapotaceae	Tree	11	GN
2	46	*Millettia zeciana* M. barteri (Benth.) Dunn	Papilionaceae	Tree	24	GN
2	47	*Terminalia avicennioides* (Guill.& Perr.)	Combretaceae	Tree	1	NE
2	48	*Daniellia oliveri* (Rolfe) Hutch.& Dalz	Caesalpiniaceae	Tree	1	NE
2	49	*Bridelia ferruginea* (Benth)	Euphorbiaceae	Tree	3	NE
2	50	*Trichilia emetica* (Vahl.)	Meliaceae	Tree	6	NE
2	51	*Markhamia tomentosa* (Benth.) K. Schum. ex Engl.	Bignoniaceae	Tree	6	GN
2	52	*Lannea microcarpa* (Engl. & K. Krause)	Anacardiaceae	Tree	2	NE
2	53	*Lonchocarpus sericeus* (Poiret) Kunth	Papilionaceae	Tree	1	GN
2	54	*Gmelina arborea* (Roxb)	Verbenaceae	Tree	15	NE
2	55	*Pterocarpus erinaceus* (Poir)	Papilionaceae	Tree	5	NE
2	56	*Lannea velutina* (A. Rich)	Anacardiaceae	Tree	2	NE
2	57	*Khaya senealensis* (Ders.) A.Juss.	Meliaceae	Tree	1	R
2	58	*Allophylus africanus* (P.Beauv. f.)	Sapindaceae	Tree	1	NE
2	59	*Deinbollia grandifolia* (Hook.f.)	Sapindaceae	Tree	1	GN
2	60	*Parkia biglobosa* (Jacq.) R. Br. ex G. Don	Mimosaceae	Tree	1	NE
2	61	*Albizia adianthifolia* (Schumach.) W.F.Wight	Mimosaceae	Tree	3	GN
2	62	*Margaritaria discoidea* ((Baill.) Webster)	Euphorbiaceae	Tree	1	GN

2	63	*Vitex doniana* (Sweet)	Verbenaceae	Tree	3	NE
2	64	*Dialium guineense* (Willd.)	Caesalpiniaceae	Tree	2	GN
2	65	*Berlina grandiflora* (Vahl) Hutch. & Dalz.	Caesalpiniaceae	Tree	3	NE
2	66	*Voacanga africana* (Stapf)	Apocynaceae	Tree	1	GN
2	67	*Alchornea cordifolia* (Schumach. & Thonn.) Müll.Arg.	Euphorbiaceae	Shrub	1	GN
2	68	*Trema orientalis* (L.) Blume	Ulmaceae	Tree	1	GN
2	69	*Antiaris toxicaria* (Rumph. ex Pers.) Leschen. ssp.	Moraceae	Tree	1	P
2	70	*Sterculia tragacantha* (Lindl.)	Malvaceae	Tree	3	GN
2	71	*Spathodea campanulata* (P.Beauv.)	Bignoniaceae	Tree	3	GN
2	72	*Elaeis guineensis* (Jacq.)	Palmae	Tree	3	P
2	73	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	1	GN
2	74	*Ficus exasperata* (Vahl)	Moraceae	Tree	2	GN
2	75	*Ceiba pentandra* (L.) Gaertn.	Malvaceae	Tree	1	GN
2	76	*Margaritaria discoidea* ((Baill.) Webster)	Euphorbiaceae	Tree	1	GN
2	77	*Khaya senealensis* (Ders.) A.Juss.	Meliaceae	Tree	1	R
3	78	*Gmelina arborea* (Roxb)	Verbenaceae	Tree	21	NE
3	79	*Ficus sycomorus* (Miq). C. C. Berg	Moraceae	Tree	8	NE
3	80	*Spathodea campanulata* (P.Beauv.)	Bignoniaceae	Tree	5	GN
3	81	*Albizia adianthifolia* (Schumach.) W.F.Wight	Mimosaceae	Tree	3	GN
3	82	*Sterculia tragacantha* (Lindl.)	Malvaceae	Tree	2	GN
3	83	*Ceiba pentandra* (L.) Gaertn.	Malvaceae	Tree	27	GN
3	84	*Albizia zygia* (DC.) J.F.Macbr.	Mimosaceae	Tree	1	GN
3	85	*Bombax buonopozense* (P.Beauv.)	Malvaceae	Tree	1	GN

3	86	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	12	GN
3	87	*Khaya grandifoliola* (C.DC.)	Meliaceae	Tree	32	R
3	88	*Spondias mombin* (L.)	Anacardiaceae	Tree	7	GN
3	89	*Cola gigantea* (A.Chev. var.)	Malvaceae	Tree	5	GN
3	90	*Holarrhena floribunda* ((G.Don) T.Durand & Schinz.	Apocynaceae	Tree	10	GN
3	91	*Afzelia africana* (Sm.)	Caesalpiniaceae	Tree	1	R
3	92	*Baphia pubescens* (Hook.f.)	Papilionaceae	Tree	10	GN
3	93	*Albizia ferruginea* (Guill. & Perr.) Benth.	Mimosaceae	Tree	2	S
3	94	*Blighia sapida* (Konig)	Sapindaceae	Tree	1	GN
3	95	*Vitex doniana* (Sweet)	Verbenaceae	Tree	1	NE
3	96	*Cola caricifolia* (G.Don) K.Schum.	Malvaceae	Tree	1	GN
3	97	*Antiaris toxicaria* (Rumph. ex Pers.) Leschen. ssp.	Moraceae	Tree	1	P
3	98	*Rauvolfia vomitoria* (Afzel.)	Apocynaceae	Tree	1	GN
3	99	*Dialium guineense* (Willd.)	Caesalpiniaceae	Tree	3	GN
3	100	*Anthocleista procera* (Lepr. ex Bureau)	Gentianaceae	Tree	1	NE
3	101	*Elaeis guineensis* (Jacq.)	Palmae	Tree	3	P
3	102	*Blighia unijugata* (Baker var.)	Sapindaceae	Tree	1	GN
3	103	*Christiana africana* (DC.)	Malvaceae	Tree	10	GN
3	104	*Alchornea cordifolia* (Schumach. & Thonn.) Müll.Arg.	Euphorbiaceae	Tree	5	GN
3	105	*Diospyros monbuttensis* (Gürke)	Ebenaceae	Tree	1	GN
3	106	*Lonchocarpus sericeus* (Poiret) Kunth	Papilionaceae	Tree	3	GN
3	107	*Ficus vogeliana* (Miq.)	Moraceae	Tree	1	GN
3	108	*Alstonia boonei* (De Wild.)	Apocynaceae	Tree	1	GN

3	109	*Morinda lucida* (Benth.)	Rubiaceae	Tree	2	GN
3	110	*Lannea microcarpa* (Engl. & K. Krause)	Anacardiaceae	Tree	1	NE
3	111	*Terminalia avicennioides* (Guill.& Perr.)	Combretaceae	Tree	1	NE
3	112	*Sarcocephalus latifolius* (Smith) Bruce	Rubiaceae	Tree	1	NE
3	113	*Anogeissus leiocarpus* (DC.) Guill. & Perr.	Combretaceae	Tree	2	GN
3	114	*Aidia genipiflora* (DC.) Dandy	Rubiaceae	Tree	1	GN
3	115	*Triplochiton scleroxylon* (K.Schum.)	Malvaceae	Tree	1	S
3	116	*Mitragyna inermis* (Willd.) Kuntze	Rubiaceae	Tree	1	NE
3	117	*Pterocarpus erinaceus* (Poir)	Papilionaceae	Tree	1	P
4	118	*Gmelina arborea* (Roxb)	Verbenaceae	Tree	185	NE
4	119	*Lonchocarpus sericeus* (Poiret) Kunth	Papilionaceae	Tree	5	GN
4	120	*Anthocleista procera* (Lepr. ex Bureau)	Gentianaceae	Tree	2	NE
4	121	*Ficus sur* (Forssk.)	Moraceae	Tree	5	GN
4	122	*Sarcocephalus latifolius* (Smith) Bruce	Rubiaceae	Tree	5	NE
4	123	*Holarrhena floribunda* ((G.Don) T.Durand & Schinz.	Apocynaceae	Tree	1	GN
4	124	*Sterculia tragacantha* (Lindl.)	Malvaceae	Tree	2	GN
4	125	*Flueggea virosa* (Roxb.ex willd.) Voigt	Euphorbiaceae	Shrub	4	NE
4	126	*Spathodea campanulata* (P.Beauv.)	Bignoniaceae	Tree	8	GN
4	127	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	1	GN
4	128	*Baphia pubescens* (Hook.f.)	Papilionaceae	Tree	4	GN

4	129	*Albizia adianthifolia* (Schumach.) W.F.Wight	Mimosaceae	Tree	3	GN
4	130	*Ficus sycomorus* (Miq). C. C. Berg	Moraceae	Tree	4	NE
4	131	*Anogeissus leiocarpus* (DC.) Guill. & Perr.	Combretaceae	Tree	3	GN
4	132	*Pterocarpus erinaceus* (Poir)	Papilionaceae	Tree	1	P
4	133	*Tectona grandis* (L.f.)	Verbenaceae	Tree	60	NE
4	134	*Grewia villosa* (Willd.)	Tiliaceae	Shrub	1	NE
4	135	*Albizia zygia* (DC.) J.F.Macbr.	Mimosaceae	Tree	1	GN
4	136	*Cnestis longiflora* (Lam.)	Connaraceae	Climber	1	NE
4	137	*Acacia nilotica* (L.) Willd. ex Del.	Mimosaceae	Tree	2	GN
4	138	*Piliostigma thonningii* (Schumach.) Milne-Redh.	Caesalpiniaceae	Tree	1	NE
4	139	*Vitex doniana* (Sweet)	Verbenaceae	Tree	1	NE
4	140	*Malacantha alnifolia* (Bak.) Pierre	Sapotaceae	Tree	1	GN
4	141	*Daniellia oliveri* (Rolfe) Hutch.& Dalz	Caesalpiniaceae	Tree	1	NE
4	142	*Ekebergia senegalensis* (A. Juss.)	Meliaceae	Tree	1	BU

List of species in 20m X 20m plot

TRANSECT NO.	QUADRAT NO.	TREE NO.	SCIENTIFIC NAME	FAMILY	LIFE FORM	CONSERVATION STATUS
1	1	1	*Panicum laxum* (Sw)	Poaceae	Grass	NE
1	1	2	*Boerhavia erecta* (L)	Nyctaginaceae	Herb	NE
1	1	3	*Tridax procumbens* (Linn)	Asteraceae	Herb	NE
1	1	4	*Cassia mimosoides* (Linn)	Caelsapiniaceae	Shrub	NE
1	1	5	*Lippia chevalieri* (Moldenke)	Verbenaceae	Shrub	NE
1	1	6	*Spigelia anthelmia* (Linn)	Loganiaceae	Herb	NE

1	1	7	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
1	1	8	*Sporobolus pyramidalis* (P. Beauv.)	Poaceae	Grass	NE
1	1	9	*Pennisetum violaceum* (Lam.) L. Rich.	Poaceae	Grass	NE
1	2	10	*Sida corymbosa* (R. E. Fries)	Malvaceae	Shrub	NE
1	2	11	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
1	2	12	*Lippia chevalieri* (Moldenke)	Verbenaceae	Shrub	NE
1	2	13	*Euphorbia heterophylla* (Linn)	Euphorbiaceae	Herb	NE
1	2	14	*Aframomum standfieldii* (Hepper)	Zingiberaceae	Herb	BU
1	2	15	*Sporobolus pyramidalis* (P. Beauv.)	Poaceae	Grass	NE
1	2	16	*Amaranthus spinosus* (Linn)	Amarantaceae	Herb	NE
1	2	17	*Icacina trichantha* (Oliv.)	Icacinaceae	Shrub	NE
1	3	18	*Mallotus oppositifolius* (Geisel), Mull. Arg.)	Euphorbiaceae	Shrub	GN
1	3	19	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	GN
1	3	20	*Clerodendron streptocaulon* (Hutch & Dalz)	Verbenaceae	Shrub	GN
1	3	21	*Triclisia patens* (Oliv.)	Menispermaceae	Climber	GN
1	3	22	*Baphia pubescens* (Hook.f.)	Papilionaceae	Tree	GN
1	3	23	*Ochna schweinfurthiana* (F. Hoffm)	Ochnaceae	Shrub	NE
1	3	24	*Malacatha alnifolia* (Bak.) Pierre	Sapotaceae	Tree	GN
1	4	25	*Baphia pubescens* (Hook.f.)	Papilionaceae	Tree	GN
1	4	26	*Mallotus oppositifolius* (Geisel), Mull. Arg.)	Euphorbiaceae	Shrub	GN

1	4	27	*Flueggea virosa* (Roxb.ex willd.) Voigt	Euphorbiaceae	Shrub	NE
1	4	28	*Leptoderris micrantha* (Dunn)	papilionaceae	Climber	GD
1	4	29	*Malacatha alnifolia* (Bak.) Pierre	Sapotaceae	Tree	GN
1	4	30	*Rhus natalensis* (Bernh. ex Krauss)	Anacardiaceae	Shrub	NE
1	4	31	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
1	4	32	*Triclisia patens* (Oliv.)	Menispermaceae	Climber	GN
1	4	33	*Rottboellia cochinchibensis* (Lour.) Clayton	Poaceae	Grass	NE
1	4	34	*Paullinia pinnata* (L.)	Sapindaceae	Climber	GN
1	4	35	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	GN
1	4	36	*Dialium guineense* (Willd.)	Caelsapiniaceae	Tree	GN
1	5	37	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
2	1	38	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
2	1	39	*Leptoderris micrantha* (Dunn)	Papilionaceae	Climber	GD
2	1	40	*Holarrhena floribunda* (G.Don) T.Durand & Schinz.	Apocynaceae	Tree	GN
2	1	41	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
2	1	42	*Clappertonia ficifolia* (Willd) Dence.	Tiliaceae	Shrub	NE
2	1	43	*Clerodendron streptocaulon* (Hutch & Dalz)	Verbenaceae	Shrub	GN
2	1	44	*Erigeron floribundus* (H. B. & K.) Sch. Bip.	Asteraceae	Herb	NE
2	1	45	*Deinbollia grandifolia* (Hook.f.)	Sapindaceae	Tree	GN

2	2	46	*Clerodendron streptocaulon* (Hutch & Dalz)	Verbenaceae	Shrub	GN
2	2	47	*Rottboellia cochinchibensis* (Lour.) Clayton	Poaceae	Grass	NE
2	2	48	*Smilax kraussianu* (Meisn)	Smilacaceae	Climber	GN
2	2	49	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
2	2	50	*Flueggea virosa* (Roxb.ex willd.) Voigt	Euphorbiaceae	Shrub	NE
2	2	51	*Mezoneuron benthamianum* (Baill.)	Caelsapiniaceae	Climber	GN
2	3	52	*Aspillia africana* (Pers.) C. D. Adams	Asteraceae	Herb	NE
2	3	53	*Hypselodelphys poggeana* (K. Schum.)	Marantaceae	Climber	GN
2	3	54	*Clerodendron streptocaulon* (Hutch & Dalz)	Verbenaceae	Shrub	GN
2	3	55	*Mucuna pruriens* (L.) DC.	Papilionaceae	Climber	GN
2	3	56	*Marantochloa purpurea* (Ridl.) Milne-Redh.	Marantaceae	Herb	GN
2	3	57	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
2	3	58	*Commelina benghalensis* (L.)	Commelinaceae	Herb	GN
2	3	59	*Clappertonia ficifolia* (Willd) Dence.	Tiliaceae	Shrub	NE
2	3	60	*Costus dubius* (Afzel.) K. Schum.	Zingiberaceae	Herb	GN
2	3	61	*Cassia mimosoides* (Linn)	Caelsapiniaceae	Herb	NE
2	3	62	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
2	3	63	*Ludwigia decurrens* (Walt. Syn)	Onagraceae	Herb	NE
2	4	64	*Digitaria horizontalis* (Willd.)	Poaceae	Grass	NE

2	4	65	*Aspillia africana* (Pers.) C. D. Adams	Asteraceae	Herb	NE
2	4	66	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
2	4	67	*Leptoderris micrantha* (Dunn)	Papilionaceae	Climber	GD
2	4	68	*Albizia zygia* (DC.) J.F.Macbr.	Mimosaceae	Tree	GN
2	4	69	*Desmodium tortuosum* (Sw.) DC.	Papilionaceae	Herb	GN
2	4	70	*Commelina benghalensis* (L.)	Commelinaceae	Herb	GN
2	4	71	*Malacatha alnifolia* (Bak.) Pierre	Sapotaceae	Tree	GN
2	4	72	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
2	4	73	*Combretum hispidum* (Laws.)	Combretaceae	Shrub	GN
2	4	74	*Sida corymbosa* (R. E. Fries)	Malvaceae	Shrub	NE
2	5	75	*Brachiara deflexa* (Schumach.) C. E.	Poaceae	Grass	NE
2	5	76	*Cyperus difformis* (Linn.)	Cyperaceae	Grass	NE
2	5	77	*Paspalum orbiculare* (Forst.)	Poaceae	Grass	NE
2	5	78	*Sporobolus pyramidalis* (P. Beauv.)	Poaceae	Grass	NE
2	5	79	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
2	5	80	*Rottboellia cochinchibensis* (Lour.) Clayton	Poaceae	Grass	NE
2	5	81	*Mezoneuron benthamianum* (Baill.)	Caelsapiniaceae	Climber	GN
2	5	82	*Albizia ferruginea* (Guill. & Perr.) Benth.	Mimosaceae	Tree	S
2	5	83	*Mucuna pruriens* (L.) DC.	Papilionaceae	Climber	GN
2	5	84	*Flueggea virosa* (Roxb.ex willd.) Voigt	Euphorbiaceae	Shrub	NE

3	1	85	*Centrocema pubescens* (Benth.)	Papilionaceae	Climber	NE
3	1	86	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
3	1	87	*Mallotus oppositifolius* (Geisel), Mull. Arg.)	Euphorbiaceae	Shrub	GN
3	1	88	*Ageratum conyzoides* (Linn.)	Asteraceae	Herb	NE
3	1	89	*Setaria barbata* (Lam.) Kunth	Poaceae	Grass	NE
3	1	90	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
3	1	91	*Gmelina arborea* (Roxb.)	Verbenaceae	Tree	NE
3	1	92	*Spigelia anthelmia* (Linn)	Loganiaceae	Herb	NE
3	1	93	*Mariscus alternifolius* (Vahl)	Cyperaceae	Grass	NE
3	1	94	*Rottboellia cochinchibensis* (Lour.) Clayton	Poaceae	Grass	NE
3	2	95	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
3	2	96	*Psychotria ivorensis* (De Wild.)	Rubiaceae	Shrub	GD
3	2	97	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
3	2	98	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	GN
3	2	99	*Setaria barbata* (Lam.) Kunth	Poaceae	Grass	NE
3	2	100	*Rottboellia cochinchibensis* (Lour.) Clayton	Poaceae	Grass	NE
3	2	101	*Paullinia pinnata* (L.)	Sapindaceae	Climber	GN
3	2	102	*Griffonia simplicifolia* (Vahl ex DC.) Baill.	Caelsapiniaceae	Climber	GN
3	2	103	*Rourea thomsonii* (Bak.) Jongkind	Connaraceae	Shrub	GN
3	2	104	*Imperata cylindrica* (Anderss.)	Poaceae	Grass	NE

			C. E. Hubbard			
3	3	105	*Acroceras zizaniodes* (Dandy)	Poaceae	Grass	NE
3	3	106	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
3	3	107	*Centrocema pubescens* (Benth.)	Papilionaceae	Climber	NE
3	3	108	*Cissus aralioides* (Welw. ex Baker) Planch.	Vitaceae	Climber	GN
3	3	109	*Ludwigia decurrens* (Walt. Syn)	Onagraceae	Herb	NE
3	3	110	*Paullinia pinnata* (L.)	Sapindaceae	Climber	GN
3	3	111	*Christiana africana* (DC.)	Malvaceae	Tree	GN
3	3	112	*Saba senegalensis* (A.DC.) Pichon	Apocynaceae	Climber	GN
3	4	113	*Baphia pubescens* (Hook.f.)	Papilionaceae	Tree	GN
3	4	114	*Lecaniodiscus cupanioides* (Planch. ex Benth.)	Sapindaceae	Tree	GN
3	4	115	*Dialium guineense* (Willd.)	Caelsapiniaceae	Tree	GN
3	4	116	*Phyllanthus amarus* (Schum, et Thonn.)	Euphorbiaceae	Herb	NE
3	4	117	*Brachiara deflexa* (Schumach.) C. E.	Poaceae	Grass	NE
3	4	118	*Physalis micrantha* (Link.)	Solanaceae	Herb	NE
3	4	119	*Acroceras zizaniodes* (Dandy)	Poaceae	Grass	NE
3	4	120	*Digitaria horizontalis* (Willd.)	Poaceae	Grass	NE
3	4	121	*Cythula prostrata* (L.) Blume	Amarantaceae	Herb	NE
3	5	122	*Phyllanthus amarus* (Schum, et Thonn.)	Euphorbiaceae	Herb	NE
3	5	123	*Brachiara deflexa* (Schumach.) C. E.	Poaceae	Grass	NE
3	5	124	*Acroceras zizaniodes* (Dandy)	Poaceae	Grass	NE

3	5	125	*Ludwigia decurrens* (Walt. Syn)	Onagraceae	Herb	NE
3	5	126	*Corchorus olitorius* (L.)	Malvaceae	Shrub	NE
3	5	127	*Ludwigia abyssinica* (A. Rich. Syn.)	Onagraceae	Herb	NE
3	5	128	*Ipomoea acquatica* (Forsk.)	Convolvulaceae	Climber	NE
4	1	129	*Imperata cylindrica* (Anderss.) C. E. Hubbard	Poaceae	Grass	NE
4	1	130	*Centrocema pubescens* (Benth.)	Papilionaceae	Climber	NE
4	1	131	*Eclipta prostrata* (Linn.) L.	Asteraceae	Herb	NE
4	1	132	*Vernonia cinerea* (Linn.) Less.	Asteraceae	Herb	NE
4	1	133	*Ageratum conyzoides* (Linn.)	Asteraceae	Herb	NE
4	1	134	*Leptoderris micrantha* (Dunn)	Papilionaceae	Climber	GD
4	1	135	*Acacia kirkii* (Oliv.)	Mimosaceae	Tree	NE
4	1	136	*Cnestis ferruginea* (Vahl ex DC.)	Connaraceae	Climber	GN
4	2	137	*Oryza longistaminata* (A. Chev. & Roehr.)	Poaceae	Grass	GN
4	2	138	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
4	2	139	*Calopogonium mucuniodes* (Desv.)	Papilionaceae	Climber	NE
4	2	140	*Imperata cylindrica* (Anderss.) C. E. Hubbard	Poaceae	Grass	NE
4	2	141	*Combretum hispidum* (Laws.)	Combretaceae	Shrub	GN
4	2	142	*Baphia pubescens* (Hook.f.)	Papilionaceae	Tree	GN
4	3	143	*Chromolaena odorata* (L.) R. M. King & Robinson)	Asteraceae	Shrub	NE
4	3	144	*Sida corymbosa* (R. E. Fries)	Malvaceae	Shrub	NE
4	3	145	*Ludwigia decurrens* (Walt. Syn)	Onagraceae	Herb	NE

4	3	146	*Cnestis ferruginea* (Vahl ex DC.)	Connaraceae	Climber	GN
4	3	147	*Paspalum orbiculare* (Forst.)	Poaceae	Grass	NE
4	3	148	*Sorghum arundinaceae* (Desv.) Stapf	Poaceae	Grass	NE
4	3	149	*Panicum laxum* (Sw)	Poaceae	Grass	NE
4	3	150	*Vernonia cinerea* (Linn.) Less.	Asteraceae	Herb	NE
4	3	151	*Clappertonia ficifolia* (Willd) Dence.	Tiliaceae	Shrub	NE
4	3	152	*Sporobolus pyramidalis* (P. Beauv.)	Poaceae	Grass	NE
4	3	153	*Brachiara deflexa* (Schumach.) C. E.	Poaceae	Grass	NE
4	3	154	*Hyparrhenia rufa* (Nees) Stapf.	Poaceae	Grass	NE
4	3	155	*Mimosa invisa* (Mart.)	Mimosaceae	Shrub	NE
4	3	156	*Desmodium adscendens* (Sw.) DC	Papilionaceae	Herb	GN
4	3	157	*Cyperus haspan* (Linn.)	Cyperaceae	Sedge	NE
4	3	158	*Centrocema pubescens* (Benth.)	Papilionaceae	Climber	NE
4	4	159	*Cnestis longiflora* (Lam.)	Connaraceae	Climber	GN
4	4	160	*Triclisia patens* (Oliv.)	Menispermaceae	Climber	GN
4	4	161	*Clerodendron streptocaulon* (Hutch & Dalz)	Verbenaceae	Shrub	GN
4	4	162	*Gmelina arborea* (Roxb.)	Verbenaceae	Tree	NE
4	4	163	*Deinbollia grandifolia* (Hook.f.)	Sapindaceae	Tree	GN
4	4	164	*Ochna schweinfurthiana* (F. Hoffm)	Ochnaceae	Shrub	NE
4	4	165	*Imperata cylindrica* (Anderss.) C. E. Hubbard	Poaceae	Grass	NE

4	4	166	*Flueggea virosa* (Roxb.ex willd.) Voigt	Euphorbiaceae	Shrub	NE
4	4	167	*Mallotus oppositifolius* (Geisel), Mull. Arg.)	Euphorbiaceae	Shrub	GN
4	4	168	*Cnestis longiflora* (Lam.)	Connaraceae	Climber	GN
4	5	169	*Mezoneuron benthamianum* (Baill.)	Caelsapiniaceae	Climber	GN
4	5	170	*Flueggea virosa* (Roxb.ex willd.) Voigt	Euphorbiaceae	Shrub	NE
4	5	171	*Ficus sur* (Forssk.)	Moraceae	Tree	GN

				Conservation Status	
SCIENTIFIC NAME	**Awura FR**	**Chirimfa FR**	**Life Form**	**National**	**IUCN**
Acacia nilotica (L.) Willd. eNo Del.	*Yes*	*No*	Tree	GN	LC
Afzelia africana (Sm.)	*Yes*	*Yes*	Tree	R	VC
Aidia genipiflora (DC.) Dandy	*Yes*	*No*	Tree	GN	NA
Albizia adianthifolia (Schumach.) W.F.Wight	*Yes*	*Yes*	Tree	GN	LC
Albizia ferruginea (Guill. & Perr.) Benth.	*Yes*	*No*	Tree	S	VC
Albizia zygia (DC.) J.F.Macbr.	*Yes*	*Yes*	Tree	GN	NA
Alchornea cordifolia (Schumach. & Thonn.) Müll.Arg.	*Yes*	*Yes*	Tree	GN	NA
Allophylus africanus (P.Beauv. f.)	*No*	*Yes*	Tree	GN	NA
Alstonia boonei (De Wild.)	*Yes*	*No*	Tree	GN	NA
Anogeissus leiocarpus (DC.) Guill. & Perr.	*Yes*	*Yes*	Tree	GN	NA
Anthocleista procera (Lepr. eNo Bureau)	*Yes*	*Yes*	Tree	GN	NA
Antiaris toxicaria (Rumph. eNo Pers.) Leschen. ssp.	*Yes*	*Yes*	Tree	P	NA
Baphia pubescens (Hook.f.)	*Yes*	*Yes*	Tree	GN	NA
Berlina grandiflora (Vahl) Hutch. & Dalz.	*No*	*Yes*	Tree	GN	NA
Blighia sapida (Konig)	*Yes*	*No*	Tree	GN	NA
Blighia unijugata (Baker var.)	*Yes*	*No*	Tree	GN	NA
Bombax buonopozense (P.Beauv.)	*Yes*	*No*	Tree	GN	NA
Borassus aethiopum (Mart.)	*No*	*Yes*	Tree	GN	LC
Bridelia ferruginea (Benth)	*Yes*	*Yes*	Tree	GN	NA
Burkea africana (Hook.f.)	*No*	*Yes*	Tree	GN	NA
Ceiba pentandra (L.) Gaertn.	*Yes*	*Yes*	Tree	GN	LC
Christiana africana (DC.)	*Yes*	*No*	Tree	GN	NA
Cola gigantea (A.Chev. var.)	*Yes*	*No*	Tree	GN	NA
Cola cordifolia (Cav.) R.Br	*No*	*Yes*	Tree	GN	NA
Combretum fragrans (F. Hoffm.)	*No*	*Yes*	Tree	GN	NA

Combretum nigricans (Lepr. ENo Guill & Perr)	*No*	*Yes*	Tree	GN	NA
Crossopteryx febrifuga (Afzel. eNo G. Don) Benth.	*No*	*Yes*	Tree	GN	NA
Daniellia oliveri (Rolfe) Hutch.& Dalz	*Yes*	*Yes*	Tree	GN	NA
Deinbollia grandifolia (Hook.f.)	*No*	*Yes*	Tree	GN	NA
Dialium guineense (Willd.)	*Yes*	*Yes*	Tree	GN	LC
Diospyros monbuttensis (Gürke)	*Yes*	*No*	Tree	GN	NA
Ekebergia senegalensis (A. Juss.)	*Yes*	*No*	Tree	BU	LC
Elaeis guineensis (Jacq.)	*Yes*	*Yes*	Tree	P	LC
Ficus exasperata (Vahl)	*No*	*Yes*	Tree	GN	NA
Ficus sur (Forssk.)	*Yes*	*Yes*	Tree	GN	NA
Ficus sycomorus (Miq). C. C. Berg	*Yes*	*Yes*	Tree	NE	NA
Ficus vogeliana (Miq.)	*Yes*	*No*	Tree	GN	NA
Gmelina arborea (Roxb)	*Yes*	*Yes*	Tree	NE	NA
Holarrhena floribunda ((G.Don) T.Durand & Schinz.	*Yes*	*Yes*	Tree	GN	NA
Hymenocardia acida (Tul)	*No*	*Yes*	Tree	GN	NA
Khaya grandifoliola (C.DC.)	*Yes*	*No*	Tree	R	VU
Khaya senegalensis (Ders.) A.Juss.	*No*	*Yes*	Tree	R	VU
Lannea microcarpa (Engl. & K. Krause)	*Yes*	*Yes*	Tree	GN	NA
Lannea velutina (A. Rich)	*Yes*	*Yes*	Tree	GN	NA
Lecaniodiscus cupanioides (Planch. eNo Benth.)	*Yes*	*Yes*	Tree	GN	NA
Lonchocarpus sericeus (Poiret) Kunth	*Yes*	*Yes*	Tree	GN	NA
Lophira lanceolata (Van Tiegh. ENo keay)	*No*	*Yes*	Tree	GN	NA
Malacantha alnifolia (Bak.) Pierre	*Yes*	*Yes*	Tree	GN	NA
Margaritaria discoidea ((Baill.) Webster)	*Yes*	*Yes*	Tree	GN	NA
Markhamia tomentosa (Benth.) K. Schum. eNo Engl.	*Yes*	*Yes*	Tree	GN	NA
Millettia zeciana M. barteri (Benth.) Dunn	*No*	*Yes*	Tree	GN	NA
Mitragyna inermis (Willd.) Kuntze	*Yes*	*No*	Tree	GN	NA
Morinda lucida (Benth.)	*Yes*	*Yes*	Tree	GN	NA

Parkia biglobosa (Jacq.) R. Br. eNo G. Don	*No*	*Yes*	Tree	GN	NA
Pericopsis laxiflora (Benth.) Van Meeuwen	*No*	*Yes*	Tree	GN	NA
Piliostigma thonningii (Schumach.) Milne-Redh.	*Yes*	*No*	Tree	GN	NA
Pterocarpus erinaceus (Poir)	*Yes*	*Yes*	Tree	P	NA
Rauvolfia vomitoria (Afzel.)	*Yes*	*No*	Tree	GN	NA
Sarcocephalus latifolius (Smith) Bruce	*Yes*	*Yes*	Tree	GN	NA
Spathodea campanulata (P.Beauv.)	*Yes*	*Yes*	Tree	GN	LC
Spondias mombin (L.)	*Yes*	*No*	Tree	GN	NA
Sterculia tragacantha (Lindl.)	*Yes*	*Yes*	Tree	GN	NA
Strychnos spinosa (Lam.)	*No*	*Yes*	Tree	GN	NA
Tectona grandis (L.f.)	*Yes*	*Yes*	Tree	GN	NA
Terminalia avicennioides (Guill.& Perr.)	*Yes*	*Yes*	Tree	GN	NA
Terminalia macroptera (Guill. & Perr.)	*No*	*Yes*	Tree	GN	NA
Trema orientalis (L.) Blume	*No*	*Yes*	Tree	GN	NA
Trichilia emetica (Vahl.)	*Yes*	*Yes*	Tree	GN	NA
Triplochiton scleroxylon (K.Schum.)	*Yes*	*No*	Tree	S	LC
Vitex doniana (Sweet)	*Yes*	*Yes*	Tree	GN	NA
Voacanga africana (Stapf)	*No*	*Yes*	Tree	GN	NA
Alchornea cordifolia (Schumach. & Thonn.) Müll.Arg.	*Yes*	*Yes*	Shrub	GN	NA
Annona senegalensis (Pers.)	*Yes*	*No*	Shrub	GN	NA
Chromolaena odorata (L.) R. M. King & Robinson)	*Yes*	*No*	Shrub	GN	NA
Clappertonia ficifolia (Willd) Dence.	*Yes*	*Yes*	Shrub	GN	NA
Clerodendron streptocaulon (Hutch & Dalz)	*Yes*	*Yes*	Shrub	GN	NA
Combretum glutinosum (Perr. eNo DC)	*Yes*	*No*	Shrub	GN	NA
Combretum hispidum (Laws.)	*Yes*	*No*	Shrub	GN	NA
Corchorus olitorius (L.)	*Yes*	*No*	Shrub	BU	NA
Flueggea virosa (Roxb.ex willd.) Voigt	Yes	Yes	Shrub	NE	NA

Grewia villosa (Willd.)	Yes	Yes	Shrub	GN	NA
Icacina trichantha (Oliv.)	Yes	Yes	Shrub	GN	NA
Lippia chevalieri (L.)	Yes	Yes	Shrub	NE	NA
Mallotus oppositifolius (Geisel), Mull. Arg.)	No	Yes	Shrub	NE	NA
Manotes kerstingii (Gilg)	No	Yes	Shrub	NE	NA
Mimosa invisa (Mart.)	Yes	Yes	Shrub	NE	NA
Ochna schweinfurthiana (F. Hoffm)	Yes	Yes	Shrub	NE	NA
Psychotria ivorensis (De Wild.)	Yes	Yes	Shrub	GD	NA
Rhus natalensis (Bernh. ex Krauss)	Yes	Yes	Shrub	NE	NA
Rourea thomsonii (Bak.) Jongkind	No	Yes	Shrub	NE	NA
Sida corymbosa (R. E. Fries)	Yes	Yes	Shrub	GN	NA
Uvaria chamae (P. Beauv.)	Yes	Yes	Shrub	NE	NA
Calopogonium mucuniodes (Desv.)	*No*	*Yes*	Climber	GN	NA
Centrocema pubescens (Benth.)	*Yes*	*No*	Climber	GN	NA
Cissus aralioides (Welw. ex Baker) Planch.	*No*	*Yes*	Climber	GN	NA
Cnestis ferruginea (Vahl eNo DC.)	Yes	Yes	Climber	NE	NA
Cnestis ferruginea (Vahl ex DC.)	Yes	Yes	Climber	NE	NA
Cnestis longiflora (Lam.)	Yes	Yes	Climber	GN	NA
Griffonia simplicifolia (Vahl ex DC.) Baill.	Yes	Yes	Climber	GN	NA
Hypselodelphys poggeana (K. Schum.)	Yes	Yes	Climber	GN	NA
Ipomoea acquatica (Forsk.)	No	Yes	Climber	GN	NA
Leptoderris micrantha (Dunn)	Yes	Yes	Climber	GD	NA
Mezoneuron benthamianum (Baill.)	Yes	Yes	Climber	GN	NA
Mucuna pruriens (L.) DC.	Yes	Yes	Climber	GN	NA
Paullinia pinnata (L.)	No	Yes	Climber	GN	NA
Saba senegalensis (A. DC.) Pichon	Yes	Yes	Climber	GN	NA
Saba senegalensis (A.DC.) Pichon	Yes	Yes	Climber	GN	NA

Smilax kraussianu (Meisn)	No	Yes	Climber	GN	NA
Triclisia patens (Oliv.)	Yes	Yes	Climber	GN	NA
Acroceras zizaniodes (Dandy)	Yes	Yes	Grass	NE	NA
Brachiara deflexa (Schumach.) C. E.	Yes	Yes	Grass	NE	NA
Cyperus difformis (Linn.)	No	Yes	Grass	NE	LC
Digitaria horizontalis (Willd.)	Yes	Yes	Grass	NE	NA
Hyparrhenia rufa (Nees) Stapf.	Yes	Yes	Grass	NE	NA
Imperata cylindrica (Anderss.) C. E. Hubbard	Yes	Yes	Grass	NE	NA
Mariscus alternifolius (Vahl)	Yes	Yes	Grass	NE	NA
Oryza longistaminata (A. Chev. & Roehr.)	Yes	Yes	Grass	GN	LC
Panicum laxum (Sw)	Yes	Yes	Grass	NE	NA
Paspalum orbiculare (Forst.)	Yes	Yes	Grass	NE	NA
Pennisetum violaceum (Lam.) L. Rich.	No	Yes	Grass	NE	NA
Rottboellia cochinchibensis (Lour.) Clayton	Yes	Yes	Grass	NE	NA
Setaria barbata (Lam.) Kunth	Yes	Yes	Grass	NE	NA
Sorghum arundinaceae (Desv.) Stapf	Yes	Yes	Grass	NE	NA
Sporobolus pyramidalis (P. Beauv.)	Yes	Yes	Grass	NE	NA
Aframomum standfieldii (Hepper)	No	Yes	Herb	BU	NA
Ageratum conyzoides (Linn.)	Yes	Yes	Herb	NE	NA
Amaranthus spinosus (Linn)	No	Yes	Herb	NE	NA
Aspillia africana (Pers.) C. D. Adams	No	Yes	Herb	NE	NA
Boerhavia erecta (L)	No	Yes	Herb	NE	NA
Cassia mimosoides (Linn)	No	Yes	Herb	NE	LC
Costus dubius (Afzel.) K. Schum.	No	Yes	Herb	GN	NA
Cythula prostrata (L.) Blume	Yes	Yes	Herb	NE	NA
Desmodium adscendens (Sw.) DC	Yes	Yes	Herb	GN	LC
Desmodium tortuosum (Sw.) DC.	No	Yes	Herb	GN	NA

Eclipta prostrata (Linn.) L.	Yes	Yes	Herb	NE	LC
Erigeron floribundus (H. B. & K.) Sch. Bip.	No	Yes	Herb	NE	NA
Euphorbia heterophylla (Linn)	No	Yes	Herb	NE	NA
Ludwigia abyssinica (A. Rich. Syn.)	Yes	Yes	Herb	NE	NA
Ludwigia decurrens (Walt. Syn)	Yes	Yes	Herb	NE	NA
Marantochloa purpurea (Ridl.) Milne-Redh.	No	Yes	Herb	NE	NA
Phyllanthus amarus (Schum, et Thonn.)	Yes	Yes	Herb	NE	NA
Physalis micrantha (Link.)	Yes	Yes	Herb	NE	NA
Spigelia anthelmia (Linn)	Yes	Yes	Herb	NE	NA
Tridax procumbens (Linn)	No	Yes	Herb	NE	NA
Vernonia cinerea (Linn.) Less.	Yes	Yes	Herb	NE	NA

Annex 4b: Fauna and Butterfly Survey List of the Project Site

Fauna Species					
Cyperus haspan (Linn.)	Yes	Yes	Sedge	NE	NA
Euxerus erythropus, Ground squirrel	*Yes*	*Yes*	Rodent	Schedule III	LC
*Thryonomys swinderianus,*Grasscutter	*Yes*	*Yes*	Rodent	Schedule V	LC
*Tockus nasutus,*African hornbill	*Yes*	*Yes*	Bird		LC
*Coracias cynogaster,*Blue-billed roller	*Yes*	*Yes*	Bird		LC
*Ploceidae spp,*Weaver birds	*Yes*	*Yes*	Bird	Schedule II	LC
*Pternistis ahantensis,*Partridge	*Yes*	*Yes*	Bird	Schedule III	LC
Ptilopachus petrosus, Stone partridge	*No*	*Yes*	Bird	Schedule III	LC
*Kinixys bellian,*Tortoise	*Yes*	*No*	Reptile	Schedule II	LC
Naja melanoleuca, Black cobra	*Yes*	*Yes*	Reptile	Schedule V	NA
*Dendroaspis,*Green mamba	*Yes*	*Yes*	Reptile	Schedule V	NA
Bitis arietans, Puff adder	*No*	*Yes*	Reptile	Schedule V	NA
Eurema hecabe solifera	*Yes*	*Yes*	Butteries	Very common	NA
Mylothris jaopura	*Yes*	*No*	Butteries	Common	NA
Libythea labdaca labdaca	*Yes*	*No*	Butteries	Common	NA
Danaus chrysippus chrysippus	*Yes*	*No*	Butteries	Very common	NA
Catuna angustatum	*Yes*	*No*	Butteries	Common	NA
Acraea pharsalus pharsalus	*Yes*	*No*	Butteries	Common	NA
Bicyclus sandace	*Yes*	*No*	Butteries	Very common	NA
Neptis alta	*Yes*	*No*	Butteries	Not Rare	NA
Bicyclus dorothea dorothea	*Yes*	*No*	Butteries	Very common	NA

LC-Least Concern

NA-Not Assessed

BUTTERFLIES SURVEY

Butterfly species encountered during the transect walk with the botanical team during the data collection for the ongoing ESIA for Awura and Chirimfa Forest Reserves.

Area: Awura Transect 1

Eurema hecabe solifera (Rarity = VC)

The Common Grass Yellow is common and widely distributed in Africa. By any criterion, it qualifies as one of the most common and widespread butterflies in Africa. Though originally a savannah species, the most important habitat is now agricultural lands and disturbed areas in the forest zone. Intact forest is not a suitable habitat, but wherever an open road or a wide path penetrates the forest, allowing the sensitive plant (*Mimosa pudica*) to follow, E. hecabe will also be present.

Mylothris jaopura (Rarity = CO)

The Karsch's Dotted Border is essentially a forest butterfly that sometimes pushes into dense Guinea Savannah and also flies in severely disturbed habitats.

Libythea labdaca labdaca (Rarity = CO)

The African Beak seems to be most common on the fringes of the forest zone and in disturbed areas of the rainforest zone, while usually uncommon or absent from high quality forest. It is however, somewhat intermittent. It may be hugely common for a period and then disappear for months on end.

Danaus chrysippus chrysippus (Rarity = VC)

The Common Tiger is found literally throughout West Africa and amongst others, is the most widely distributed large butterfly in the area. Originally it was a butterfly of the savannahs, but it has successfully colonized disturbed habitats in the forest zone,being absent only from wetter forests in good condition.

Catuna angustatum (Rarity = CO)

The Large Pathfinder is somewhat more tied to forest in reasonable condition. It tends to be slightly scarce.

Acraea pharsalus pharsalus (Rarity = CO)

The Pharsalus Acraea is a relatively common and widespread butterfly. It flies in both forests and disturbed areas even extending into Guinea Savannah along rivers, and is essentially a species of clearings. During the dry season and in submontane areas many come to water.

Bicyclus sandace (Rarity = VC)

The Dark Vulgar Bush Brown is a common butterfly in forest, secondary growth and agricultural areas, pushing into riverine vegetation and dense savannah.

Neptis alta (Rarity = NR)

The High Sailer is considered to be a species of wetter forests but records from elsewhere indicate some adaptability. It usually flies high but may swoop down in paths and clearings, often basking on the ground. It comes to water during the dry season.

Area: Awura Transect 2

Bicyclus dorothea dorothea (Rarity = VC)

The Light Bush Brown is one of the most common butterflies in the forest zone of West Africa. Though the species is hardly found in primary forest, as soon as a clearing or path receives some sunlight and contains grass, a colony gets established.

Bicyclus sandace (Rarity = VC)

Neptis alta (Rarity = NR)

Acraea pharsalus pharsalus (Rarity = CO)

Area: Chirimfa Transect 2

Acraea pharsalus pharsalus (Rarity = CO)

Eurema hecabe solifera (Rarity = VC)

Rarity categories
VC *= very common – species that are usually found on any visit to a suitable locality*
CO *= common – species that are usually found on 75% of visits to most suitable localities*
NR *= not rare – met with frequently but often not common*

Annex 5: Aquatic Study Report

Baseline Survey of the Aquatic Environment in the Proposed Reforestation of the Chirimfa and Awura Forest Reserves

SUMMARY
A proposal is made to rehabilitate the degraded Chirimfa and Awura Forest Reserves in the Ashanti-Akyem North District of the Ashanti Region of Ghana. To satisfy conditions for permit under L.I. 1652, a survey was conducted on the water bodies within the catchment of the reserves to assess species composition, diversity and community structure of macrophytes, phytoplankton, and faunal organisms like the macro-invertebrates, crustaceans and amphibians. The goal of the survey was to collect baseline information on the existing aquatic environment to allow prediction of likely impacts of the rehabilitation on the immediate environs of these reserves to prepare an Environmental Impact Assessment (EIA) document. The study revealed that the project area is generally devoid of any significant macrophyte community, as few emergent macrophytes including *Alternanthera* sp*., Brachiara mutica, Commelina flos-capa, Cyperus* sp., *Ludwigia* sp*., Polygonum* sp. and *Pycreus* sp. were observed in marginal quantities. All the macrophytes were observed and recorded at Drobon Upstream and downdtream. *Luffa* sp was observed in Atonsu Upstream sites**.** *Lemna* sp. was the only free-floating macrophyte observed in the study (Afram sites). The phytoplankton survey recorded 49 genera of Bacillariophyta, Chlorophyta, Cyanophyta, Flagellates and the Rhodophyta in varying quantities and proportions at the various sampling sites. The community was dominated by the Bacillariophyta, (35%), and followed by the Chlorophyta (29%) and Cyanophyta recording 16%. The Flagellates and the Rhodophyta recorded 10% each. This observation compares favourably with freshwater systems occurring in West Africa. The aquatic fauna species recorded were also typical of similar ecosystems and are therefore not threatened by the project. A strict monitoring exercise is however proposed for the macrophyte community to prevent proliferation during the operation phase of the project which might involve impoundment and water collection. Recommendations have also been made to ensure environmental compliance of the project.

2.0 METHODOLOGY

Site description

The project area is generally forested but degraded in its current state. Typically, a gallery forest fringes the various sites selected for the aquatic survey. Few aquatic and semi aquatic plant species like *Commelina flos-capa* and emergent aquatic s like *Alternanthera* sp*., Brachiara mutica,Cyperus* sp., *Ludwigia* sp*., Luffa* sp*., Polygonum* sp. and *Pycreus* sp., were present in marginal and varying quantities at the various sampling sites selected for the survey.

2.1 Sites Selection

To ensure a fair representation of the aquatic environment of the catchment of the concessions earmarked for rehabilitation, sites were selected within the concessions designated as follows:

- Drobon Upstream
- Drobon Downstream
- Atonsu Upstream
- Atonsu Downstream
- Afram Upstream
- Afram Downstream

Sites Description

a. ***Drobon Upstream***

The Drobon Upstream site has less human activity, serves as a water collection point for adjoining settlements for domestic purposes such as washing and drinking. The flow rate or the current of River Drobon was observed to be normal. The section of the river at this site was fringed by plants like Alternanthera sp., Brachiara mutica and others. The site recorded the highest number of aquatics. The water looked slightly turbid due to movement of people through the water in crossing over to their farms.

b. *Drobon Downstream*

Picture 1

Picture 2

The river was at a low level at this site. There was evidence of a higher level of human activity due to some re-vegetation activities occurring here. Picture 1 shows a water pump used to draw water from the river for the re-vegetation activities. This river at this site is relatively more vegetated with terrestrial plants, but less number of aquatic plants with respect to the upstream. The bed of the river has a sheet of rocks and boulders (picture 2) which creates a foamy situation. Water at this site also looked slightly turbid.

c. **Atonsu**

Picture 1

Picture 2

This site, though located outside the concession was selected to serve for vital monitoring purposes. This is because it is close to a GWCL water intake point and therefore any changes to the quality of water apparently due to project activities would be noted quickly and appropriate remedial measures effected. The Atonsu river serves as a water collection point for adjoining settlements. The river level is low and flow rate or the current of the river was observed to be normal. The water appeared very clear and suitable for drinking by nearby settlements. The lower right side of the picture shows the growth of an aquatic, i.e. *Polygonum* sp. (**arrowed**) (picture 2). The river bed is rocky with boulders highly exposed with some exposed at the time of visit.

d. **Afram Upstream**

The upper reaches of this site exhibits typical gallery vegetation with dense undergrowth mainly consisting of climbers. This site seemed to experience low human interference despite evidence intensive agricultural activities with some rice farms found about 150- 200 m away from the sampling point. The river is flows slowly here at this site, with a virtual absence of macrophytes.

2.2 Aquatic Flora

2.2.1 Macrophytes

A survey of the aquatic flora was conducted with visits to the selected sites on foot. The structure of the macrophyte community and composition of the aquatic vegetation, particularly those of interest to the project were assessed, and the members of interest were identified and recorded. Of special interest in such exercises is the presence of noxious or dangerous aquatic plants likely to impact negatively on the operation of the project, which are then given particular attention during the survey. The conservation status of all the species encountered, as provided for in the IUCN Red list, was considered.

2.1.2 Phytoplankton

Water samples were collected for micro flora assessment at the same time and sites selected for macrophytes study. Phytoplankton groups, namely the Bacillariophyceae (Diatoms), the Chlorophyta (Green algae) and Cyanophyta (Blue-Green), Rhodophyta (Red algae) and the Flagellates were sampled.

2.1.2.1 Collection and Preservation of Phytoplankton samples

30ml water samples were collected in triplicates from each site, and were mixed into a composite sample for each site, and about 1 ml of Iodine in Potassium Iodide solution (Lugol's iodine) was added to the composite sample (Prescott, 1970). The samples were then kept appropriately for identification and enumeration of resident microalgae.

2.1.2.2 Enumeration and Identification of Phytoplankton species

The phytoplankton community in the samples collected was enumerated using 25 ml of the iodized samples, following the procedure of Biswas (1966) and Lund *et. al*., (1958). Phytoplankton density,

measured as numbers of individuals per ml, was estimated by counting individuals represented as single cells, colonies or filaments in a counting cell after about an hour of sedimentation. Identification of planktonic flora species, including flagellates, was done using relevant text, keys and manuals (Whitford & Schumacher, 1973) and complemented with web based sources like http://algaebase.org.

2.2 Macro-invertebrates (Benthos)

The macro-invertebrates (Benthos**)** associated with the vegetation in, or trailing into the water at the various sites were appropriately collected. Where necessary sampling sites around rocky areas were agitated and the water collected into glass tubes and fixed. The resultant suspension was later passed through a 500-µm mesh size sieve for identification and enumeration. This method also provided some samples for the assessment of diatoms. Where available, tree branches submerged in the river were inspected for burrowing fauna, as well as the surface of tree or log to check deeper layers in some cases. This approach also provides quantitative estimates of abundance when necessary.

2.3 Aquatic fauna

Fish/Crustaceans/Amphibians

Information and knowledge on the fish, crustaceans and amphibians occurring in the study area, especially ecologically important were solicited from local people and field assistants through interviews to complement the presence/absence survey. This mode of seeking information was complemented by active searching and direct or opportunistic observation of the catchment area. A desktop literature review was also conducted to obtain existing information on the project area and on the aquatic fauna of the area.

3.0 FINDINGS AND ANALYSIS

3.1 Macrophytes diversity and community stricture

The water bodies in the project area are generally poor in macrophyte community structure, with composition list of very few members. All sampling sites visited were found to be generally devoid of any significant levels of macrophyte vegetation. A species compositing list for the aquatic and semi-aquatic plants encountered during the survey is presented in Appendix 1.

The emergent aquatic and semi-aquatics found in the survey included *Alternanthera* sp., *Brachiara mutica, Commelina flos-capa, Cyperus* sp., *Ludwigia* sp., *Luffa* sp., *Polygonum* sp. and *Pycreus* sp., which were observed in marginal quantities at the various sampling sites. Drobon Upstream and Atonsu sites recorded relatively higher numbers of species of 7 plants genera each, with the other sites recording between 1 and 4 species. The emergent aquatic and semi-aquatics found in the survey are quite common, and associated with similar tropical freshwater systems. These plants were present in quite small numbers confirming the poor nature of their occurrence.

3.1.1 Free-floating aquatic vegetation

With the exception of few stands of ***Lemna*** sp. observed at the Afram sites, the survey did not reveal any free floating aquatic vegetation. Aquatic vegetation of this life form includes dangerous invasive floating macrophytes with a very high proliferation or growth rate generally observed in freshwater systems in Ghana. Further these plants generally prefer conditions of continuous supply of water like in a reservoir or collected pool for growth. Their chances of proliferating and negatively impacting water abstraction during the dry season of project operation are slim considering the current environmental conditions observed in the survey.

The diversity of the macrophyte vegetation is quite poor, with very few members of emergents and near non-existent free floating types, with only *Lemna* sp., only observed at the Afram sites. The structure of the macrophyte community can therefore be described as ordinary with marginal numbers of components, and without any unique species.

The macrophyte community observed in the survey is not in any disturbing quantities. Caution should however be exercised by monitoring the vegetation to prevent proliferating during the operation phase of the project, mainly impounding to aid water abstraction for watering. However, in case of low water yield by the rivers or stream, which could warrant blocking to collect water or create standing water conditions, the presence of any aquatics should be reported for monitoring.

3.2 Phytoplankton densities, diversity & community structure

The phytoplankton population densities and diversity recorded during the survey is cumulatively presented in Appendix 2.
The diatoms (Bacillariophyceae) were observed to dominate the composition of the phytoplankton, in terms of genera distribution as well as numbers of individual species recorded. The green and blue-green algae were fairly represented while the Rhodophyta and the Flagellates were the lease represented. All species of phytoplankton encountered are typical of fresh water systems and no species of special ecological interest were found. Typically, the diatoms (Bacillariophyceae) seemed to occur in relatively high densities or numbers due to presence of rock surfaces for habitation at the sites. This condition could be confirmed by the limnological investigations of the study. The observation of very little interference from human sources at the sampling sites reflected in the phytoplankton species composition recorded in the survey, which can be described as normal flora of freshwater systems in Ghana. and therefore would not require any special conservation attention from the project operation.

The species diversity of the phytoplankton community recorded during the survey area is typically pan-tropic is very characteristic of similar freshwater bodies in the tropics. The project has very minimal potential to upset this community structure and impact negatively on it.

3.3 Macro-Invertebrates (Benthos)

The results of the macro-invertebrate sampling undertaken in the study are presented below in Appendix 3. Identification was taken to the lowest taxonomic level allowed by the reporting schedule. The macro invertebrates observed during the survey belonged to various orders like Ephemeroptera (mayflies) Diptera (Chironomid midges), and Odonata (dragonflies and damselflies) which are quite common to freshwater systems in Ghana. Some of these like the dragon flies indicate water bodies of appreciably good quality. This could provide some preliminary leads into the general quality of the rivers targeted for use in the rehabilitation exercise. The number of species and diversity of benthos collected during the survey show a generally fair representation of macro-invertebrates and compare favourably with observations in similar habitats (Dejoux, C., J. M. Forge, P & J. L. Maslin, 1982; Kyerematen, R., 2014). Significantly no species of special ecological interests and threats were found.

3.4 Aquatic fauna

Fish /Crustaceans/Amphibians

Information solicited from indigenes in the study area indicated the presence of these organisms in the proposed project area.

3.4.1 Fish Population

Interviews conducted with people during the survey on the presence/absence of these species was complemented and confirmed with desktop search Fish species recorded during the survey are listed below**.**

Fish species occurring in the study area

Sampling sites ***FAMILY*/Species**	**Upstream**	**Dam site**	**Downstream**
MOCHOKIDAE			
Synodontis sorex	+	+	+
Synodontis schall	+	+	+
Synodontis violaceus	+	+	+
CICHILDAE			
Chromidotilapia guentheri	+	+	+
Oreochromis sp.	+	+	+
Sarotherodon sp.	+	+	+
Steatochromis irvinei	+	+	+
Tilapia zillii	+	+	+
CENTROPOMIDE			
Lates niloticus	+	+	+
CLARIIDAE			
Clarias sp.	+	+	+
CLUPEIDAE			
Pellonula vorax	+	+	+
P. miri,	+	+	+

NB: + *species present*

The species recorded are known to widely occur in the Volta system and distributed in similar habitats within Central, Southern and Western Africa. It is pertinent to note that virtually all the rivers or streams within the project area are tributaries of the Afram River and therefore very important nursery or breeding grounds for the fishery. Therefore, none of these is of any conservation concerns as they are known to be widely, and are therefore not faced with any known major widespread threats from the project. All species indicated are therefore listed as Least Concern. It is however important that every effort is made to protect the quality of water for sustainability.

3.4.2 Crustaceans The field survey confirmed the presence of crustaceans as follows:

3.4.2.1 Shrimps: *Penaeus notialis*, *Parapenaeus longirostris*, *Penaeus kerathurus*, *Triops longicaudatus (*common name: Tadpole shrimp) *Asellus aquaticus (*common name: Aquatic sow bug or water louse), *Gammarus fossarum (*common name: Scud) cyclops seed shrimp

3.4.2.2 Prawns common to freshwater systems were identified in the benthos as well.

3.4.2.3 Crabs: River and freshwater living crabs like *Liberonautes* sp. and *Sudanonautes* sp. are known to commonly and widely occur in major rivers in Ghana and other countries in West Africa. Though these were not encountered physically, nor burrows observed during the survey. The crustaceans observed are listed as least concerned (IUCN) in view of the wide distribution and abundance. They are also under any known ecological threats. It is significant to note that none of the species documented in the study area are of international or national conservation significance and are therefore not threatened by the proposed project.

3.4.2.4 Amphibians

The amphibian survey revealed the following species: *Afrixalus dorsalis*, *Hyperolius concolor* and *Leptopelis* sp., all common species in these parts of the world. The more common *Bufo sp.* (common toad) was recorded as well. These species have been reported in literature as components of an assemblage of West African amphibian species and endemic to forests areas like the study area. These species are widespread in the project area and similar habitats, and are not ecologically threatened by the proposed project.

4.0 DISCUSSION AND RECOMMENDATIONS

The aquatic community is fairly represented in the project area. The species composition and community structure of the various indicators are not unique to the project area but a representation of similar habitats. The plants appear in quantities that could conveniently be described as serving basic ecosystem functions.

The diversity of the macrophyte vegetation is quite poor, with very few emergents and near non-existent free floating types, with only *Lemna* sp., only observed at the Afram sites. The structure of the macrophyte community can therefore be described as ordinary with marginal numbers of components, and without any unique species. The macrophyte community observed in the survey is not in any disturbing quantities. Caution should however be exercised by monitoring the vegetation to prevent proliferating during the operation phase of the project, possibly through impounding the rivers water abstraction. However, in case of low water yield by the rivers at certain times of the year which could call for blocking to collect water or create standing water conditions, the presence of any aquatics should be targeted for monitoring. These macrophytes also have the ability to reduce water levels through increased evapo-transpiration. Therefore, a massive aquatic vegetation level would invariably mean a higher rate of water loss through this means.

The absence of any submerged macrophyte should be appreciated as some of these plants serve as host of agents/vectors of water related disease like Bilharzia. The presence of any submerged plant should be monitored to prevent entry and proliferation during the operation phase of the project to keep the project area disease-free. This is also in view of the presence of some macro-invertebrate agents in the area, and the likely regulation of the flow rate of the rivers by the project, which condition favours the vectors.

The phytoplankton community is typical of freshwater systems and pan-tropic and no species of special ecological interest were found. The various phytoplankton groups were fairly distributed in the project area. Though the distribution followed no particular trend, diatoms recorded relatively high numbers probably due to low water levels in the rivers and rocky substratum of these. The listed phytoplankton community compares favourably with the reports of Gordon *et al*. (2003), who documented similar species of micro flora in the Black Volta River, including 17 species of green and blue-green algae and 12 species of diatoms. This microfloral species assemblage is typical of the Volta system. Generally, none of these species of aquatic vegetation observed in the study area are considered rare or of conservation concern and would face no threats from the project.

Benthos species and diversity of aquatic species in the survey fairly represented macro-invertebrates and compare favourably with similar habitats. The survey did not record any species of particular ecological interest. Further the likely changes to the river system possibly due to impoundment during project operation would not impose any ecological consequences on these species.
The composition of the fauna recorded ecologically significant organisms in the project area, which would not be significantly affected by the proposed project.

Generally, this project will not impose any ecological threats to the biological structure of the area but it is expected that best practices measures will be employed in the project operations.

5.0 CONCLUSION AND RECOMMENDATIONS

The study revealed that the area where the forest reserves targeted for rehabilitation is generally devoid of any significant macrophyte community, as about 7 emergent macrophytes were observed in marginal quantities. *Lemna* sp. was the only free-floating macrophyte observed in the study. This phytoplankton community observed and dominated by the Bacillariophyta, (35%), and followed by the Chlorophyta (29%) and Cyanophyta recording 16%. The Flagellates and the Rhodophyta recorded 10% each, compares favourably with freshwater systems occurring in West Africa.

The number of species and diversity of benthos collected during the survey show a generally fair representation of macro-invertebrates and compare favourably with observations in similar habitats. Similarly, the aquatic fauna species observed were also typical of similar ecosystems and are therefore not threatened by the project.

It is recommended that a strict monitoring exercise should be followed for the macrophyte community to prevent proliferation during the operation phase of the project, which might involve impoundment and water collection. to ensure environmental compliance of the project.

6.0 REFERENCES

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APPENDICES

Appendix 1. Aquatic and semi-aquatic species observed in the survey

Drobon Upstream

Vegetation Growth Habit	Species observed	Comment
Emergents	*Alternanthera* sp.	These plants were observed at this sites in marginal quantities
	Brachiara mutica	
	Commelina flos-capa	
	Cyperus sp.	
	Ludwigia sp.	

	Polygonum sp.	
	Pycreus sp.	

Drobon Downstream

Vegetation Growth Habit	Species observed	Comment
Emergents	*Brachiara mutica*	These plants were observed at this site in marginal quantities.
	Commelina flos-capa	
	Cyperus sp.	
	Ludwigia sp.	

Atonsu Upstream

Vegetation Growth Habit	Species observed	Comment
Emergents	*Commelina flos-capa*	These plants were observed at all sites in marginal quantities
	Cyperus sp.	
	Ipomoea sp.	
	Luffa sp.	
	Ludwigia sp.	
	Polygonum sp.	
	Pycreus sp.	

Atonsu Downstream

Vegetation Growth Habit	Species observed	Comment
Emergents	*Cyperus* sp.	Species observed in patches or marginal quantities
	Ludwigia sp.	
	Polygonum sp.	
	Pycreus sp.	

Afram Upstream

Vegetation Growth Habit	Species observed	Comment
Emergents	Ludwigia sp.	This site was virtually free except few members.

Afram Downstream

Vegetation Growth Habit	Species observed	Comment
Emergents	*Polygonum* sp.	Species in marginal quantities

Appendix 2. Phytoplankton community recorded in the survey

Algal Groups	Sampling points					
	Drobon		Atonsu		Afram	
	Upstream	Downstream	Upstrea m	Downstream	Upstrea m	Downstreanm
CYANOPHYTA (BLUE-GREEN ALGAE)						
Aphanizomenon	1		2	2	4	2
Lyngbya	2	1		1	3	1
Merismopedia		2		1	1	
Microcystis	1		1		1	
Oscillatoria	1	2		1		1
Rivularia	2	2	1		1	1
Scytonema	1	2			2	
Spirulina	1	2	2	1	2	1
CHLORPHYTA (GREEN ALGAE)						

Botryococcus	1	1	2	1		2
Chaetophora		1			1	
Characiopsis	1		1	2	2	1
Chlorella	2	2	4	2	1	
Chlorogonium	2	2	2	1		2
Closterium	2	1	3	1	2	
Cosmarium	5		2	1	2	1
Desmidium	3	2	4	3	2	4
Hyalothea	1	4		1		
Microspora	1		1		1	1
Oedogonium	4	1	1	1		
Scenedesmus	1		2	1	2	
Tetradesmus		2	1	2	1	2
Zygenema	1		2		2	1
BACILLARIOPHYTA (DIATOMS)						
Achnanthes	4	8	4	2	1	1
Amphipleura	2		1	1	1	
Asterionella	5	6	9		2	1
Bacilaria	2	4	7	2	3	1
Cymbella		4	1	2	2	1
Eutonia	3	1	8	1	3	1
Fragilaria	4	3	3	1	1	
Gomphonema	1	2	1	1		1
Pinnularia		1	2		1	
Melosira	2	4	2	1		1
Meridion		2	2	1	1	2
Navicula	6	4	3			
Nitzschia	2	2	4	1	2	1
Rhizosolenia		2	3	2	1	1
Surirella		4	6	1		1
Synedra	3	5	4		1	
Synura	1	2	4	1		1
RHODOPHYTA (RED ALGAE)						
Batrachospermum	2	1	1		2	
Boldia		1	1	1		
Compsopogon	1	2	1		1	2
Lemanea		1		1		1
Siridotia	2		2	1	1	
FLAGELLATES						
Gymnodinium	2	1	1	1		1
Lepocinclis			1		1	
Peridinium	1	1		1		
Phacus	2	2	3			1
Trachelomonas	1	1	1		1	

Nb: ***Blank cells denote absence of species***

Appendix 3. Macro-invertebrate species recorded during the study

Site **DROBON**	**Taxa**		**Mean Numbers m^{-2}**
Upstream	Odonata	Calopterygidae	103
Upstream	Diptera	Chironomidae	52
Upstream	Diptera	Chironomidae	802
Upstream	Diptera	Psychodidae	34
Upstream	Coleoptera	Elmidae	12
Upstream	Ephemeroptera	Heptageneidae	15
Downstream	Diptera	Simuliidae	10
Downstream	Odonata	Libellulidae	112
Downstream	Gastropoda	Limnaeidae	36
Downstream	Hemiptera	Nepidae	22
Downstream	Gastropoda	Piladae	28
Downstream	Prawn	Crustacea	276
ATONSU	**Taxa**		**Mean Numbers m^{-2}**
Upstream	Diptera	Chironomidae	10
Upstream	Coleoptera	*Nanocladius*	55
Upstream	Odonata	Coenagriidae	67
Upstream	Prawn	Crustacea	235
Upstream	Hemiptera	Notonectidae	23
Upstream	Gastropoda	Piladae	42
Downstream	Hemiptera	Gerridae	134
Downstream	Libellulidae	Odonata	6
Downstream	Odonata	Libellulidae	21
Downstream	Coleoptera	Gyrinidae	50
Downstream	Odonata	Coenagriidae	875
Downstream	Hemiptera	Belostomidae	67
AFRAM	**Taxa**		**Mean Numbers m^{-2}**
Upstream	Diptera	Chironomidae	14
Upstream	Hemiptera	Pleidae	29
Upstream	Coleoptera	Elmidae	15
Upstream	Ephemeroptera	Caenidae	23
Upstream	Ephemeroptera	Baetidae	45
Upstream	Ephemeroptera	Baetidae	35
Downstream	Hemiptera	Belostomidae	30
Down stream	Gastropoda	Limnaeidae	35
Down stream	Hemiptera	Gerridae	122
Downstream	Ephemeroptera	Heptageneidae	27
Down stream	Odonata	Libellulidae	135
Downstream	Diptera	Chironomidae	65

Annex 6 Environmental, Health/Safety Policies.

Miro Forestry Company Policies & Procedures

Approved by:

Andrew Collins, CEO

21st December 2015

Contents

ANTI-CORRUPTION and WHISTLEBLOWING Policy

The Policy

This document sets out the Policy of Miro Forestry Developments Limited ("Miro Forestry" or the "Company") on combatting corruption. It was endorsed by the Board of Directors of the Company on 24th April 2015 and applies to all subsidiaries and global operations.

The Policy consists of two Principles and a series of Practical Procedures to give effect to those Principles. The objective of the Policy is to clearly set out the Company's "Zero Tolerance" approach to corruption. This Policy applies to all employees of Miro Forestry (which for the purpose of this Policy includes all contractors to and agents of the Company) and its subsidiaries and divisions as well as members of its Board of Directors.

The Principles

1. Miro Forestry will not pay nor accept bribes, kickbacks, or facilitation/speed payments ("corrupt payments"), either directly or via third parties, in any circumstances. Breaches or attempted breaches of this Principle by an employee will be regarded as an act of gross misconduct.

2. Miro Forestry will seek to encourage an equivalent Policy in other entities with which it has a significant business relationship.

3. Miro Forestry will comply with all relevant legislation and the UK Bribery Act (2010).

Practical Procedures

1. **Responsible Person**
   Miro Forestry will at all times have a nominated Director or senior manager responsible for overseeing and reporting on the implementation of this Policy.

   The Director/senior manager will be sufficiently senior to be fairly regarded as independently minded.

   The current Director/senior manager responsible for this role is Mr. Andrew Collins, Group CEO (the "Responsible Person"). In discharging this role he will report to Mr. Richard Laing, Chairman of the Board of Directors of the Company.

2. **Review and Report**
   The Responsible Person will monitor, review and at least annually report on the effectiveness of and adherence to this Policy, and the steps taken to implement it. The report will be submitted for approval by the Board of Directors.

3. **Senior Management Information**
   Miro Forestry's senior management will be kept informed of the steps taken to implement the Policy, the conclusions of any reviews and any material findings arising out of the work of the Responsible Person.

4. **Internal Record Keeping**
   Miro Forestry will ensure that records are maintained of such reviews and the consequent reports to senior management.

5. **Employee Conduct**
   Employees are required to report any knowledge or suspicions of the request for, offering, giving or receiving of a corrupt payment. A failure to do so may be considered gross misconduct.

   No employee will suffer demotion, penalty or other adverse consequence for refusing to pay or accept a corrupt payment even if such a refusal may result in Miro Forestry losing business or failing to win a contract.

6. **Whistleblowing**
   Miro Forestry is open to and regards the reporting of any instance of actual or attempted corruption as a legitimate example of “whistleblowing,” and affirms that no employee will suffer demotion, penalty, or other adverse consequences for reporting corruption.

7. **Internal Communication and Training**
   Miro Forestry will communicate these Principles and Practical Procedures to all employees, and will reflect this Policy in the Employee/Staff Handbook.

   Training will be provided to staff so that they are aware of this Policy, relevant anti-corruption legislation and their obligations under the Policy and their contract of employment.

   Regular training will be provided to employees in particularly high risk roles.

8. **Associates**
   Miro Forestry will conduct screening procedures on agents, advisers, contractors, intermediaries, and other representatives who supply material goods and services to it ("Associates") to protect the Company from the risk of it being associated with or benefiting from corrupt payments, and to ensure that the highest ethical standards are maintained.

   Miro Forestry requires that Associates are made aware of this Policy and to confirm that they will not participate in any transaction that will put it in breach of the Policy, and that such Associates have adequate procedures for preventing their own staff engaging in the giving or receiving of bribes, kickbacks, or facilitation/speed payments.

9. **Gifts & Hospitality Register**
   Miro Forestry will record all gifts and corporate hospitality given and received by its staff, subject to an appropriate minimum threshold of USD 50 or equivalent, in a Gifts & Hospitality Register. These records will be reviewed regularly by the Responsible Person.

10. **Auditing and Reporting**
    The report and accounts of Miro Forestry will include an assessment of the implementation, workings and effectiveness of this Policy.

LAND DEVELOPMENT Policy

The Policy

This document sets out the Policy of Miro Forestry Developments Limited ("Miro Forestry" or the "Company") on ensuring responsible and sustainable stewardship of the land that the Company leases or manages, and applies to all subsidiaries and global operators.

Miro Forestry is firmly committed to operating with integrity and to delivering maximum long-term economic, social and environmental benefits to its stakeholders. To achieve this the Company has a strict approach to land development. This Policy is based on good international industry practice and national laws and legislation. In order to give effect to the Principles of this Policy there are a number of Practical Procedures to be followed as set out below. This Policy applies to all employees of Miro Forestry (which for the purpose of this Policy includes all contractors to and agents of the Company) and its subsidiaries and divisions.

The Company will monitor, audit and review this Policy, the Principles and Practical Procedures (detailed below) on a regular basis to ensure they remain current and appropriate to the nature and scale of the Company.

The Principles

1. Miro Forestry respects all national and local laws and regulations. Long-term tenure and rights to the land and forest resources are clearly defined, documented and legally established under national legislation.
2. Miro Forestry recognises and respects the rights of the local communities and respects the cultural heritage of the communities where the Company operates. The Company's goal is to have a positive impact on the livelihoods of the people surrounding and affected by its operations. Miro Forestry works closely to consult with stakeholders to ensure the protection of their land rights, cultural heritage sites and values.
3. Miro Forestry aims to conserve biological diversity and its associated values including water resources, soils, ecosystems and landscapes.
4. Miro Forestry is firmly committed to sustainable forest management practices, including those prescribed by the Principles and Criteria of the Forest Stewardship Council (FSC) and the International Finance Corporation (IFC) Performance Standards.

Practical Procedures

1. **External Verification of Environmental and Social Impacts**

   The Company contracts reputable independent experts to conduct Environmental and Social Impact Assessments for the Company's land areas. This provides the Company with a verified baseline on which to base its sustainable forest management.

   All areas identified for environmental and social conservation are demarcated and protected with buffer zones.

2. Management Systems

The Company follows a strict **Land Development Implementation Framework** to ensure all involved in the process are aware of their responsibilities.

The Company conducts its own robust due diligence prior to land preparation. It does this in the form of a plot by plot **Environmental and Social Risk Assessment**. The Company demarcates all areas of cultural and biodiversity significance and protects them with a buffer zone. The Company aims to facilitate the rehabilitation of degraded forests and ecosystems within the conservation areas and will always conserve areas of pristine indigenous forest and other high conservation value areas.

On an annual basis the Company conducts stakeholder mapping which feeds directly into a **Stakeholder Engagement Plan** to ensure proactive and open communication with all communities and stakeholders. The Company aims to build enduring relationships with its neighbours that are characterised by mutual respect, active partnership and long-term commitment. Through this relationship any concerns can be bought to the forefront.

The Company has a **Grievance Mechanism** that provides an open and neutral mechanism for grievances to be raised and ensures appropriate mechanisms to aim to resolve any disputes.

3. External Auditing

The Company is working toward FSC certification in 2017, for certification the Company will undergo annual audits to ensure that it is operating in an environmentally and socially responsible way.

OCCUPATIONAL HEALTH AND SAFETY and LABOUR Policy

The Policy

This document sets out the Policy of Miro Forestry Developments Limited ("Miro Forestry" or the "Company") on ensuring fair labour and continuous improvement in Safety and Health performance, and applies to all subsidiaries and global operations.

This Policy is based on good international industry practice and national laws and legislation. In order to give effect to the Principles of the Policy there are a number of Practical Procedures. This Policy applies to all employees of Miro Forestry (which for the purpose of this Policy includes all contractors to and agents of the Company) and its subsidiaries and divisions.

The Company will monitor, audit and review this Policy, the Principles and Practical Procedures (detailed below) on a regular basis to ensure they remain current and appropriate to the nature and scale of the Company.

The Principles

Miro Forestry will:

1. Comply with all national and international laws, acts, regulations, permit conditions and standards as a minimum to ensure a safe and healthy workplace.
2. Maintain a productive workplace by minimising the risk of accidents, injury and exposure to health risks. The Company aims to have no incidents that harm people or put neighbours or operations at risk.
3. Promote workplace equality and endeavour to eliminate all forms of discrimination. The Company will not tolerate unfair treatment of any of its employees.
4. Ensure that all wages will meet or exceed the legal or industry minimum standard.
5. Respect the right of all personnel to form and join trade unions of their choice and to bargain collectively. Where employees are represented by a legally recognised union, the Company is committed to establishing a constructive dialogue with the employees freely chosen representatives.
6. Prohibit the use of forced and child labour.
7. Aim towards a diverse, multinational workforce reflective of the diversity of its customers, stakeholders and the countries and communities in which it operates.
8. Make available adequate resources to safely undertake work and to implement this Policy.
9. Ensure that all site personnel and contractors understand the Policy and their Health and Safety and Labour responsibilities. Contractors are obliged to comply with this Policy.
10. Ensure the development and implementation of appropriate emergency response plans.
11. Follow the health and safety guidelines set out in the International Labour Office (ILO) 'Safety and Health in Forestry'.
12. Miro Forestry is firmly committed to sustainable forest management practices, including those prescribed by the Principles and Criteria of the Forest Stewardship Council (FSC) and the International Finance Corporation (IFC) Performance Standards.

Practical Procedures

1. **Accountable Leadership**

The Company can achieve a safe workplace free of discrimination through strong accountable leadership. The basis for recruitment, hiring, placement, training, compensation and advancement at the Company is qualifications, performance, skills and experience.

The Company sets non-negotiable performance requirements for employee safety and workplace quality.

All employees are required to take reasonable care for their own health and safety and that of others who may be affected by their acts or omissions and to co-operate with management in the enforcement of this Policy. Employees must not take any action that might present Occupational Health and Safety (OHS) risk to themselves, their colleagues or the public.

The Policy and OHS arrangements will be communicated to all staff and other relevant persons working for the Company to ensure they are made aware of their individual responsibility.

2. **Internal Training and Communication**

The Company will provide the appropriate resources, training and education to ensure employees are equipped to meet these Company commitments.

We are committed to engaging with our employees to continually improve health and safety in our workplaces, including the identification of hazards and remediation of health and safety issues. If any employee feels that the health and safety standards are not adequate within the Company they are strongly advised to report this to top management through existing communication mechanisms.

The Company's Grievance Mechanism has been designed to ensure that any discrimination or concerns for safety in the work place can be voiced and addressed in a confidential and timely manner.

The Company will employ qualified Health and Safety personnel who will be responsible for providing appropriate instruction, supervision and information to enable employees to carry out their duties safely and to actively contribute to safety within the Company.

3. **Management Systems**

The Company is committed to the development and implementation of local safety and occupational health management systems that meet its commitments. The Company sets objectives annually for Health and Safety Standards to enable it to meet with relevant statutory obligations and ensure a culture of continual improvement and one which strives towards attainment of a world class standard.

Through excellent risk management practice, the Company will aim to minimise occupational health and safety risk. The Company has an Integrated **Corrective and/or Preventative Action Request System** that enables all employees to raise potential or present risks. Incidents, Accidents and Near-misses are recorded in an **Incident, Accident and Near-miss register** which is reviewed monthly and appropriate mitigation measures put in place.

Due to the nature of forestry and operating in Africa the Company has a focus on Road Safety, realised through the Company **Road Safety Management Plan**.

There is a **Grievance Mechanism** in place for any employee to raise any concerns, for example of discrimination or unfair treatment, this can be done anonymously.

The Company will establish an effective organisational structure for implementing these Management Systems and integrating occupational health and safety arrangements with other general management systems.

4. Internal and External Auditing

All Policies and Management Systems are reviewed on an annual basis to ensure they remain current and appropriate to the nature and scale of the Company's safety, security and occupational health risks.

The Company is working toward FSC certification in 2017, for certification the Company will undergo annual audits to ensure that it is operating to Occupational Health and Safety and Labour highest standards.

Management System and Incident and Accident updates are given to the Environmental, Social and Governance (ESG) Committee on a quarterly basis. The Committee have the power to escalate any concerns if a worrying incident or pattern is noted.

ENVIRONMENTAL and SUSTAINABILITY Policy

The Policy

This document sets out the Policy of Miro Forestry Developments Limited ("Miro Forestry" or the "Company") on ensuring sustainable and environmentally friendly forest management practices, and applies to all subsidiaries and global operators.

This Policy is based on good international industry practice and national laws and legislation. In order to give effect to the Principles of the Policy there are a number of Practical Procedures. This Policy applies to all employees of Miro Forestry (which for the purpose of this Policy includes all contractors to and agents of the Company) and its subsidiaries and divisions.

The Company will monitor, audit and review this Policy, the Principles and Practical Procedures (detailed below) on a regular basis to ensure they remain current and appropriate to the nature and scale of the Company.

The Principles

Miro Forestry will:

1. Conduct the Company's activities according to the requirements set by all relevant laws, regulations, and standards.
2. Conserve biological diversity and its associated values - water resources, soils, and unique and fragile ecosystems and landscapes.
3. Prevent pollution and strive for continual reduction in emissions of environmentally damaging substances.
4. Monitor and mitigate environmental impacts, particularly the use of chemicals, and promote biodiversity in plantation operations through systematic environmental programs.
5. Implement and maintain good practices of waste management and promote principles of reduce, reuse and recycle where possible to ensure the effective use of available resources
6. Not import, develop or establish any non-indigenous species which pose a risk to the local ecosystem.
7. Proactively identify and protect High Conservation Value (HCV) areas.
8. Provide employees adequate and appropriate training, and the required resources to perform their tasks safely, and fulfil their environmental responsibilities cost effectively
9. Ensure the development and implementation of appropriate emergency response plans
10. Apply best available, cost-effective technology in all new projects.
11. Miro Forestry is firmly committed to sustainable forest management practices, including those prescribed by the Principles and Criteria of the Forest Stewardship Council (FSC) and the International Finance Corporation (IFC) Performance Standards.

Practical Procedures

1. **Accountable Leadership**

The Company is committed to implementing this policy. The Company will use accountability for environmental issues as a measure for management performance and integrate environmental issues into strategy and plans aligned with public expectations.

2. **Internal Training and Communication**

The Company will provide the appropriate resources, training and education to ensure employees are equipped to meet our commitments.

The Company is committed to engaging with employees and communities to continually improve environmental awareness. If any stakeholder feels that there has been a breach of the environmental and sustainability policy they are strongly advised to report this to top management through existing communication mechanisms.

The Company will employ qualified environmental personnel who will be responsible for providing appropriate instruction, supervision and information to enable employees to carry out their duties minimising detrimental environmental effects.

3. **Management Systems**

The Company sets objectives annually for managing all environmental aspects of its operations and to ensure that they meet with national and international standards.

Through excellent risk management practice, the Company minimises negative environmental effects. The Company has an integrated **Corrective and/or Preventative Action Request System** that enables all employees to raise potential or present environmental risks.

There is a **Grievance Mechanism** in place for any stakeholder to raise any concerns of a breach in Policy.

The Company will establish an effective organisational structure for implementing these Management Systems and integrating environmental aspects with other general management systems.

4. **Internal and External Auditing**

All Policies and Management Systems are reviewed on an annual basis to ensure they remain current and appropriate to the nature and scale of the Company's safety, security and occupational health risks.

The Company is working toward FSC certification in 2017, for certification the Company will undergo annual audits to ensure that it is operating to stringent environmental standards.

Updates are given to the Environmental, Social and Governance (ESG) Committee on a quarterly basis, the Committee have the power to escalate any concerns should they feel the Company is not operating in a sustainable or environmentally friendly manner.

COMMUNITY ENGAGEMENT and EXTERNAL STAKEHOLDER Policy

The Policy

This document sets out the Policy of Miro Forestry Developments Limited ("Miro Forestry" or the "Company") on ensuring that the Company engages with all of its relevant stakeholders and has a positive impact on the communities where it operates.

This Policy is based on good international industry practice and national laws and legislation. In order to give effect to the Principles of the Policy there are a number of Practical Procedures. This Policy applies to all employees of Miro Forestry (which for the purpose of this Policy includes all contractors to and agents of the Company) and its subsidiaries and divisions.

The Company will monitor, audit and review this Policy, the Principles and Practical Procedures (detailed below) on a regular basis to ensure they remain current and appropriate to the nature and scale of the Company.

The Principles

Miro Forestry will:

1. Conduct the Company's activities according to the requirements set by all relevant laws, regulations, and standards.
2. Engage pro-actively with all stakeholders to ensure that we are listening to, learning from and taking into account their views as we conduct our business.
3. Support all cultural values and respect local customs.
4. Operate sensitively in the communities of which we are part and maintain good relations.
5. Creating economic opportunity and have a positive impact on the local communities in which the Company operates.
6. Ensure community participation in its project development and contribute to community development through Company funded development projects.
7. Ensure that all community development activities affect those in the local vicinity of Company operations. All development projects are at the discretion of the Company, all projects will have consistent design and branding.
8. Work with a select group of relevant development organisations to maximise positive impact.
9. Provide a grievance mechanism whereby all stakeholders can voice any concerns anonymously or without fear of reprisal, the grievance mechanism has multiple communication channels to ensure inclusiveness, particularly for vulnerable groups.
10. Respond to all legitimate grievances with suggested solutions within 30 days, if an agreement cannot be made, a neutral mediator will be used.
11. Miro Forestry is firmly committed to sustainable forest management practices, including those prescribed by the Principles and Criteria of the Forest Stewardship Council (FSC) and the International Finance Corporation (IFC) Performance Standards.

Practical Procedures

1. **Internal Training and Communication**

The Company will provide the appropriate resources, training and education to ensure employees are equipped to meet our commitments.

The Company is committed to engaging with stakeholders to continually improve mutually beneficial relationships. If any stakeholder feels that there has been a breach to any commitments they are strongly advised to report this to top management through existing communication mechanisms.

The Company will employ qualified personnel who will be responsible for liaising with stakeholders and provide relevant information to stakeholder groups.

2. **Management Systems**

The Company sets objectives annually for managing all stakeholder relations and community development and to ensure that they meet with national and international standards.

An annual **Stakeholder Engagement Plan** forms a backbone to all stakeholder engagement. A monthly **Stakeholder Engagement Record** is used to monitor the effectiveness of the plan.

There is a **Grievance Mechanism** in place for all stakeholder to raise any concerns, the Company has committed to replying to legitimate grievances within 30 days with suggested resolutions, if a mutual agreement cannot be made a meditator will be enlisted. All grievances are recorded in a **Grievance Register** which is analysed monthly.

All documentation relating to community and stakeholder issues is kept in a consistent, Company-wide, documentation management system.

The Company will establish an effective organisational structure for implementing these Management Systems and integrate stakeholder engagement with other general management systems.

3. **Internal and External Auditing**

All Policies and Management Systems are reviewed on an annual basis to ensure they remain current and appropriate to the nature and scale of the Company's safety, security and occupational health risks.

The Company is working toward FSC certification in 2017, for certification the Company will undergo annual audits to ensure that it is operating to highest international standards.

Updates are given to the Environmental, Social and Governance (ESG) Committee on a quarterly basis, the Committee has the power to escalate any concerns should they feel the Company is not operating in a sustainable or socially correct manner.

PUBLIC RELATIONS, COMMUNICATIONS and MEDIA Policy

The Policy

This document sets out the Policy of Miro Forestry Developments Limited ("Miro Forestry" or the "Company") on Public Relations, Communications and Media and applies to all subsidiaries and global operations.

The Policy consists of Principles and a series of Practical Procedures to give effect to those Principles. The objective of the Policy is to clearly set out the Company's approach to Public Relations, Communications and Media. This recognises the importance of maintaining an open and responsive approach to maintain and build positive perceptions of the Company with stakeholders, all third parties and in the public eye.

The Principles

1. This Policy exists to assure that information disclosed by Miro Forestry is timely, accurate, comprehensive, authoritative and relevant to all aspects of the Company. Adherence to this Policy is intended to provide an effective and efficient framework to facilitate the timely dissemination of information.

2. This Policy applies to all employees of Miro Forestry (which for the purpose of this Policy includes all contractors to and agents of the Company) and its subsidiaries and divisions as well as members of its Board of Directors. This Policy covers all contact with all stakeholders and third parties which could be expected to result in publicised media coverage and therefore includes contact with NGO's and similar organisations.

3. This Policy covers all external news media including broadcast, electronic and print.

Practical Procedures

1. **Designation of Company Spokesperson**
   The CEO of Miro Forestry (Mr. Andrew Collins), and in his absence the Chairman of the Board of Directors (Mr. Richard Laing), and in his absence a named individual appointed by the Board of Directors, is designated as the Company's principal media contact and Company spokesperson (the "Primary Spokesperson"). The Primary Spokesperson has the group knowledge and authority to interpret each media inquiry to determine the best way to provide information. The Primary Spokesperson will convey the official Company position on issues of significance or situations that are particularly controversial or sensitive in nature.

2. **Primary Spokesperson Responsibilities**
   Company communications responsibilities of the Primary Spokesperson include:
   - Providing accurate true information on the Company.
   - Increase public awareness and understanding of the Company, the services provided by the Company and future prospects.
   - Promoting a positive public image of the Company and the work it undertakes that is important to the Company and stakeholders including customers, suppliers, employees, local persons, governmental officials, shareholders and industry peers amongst others.

Depending on the situation, a third party individual or group may be asked to be a spokesperson (under the authority of the Primary Spokesperson or Board of Directors only) on a particular issue due to their knowledge, experience and expertise. The Primary Spokesperson will work with that designated spokesperson to prepare them for the media interview as needed.

3. Guidelines for Talking with the Media

A reporter, producer or other actual or possible news / information media or enquirer may contact any employee or associate of the Company for a number of reasons, for example:

- To get information about the Company.
- To get information about a recent unexpected event such as natural disasters, thefts or arrests, accidents or injuries; customer or employee complaints, federal, state or local regulatory actions etc.
- To get information or comment about an action or event that could impact the Company's industry, new competitive entrants, new product launches, changes in government or Company policies etc.
- To get general information on a topical story that may affect the Company such as changes in local governmental officials or policies, problems or issues specific to the community in which the Company operates etc.

Employees must refer all media calls to the Primary Spokesperson. The employee should tell the reporter/enquirer that "Miro Forestry's policy is to refer all media inquiries to senior management. Senior management can be reached at +44 (0)203 675 0994 or through any of the contact details given on the Company's website which is www.miroforestry.com".

Whenever having contact from the media the employee should be courteous, professional and prompt (first impressions are important). Employees should inform their line manager after media contact, outlining the enquiry being made and any relevant context. The message must be promptly passed to the Primary Spokesperson after there has been an approach by the media.

4. Guidelines for Photographs and Film

A similar process as described above will be used when someone from the media is requesting permission to take photographs or to film inside / on Company property or facilities. The employee should inform his/her line manager and the message passed to the Primary Spokesperson. No one will be given access to Company property / facilities for a photo or filming without approval from the Primary Spokesperson, and equally important, the Primary Spokesperson will not give approval without talking in advance with the direct manager of the particular operation / facility. This is a joint decision between the manager of the particular operation / facility and the Primary Spokesperson. Decisions will be based upon a number of considerations including but not limited to:

- What does the Company have to gain from the photo and filming?
- How much disruption will this cause to operations?
- What is the condition of the facility?

A reporter or camera crew may show up unannounced at a Company operation / facility. This is most likely to occur in crisis situations or if the media has been informed about an event at a Company operation / facility from an internal or external source.

When dealing with reporters and camera crews who may show up unannounced, employees should act with courtesy and professionalism. Contact the Primary Spokesperson immediately to explain the

situation and so that they can coordinate the necessary response. Please note that we cannot prevent the filming or photographing of common areas outside of Company property.

5. **Guidelines for Seeking Media Coverage**
   In circumstances in which you believe you have a positive news story to share with the public, contact the Primary Spokesperson, who is the only authority to decide upon the distribution of Company news releases, pitch coverage of particular events or hold news conferences.
   - Do not call a reporter directly without first consulting and gaining permission from the Primary Spokesperson.
   - The Primary Spokesperson will work with you to gather information and determine if and how media should be contacted.