

Summary Report Submitted for  
HCS Approach  
Peer Review Process

**HCS Study Project Title:**  
**Palm Bay Estate Phase 1 New Planting Area**  
**(LIBINCO)**  
**Liberia**

**Company/Organisation:**  
**Equatorial Palm Oil Plc (EPO)**  
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**May 5, 2016**

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# 1. Project Description

Location and size of study area:

- **PALM BAY ESTATE: PHASE 1 NEW PLANTING AREA** [Grand Bassa County, Liberia]
- 1570 ha

## 1.2 Overview of proposed plantation development, including land tenure claim/permit

### Concession Tenure<sup>1</sup>

On December 14, 1965, Liberia Operations Inc (LIBINC) entered into a concession agreement for the development of oil palm and other related agricultural products on a tract of land situated in New Cess area, Grand Bassa County. In October 2007, LIBINC exercised its option to renew this concession agreement under Liberia Oil Palm Inc. (LIBINCO), after transferring its rights in this concession agreement to the latter. LIBINCO is to operate under Liberia's own laws and regulation to rehabilitate and develop the 13,962ha LIBINCO Palm Bay Oil Palm Estate in District 4 of the Grand Bassa County under this 50-year concession agreement. The agreement was signed on December 21, 2007 and ratified on May 22, 2008. Since the 1960s, this land has been deeded by Palm Bay. However, following the restoration of activities by the company, there was a robust FPIC process conducted with the towns and villages within and surrounding the project area, leading to a Memorandum of Understanding (MoU) for the resurvey and land development processes in the concession area. At the end of the participatory resurvey process, the land area was reduced to 13,006.88 hectares. Under this new ratified agreement, the government also allows LIBINCO to develop an additional 20,234ha after the completion of development in the existing concession area. The additional area of which 50% of this land area needs to be used for an out-growers" scheme The existing concession area involves the rehabilitation and replanting of the existing oil palm plantation which was abandoned and engulfed by shrubs and other wild woody growth, rehabilitation of the infrastructures within the concession including staff houses, clinic, school, roads, preparation of palm nursery and the development of an oil palm mill.

a. Date concession awarded	:	August 2008
b. Terms of concession (years)	:	50
c. Rehabilitation period (years)	:	7
d. Remaining concession terms (years)	:	43
e. EPO allocation (ha)	:	13,962
f. Gross License Area (ha)	:	13,007
g. EPO Expansion area (ha)	:	10,117
h. Out Grower Allocation (ha)	:	10,117

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<sup>1</sup> It should be noted that KKK only took over the operations of EPO in 2014

Palm Bay Estate covers a total area of 13,007 Ha, which consists of two parts:

1. 8,370 Ha (Phase 1)

Majority of this area was originally developed prior to the civil war and has been abandoned ever since. Since the takeover of the estate, EPO's activity has mainly focused on rehabilitation of this area as the palms have past their economic life span. These activities as per the concession agreement were ongoing until a self-imposed moratorium was enforced in November 2014, pending the results of the HCS study.

Within Phase 1, an area of 1,570 Ha has been designated for new planting – the focus of this HCS assessment. Its NPP (New Planting Procedure) was approved by RSPO in June 2015.

2. 4,637 Ha (The remaining area on the east of Phase 1)

This area was not developed by the previous owners. The area holds a lot of communities and land cover consists primarily of shifting agriculture areas.

EPO is seeking community consent for development but response so far has been mixed. The development remains off the table in the short term.

### 1.3 Description of surrounding landscape

Grand Bassa county is located in the area from latitude 6°45' to latitude 5°30' North, and from longitude 10°30' to longitude 9°00' West (ISO 3166-2 geocode: LR-GB). On the Southwest of the County there is the Atlantic Ocean. Grand Bassa borders with four counties: Margibi on the Northwest, Bong on the North, Nimba on the East, and River Cess on the Southeast. The total land area the County is approximately 3,382 miles<sup>2</sup> (8,759 km<sup>2</sup>).

The project area falls in New Cess, District 4, Grand Bassa County. The phase 1 new planting area to be cleared is mostly agriculture land mixed with secondary forest, whereas most of the secondary forest is found along flowing streams. Except for a fragment of late secondary forest found in the extreme north of the area, the remaining vegetation is mainly young bushes, fallow areas and swamps. The late secondary forest has been greatly impacted over the years. There vegetation is fragmented with degraded agriculture vegetation and old farmland. There is a closed dense vegetation - late secondary fragmented forest directly bordering the boundary of the LIBINCO new planting block. In spite of this late secondary vegetation, there is no primary forest found within this new area neither is there any peat soil discovered.

The soil in the project area is generally a mixture of lithosols and some laterite, which is reddish brown in color containing aluminum iron, oxide and low in nitrogen concentration; swamp soil occurring in swampy areas, high concentration of humus with layers consisting of biodegradable materials; and alluvial soil with a high nutrient concentration which is suitable for agriculture. The major surface water identified in the area was the Kpoi River. This is the main surface water body that drains the project area. The eastern boundary of the existing concession is the Timbo River. This is found outside of the phase 1 LIBINCO project area. There are other small streams and creeks like the Yana Creek, Bo Creek, Kpayekoni Creek and the Zeohn Creek in the project area.

Predominantly, villages are nestled among fallow and cultivated agricultural fields, which dominate the landscape. Closest to the border of the current estate are the villages of Piakar (with an estimated population of over 100 people), New Town (about 50) as well as Debbah (around 550). These villages are situated along a gravel road and well connected to the estate with several connecting roads. Alongside this particular road are also additional, smaller villages namely Sammy Doe, the SDA Mission, Don't Care Gbah Village, Boe Dayugar, Benzon Mission and Debbah

Extension. Apart from Kphias and a small associated hamlet, which are both located amidst plantations, several villages are very close to the current planting areas. These include Gbapaywhea (just outside the entrance gate to the west), Goldmine, Joeweh, Debbah, Sugar Hill, Wisseh and Taekpelleh. Of these, Gbapaywhea is the largest village with approximately 700 villagers, followed by Debbah (around 550).

Other larger villages also include Blayahbeh at approximately 650 people, as well as Tarloe (around 375) both of which are not in the phase 1 area. Road access seems to be limited to one central road network running past Yeaway Camp. The Timbo River runs along the eastern boundary of the concession, which is a pivotal livelihood and water source for most villagers in this region. However, this river lies outside of the phase 1 project location. The closest villages to the estate and the current planting areas are Buegbor, Yonema, Geebeor and Dukpo. Beugbor is the largest village with approximate 275 residents.

## 1.4 Map of the site within the region

Please see maps below:

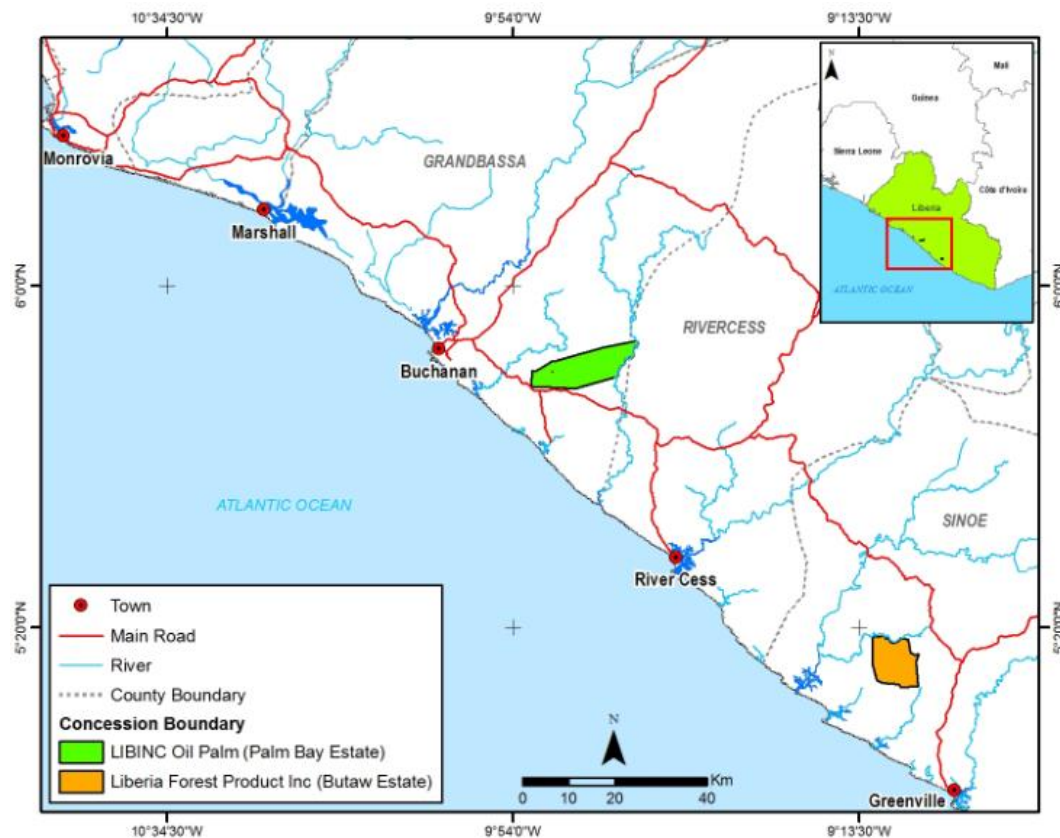


Figure 1 : Location of Palm Bay Estate, Grand Bassa County, Liberia

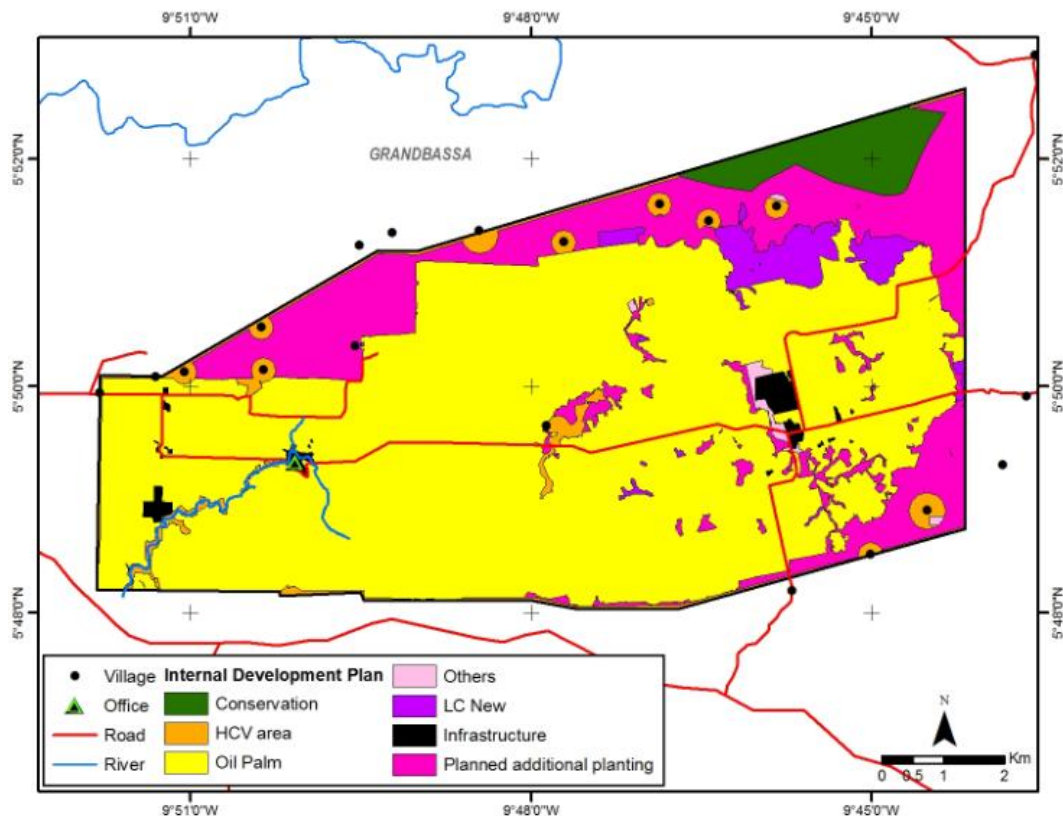


Figure 2 : Palm Bay: Phase 1 New Planting area

## 1.5 Relevant data sets available

The relevant data sets are available at the respective section of this document.

## 1.6 List of any reports/assessments used in the HCS assessment

The HCS Team reviewed the following documents:

- Reports: 1) Social & Environmental and HCV Assessments. HCV assessment was done in 2014. It did not go through the ALS as the scheme did not yet exist.
- Company internal documents (Concession agreement, CSR reports, certificate, SOPs, maps ...),
- Meetings minutes with communities;
- RSPO's communications (both from the company and RSPO);
- Other documents and reports from different stakeholders concerned by EPO activities

## 2. HCS Assessment Team

### 2.1 Names and qualifications, including in-country experience

Name	Organization	Role in the Assessment	Credentials
ALEX THORPE	Ata-Marie Group Ltd	Team leader, Remote sensing, forest inventory planning and management	A professional forester with over 20 years of experience working as an industry consultant, resource manager and trader in the forestry and agri-business sectors in South East Asia. Specific expertise focuses on project identification and due diligence, forest inventory and raw material supply assessment, resource management, and forest certification support.
GEORGE KURU	Ata-Marie Group Ltd	Processing of forest inventory data	A graduate forester and biometrician from New Zealand. George specialises in resource inventory, growth and yield modelling, information technology and traceability for the forestry and agricultural sectors. George has over 20 years of working experience in South East Asia. George is a founder and Director of Ata Marie Group Ltd.
DADAN SETIAWAN	Ata-Marie Group Ltd	Remote sensing	AGIS engineer based out of Ata Marie's Jakarta office, Dadan has been working with Ata Marie since 2010. Specific expertise focuses on land cover assessment using remote sensing techniques, and HCS GIS procedures.

Note : Forestry team members are listed under section 7.3

### 2.2 Time period for major steps in the study

- a) Environmental & Social Impact Assessments (Coastal & Environmental Services): 2013
- b) HCV Assessment (Green Consultancy): 2014
- c) HCS<sup>2</sup> (Ata Marie): August 24th to September 5th 2015

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<sup>2</sup> a socioenvironmental assessment was also conducted concurrently

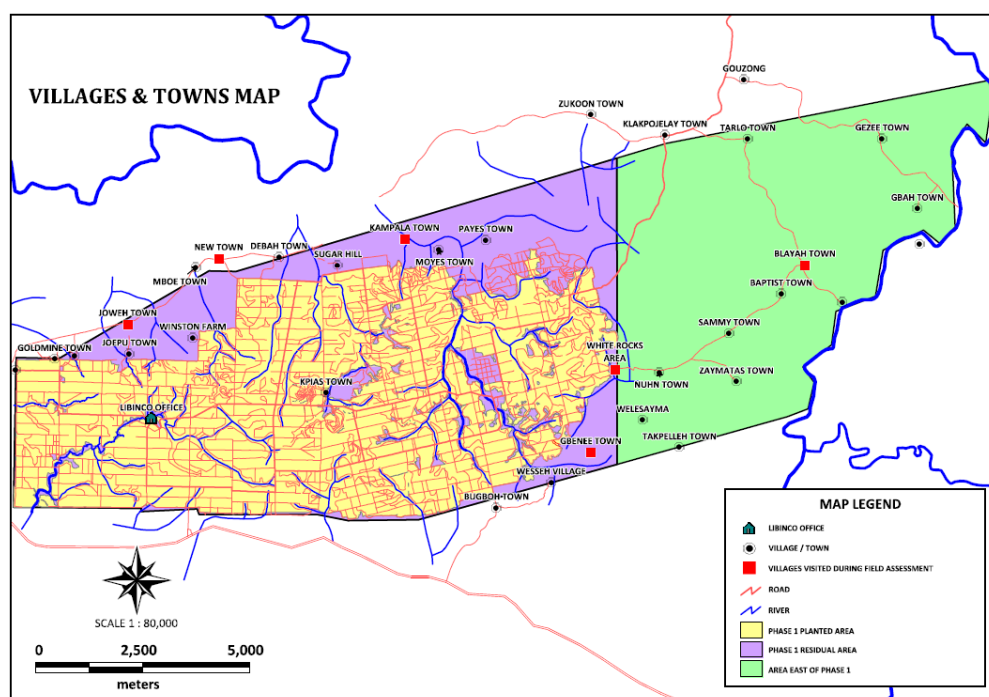


### 3. Community Engagement/ FPIC

#### 3.1 Summary of community engagement, FPIC, participatory mapping

Results and recommendations provided in the respective SEIA and HCV assessments<sup>3</sup> : <http://www.rspo.org/certification/new-planting-procedures/public-consultations/equatorial-palm-oil-libinco> , the NPP process and the impact of oil palm during operation have been communicated to the respective communities<sup>4</sup> through FPIC meetings prior to the NPP submission to RSPo. The views and suggestions of the communities during these assessments were also taken into consideration – including their participation.

While the above engagements were conducted for the earlier processes, eg : SEIA, HCV and NPP and some other FPIC engagements performed on other issues, the FPIC engagements with the communities<sup>3</sup> on the outcome of the HCS assessment have not been done<sup>5</sup>. This would take place after the finalization of the peer review process to ensure that the identification of HCS process is in accordance to the HCS Approach methodology.



#### 3.2 Summary of Social Impact Assessment link to public summary report

The public summary of the HCV and Social & Environmental Impact Assessment<sup>3</sup> is available at : <http://www.rspo.org/certification/new-planting-procedures/public-consultations/equatorial-palm-oil-libinco>

<sup>3</sup> This SEIA covered the entire Palm Bay estate and a possible expansion land, while the HCV assessment covered only the Phase 1 area of Palm Bay estate.

<sup>4</sup> Communities of Palm Bay : Phase 1 new planting area.

<sup>5</sup> not done at time when the HCS assessment was finalised – early 2016. The summary of the HCS assessment has been disclosed to the communities of Palm Bay Phase 1 during subsequent meetings.

As per Liberian laws and regulations, EPO committed respectively Green Consultancy Inc. (December 2010) to conduct the Environmental & Social Impact Assessment (ESIA). The Environmental Protection Agency of Liberia (EPAL) based on this study issued a permit covering the entire concession (existing oil palm plantation including the proposed new planting of the gross 13,007 hectares).

An Environmental, Social and Health Impact Assessment (ESHIA) was subsequently initiated by the management of LIBINCO in 2012. This assessment was conducted by Coastal and Environmental Services (CES) and completed in April 2013. This report has also been permitted by the EPAL following a public hearing in which communities members and all in attendance were allowed to give input to the presentation. The ESHIA assessment covers 24,057 ha, comprises of the current estate area (13,007 ha) and a possible expansion land. These two studies proposed (ESIA and ESHIA) that were incorporated into the detailed management and monitoring plan by the management of LIBINCO.

### ***Summary of assessment findings (for SEIA assessments)***

#### **Evaluation of positive social issues**

##### **Issue 1: Employment opportunities**

The need for employment opportunities has been stressed by all the villagers studied. In light of the estate development in the area, access to arable farmland and natural resources will be reduced. This might force households to diversify their livelihood and income-earning strategies. The value of even having one or two member in a household employed should not be under-estimated; as such, income is normally shared between household members and even between households. The local community will be considered in the first instance before migrants. A special effort will be made to provide training in various apprenticeship positions for the trainable youth. This is a positive impact of the project and will go to develop the local community directly.

The project will also provide employment avenues to local contractors/consultancy companies to carry out various project activities such as estates construction, water and electricity provision for estates and offices among others. These will create job opportunities for the local firms.

#### **Improved Local/National Economy and Institutional/National Revenue**

In addition to the direct employment, the project will result in increased trade due to the increased need for goods and services within the communities. Regular monthly earnings for laborers and artisans will give a boost to the local economy. Their purchasing power will be greatly enhanced and members of the community will be in a good position to plan their personal and family lives better. The project will infuse money into the local economy in the form of payment of workers' salaries. Building and construction materials like sand will be obtained locally. Cement will be purchased from Monrovia and Buchanan. The purchase and use of such materials will impact positively on the local as well as the national economy. The deduction of both workers and corporate taxes will enhance the national economy.

This project is expected to accrue revenue for the state through levies and taxes applied on the crude palm oil production and tax deductions from workers' salaries and contractor fees. Some government agencies will charge fees which will increase the revenue base of the institution.

Impacts	Significance without mitigation		Significance with mitigation	
	Severity	Significance	Severity	Significance
The provision of employment opportunities	slight	moderate negative	very beneficial	very high positive
A concern that access to farm labour might be reduced	severe	high negative	Moderate	Moderate negative
Skills training and scholarships	slight beneficial	moderate positive	Beneficial	High positive
The out-growers' scheme	beneficial	high positive	Highly beneficial	Very high positive

## Issue 2: Provision of Basic Social Services

Under the ratified concession agreement, LIBINCO is required to undertake initiatives aimed at providing basic social services, such as education and health services, as well as clean water. The provision of such services is also part of a project's Corporate Social Responsibility (CSR), and reinforces a client's commitment to its project affected communities. LIBINCO has made effort for the provision of access to these services in line with its CSR obligations particularly in the communities within the proposed new planting area. However, some village representatives, especially those from the communities out of phase 1 development area have stated that LIBINCO is not providing much needed social services in the area. These refer to wells, schools, clinics as well as the upgrading of roads. This seems to shape opinions that the project has not improved villagers' livelihoods to date, as many seem to have great expectations in this regard. The most pressing need amongst all the village members appears to be the need for improved road access. The project is expected to make a contribution towards social development including feeder roads upgrading and maintenance within the project catchment, sanitation facilities, schools etc. The project is also expected to open up the area through road construction to link the communities and the project site. The project will create incentive for the population in the area to increase. This will provide opportunity for mobile communication and other public utilities to emerge in the area.

Impacts	Significance without mitigation		Significance with mitigation	
	Severity	Significance	Severity	Significance
The need to upgrade roads	severe	moderate negative	very beneficial	high positive
The need to provide health, water and sanitation services	moderate	moderate negative	moderate beneficial	moderate positive

## Evaluation of the negative social values

### Issue 1: Reduced access to and loss of productive agricultural land and farming practices

Subsistence agriculture accounts for the primary livelihood of the entire project affected communities. Some village members have expressed concern that their access to productive farmland might be reduced if the project expands. This concern is coupled with the possibility of economic displacement (i.e. where productive or future farmland might be taken for oil palm plantings). Some of the concerns are based on villages' past experience with the LAC Plantation to the north, as many claim that their villages have undergone relocation to accommodate rubber plantations. Consequently, many fear that the project might restrict them from their agriculturally based livelihood by seizing land for oil palms. Moreover, some villages are engaged in small-scale gold mining (especially along mountain edges and some rivers). For these villages, income from these mining activities is significant, and in some cases supersedes that of wild palm oil. Subsequently, some elements of the population from these villages voiced apprehension that the expansion of the project might reduce their access to these gold fields, which are distantly located outside of the concession area. These concerns have limited the amount of land LIBINCO can develop in the area with some communities in the eastern front of the concession rejecting attempts by LIBINCO to develop oil palm in their areas. Hence, LIBINCO is currently engaged with the

communities and would only develop plantation in those areas where there is a clear consent from the local people.

## Issue 2: Heightened food insecurity

Current agriculture production in the project affected communities are very much limited due to limited agriculture extension and support services, lack of seeds and farm inputs, threats posed by pests and rodents and climate change<sup>4</sup>. The conversion of farm land to oil palm plantation could reduce the amount of land available for agriculture. As mentioned earlier, most villagers are subsistence farmers. Few household members are employed, whilst commercial agricultural is very limited across the study area. Food insecurity might become an issue for several reasons. These include a reduction in the local agriculture labor force with many locals showing preference for employment with LIBINCO, which might result to low food production. The influx of job seekers in the area will also result in increase on demand for food. Additionally, the oil palm development will limit the amount of land available for agriculture activities for those communities that are within the development area. LIBINCO have engaged the affected communities in a consultative process for the setting aside of reserve land for farming activities within the development area to enable local farmers to continue to farm on lands that are contiguous to their communities and avoid displacement.

Traditionally, local farming activities such as clearing, burning and planting have been associated with seasonal calendar with which local farmers have become accustomed. Recent changes in the local climate resulting to irregular shift in the calendar for the rainy season or dry season (irregular rainfall, flooding, drought, temperature variation); and the lack of climate forecast information has left farmers vulnerable in respect to the timing of their farming activities, which has resulted to poor land preparation, crops failures and poor harvest (Liberia National Adaptation Programme of Action-2006).

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Reduced access to productive land	very severe	very high negative	beneficial	high positive
Heightened food insecurity	very severe	very high negative	moderate beneficial	high positive
Fire hazard	very severe	high negative	moderate beneficial	low positive
Village out-migration	severe	moderate	slightly beneficial	moderate positive

## Issue 3 : Reduced access to natural resources

Conversion of forest areas to oil palm would result in the clearing of valuable forest products that are essential to community livelihood, or that village members might be restricted from accessing such resources. Dependence on the natural resources is significant, and without this access, the livelihoods of these villagers are compromised, as most do not have access to regular income or alternative livelihood strategies. At present, the villages' lifestyles are culturally interwoven with the collection of plants and fruits, as well as hunting. Many villages near the LAC Plantation seem to bear witness to how the rubber plantations have already reduced the natural resources. Such recollection produces concern among many that this issue will be replicated by the expansion of the oil palm estate. There is also concern that the project could result to possible reduction in forested areas, villagers fear that they might not have access to natural oil palms any longer. Many harvest natural oil palms in the forests, and are dependent on this income; the highest sources of incomes amongst all the villages. It is anticipated that the proposed outgrower's scheme will compensate for this possibility.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Reduced access to forest & wildlife	very severe	very high negative	moderate beneficial	moderate positive

#### Issue 4 : Loss of cultural sites

Under the ratified concession agreement, the protection of the environment and continued community access to public spaces and culturally significant sites are stressed. The agreement states foremost that operations will proceed in accordance with the Forestry Law, as well as the Environmental Protection and Management Law of Liberia. Moreover, it has been agreed that all trails across the production area, used immemorially by the population, shall remain open to free use by the public, whilst tribal reserves, or sacred tribal land (or sites) shall be set aside for the communal use of any tribe in the area.

With the reduction of forest areas, there are concerns that the forested areas might be reduced. This, it is feared, might reduce the areas available for local people's sacred sites. Secondly, another associated impact is that of the loss of graveyards. Amongst the studied villages, some graveyards are very sacred and embody the spirits of ancestors for whom much respect is garnered. LIBINCO has already identified and mapped out grave yards within the affected communities. These will be isolated from the development areas and be managed as HCVs in concert with the communities.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Loss of sites for cultural practices	very severe	high negative	slight	moderate negative
Loss of graveyards	very severe	high negative	moderate	moderate negative

#### Issue 5 : Community Values

Community and social values can be compromised by the establishment of the plantation dwelling, Crime, use of alcohol and disagreeable behavior by workers are all problems that can arise. The introduction of these workers together at the project area has the potential to create some social concerns. There is the potential for an increase in criminal activities, and abuse of alcohol as a result of additional income. In addition, since the workers will be housed at the same campsite there is the potential for conflicts through disagreements. Recreational activities such as sports will also be promoted by the Company. Every effort must be made by the company to ensure that it does not promote alcoholism.

Increase in volume of traffic: There may also be project infrastructure and project activities which cause safety risks. This may increase the potential for accidents. Transportation of the Fresh Fruit Bunch to the palm oil mills and of the palm oil to the port respectively by tractors and trucks and the workers' transportation vehicles, will impact the traffic activities by generating dust and noise pollution.

#### Increased noise levels are expected from:

- machinery use during vegetation clearance;
- movement of heavy duty vehicles; and
- Operations of earthmoving equipment.

The removal of vegetation and construction spoils can be a nuisance and create insanitary conditions and aesthetic problems. These include: The agrochemicals: (Fertilizers, Pesticides, Insecticides, fungicides, etc); the hydrocarbon products for the generators, cars, tractors and trucks, etc., such as diesel fuel, oil and grease, lubricants, etc...

Increase in population in the area will exert pressure on the weak sanitation systems in the communities with increase in the use of open pit latrines and bushes. This means people may come in direct contact with rivers and streams, which can lead to faecal contamination. Limited access to clean water and poor sanitation include diarrheal diseases which can lead in severe cases to cholera outbreaks. These diseases present a high risk to vulnerable persons such as children or those with pre-existing health conditions.

Workers health and safety can be impacted during the operation of the project. The main impacts likely are:

- Risk of accidents from the operation of mills and heavy-duty machines,
- Exposure to excessive noise and fumes from the operation of machines; and
- Exposure to vector borne diseases (already high).
- Increase in community injuries and fatalities due to road traffic accidents
- Deterioration of community health due to exposure to contaminated water supply
- Deterioration of community health due to degradation of air quality from particulate matter arising from unpaved roads likely, with the introduction of increased traffic in the area as project operations intensifies

## 4. High Conservation Value Assessment

### 4.1 Summary and link to public summary report

The public summary of the HCV<sup>6</sup> and Social & Environmental Impact Assessment is available at : <http://www.rspo.org/certification/new-planting-procedures/public-consultations/equatorial-palm-oil-libinco>

The following HCVs were found to be present in Palm Bay (Phase 1, the scope of the assessment) :

- a) HCV 1.2: Concentrations of rare, threatened or endangered species: It is most likely that the vegetation along the Yana, Bo, Kpayekoni and Zeohn Creeks and Kpoi rivers contain rare, threatened or endangered species since other endemic mammals species like the Lesser Spot-nosed Monkey (*Cercopithecus petaurista buettikoferi*) and Maxwell's Duiker (*Philantomba maxwellii*) were found around such area.

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<sup>6</sup> This HCV assessment covered the phase 1 area of Palm Bay estate - 8370ha , while the scope of this HCS assessment encompass the Palm Bay : Phase 1 New Planting area only.

b)

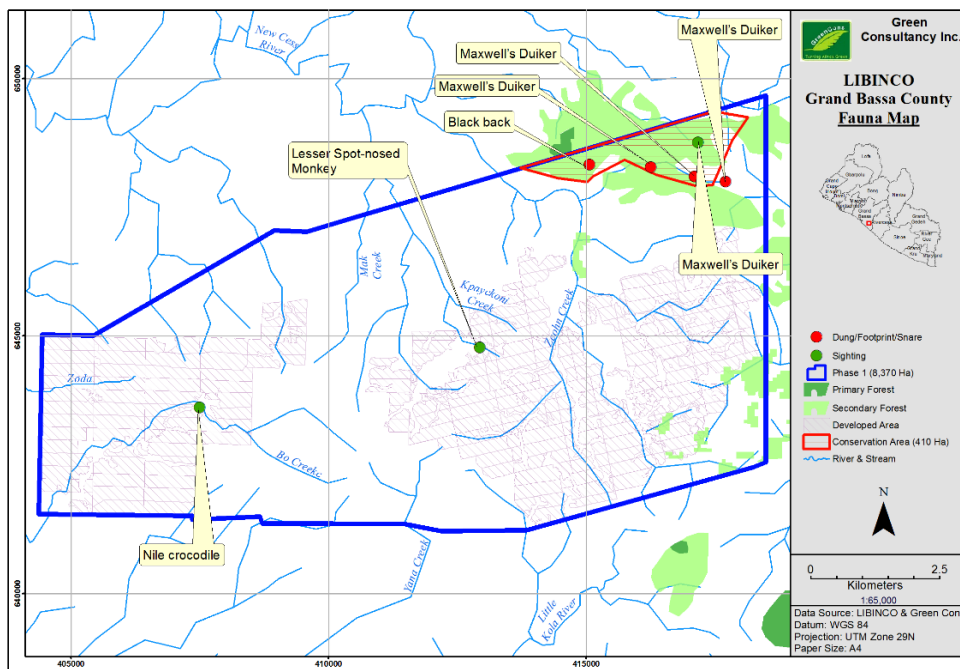


Figure 4 : Map showing fauna species distribution

The presence of the herpetofauna like the Nile crocodile (*Crocodylus niloticus*) reported by the locals along these vegetation are indications of habitat characteristic of rare, threatened or endangered species. The presence of two species of birds, the Gray Parrot (*Psittacus erithacus* African) and the Copper-tailed Glossy Starling (*Lamprotornis cupreocauda*) were discovered within the late secondary forest located mainly in the North-east of the new planting block. It is certain that, should an adequate faunal sampling take place in both wet and dry seasons around these sites, many more mammal species would be recorded, especially along the rivers and swamps. In light of this determination and the precautionary principle, HCV 1.2 is deemed to be potentially present.

- c) HCV 1.3: Concentrations of endemic species: One endemic mammal species the Lesser Spot-nosed Monkey, *Cercopithecus petaurista buettikoferi*) was recorded during the site visit to the Palm Bay concession. Reports from locals also confirmed sighting of the Nile crocodile (*Crocodylus niloticus*) along major river and creeks and its surrounding tributaries of the project area.

While none of these endemic fish species were seen, interview with the local communities confirmed and were certain of the presence of the *Tilapia coffea* in most of the streams and rivers within their areas. With the potential presence of some endemic species it can be concluded that some endemic species are present within the new planting block as well as the rehabilitated estate. It can therefore be concluded that HCV 1.3 is potentially present within the proposed NPB.

- d) HCV 1.4: Critical temporal concentrations of species: The vegetation along the New Cess and Kpoi Rivers could possess suitable habitat for most bird species some of which could be migratory birds. There are area of High sensitivity which have high species richness and are not hugely impacted by current land-use and consequently are not degraded, for instance the vegetation along the Yana Creek, Bo Creek, Kpayekoni Creek and Zeohn Creek, including those found outside of the project area along the Timbo River. In the absence of extensive ground truthing along the swamps, streams and river banks, the precautionary principles can be invoked

to accept these areas as area containing habitats for temporary and seasonal use and therefore, HCV 1.4 can be considered potentially present.

- e) HCV 4.1: Areas critical to water catchments: There are no wetlands of international significance within the project area even though there are other areas which are essential for the regulation of the flow of rivers or streams, preventing severe floods, or maintaining water quality. The assessment recorded swamps and other riparian areas with species such as *Bambusa vulgaris*, *Lymnophyton angolense*, *Osmunda*, *Cyper cyperanius*, *Laccosperma*, *Azelia*, *Amphimas pterocarpoides*, *Lymnophyton*, *Lophira alata sclaria*, *Abura*, *Liberia Hut McBride E Hurry roof* thatch, *Raphia Hookeri*, *Xylopia*, *fagara*, among others. Many of these species have been harvested heavily by inhabitants in the area mainly for construction purposes. The buffering of the streams, rivers and creeks of the project area and the riparian and catchment vegetation protecting these water bodies from continuous runoff indicate the presence of HCV 4.1. The buffering of these waters is indicative of the width of the water body.
- f) HCV 4.2: Areas critical for erosion control. The vegetation overlooking surface water bodies controls erosion, land degradation and discharge of sediments into rivers. These have restricted flooding of farmland, village pathways and sometimes bridges and roads. Besides erosion control, the vegetation along waterways has been critical in terrain stability, landslides, avalanches and downstream sedimentation. The late secondary forest in the area is situated on a steep hill with partially close canopies; while agriculturally degraded forest is mainly found on flat plain and clear area. The flat plain has been mainly disturbed by human activities. Most of the smaller streams and creeks overflow their banks during heavy rains. The steep hills vegetation has been strategic in avoiding massive erosion to the lowland especially during the heavy rain between June-August. Because of these function provided by the vegetation along the waterways, it can be stated that HCV 4.2 may exist within the study area. It is recommended that vegetation along waterways and those on steep hill be identified, demarcated and avoided during land clearing.
- g) HCV 5: Areas fundamental to meeting the basic needs of local communities<sup>7</sup>. There are about 20 communities located within or surrounding the Palm Bay : Phase 1 New Planting area. Residents of these communities heavily depend on the forest and natural resources for their livelihood to include farming, fishing, hunting, collection of building materials, etc. Additionally, the non forest timber product (NTFP) used by the communities are collected from vegetation along different rivers and creek, and especially wetlands. In the absence of these wetlands, stream, rivers and forest area, communities within Palm Bay : Phase 1 New Planting area would be pushed to migrate in order to survive, as there will be no areas to be used for their daily livelihood. Species such as the *Liberia hut McBride roof* thatch, *Musanga cecropioides*, *Elaies guineensis*, *Raphia hookeri*, *Laccosperma opacum*, *Eremospatha macrocarpa* and *Bambusa vulgaris* are some of the important species used for food and construction materials in the area. As a result of communities' reliance on these forest, wetlands, rivers and streams for livelihood, it can be stated that HCV 5 does exist. Hence, LIBINCO will have to ensure that its operation does not clear the conservation area identified within the project area to allow communities access to construction materials and farmland.
- h) HCV 6: Areas critical to cultural identity (values):  
Several burial ground have been identified and demarcated within the rehabilitated area and the ten towns of which fall within proposed new planting block. This was done by the management of LIBINCO in consultation with the local communities. In addition, some communities have also

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<sup>7</sup> Most of these are located in the Palm Bay : Phase 1 New Planting area



indicated the presence of sacred sites (Sande) in relation to their community. These sites exist normally in forested areas. The team was unable to collect GPS coordinates for these locations owing to local taboos regarding outsiders getting in proximity to these areas. As a result of identification of burial grounds and sacred areas used and value by communities, it can be concluded that HCV 6 is present.

Discussion pertaining to HCV which are found to be absent is as follow :

a) HCV 1 Concentrations of biodiversity values

As a result of 1,570 hectares proposed new planting block which is set to be develop by LIBINCO, all areas within the new planting block have been assessed for HCVs identification, demarcation and mapping. As it relates to HCV 1.1 neither the proposed new planting block (NPB) nor the rest of the replanted and rehabilitated areas is found near or adjacent to any protected or proposed protected area. The nearest proposed protected area is the important bird area (IBA) in Cestos-Senkwen, which is approximately 55.63km east of the project site, The next nearest in terms of large landscape area to the phase 1 project area is the Margibi Mangrove which is 47.8km west of the NPB. Thus, HCV 1 does not exist within this phase 1 project area.

b) HCV 2 Landscape---level ecosystems and Mosaic

HCV 2 is present where a forest area is sufficiently large and relatively undisturbed enough to support viable populations of the great majority of the naturally occurring species, From this definition, it is certain that the LIBINCO proposed NPB does not fall within such consideration and therefore HCV 2 is absent from the new planting block and the rest of the replanted area.

c) HCV3: Ecosystems and habitats

This HCV is considered if the existing ecosystem is naturally rare, for instance mountain ecosystem and mangroves. There were no mangroves swamps within the rehabilitated area or the proposed NPB neither were there any wetlands of international significance especially those of the RAMSAR sites. In view of these assessment findings, it is certain that HCV 3 is ABSENT from the project area.

d) HCV 4.3: Area critical for fire prevention

Grand Bassa County has a tropical, hot and humid climate. Bassa is among the wettest counties of Liberia with an annual average rainfall of about 4000 mm per year. Grand Bassa has a flat coastline. A narrow coastal plain extends inland from the seashore, and the land gradually rises to the hilly hinterland of the County. High elevation regions have forest of evergreen and deciduous trees. As a result of such vegetation and climatic conditions the area has not been prone to fire and therefore HCV 4.3 is absent.

### **HCV Conclusion**

The outcome of the HCV assessment identified four HCVs to be absent from the phase 1 project area. The four include HCV 1.1, HCV 2.0, HCV 3.0 and HCV 4.3. There were also four HCVs that were categorized as potentially present, HCV 1.2, HCV 1.3, HCV 1.4, and HCV 4.2. The HCVs which were present HCV 4.1, HCV 5 and HCV 6. These HCVs were identified, demarcated and mapped out. All of the processes leading to the mapping of these HCVs were with the consent and involvement of the local communities. The late secondary forest in the north of the project area was earmarked as conservation sensitive areas as it borders a primary forest outside the project area. The area was identified as important conservation area as a result of the closed dense vegetation directly bordering the boundary of the LIBINCO new planting block, It is essential that a great portion of this late secondary fragmented forest is excluded from the new planting block. This will protect the conservation importance of the closed dense vegetation. The tendency of such fragmented late secondary forest regaining its conservation relevance is also high. It is recommended that

conservation area established at the north which will conserve viable vegetation growth and which will provide sufficient cover to allow the free movement of the large number of faunal species in the area. This conservation area have been proposed based on linking areas of late secondary to the primary forest out of the project area.

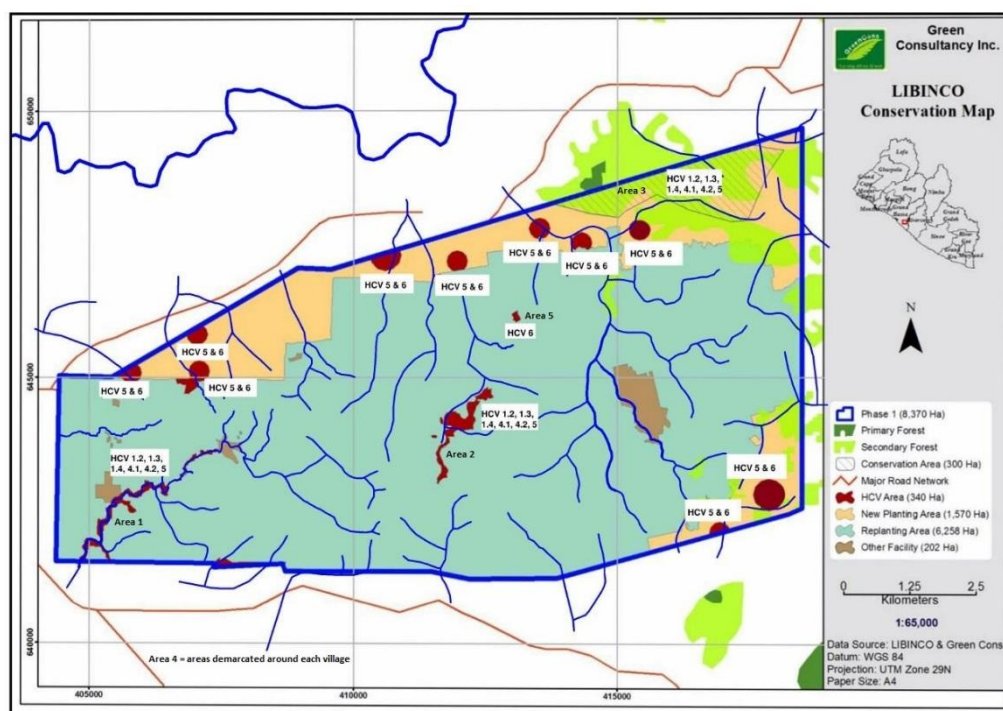


Figure 5 : Location of HCV, Conservation and River riparian areas

No.	Area	HCV	Ha
1.	Vegetation along Kpoi river	1.2, 1.3, 1.4, 4.1, 4.2 & 5	39.37
2.	Vegetation along Kpias	1.2, 1.3, 1.4, 4.1, 4.2 & 5	35.40
3.	Late secondary forest conservation area	1.2, 1.3, 1.4, 4.1, 4.2 & 5	300.38
4.	Villages buffer area	5 & 6	262.83
5.	Gravesite at J/K block boundary	6	2.03
<b>Total HCV area</b>			<b>640.01</b>

## 5. Environmental Impact Assessment

### 5.1 Summary

As per Liberian laws and regulations, EPO committed respectively Green Consultancy Inc (December 2010) to conduct the Environmental & Social Impact Assessment (ESIA). The Environmental Protection Agency of Liberia (EPAL) based on this study issued a permit covering the entire concession (existing oil palm plantation including the proposed new planting of the gross 13,007 hectares).

An Environmental, Social and Health Impact Assessment (ESHIA) was subsequently initiated by the management of LIBINCO in 2012. This assessment was conducted by Coastal and Environmental Services (CES) and completed in April 2013. This report has also been permitted by the EPAL following a public hearing in which communities members and all in attendance were allowed to give input to the presentation. The ESHIA assessment covers 24,057 ha, comprises of the current

estate area (13,007 ha) and a possible expansion land. These two studies proposed (ESIA and ESHIA) that were incorporated into the detailed management and monitoring plan by the management of LIBINCO.

## **Waste and Wastewater Issues and Impacts**

### **Issue 1: Management of Solid and Liquid Process Wastes**

- a) Reduced requirement for chemical use (fertiliser and herbicides) : All of the process solid waste from the development is organic and biodegradable. This includes vegetation from the plantation and waste from extraction of palm oil. All these will be returned to the plantation, together with treated POME, as a soil conditioner and to reduce the required input of chemical fertilisers. The application of the organic material as a mulch will suppress growth of weeds which should reduce the requirement for use of herbicides.
- b) Pollution of water resources : Although the release of stored nutrients from organic matter can be beneficial, the uncontrolled release of large quantities of nutrient-rich leachate from stockpiles of organic material prior to spreading in the plantation can result in localized concentration of nutrients (in excess) that could readily be used by nearby plants. In such cases, particularly when stockpiles are located close to water resources or during periods of high rainfall, these nutrients may be transported into nearby surface and ground water resources. This may lead to eutrophication of surface water resources and elevated nutrient levels may render surface and ground water resources unsuitable – an undesirable when this is a key source of potable water for local villages. Similarly, the release of raw or partially-treated POME (high BOD), will also result in degradation of water resources.
- c) Nuisance impacts (odour and attraction of vermin and insect pests) : The microbial decomposition of large volumes of organic matter (eg. waste vegetation and EFBs) or high-strength effluents (eg. POME) may lead to generation of odours that may be regarded as unpleasant by the community, and may also attract pests (eg. rats, birds and flies). The magnitude of the impact would be influenced by the location of this facility relative to the communities, climatic conditions (particularly wind direction and rainfall events) and the quantity and degree of decomposition of the organic material. According to the latest layout of the proposed project there is one village within 1km of the north western border of the factory and numerous other villages within a 4km radius of the facility.

Impacts	Significance without mitigation		Significance with mitigation	
	Severity	Significance	Severity	Significance
Reduced requirement for chemical use (fertiliser and herbicides)	Moderately beneficial	Moderate positive	Highly beneficial	High positive
Pollution of water resources	Severe	High negative	Slight	Low negative
Nuisance impacts (odour and attraction of vermin & insect pests)	Moderately severe	Moderate negative	Slight	Low negative

### **Issue 2: Management of Non-Process General and Hazardous Wastes**

- a) Pollution of land and water sources : Inappropriate storage of wastes, particularly those exhibiting harmful properties (i.e. hazardous wastes), can result in the contamination of land and water resources. As a result of rainfall events, leachate may be formed as water percolates through the solid waste, and it may contain nutrients and a variety of toxic compounds, including

metals. Thus, it could result in the contamination of water and land. In extreme cases, release of large quantities of nutrients to a water body can result in eutrophication. The presence of certain toxic compounds in water as a result of pollution by wastes may have significant long-term negative impacts on the aquatic ecosystems and render the water unsuitable for certain applications including human consumption.

- b) Nuisance impacts : The uncontrolled storage of solid waste, in particular food waste, can attract vermin and pests including rodents, birds and flies. The latter may pose a nuisance to adjacent land-users and may act as vectors for disease. The uncontrolled storage of solid waste can result in the release of unpleasant odours which may be regarded as a nuisance to adjacent land-users, particularly that down-wind of the material. Odorous compounds are also released from relatively well-managed solid waste disposal facilities. The presence of large quantities litter around the facility or at the landfill may constitute a visual impact to employees and local communities.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Pollution of land and water sources [general, non-hazardous wastes]	Moderately severe	Moderate negative	Slight	Low negative
Pollution of land and water sources [hazardous wastes]	Very severe	Very high	Moderate	Moderate negative
Nuisance impacts	Moderately severe	Moderate negative	Slight	Low negative

### Issue 3: Disposal of Sewage

- a) Pollution of soil and water : Ablution facilities within the project area will include septic tank systems for the factory, offices and accommodation areas. Domestic sewage is characterised by a high concentration of nutrients, organic matter (BOD) and a variety of pathogens. As such, it must be properly treated prior to discharge to avoid negative impacts to human health and the environment as it could lead to eutrophication of surface water resources and subsequent disruption of ecological function within the aquatic environment. It may also have a similar impact on water resources if not managed appropriately.
- b) Health impacts to employees and the villagers : Sewage and sewage sludge is normally high in concentrations of pathogenic microorganisms (viruses and bacteria) and helminths. Exposure to untreated effluent, either directly or through contaminated water resources, and a lack of adequate ablution facilities can result in the spread of numerous diseases including cholera.
- c) Nuisance : Raw sewage, sewage sludge and sewage treatment facilities are frequently associated with the release of unpleasant odours and may attract large numbers of insect pests such as flies. The persistent odours and presence of insect pests would most likely be regarded as a nuisance to employees and local village members. If sewage is managed correctly, the level of these nuisance factors can normally be reduced significantly.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Pollution of soil and water	Moderately severe	Moderate negative	Slight	Low negative
Health impacts to employees and the villages	Severe	Moderate negative	Slight	Low negative
Nuisance impacts (odour and flies)	Moderately severe	Moderate negative	Slight	Low negative

#### Issue 4: Disposal of Run-Off/Storm Water

- a) Disposal of run- offs/storm water : Run-off water is likely to be generated on site as a result of rainfall, washing of machinery (including vehicles) and possibly dust suppression activities. As this water migrates across the site or through waste stockpiles, it will pick-up solids which may contain pesticides and fertilisers and concentrate them. Furthermore, the run-off from machine washing activities is also likely to contain hydrocarbons. If this water is discharged without treatment, chemicals (hydrocarbons, pesticides etc.) and sediment could be transported into surface and sub-surface water bodies, resulting in ecological disruption.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Disposal of run-offs/storm water	Moderately severe	Moderate negative	Slight	Low negative

#### Issue 5: Management and Disposal of Obsolete Equipment, Scrap and Tyres

- a) Management and disposal of obsolete equipment, scrap and tyres : Obsolete equipment, including mechanical components from the processing plant or vehicles, may be stored on site until such time as they can be reused or disposed of. This scrap may contain lubricants (including hydrocarbon-based lubricants), hydraulic fluid(s) or other potentially hazardous substances that if released to the environment could lead to negative impacts. The project is likely to generate significant quantities of scrap, eg obsolete equipment and waste tyres. While much of this may simply be bulky, some may be associated with potentially hazardous materials, such as hydrocarbons, and must therefore be managed appropriately in order to minimise threats to human and environmental health.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Management and disposal of obsolete equipment, scrap and tyres	Moderately severe	Moderate negative	Slight	Low negative

#### Issue 6: Development of On-Site Landfills

- a) Development of on-site landfills : Based upon available information, there appears to be a complete absence of well-designed and operated waste disposal facilities in Liberia. According to UNEP (2007), those facilities which do exist close to the cities are no more than dumps and are located inappropriately. There is no evidence of the existence of any facilities for the safe disposal of hazardous wastes within the country. The proposed development would therefore present an opportunity to develop and operate a landfill facility with due consideration of environmental issues. It is expected that the facility would, to some degree, reduce the inappropriate disposal of solid wastes generated by the villagers within the immediate vicinity of the project. Local knowledge and understanding of the importance of sound waste management are most likely limited. Thus, all employees, many of whom will come from surrounding villages, will need to be trained on this knowledge which will then most likely be transferred to the villages.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Development of on-site landfills	Slightly beneficial	Low positive	Slight beneficial	Low positive

## Biophysical issues and impacts

### Issue 1 - Loss of Species and Habitat Biodiversity

- a) Further loss of 'natural vegetation types', namely forest pockets, riparian vegetation and wetlands : Within the current estate the plantation clearing and replanting practices have caused extensive fragmentation of habitats, and all habitats have been severely impacted by long-term land-use practices. The extent of the proposed clearing for palm oil plantation expansion, coupled with additional infrastructure such as roads and housing facilities, could result in a significant loss of natural vegetation. There are two remaining areas (namely Doebha Hill and Jaitro Hill<sup>8</sup>) which can be described as primary forest and which still serve as important refugia for the surviving faunal and IUCN noted floral species. Clearing of extensive areas for palm oil plantation will result in direct and permanent habitat loss which will affect both a large number of species and number of individuals.
- b) Loss of unknown, unidentified species, rare or endangered : As the project site which was studied extended over 37,149.90 hectares, not all vegetation types and habitats could be accurately described. This coupled with the lack of data for the study area and Liberia in general, meant that potentially valuable species have gone undetected. However, it is important to note that large tracts of the study site are already heavily impacted.
- c) Removal of vegetation and replacing natural vegetation with monocultures : Mono-culture crops have been implicated as the main cause of significant shifts in plant, animal and fungal community composition. Large stands of the same plant species will preferentially benefit non-selective (often generalist) species (including disease vectors) and negatively select against specialist, sensitive species. A community shift has an unpredictable 'knock-on' effect, which ultimately results in localized extinctions and reduction of biodiversity
- d) Habitat fragmentation : when isolated habitats may stop functioning as an ecosystem unit, and hence fragmentation of them can lead to the loss of viable populations, especially in animals requiring large home ranges. The disruption to the gene flow between 'island' populations reduces biological fitness in the long-term, compromising the abilities of populations to adapt to future environmental perturbations. Species prone to habitat fragmentation are sessile, habitat-specialists with low fecundity. The study area is already very heterogeneous, and a large amount of habitat fragmentation has already taken place. This means further fragmentation will be serious, as the practical isolation of populations by the fields and roads will occur, but may not be too significant for the few surviving faunal groups.
- e) Conservation of the diversity of vegetation types : this is essential for the maintenance of the biodiversity of the area. A reduction in the number of vegetation types will have a detrimental effect on the diversity of faunal species. Most animal species have evolved to exist in specific vegetation types so any loss of a specific vegetation type will undoubtedly result in the loss of associated faunal species.
- f) Reserve threshold (area required) for maintaining the different natural ecological biomes : The current study did not seek to determine species, habitat and ecosystem thresholds or conservation targets, which would ensure that appropriate areas of different habitats are protected. A large amount of scientific research in conservation planning would be required. It is unknown for example, whether the primary forests in the area are of sufficient size to support their current biodiversity without having corridors to other suitable habitats. There is a need to gain a better understanding of the numbers and movements of animal populations in and out of the area before it would be possible to determine the size of required protected areas within the project site. In the absence of this data logic and a precautionary approach has been adopted in the assessment of ecological sensitivity, and the determination of areas for ecological corridors.
- g) Determination of conservation status and conservation targets for vegetation types identified : The current study only conducted a preliminary HCV assessment of the area to determine the

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<sup>8</sup> Both hills are located outside of Palm Bay estate



conservation status and conservation targets. This assessment shows that there are areas of primary forest, late secondary forest and riparian vegetation in the project site which are of high conservation status and which should be afforded appropriate protection.

- h) Permanence of ecological loss and ability of the environment to adapt to the proposed activity : There will be extensive vegetation clearing in the area which will result in the loss of plant species in these areas and most of the faunal species dependant on the vegetation type cleared. While there may be a permanent depletion in the number of species existing in the new plantation areas there may be an increase in the numbers of individual species who can adapt to the new vegetation type. This may have knock-on effects which may take many years to reach equilibrium.
- i) The fire hazard (accidental or deliberate) which Oil Palm plantations poses : Fire in forest habitats is infrequent and forest specialists are easily eradicated by large fires. The size, number and spacing of woody vegetation is likely to decrease if fires are a frequent occurrence. Fires are very unlikely to occur in mature Oil Palm estates where there is little vegetation under the palm trees. In younger plantations fire risk is greater, but still low (G Brown, pers comm). The use of fire breaks to protect isolated forest habitats is recommended.
- j) Utilising agricultural land (already impacted) more effectively : Much of the proposed expansion area is heavily impacted land currently being cultivated inefficiently through slash and burn practices or small scale Oil Palm or rubber plantations. It is envisaged that some of these areas will be utilised more effectively through agricultural programmes with a focus on conservation farming practises.
- k) Rehabilitation of riparian vegetation : LPD should undertake practices to preserve and where possible, actively stabilize riparian habitats that are sensitive and those that have been degraded, respectively. As mentioned in previous impacts, the riparian corridors on the study site are very important from an ecosystem process perspective.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Further loss of 'natural vegetation types', namely forest pockets, riparian vegetation and wetlands	Severe	High	Moderately severe	Moderate negative
Loss of unknown, unidentified species, rare or endangered	Severe	High negative	Severe	Moderate negative
Removal of vegetation and replacing natural vegetation with monocultures	Severe	High negative	Moderate Severe	Moderate negative
Habitat fragmentation	Severe	Moderate negative	Moderate severe	Moderate negative
Conservation of the diversity of vegetation types	Severe	High negative	Moderately severe	Moderate negative
Reserve threshold (area required) for maintaining the different natural ecological biomes	Severe	High negative	Moderately severe	Moderate negative
Determination of conservation status and conservation targets for vegetation types identified	Severe	High negative	Moderately severe	Moderate negative
Permanence of ecological loss and ability of the environment to adapt to the proposed activity	Severe	High negative	Moderately severe	Moderate negative
The fire hazard (accidental or deliberate) which Oil Palm plantations poses	Moderately severe	Moderate negative	Slight	Low negative
Utilising agricultural land (already	Moderately	Moderate	Beneficial	High positive

impacted) more effectively	beneficial	positive		
Rehabilitation of riparian vegetation	Moderately beneficial	Moderate positive	Beneficial	High positive

## Issue 2: Impacts on Fauna and Conservation Issues

- a) Loss of natural pathways/corridors : Natural pathways for fauna and flora are vital for genetic mixing, breeding and dispersal. By disturbing these pathways, ecological processes are inhibited. The most important natural corridors in the study area are the drainage lines, followed by the forest patches that provide refugia for fauna. The area still appears to have good animal diversity and populations. Many of the faunal species have seasonal movements and are dependent on food from seasonal fruiting trees. The ability to move from area to area is vital for their existence in the area. There needs to be careful consideration to the planting regime in order to maintain or create vegetative corridor which will allow for continued animal movement in and out of the area.
- b) Reduction in inundation patterns within wetland river systems, particularly in the drier seasons. This then impacts on the biological communities (plants) which in turn reduce available habitats and food sources : The Oil Palm plantations may modify inundation patterns within wetland systems both inside and outside the planting area. Many vertebrates are adapted to the seasonal flooding of rivers and wetlands, including amphibians, aquatic reptiles, and numerous waterbirds and waders. For example, during the height of the rains hippopotami are known to frequent and seek shelter in the Raphia wetlands which extend far into the low lying forests. Many other aquatic species will take advantage of these flooded areas for shelter and breeding purposes. It is important that flow dynamics in streams and wetlands be maintained in order to ensure that these habitats remain functional to support this fauna.
- c) Edge-effect pressure on sensitive ecosystems (forests and wetlands) as a result of estate activity : Inappropriate management of plantation activities could result in indirect impacts on ecosystem boundaries (e.g. fire disturbance, crop pest impacting on natural systems etc.), causing substantial disturbance and extensive edge effect.
- d) Mono-culture Oil Palm plantation may result in shifts in community structures e.g. of birds and/or insects etc., resulting in species dominance and reduced species diversity : Mono-culture crops have been implicated as the main cause of significant shifts in animal communities. Large stands of the same plant species will preferentially benefit non-selected (often generalist) species and negatively select against specialist, sensitive species. A community shift has an unpredictable 'knock-on' effect, which ultimately results in localized extinctions and reduction of biodiversity.
- e) Loss of unknown or unidentified, rare or endangered animal species due to clearing and loss of habitat : As the project site studied extended over 37,149.90 hectares, the presence or absence of all rare or endangered animal species could not be established or accurately described. This coupled with the lack of data for the study area and Liberia in general, means that potentially valuable species have gone undetected. However, it is important to note that large tracts of the study site are already heavily impacted.
- f) Impact of species of special concern including reserve determination for species of special concern (i.e. identification of habitat requirements for these species) : The expansion of the Oil Palm plantation will involve the loss of important habitat currently used by some species of special concern. It is known for example that chimpanzees do appear in the area from time to time and use the existing forest and riparian habitats as corridors for moving between feeding and nesting areas. The loss of these habitats will have a serious effect on the number of species of concern currently present on site.



Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Loss of natural pathways/corridors	Severe	High negative	Moderately severe	Moderate negative
Reduction in inundation patterns within wetland river systems, particularly in the drier seasons	Severe	Moderate negative	Moderate	Moderate negative
Edge-effect pressure on sensitive ecosystems (forests and wetlands) as a result of estate activity	Severe	High negative	Slight	Moderate negative
Mono-culture Oil Palm plantation may result in shifts in community structures e.g. of birds and/or insects etc., resulting in species dominance and reduced species diversity	Severe	High negative	Moderately severe	Moderate negative
Loss of unknown or unidentified, rare or endangered animal species due to clearing and loss of habitat	Severe	High negative	Moderate severe	Moderate negative
Impact of species of special concern including reserve determination for species of special concern (i.e. identification of habitat requirements for these species)	Moderately severe	Moderate negative	Slight	Low negative

### Issue 3: Soil Erosion

- a) Soil erosion due to vegetation clearing and soil exposure : The planting of Oil Palm trees on virgin soil will require that all existing vegetation (cultivated and indigenous) be removed. During this period, before replanting and when tree seedlings are being established, the soil is vulnerable to high rainfall, wind and storm water erosion.
- b) Change in soil characteristics: pH, fertility, micro-organisms and general soil features as a result of agricultural practises : Through the application of inorganic fertilisers, pH balancing chemicals and general fungicides and pesticides, significant impacts on soil characteristics, which may indirectly affect soil health, are expected.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Soil erosion due to vegetation clearing and soil exposure.	Severe	High negative	Slight	Low negative
Change in soil characteristics: pH, fertility, micro-organisms and general soil features as a result of agricultural practises.	Severe	Moderate negative	Slight	Low negative

### Issue 4: Social Interactions with the Natural Environment

- a) Reduced access to natural resources, e.g. wildlife as a sources of food : Forest resources are an important source of food and medicinal plants. In addition, communities have close cultural links to selected sacred forests. Forest preservation has been raised as an issue by project affected people.
- b) Due to immigrant labour, hunting for bush meat may increase and further reduce dwindling faunal populations : An increase in immigrant workers may lead to an increase in the number of snares and traps set in the forests resulting in a rapid depletion of faunal biodiversity.

Impacts	Significance without mitigation		Significance with mitigation	
	<i>Severity</i>	<i>Significance</i>	<i>Severity</i>	<i>Significance</i>
Reduced access to natural resources, e.g. wildlife as a sources of food	Severe	High negative	Moderately severe	Moderate negative
Due to immigrant labour, hunting for bush meat may increase and further reduce dwindling faunal populations	Severe	High negative	Moderately severe	Moderate negative

## 6. Image Analysis

### 6.1 Area of Interest and how it was defined

Spatial data provided by EPO to Ata Marie with regards to development plans in Phase 1 indicates the following:

- Over the 2011-15 period EPO planted 5,825 ha of oil palm, and has cleared an additional 241ha ready for planting. Land cover in these areas prior to clearing was mostly over mature palm oil plantation planted by the previous owners.
- EPO has earmarked an additional gross area of 1,542 ha of land for development in Phase 1. This area is predominantly located along the northern boundary, plus a small area in the south eastern corner. Vegetation is predominantly young scrub but some residual forest areas exist.
- Within the 1,542 ha area, 332 ha of HCV land has identified, consisting predominantly of buffers around villages and a buffer along the concession boundary. In addition, a forest conservation area covering 277 ha has also been set aside in the north east (note HCV and conservation areas overlap and this overlap area has been allocated to HCV).
- The shp file received from EPO describing the planted area records some areas which satellite imagery indicates have not yet been cleared. These are for the most part riparian areas – see discussion on riparian buffers in Section 7.

The map and table below describe EPO's development plan for the Phase 1 area. EPO is planning to restart development as soon as the HCS analysis is completed. The HCS analysis is focused on the undeveloped area covering 2,183 ha.

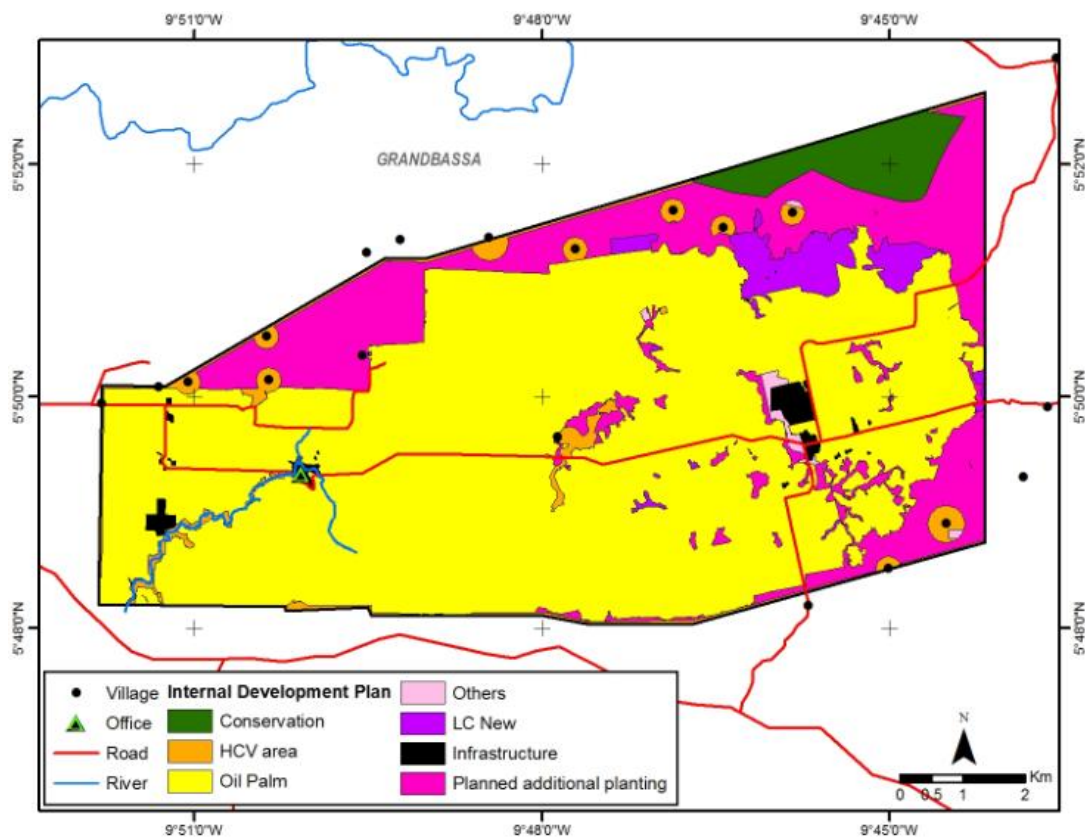


Figure 6 : Palm Bay Estate Phase 1 Internal Development Plan

#### Area of Interest for HCS Study

Development Status		Area (ha)	%
Developed Area	Oil Palm	5,825	70%
	Recent Land Clearing	241	3%
	Infrastructure	80	1%
	<b>Sub Total Developed Area</b>	<b>6,146</b>	<b>74%</b>
Undeveloped Area	Planned additional planting	1,542	19%
	HCV	332	4%
	Conservation Area	277	3%
	Other / unknown	32	0%
	<b>Sub Total Undeveloped Area</b>	<b>2,183</b>	<b>26%</b>

## 6.2 Description of images used for classification

- 1) Recent (2014 and 2015) Landsat satellite images downloaded from the USGS website.
- 2) High resolution imagery data (2014) extracted from Google Earth (partial coverage only).

## 6.3 Sample image

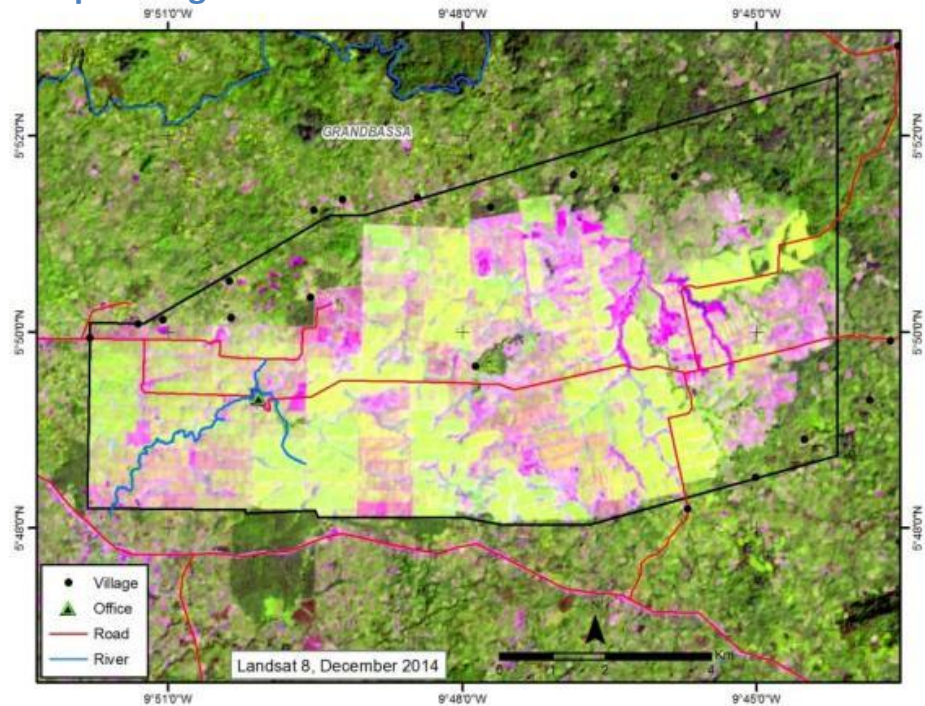
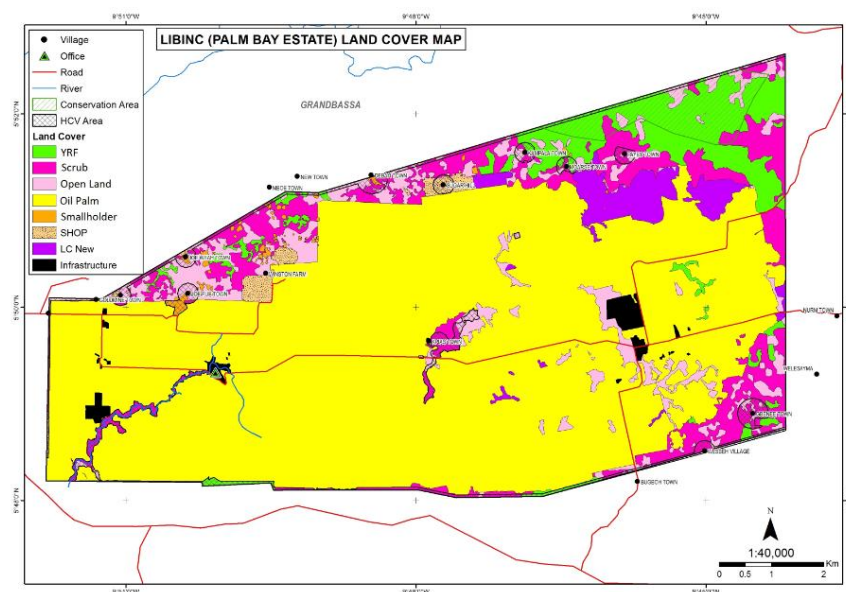


Figure 7 : Sample Satellite Image of Palm Bay Estate Phase 1

## 6.4 Method of stratification (supervised, unsupervised, visual etc.) and software used

Combination of Unsupervised stratification, Supervised stratification, and Manual (heads up) stratification

## 6.5 Map of initial vegetation classes, with legend



YRF = Young Regenerating Forest

## 6.6 Table of total hectares per vegetation class

Land cover class	Number of Hectares	% of total concession
Potential HCS classes:		
High Density Forest	0	0%
Medium Density Forest	0	0%
Low Density Forest	0	0%
Young Regenerating Forest	618	28%
Non-HCS classes:		
Scrub	863	39%
Open Land	595	27%
Smallholder	111	5%
TOTAL		99%

## 6.7 Summary of which areas are potential HCS forest, subject to further analysis

A total area of 618 ha or 28% of the undeveloped area is considered as potential HCS forest requiring further analysis in the HCS patch analysis process. The largest concentration of potential HCS forest is located in the north east. This area is partly overlapping (238 ha) with the existing Conservation Area.

Land cover in the remaining areas is predominantly young scrub / ex shifting cultivation land.

Scrub and to a lesser extent YRF may contain small patches of smallholder agriculture.



## 7. Forest Inventory Results

### 7.1 Inventory sample design and plot rational

Sampling points were planned prior to going to the field using the preliminary Land Cover stratification. Plots are generally located every 75m along transects cut on predetermined compass bearings from a pre-determined starting point.

### 7.2 Map indicating plots

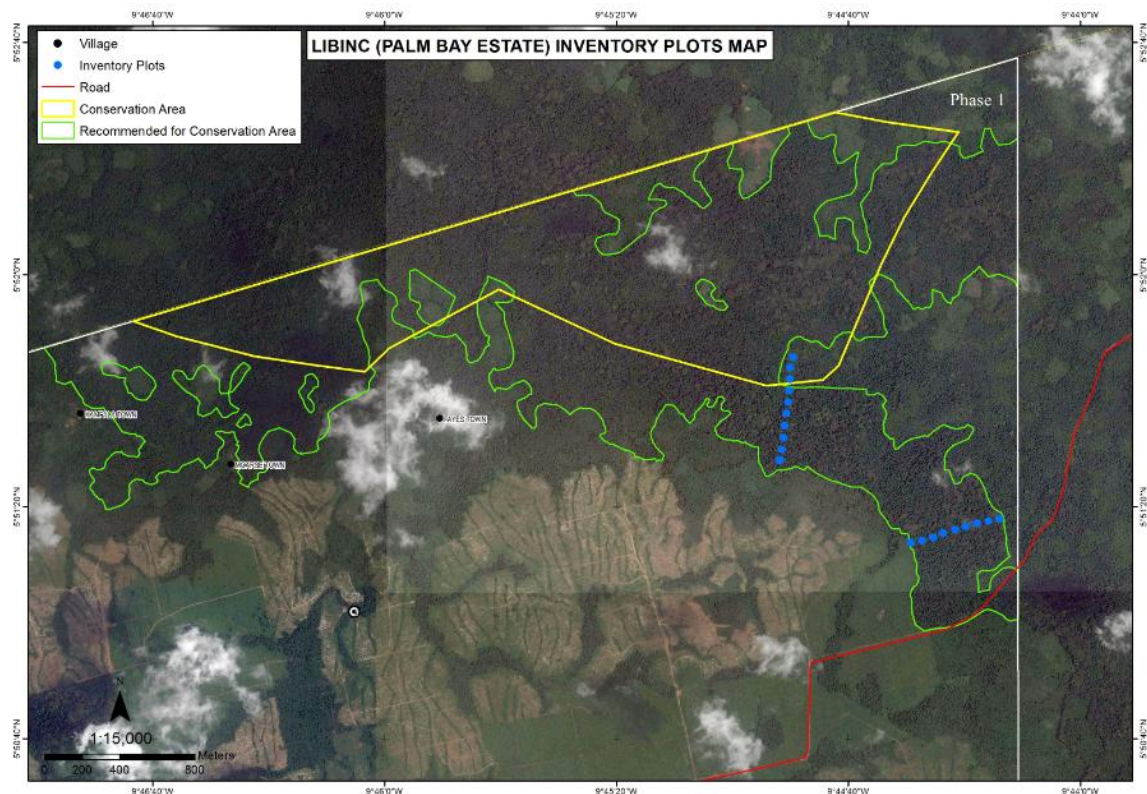


Figure 8 : Map indicating plots



Figure 9 : Sampling plots

### 7.3 Forest inventory team members and roles

- 1) Cutting the line through the vegetation:
  - a) Joshua Joe (LIBINCO)
  - b) Solomon King (LIBINCO)
- 2) Measuring the circumference of the trees
  - a) Papa Williams (LIBINCO)
  - b) Joshua Joe (LIBINCO)
- 3) Identifying the tree species:
  - a) James T. Kpadehyaa (Botanist)
- 4) GIS information and recording:
  - a) Muzzammil Rahapurna (LIBINCO)

### 7.4 Methodology used for forest sampling

The plot shape used was concentric circular plots with areas of 0.05 and 0.01 hectares respectively. The figure below shows the layout of a single HCS plot. Small diameter trees (<15cm DBH) were measured in the small plot. Large trees ( $\geq 15$ cm DBH) were measured in the large plot.

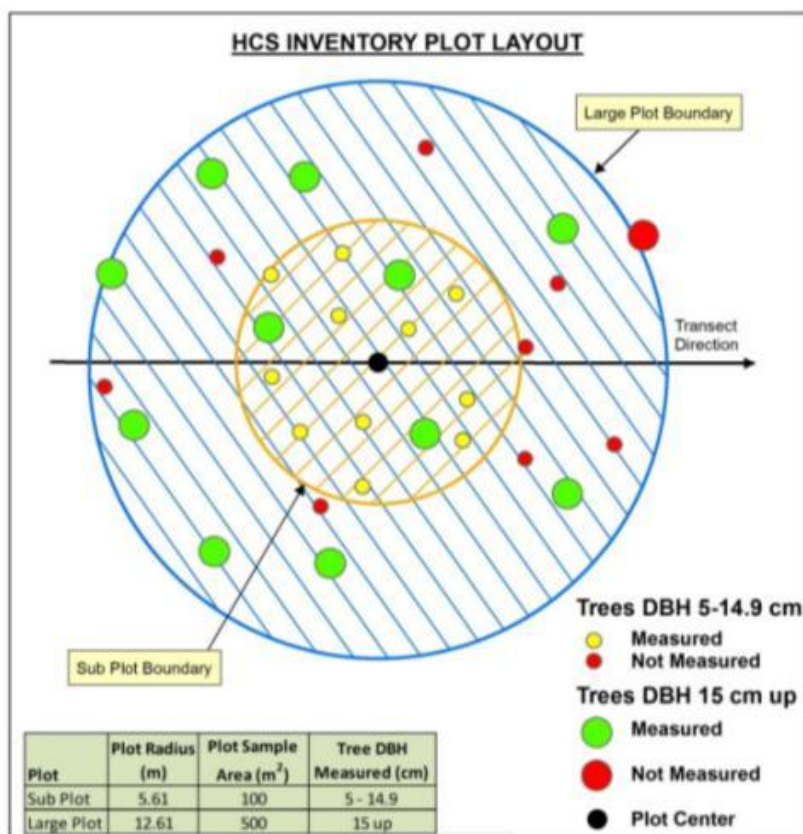


Figure 10 : Layout of a single HCS plot

## 7.5 Methodology used for carbon calculations

The carbon stock was estimated for all living trees with DBH larger or equal to 5 cm using the Allometric Equations method. The following equation for wet tropical forests (Chave, et. al. 2005) was applied. This widely used equation relates DBH, total tree height and species specific wood density ( $\rho$ ) to estimate Above Ground Live Biomass (AGLB) per tree measured in the forest plots.

The resulting AGLB is the total biomass of the stem, crown, and leaves for trees in kilograms.

$$AGLB_i = 0.0776[\rho_i D_i^2 H_i]^{0.940}$$

where: AGLB = Above ground live biomass in kilograms

D = Diameter at breast height (1.3m above ground) in centimetres

H = Total tree height in metres

$\rho$  = Specific gravity in grams per cubic centimetre.

### **Calculation of Tree Carbon**

The C fraction of biomass is calculated in tonnes of C (Mg C). The equation used for estimating Tree and Palm Carbon Content was:

Carbon Mass (tonne) = Biomass \* (Carbon conversion factor)

The carbon conversion factor estimates the carbon component of the vegetation biomass. This can be derived for specific forest types or the IPCC standard value of 0.47 can be used. In this analysis the IPCC standard value has been used.

### **Calculation of Carbon Mass per Hectare**

Each plot will be analysed to provide estimates of tree carbon mass per ha. The equation for estimating tree carbon mass per hectare in each plot is:

Total Carbon (tonne/ha) =  $\Sigma$  ([Tree Carbon]) / [Plot size in hectares]

## 7.6 Indicative photos (N,S,E,W canopy) of each vegetation class



Figure 11 : Old over mature palm





Figure 12 : Scrub



Figure 13 : Young Regenerating Forest

## 7.7 Statistical analysis (allometric used, confidence tests, justification)

The tables below show the results of the forest inventory carried out. A total of 31 inventory plots were measured. The YRF stratum has an average carbon stock of 57.7 tonnes per ha while the Scrub stratum has an average carbon stock of 33.1 tonnes per ha.

### Carbon Stock Statistics

Land cover class	Number of Plots	Stems per hectare	Biomass (kg/ha)	Carbon Stocks		
				Average	Confidence limits (90%)	
					Lower	Upper
Young Regenerating Forest	20	1023	123	57.7	44.4	71.0
Scrub	11	1235	70	33.1	17.3	48.9

### Stand and Stock

Stratum	Stems per hectare by DBH class					Carbon (tonnes per ha) by DBH class				
	Total	5.0-14.9	15.0-29.9	30.0-49.9	50.0+	Total	5.0-14.9	15.0-29.9	30.0-49.9	50.0+
Young Regenerating Forest	1023	830	135	48	10	57.7	10.7	12.2	22.8	12.0
Scrub	1235	1100	116	18	0	33.1	12.9	10.6	9.6	n/a

The ANOVA table below shows that there are significance differences between the YRF and Scrub strata. To determine which groups are significantly different, a Scheffé's pairwise multiple comparisons test has been conducted.

**Table: Analysis of Variance (ANOVA)**

Source	SS	df	MS	F	F_90% CL	Significant Diff?
Model	4303	1	4303	4.05	2.89	Yes
Error	30789	29	1062			
Total	35092	30				

The table below shows the differences between strata average carbon values, the Scheffé comparison values, and the determination of significant differences between strata. This analysis confirms that there is a significant difference between YRF and Scrub average carbon estimates.

**Table: Scheffé's Test Results**

Pair Wise Differences Between Sample Means		
Type	YRF	Scrub
YRF		24.6
Scrub		
Scheffe Comparison Values		
Type	YRF	Scrub
YRF		20.8
Scrub		
Significant Differences		
Type	YRF	Scrub
YRF		Yes
Scrub		

## 7.8 Table with summary of statistical analysis of carbon stock results per vegetation class

Land cover class	Number of Plots	Stems per hectare	Biomass (kg/ha)
Scrub	11	1235	70
Young Regenerating Forest	20	1023	123

## 7.9 Table with forest inventory results (with descriptions of each class)

Land cover class	Physical description of the land cover, e.g. species mix, forest type (pioneer, regenerating, primary etc.), diameter distribution, structural indices, maturity indices, etc.	Average Carbon Stocks
Scrub	Ex-shifting cultivation land	33.1
Young Regenerating Forest		57.7

## 8. Land Cover Classification

### 8.1 Refined land cover map with title, date, legend and any HCS forest patches identified

See map below - the large green patch is Patch 1, in addition there are 114 other very small patches (<2 ha)

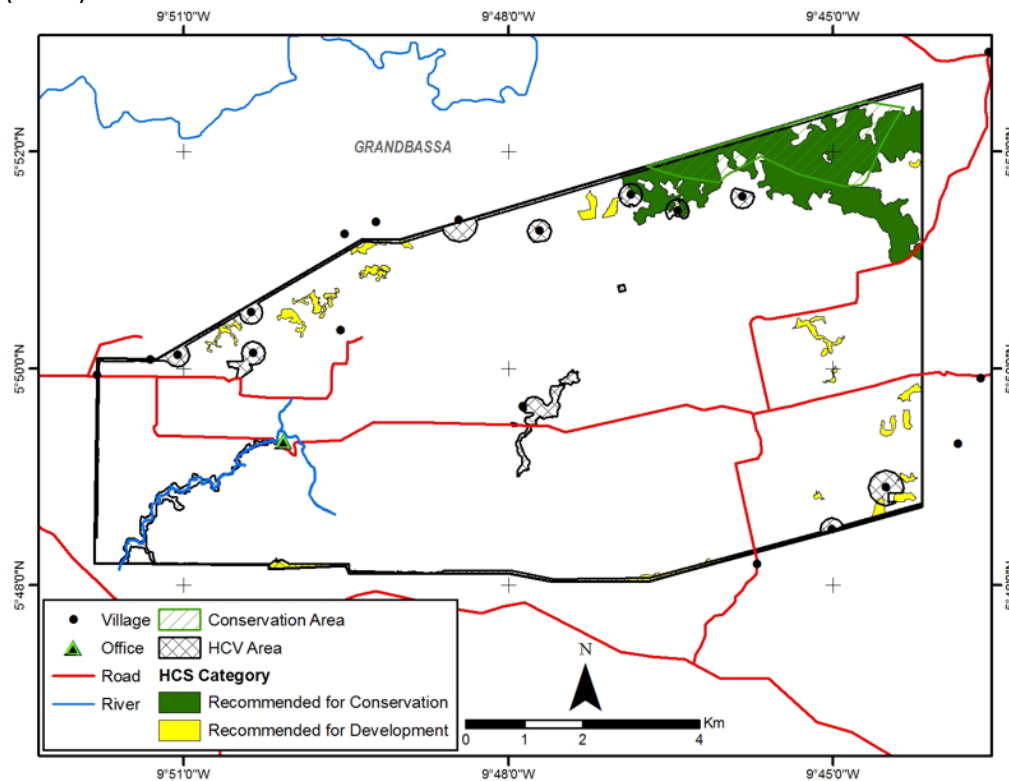


Figure 14 : HCS forest patches

## 9. Patch Analysis Result

### 9.1 Results of Decision Tree

Patch number	Total area (ha)	Of which core (ha)	Priority (Low-LP, Medium-MP, High-HP)	Description of Decision Tree results
1	503	189	HP	Recommend for conservation
All others	115	0	LP	Recommend for development because Patch Area < 2 Ha or Patch Core Area 0 ha

### 9.2 Comments on Decision Tree outcome

*Including pre-RBA and RBA results. For any RBAs, describe the methodology used and results per patch*

503 ha (81%) of the potential HCS forest area is recommended for conservation. This is all found in one single patch in the north east.

115 ha of the potential HCS forest area is recommended to be released for development. This land is in patches smaller than 2 ha or with patch core area of 0 ha.

Patch Analysis Results did not identify any areas requiring Pre-RBA Check or RBA.

## 10. Indicative Land Use Plan

### 10.1 Summary of results of final ground verification (if any)

Not available.

### 10.2 Final HCS map

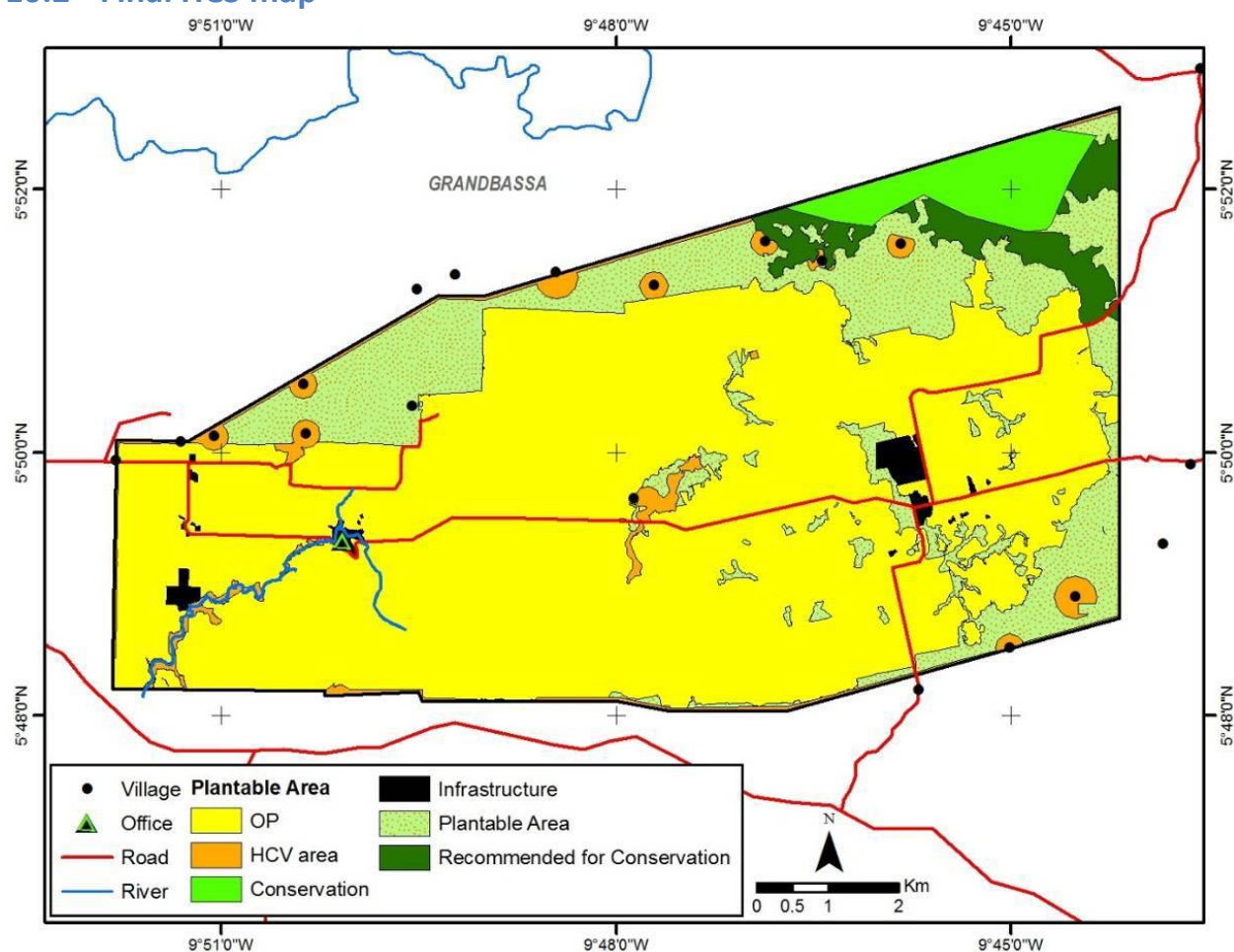


Figure 15 : Final HCS Map (together with the other conservation areas)

### 10.3 Overview of forest conservation management and monitoring activities to be included in the Conservation and Development (land use) plan

Not available. These activities would be developed once this report is finalised. A joint committee is preferably setup with the community to carry out this conservation work. Please refer to 10.4 as well.



## 10.4 List of activities still to be carried out before Conservation and Development plan can be finalised

Since takeover of the Estate EPO has cleared and replanted 5,853 ha.

Based on the results of the HCS analysis, a single patch of Young Regenerating Forest (YRF) in the north east of Phase 1 covering 503 ha meets the criteria for HCS. 45% of the patch is within the existing conservation area. The patch is surrounded by shifting cultivation on three sides and as such it is imperative that EPO socialise the conservation plan and seek consent from communities.

Land cover in the remaining areas is predominantly young scrub / ex-shifting cultivation land. The area surrounding the Estate is also heavily modified by shifting agriculture – remnant forest is limited to small patches.

The map above shows the estimate of gross operable area, including existing plantations, resulting from the analysis of standing carbon stock. Further reductions to this area are likely as the following items are yet to be completed:

- Results of participatory mapping to be carried out by EPO and communities to finalize which area surrounding the villages will be cleared for development or preserved for communities' purpose
- Allowances for river and stream buffers.