montrose

Natural Habitats
Sierra Leone
organic products grown in a sustainable habitat

Greenhouse Gas (GHG) Estimation Assessment for the Natural Habitats: Oil Palm Plantation – Sierra Leone

May 2017

TABLE OF CONTENTS

FIGURES/TABLES/GRAPHS

ACRONYMS

EPA	Environment Protection Agency
GHG	Greenhouse Gas Emissions
GFNP	Gola Forest National Park
HCV	High Conservation Value
HCS	High Carbon Stock
KBA	Key Biodiversity Area
INDC	Intended Nationally Determined Contribution
NPP	New Planting Procedure
RSPO	Roundtable on Sustainable Palm Oil

1 ASSESEMENT PROCESS AND PROCEDURES

1.1 BACKGROUND

The revised Roundtable on Sustainable Palm Oil (RSPO) Principles and Criteria (2013) has a criterion (7.8) that requires new plantations are designed to minimise net greenhouse gas (GHG) emissions.

- The first indicator for this criterion entails the identification and estimation of the carbon stock and major potential emission sources for the proposed development.
- The second indicator requires new developments have plans to minimise GHG emissions, which considers the avoidance of land areas with high carbon stocks and consideration of carbon sequestration options.

1.2 SIERRA LEONE AND THE NATIONAL COMMITMENT FOR EMISSION REDUCTION

Geography and Population

Sierra Leone is on the West Coast of Africa, bordering Guinea to the northeast and Liberia to the southeast. It has a total area of 71.740 km^2, with a population of 7.092.113[1]. Sierra Leone is extremely poor and nearly half of the working-age population engages in subsistence agriculture.[2]

Economy

Sierra Leone possesses substantial mineral, agricultural, and fishery resources, but it is still recovering from a civil war that destroyed most institutions, before ending in 2002. In recent years, economic growth has been driven by mining, particularly iron ore. The country's main exports are diamonds, iron ore, titanium ore, aluminium ore and cocoa beans[3] The Ebola outbreak of 2014 and 2015, combined with falling global commodities prices, caused a significant contraction of economic activity in all areas.[4]

Land Use

An estimated 2,72 million ha of Sierra Leone's total land area (7,16 million ha) is forested (i.e., approximately 38% of the country is covered with forest). Average annual rates of deforestation are relatively high and, in 2010, was estimated at 0,70% (20.000 ha).[5] The foremost driver of deforestation is agriculture, both small-scale shifting cultivation and large-scale agricultural. Investments are taking up large tracts of arable and forested land. Other important drivers are logging (both legal and illegal), commercial and artisanal mining activities, and the unregulated use of wood for construction and fuel, such as charcoal production.[6]

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[1] Population and Housing Census 2015. https://www.statistics.sl/wp-content/uploads/2017/01/final-results_-2015_population_and_housing_census.pdf
[2] https://www.cia.gov/library/publications/the-world-factbook/geos/sl.html
[3] http://atlas.media.mit.edu/en/profile/country/sle/
[4] https://www.cia.gov/library/publications/the-world-factbook/geos/sl.html
[5] FOOD AND AGRICULTURAL ORGANISATION OF THE UNITED NATIONS (FAO). 2010. Global Forest Resource Assessment. Country Report Sierra Leone. FRA 2010/189. FAO, Rome.
[6] GOVERNMENT OF SIERRA LEONE (GoSL). 2010. Forestry Policy 2010. Freetown: Government of Sierra Leone.

Climate Change

The mean annual temperature has increased by 0,8˚C since 1960, an average rate of 0,18˚C per decade and the mean annual temperature is projected to increase by 1,0 to 2,6˚C by the 2060s (McSweeney et al. 2010)[7]. Climate change could lead to consequences in Sierra Leone, where projected changes include an increase in temperatures of 1,0–2,5°C by 2060, with more rapid warming inland. Although rainfall projections are less certain, the trend could be towards an overall increase, particularly between July–December, with the intensity of single heavy rainfall events increasing. The level of the Atlantic Ocean could rise (dependent on the projection) by 0,1– 0,56 m by 2100. These expected changes could lead to severe economic impacts that will undermine decades of development gains.[8]

International Commitment to Reducing Emissions

Sierra Leone's Intended Nationally Determined Contribution (INDC) as per the Paris Agreement[9] intends to maintain its emission levels relatively low (close to the world average of 7,58 MtCO2e) by 2035 or neutral by 2050 through the reduction of the country's carbon footprint and by following green growth pathways in all economic sectors. Sierra Leone also intends to present an intensity based reduction target of 25-35%, by 2050 in two phases (2020-2030, 2030-2050) compared to 1990 baseline. This includes the use of international credits as well as the vision to hold per capita emissions in Sierra Leone's at the average world level in the long term.

Priority climate change response strategies have been identified and included in the INDC. The following strategies are focussed on the mitigation of greenhouse gas emissions. These strategies include:

Strategy 1: Institutionalization of coordination, monitoring, reporting and verification of climate change issues by strengthening the Environment Protection Agency (EPA) for effective and efficient provision of technical policy advice to the Government and people of Sierra Leone for relevant decision making in transitioning to green economic growth.

Strategy 2: Transformation of the National Meteorological Services of Sierra Leone and strengthening of the country's Climate Change Early Warning System.

Strategy 3: Promotion of energy efficiency, enhanced management and expansion of the energy mix through the uptake of renewable energy sources (solar, wind, hydro, biomass) particularly in the rural areas of Sierra Leone.

Strategy 4: Enhancement of waste management systems at all levels, to reduce pollution and greenhouse gas emissions under the category to improve health of both humans and animals, and reduce global warming.

Strategy 5: Diversification of economic growth through a strengthened transport sub-sector, particularly the infrastructure to contribute to the reduction of regional and global emissions of greenhouse gases and the development of a stable economy.

Strategy 6: Adoption and application of climate-smart and conservation agriculture through best agricultural practices that enhance soil fertility and improve crop yields.

7 McSweeney, C., New, M. & Lizcano, G. 2010. UNDP Climate Change Country Profiles: Sierra Leone. Available: http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Sierra_Leone/Sierra_Leone.hires.report.pdf [Accessed 19 April 2017].

8 Republic of Sierra Leone. 2012. Second National Communication on Climate Change. http://unfccc.int/resource/docs/natc/slenc2.pdf

9 Sierra Leone's Intended Nationally Determined Contribution Submission to UNFCCC Secretariat 01/10/2015.

1.2.1 NATURAL HABITATS SIERRA LEONE LTD.

Natural Habitats Sierra Leone Ltd, a subsidiary of the Natural Habitats Group ((NHG), has been an RSPO member since September 2011. This is the group's first development to have followed the New Planting Procedure (NPP). NHG commissioned an independent regulatory Environmental and Social Impact Assessment (INTEGEMS), High Carbon Stock Assessment (HCS) (Montrose) and High Conservation Value (HCV) (Digby Wells, led by Philip Patton (ALS15041PP)) to meet the requirements of the RSPO's New Planting Procedure (NPP).

In July 2014, NHSL acquired the company West Africa Agriculture Number 2 Limited (hereafter WAA2). WAA2 owns a land lease concession for 99 years (the land lease is 50 years with an option to extend for 21 years + 21 years + 7 years) in Makpele Chiefdom, Pujehun District, Southern Province, Sierra Leone. The land lease covers about 30,700 hectares and is within the Makpele chiefdom (41.218ha) The assessments have been done covering the entire Makpele chiefdom as this is considered to be important, due to the proximity to the Gola Rainforest National Park. Out of the 41.218 ha, 25.293,13 ha has been identified as HCV conservation area (through the HCV assessment) and approximately 10,185 ha identified as High Carbon Stock forest area by the HCS assessment. Up to 7,500 ha will be developed by the company into an oil palm plantation in the next five years.

1.2.2 NEW PLANTATION PROCEDURE SITE

The NH concession is in a biodiversity hotspot (Myers, 2000), in the Upper Guinean Rainforest, which places conservation significance on the site from an international perspective. The concession is also in a global ecoregion[10], namely, the Tropical and Subtropical Moist Broadleaf Forests. This indicates the ecological sensitivity of the site for large vertebrates, water resources and forest flora. The concession includes a portion of the Gola Rainforest National Park (GRNP); this protected area serves as a critical biodiversity resource for Sierra Leone, conserving numerous endemic and Red Data species and supporting exceptional biodiversity. The GRNP has been identified as a Key Biodiversity Area (KBA) by the IUCN (Kouame et al. 2012).

The Project is in the Makpele Chiefdom (Pujehun District, Southern Province), between latitude $7^0$13' N and $7^0$24' N and longitude $11^0$13' W and $11^0$35' W. Geo-politically, Makpele Chiefdom is bounded to the east by the Republic of Liberia; to the north by the Koya and Tunkia Chiefdoms of the Kenema District; to the northeast by the Barri Chiefdom of the Pujehun District; and to the southwest and south by the Sorogbema Chiefdom of the Pujehun District. The Project area is in four administrative sections, namely: Samagbe, Selimeh, Seitua and Kengo sections. Zimmi Town, the administrative headquarters town, is l in Samagbe section.

An HCS assessment has been conducted and is based on the HCS Approach Toolkit (2015) to map potential high carbon stock areas (Section 1.4.1).

The Concession is a contiguous parcel of shrubland, secondary forest, primary forest and agricultural land. About 20% of the north and northeast Makpele Chiefdom is covered by the GRNP (7,925 ha). The total plantable area is approximately 11.150ha, excluding the GRNP leakage belt, HCV areas, and buffer zones.

10 World Wildlife Fund http://wwf.panda.org/about_our_earth/ecoregions/guinean_moist_forests.cfm

1.3 ASSESSORS AND CREDENTIALS

Name	ALS Licence	Organisation	Role	Expertise
Phillip David Patton	Provisional registration: ALS15041PP	Montrose Environmental	Lead Assessor for GHG Assessment and HCS Assessment	Environmental auditor, ecosystem services, conservation and biodiversity
Christopher Fell	Not yet registered	Montrose Environmental	Senior HCS Assessment Consultant	Forestry, community forestry, stakeholder engagement, ecosystem services assessment, conservation and biodiversity planning

1.4 METHODS AND PROCEDURES USED FOR CONDUCTING CARBON STOCK AND GHG ASSESSMENTS

1.4.1 HIGH CARBON STOCK ASSESSMENT

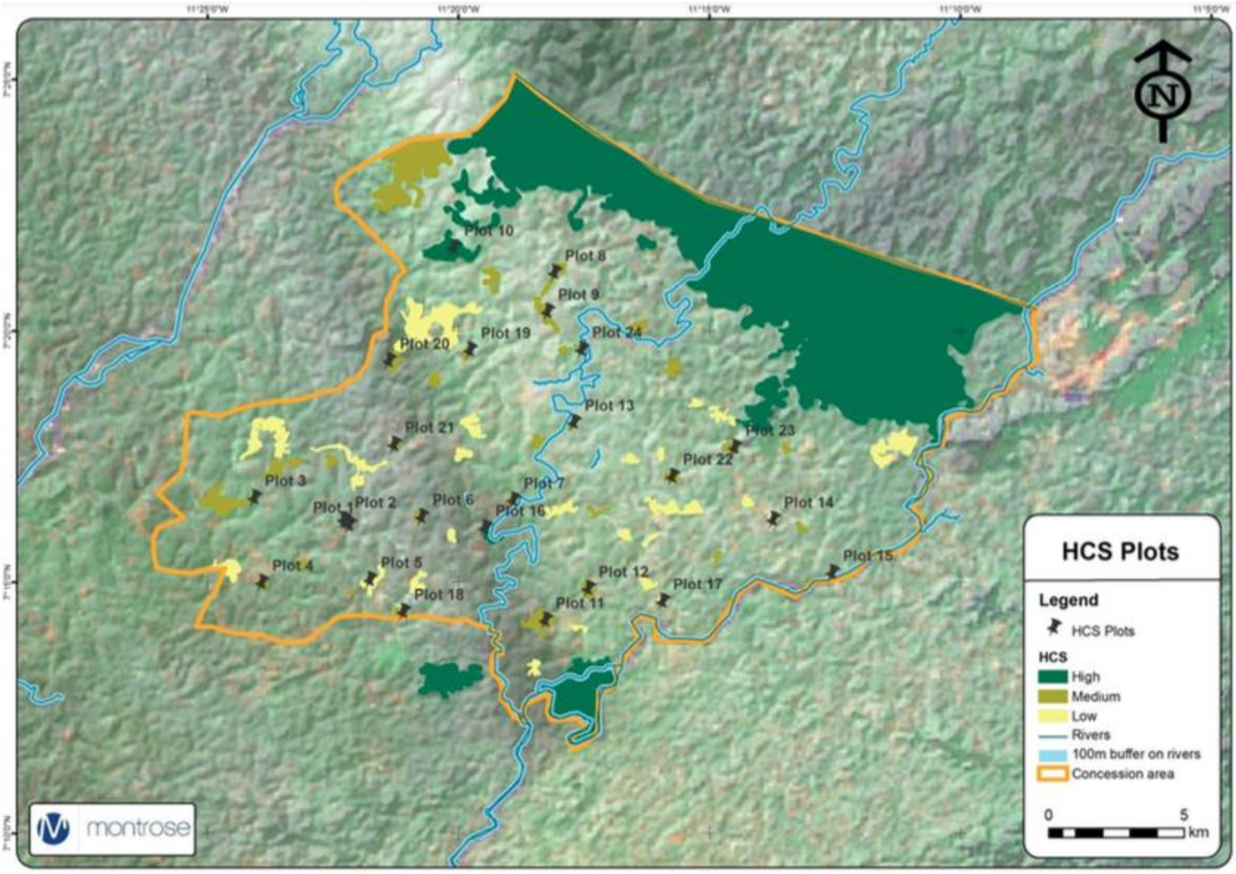
The HCS assessment was based on the HCS Approach developed by Greenpeace, The Forest Trust and Golden Agri-Resources Ltd., and the Version 1 of the HCS Forest Patch Analysis Decision Tree. Although the HCS survey focused on the Natural Habitats concession, the area of influence was deemed to be the concession area and immediately adjacent area, including the southern boundary of the GRNP and the leakage belt.

The carbon stock map (Figure 4) was integrated with other conservation focus areas, identified in the HCV assessment. The integrated map (Figure 5) serves as a guide to project emission associated with land-use change and projecting GHG emissions from different development scenarios. The final GHG emission estimation is based on the optimum scenario for a low emission development plan (Table 7).

Core Datasets:

- Satellite imagery;
- Concession boundaries;
- Polygons of the identified HCV areas;
- Although the negotiations between Natural Habitats and the local communities are still ongoing, and attempt was made to delimit the areas which will be set aside for use for the community usage;
- Settlements and road network; and
- Field verification of high carbon forest plots (plots are shown in Figure 1).

Figure 1 HCS Plots in the Concession Area



Techniques and Thresholds

The methodology used in this study is based upon the HCS Approach Toolkit Version 1 (2015).

The high carbon stock forest classification is as follows:

- Young Regenerating Forest (YRF)
- Low Density Forest (LDF);
- Medium Density Forest (MDF); and
- High Density Forest (HDF)

It was assumed that YRF was equivalent to forest of >=35tC/ha but less than 75tC/ha, and LDF contained >=75tC/ha.

The low carbon stock classification includes:

- Scrub; and
- Cleared/Open Land.

The average carbon stocks of the forest classifications are based upon the biomass layer, using field data collected during the HCS assessment. First, a carbon map was developed (based on the stratification of the vegetation classes). Next forest patches were divided into (a) HCS forest to be protected, and (b) low carbon stock (scrub/open land), that are potentially suitable for oil palm plantation development. Figure 4 shows the delineation of the concession carbon stock forests.

1.4.2 SOIL CARBON

Vaersa Partners conducted a soil survey at four locations in the Project area/concession. During the Project Feasibility Study (2014), soil pits were dug and showed that soil conditions have generally similar characteristics:

- A top colluvial layer 40cm to 60cm deep, overlying a gravelly subsoil. This indicates that the physical properties of this soil would be suitable for oil palm cultivation;
- High porosity resulting in low available water holding capacity;
- pH is low (4,9 in the layer between 0cm – 20cm);
- High leaching rates;
- Low Ca:Mg ratio;
- Low phosphorous and total bases;
- Optimum available K;
- Optimum C:N ratio; and
- Positive response to fertilizer application.

Peat

Soil analyses results categorised the soil order as Oxisol (USDA Soil Taxonomy), also known as Ferrasol (World Reference Base for Soil Resources)[11]. This confirms that no Histosols are present in the concession.

Soils are carbon pools that can be influenced by land-use and management activities. The soil carbon stock in mineral soil is relatively low. Therefore, conversion to oil palm on mineral soils does not significantly alter soil carbon stock levels or significantly increase soil GHG emissions. Therefore, carbon stocks of mineral soils are not considered significant in the RSPO New Development Calculator.

1.4.3 RSPO NEW DEVELOPMENT CALCULATOR

The net greenhouse gas emissions from the development of the Natural Habitats Project are calculated by adding the emissions released during land cover change (during the conversion to plantations), crop production and processing, and subtracting these from the carbon emissions sequestered from the standing crop and in any conservation/forest areas.

The calculator uses the emissions sources listed below:

- Change in land cover carbon stocks from conversion to palm oil;
- Manufacture of fertilisers and their transport to the plantation;
- Nitrous oxide and carbon dioxide resulting from the field application of fertilisers and mill by-products and other organic sources such as palm litter;
- Fossil fuel used in the field and at the mill (diesel);
- Methane produced during anaerobic digesting of the palm oil mill effluent (POME); and
- Any emissions related to the cultivation of oil palms on peat soil (not applicable).

Emission sequestration from the following sources are also considered:

[11] http://www.fao.org/docrep/003/y1899e/y1899e08a.htm

- Carbon dioxide sequestrated by the oil palms trees in the plantation, ground cover, and palm litter;
- Carbon dioxide sequestrated by biomass in conservation areas (only for forested conservation areas); and
- Greenhouse gas emissions avoided because mill energy by-products are sold (e.g. electricity sold to the grid; palm kernel shells sold to power industrial furnaces).

1.5 TEAM RESPONSIBLE FOR DEVELOPING THE MITIGATION PLAN

Table 1 Development of Mitigation Plan

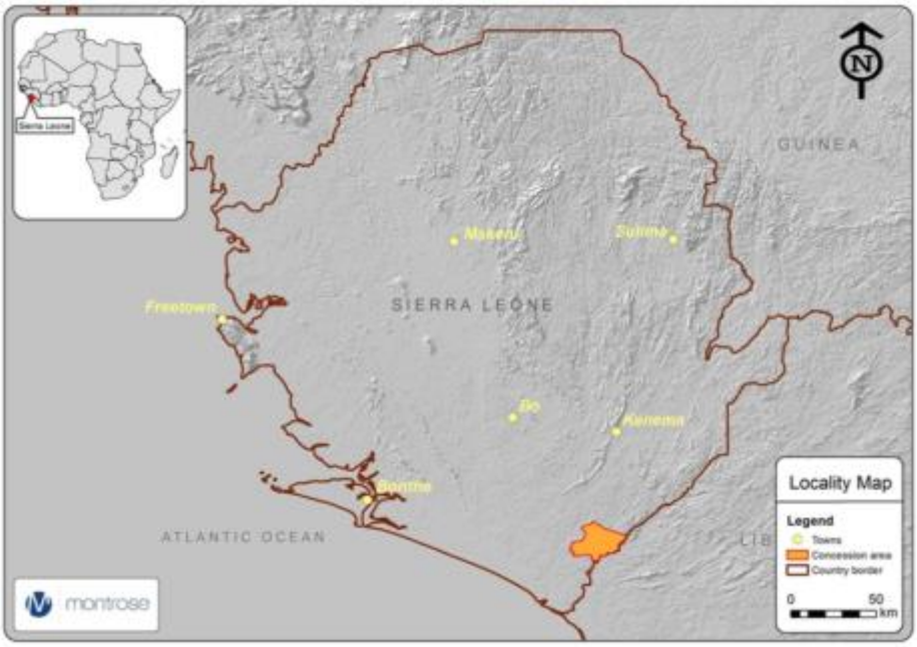
Name	Organisation	Role	Expertise
Jessenia Angulo	Natural Habitats Group	Group Sustainability Manager	Sustainability Management
Lilian Garcia	Natural Habitats Group	West Africa Coordinator	Environmental Engineering
Adrian Perez	Natural Habitats Group	GIS and Environmental Technician	GIS Software and Mapping
Kalindi Lorenzo	Natural Habitats Group	Sustainability Coordinator	Biodiversity and Conservation Strategies

2 CARBON STOCK ASSESSMENT

2.1 LOCATION MAPS

Landscape Level

Figure 2 Regional Location of the Natural Habitats Concession



District Level

Figure 3 District Level Concession Boundary

2.2 LAND COVER

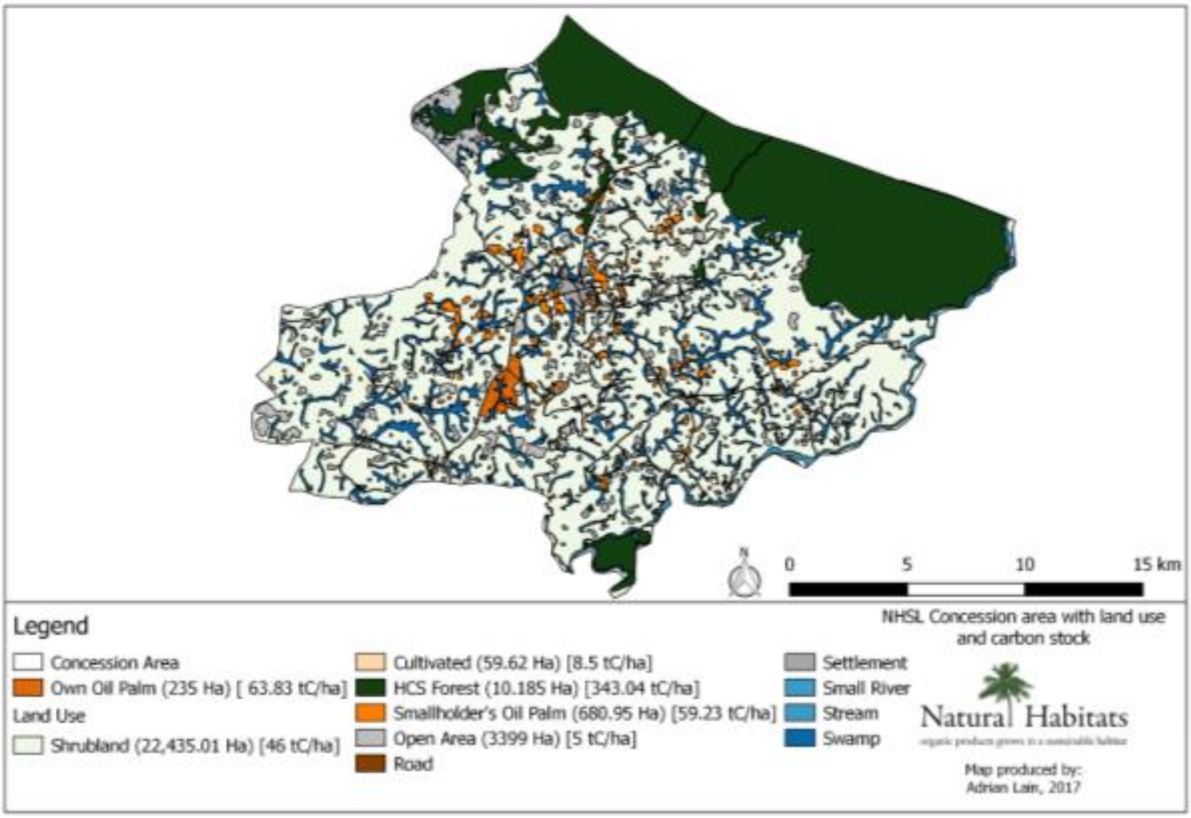
A map for the concession was developed to show different land cover categories (these are detailed in Table 2). Each land cover type was assigned a carbon stock estimation, based on RSPO default values. Areas that were identified as being High Carbon Stock (in the HCS assessment) have been assigned the average value for HCS forests in the concession. This was calculated to be 343,43 tC/ha, which is higher than the RSPO default value of 'undisturbed forest' of 263 tC/ha. Based on the findings of the HCS assessment, NH is confident that potential emissions will be avoided (i.e., HCS areas will be avoided and protected, and there will be no conversion to plantation). The verification procedure used to identify high carbon stock areas (the HCS Assessment) is described in 1.4.1.

Carbon stocks for HCV areas, settlements/villages, roads and water bodies (and their buffer areas) were not calculated as the HCV areas are not being considered for conversion to oil palm because of their protected and /or developed status. The other categories (water sources, settlements, infrastructure) are not considered because they will also not be converted to oil palm plantation and contain negligible carbon stocks.

2.2.1 MAP SHOWING STRATIFICATION OF CARBON CLASSES IN THE CONCESSION

Figure 4 gives an overview of the carbon stored in the concession (derived from the land cover classes of the RSPO New Development calculator defaults and the HCS assessment's average carbon value). Most of the concession consists of shrubland vegetation with low carbon content, and most of the biomass in the area is concentrated in HCS forest patches.

Figure 4: Map Showing Land Carbon Stock Classifications in the Concession



2.2.2 LAND COVER CLASS CARBON ESTIMATION

Table 2 Carbon Stocks Per Land Cover Type (tC/ha)

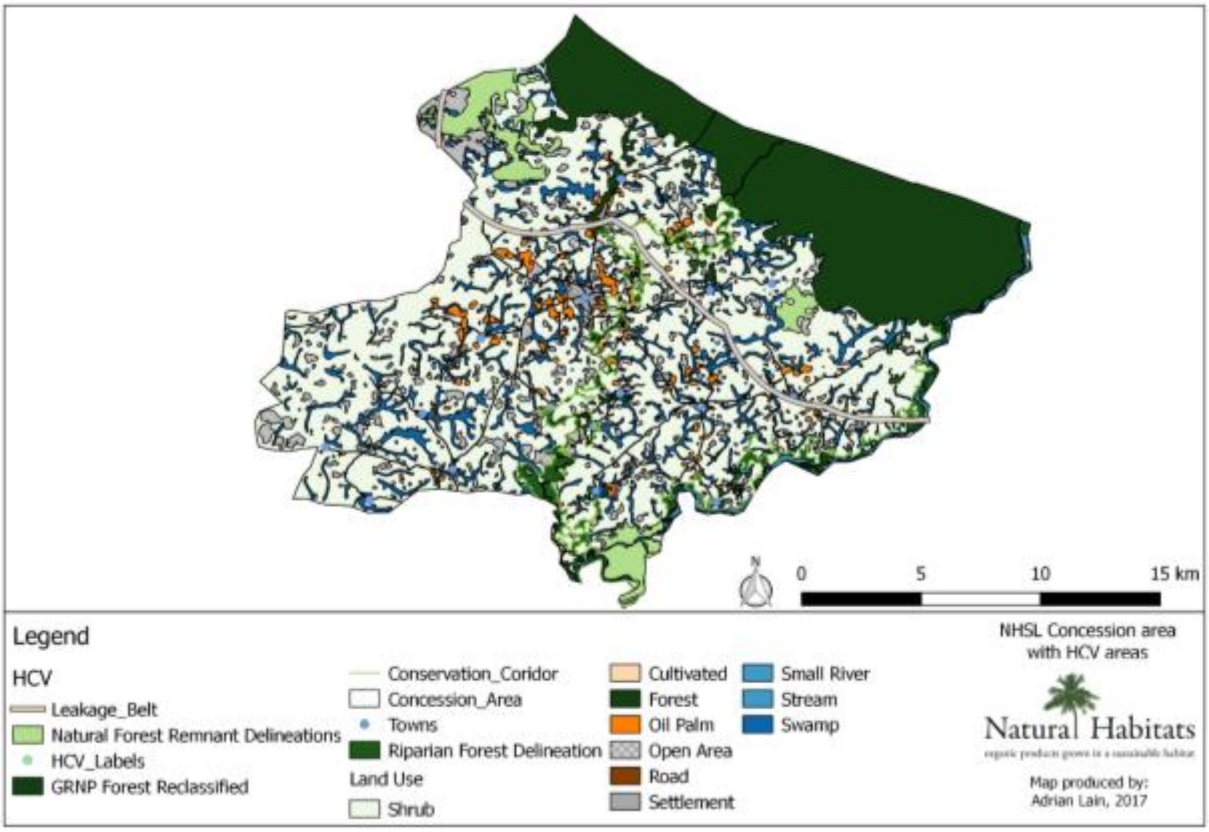
Vegetation Type	Area (ha)	Average Carbon Stock (tC/ha) (All are RSPO default values[12] except the HCS forest).	Total Carbon Stock (tC) = (area x average carbon stock tC/ha)
High Carbon Stock Forest	10.185	343,04	3.493.862,4tC
Shrub Land (Young and Old)	22.435,01	46	1.073.962,46tC
Own Plantation Oil Palm	235	63,83	15.0000,05tC
Smallholder Oil Palm	680,95	59,29	40.373,53
Cultivated Food Crops/Annuals	59,62	8,5	506,77tC
Open Area (Grassland)	3399	5	16.995tC
Roads/Settlements/Waterbodies	4624,03	0	0tC
Totals	41.618,61		4.775.700,21tC

[12] RSPO Default Above Ground Biomass and Below Ground Biomass Values (tC/ha), New Development Calculator 2016.

3 GHG EMISSIONS ASSESSMENT FOR NEW PLANTINGS

By stratifying the concession into carbon stock areas, an abundance of low carbon stock (shrub and open land) areas that can be used for development has been identified and HCS avoided. The next stage is to integrate these areas with social and HCV focus areas (Figure 5) so that community areas are avoided.

Figure 5: Map Showing Integrated Social and HCV Classifications



3.1 DEVELOPMENT SCENARIOS

Based on carbon stock and HCV maps, two scenarios were developed to estimate the different potential emissions of the proposed NPP area.

Assumptions used for the calculator that are the same for both scenarios include:

- A yield of 20tFFB/ha.
- Fuel use of 63l/ha/yr for field and transport, fuel use in the mill of 0,45lt/FFB processed.
- No conversion of peat land.
- Vigorous growth for oil palms.
- Oil extraction rate of 22%.
- 100% of POME is diverted to anaerobic digestion ponds.
- 50% of empty fruit bunches (EFB) applied directly to the field, 50% of EFB converted to compost.

Table 3 Description of New Development Scenarios

Scenario One	• Fertiliser use is restricted to the nursery (19ha) and applied at rate of Phosphate[13] 12kg/ha/yr and Potassium Chloride[14] 20kg/ha/yr. This is to maintain the whole plantation as a completely organic operation, as the seedlings are certified organic before they reach the age of commercial production. • All HCS areas are reserved for conservation purposes, preventing the development of these high carbon stock areas.
Scenario Two	• Half the plantation (3750 ha) is managed organically (non-synthetic inputs and compost application), and the other half (3750 ha) is managed conventionally with compound fertiliser application specialised for oil palms (Commercial Name: MPOB 1 with a formula of: 10%N+5,4%P2O5+16,2%K2O+2,7%MgO+0,5%B2O3[15]).With an application rate of 1287kg/ha/yr in the conventional 3750 ha plantation. • All HCS areas are reserved for conservation purposes, preventing the development of these high carbon stock areas.

Table 4 Showing the Main Emission Difference between the Scenarios

	Scenario One	**Scenario Two**
Planting Area (ha)	7500	7500
HCS Forest Set Asides/Focus Areas (ha)	10,185	10,185
Combined Fertiliser + N2O Emissions (tCO2e)	3135	13114,02

[13] X5Y(PO4)3: Phosphate (P2O5) from rock phosphate, K2O from muriate of potash

[14] Potassium Chloride = MOP = muriate of potash

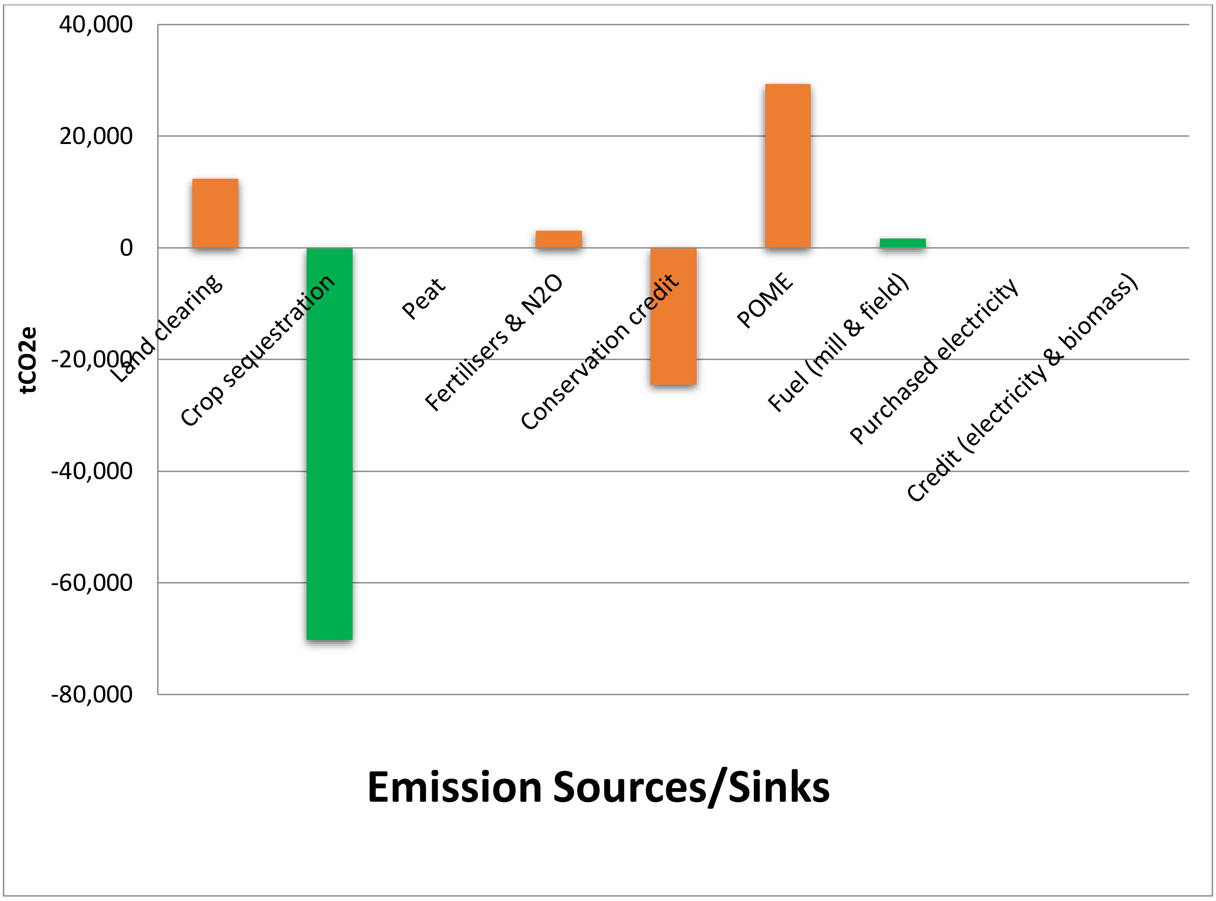
[15] Complex fertilizer: N from sulphate of ammonia, P2O5 rock phosphate, K2O from muriate of potash.

3.1.1 SCENARIO ONE

Table 5 Projections of GHG Emissions from Scenario One

Summary of results			
Field emissions & sinks (assumes vigorous growth for oil palm - for use by large-scale operations)			
	t CO_2e	t CO_2e/ha	t CO_2e/t FFB
Land clearing	**12.341,08**	**1,65**	**0,08**
Crop sequestration	**-70.215,33**	**-9,36**	**-0,47**
Fertilisers	**395,30**	**0,05**	**0,00**
N2O	**2.740,13**	**0,37**	**0,02**
Field fuel	**1.474,25**	**0,20**	**0,01**
Peat	**0,00**	**0,00**	**0,00**
Conservation credit	**-24.545,85**	**-3,27**	**-0,16**
Total	**-77.810,43**	**-10,37**	**-0,52**
Mill emissions & credit	tCO_2e	t CO_2e/ha	tCO_2e/tFFB
POME	**29.403,52**	**3,92**	**0,20**
Mill fuel	**210,61**	**0,03**	**0,00**
Purchased electricity	**0,00**	**0,00**	**0,00**
Credit (excess electricity exported)	**0,00**	**0,00**	**0,00**
Credit (sale of biomass for power)	**0,00**	**0,00**	**0,00**
Total	**29.614,12**	**3,95**	**0,20**
Total emissions, tCO_2e (field and mill)	**-48.196**		
Allocation:			
t CO_2e/t CPO	**-1,46**		

Graph 1 Showing Emissions Sources and Sinks



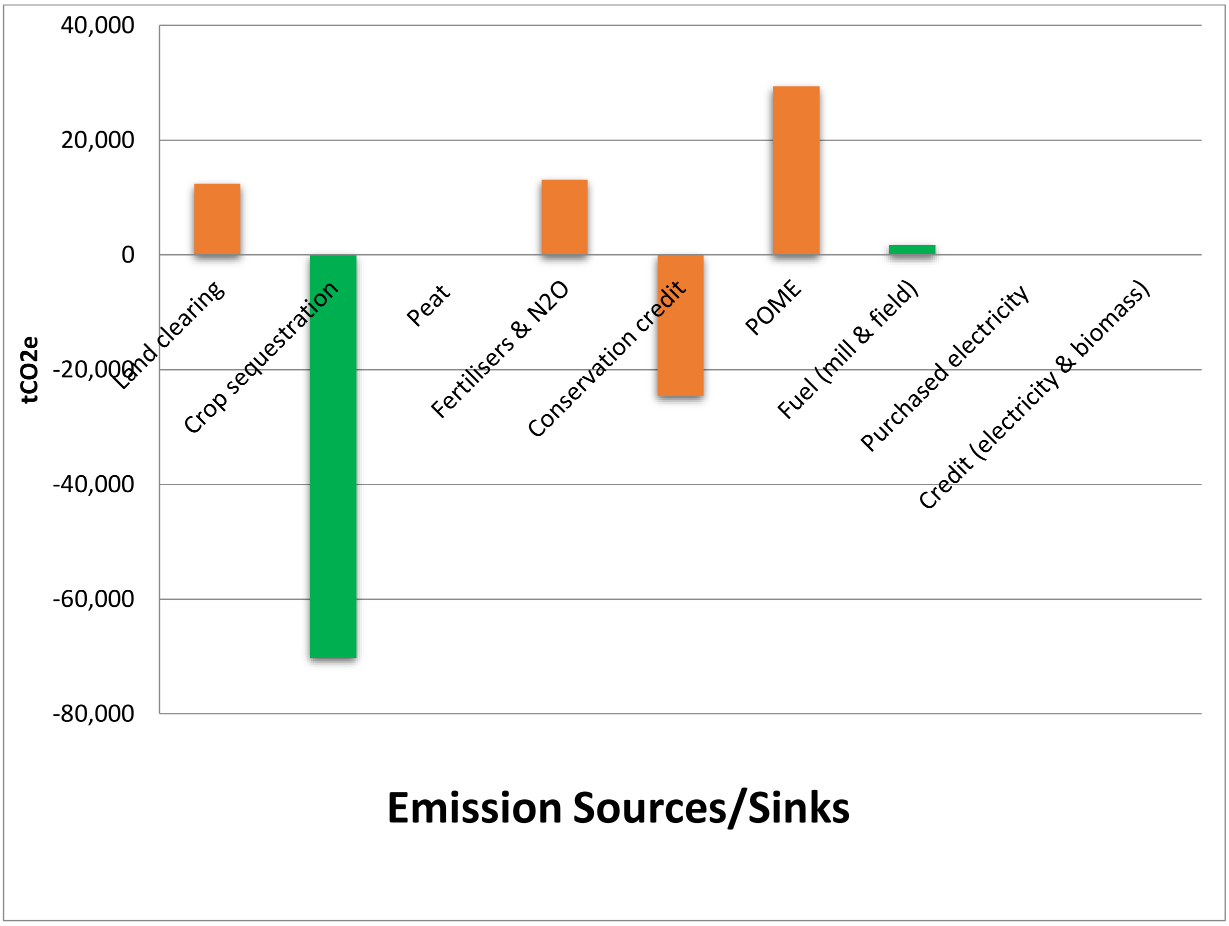
3.1.2 SCENARIO TWO

Table 6 Projections of GHG Emissions from Scenario Two

Summary of results			
Field emissions & sinks (Assumes vigorous growth for oil palm - for use by large scale operations)			
	t CO_2e	t CO_2e/ha	t CO_2e/t FFB
Land clearing	12.341,08	1,65	0,08
Crop sequestration	-70.215,33	-9,36	-0,47
Fertilisers	7.381,93	0,98	0,05
N2O	5.732,09	0,76	0,04
Field fuel	1.474,25	0,20	0,01
Peat	0,00	0,00	0,00
Conservation credit	-24.545,85	-3,27	-0,16
Total	-67.831,84	-9,04	-0,45
Mill emissions & credit	tCO_2e	t CO_2e/ha	tCO_2e/tFFB
POME	29.403,52	3,92	0,20

Mill fuel	210,61	0,03	0,00
Purchased electricity	0,00	0,00	0,00
Credit (excess electricity exported)	0,00	0,00	0,00
Credit (sale of biomass for power)	0,00	0,00	0,00
Total	29.614,12	3,95	0,20
Total emissions, tCO_2e (field and mill)	-38.218		
Allocation:			
t CO_2e/t CPO	-1,16		

Graph 2 Showing Emissions Sources and Sinks



3.2 CONCLUSION

Both scenarios will result in net sequestration of CO2 from the atmosphere. However, because the NH Group is committed to organic practices, Scenario 1 has been selected. This will maximise the development's ability to mitigate the potential emissions sources of inorganic fertilisers. It will allow all of the 7.500 ha of plantation to be maintained under wholly organic practices. This scenario includes conserving all identified HCS and HCV areas, and maintaining appropriate communities' areas. It is estimated that -1,47 t CO2e/t CPO is the potential emission (sequestration) from our proposed development.

3.2.1 FINAL DEVELOPMENT MAP

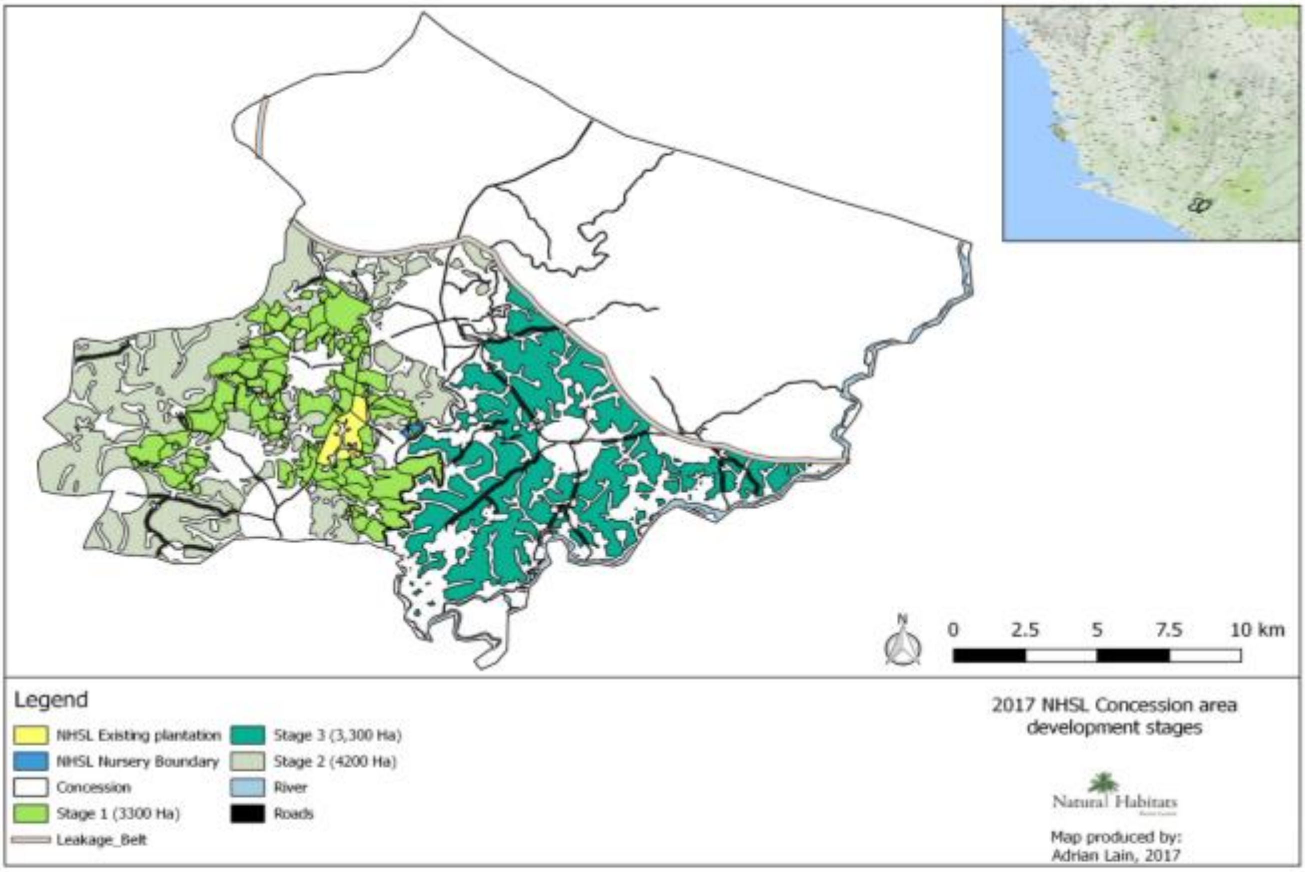


Figure 6 The Development Stages[16]

Figure 6 shows development stages and takes into consideration all constraints of the development:

- Social (community areas with relevant buffer zones);
- HCV areas (with relevant buffer zones);
- HCS areas (with relevant buffer zones); and
- Infrastructure (roads with relevant buffer zones).

The remaining areas of low carbon stock values (shrub and open land) are delineated for development in two main stages (i.e., the conversion of 921 ha of open land and 6607 ha of shrubland to oil palm plantation; with a combined carbon value of 12.156,28tC). Stage 3 comprises of areas for a possible independent outgrower scheme.

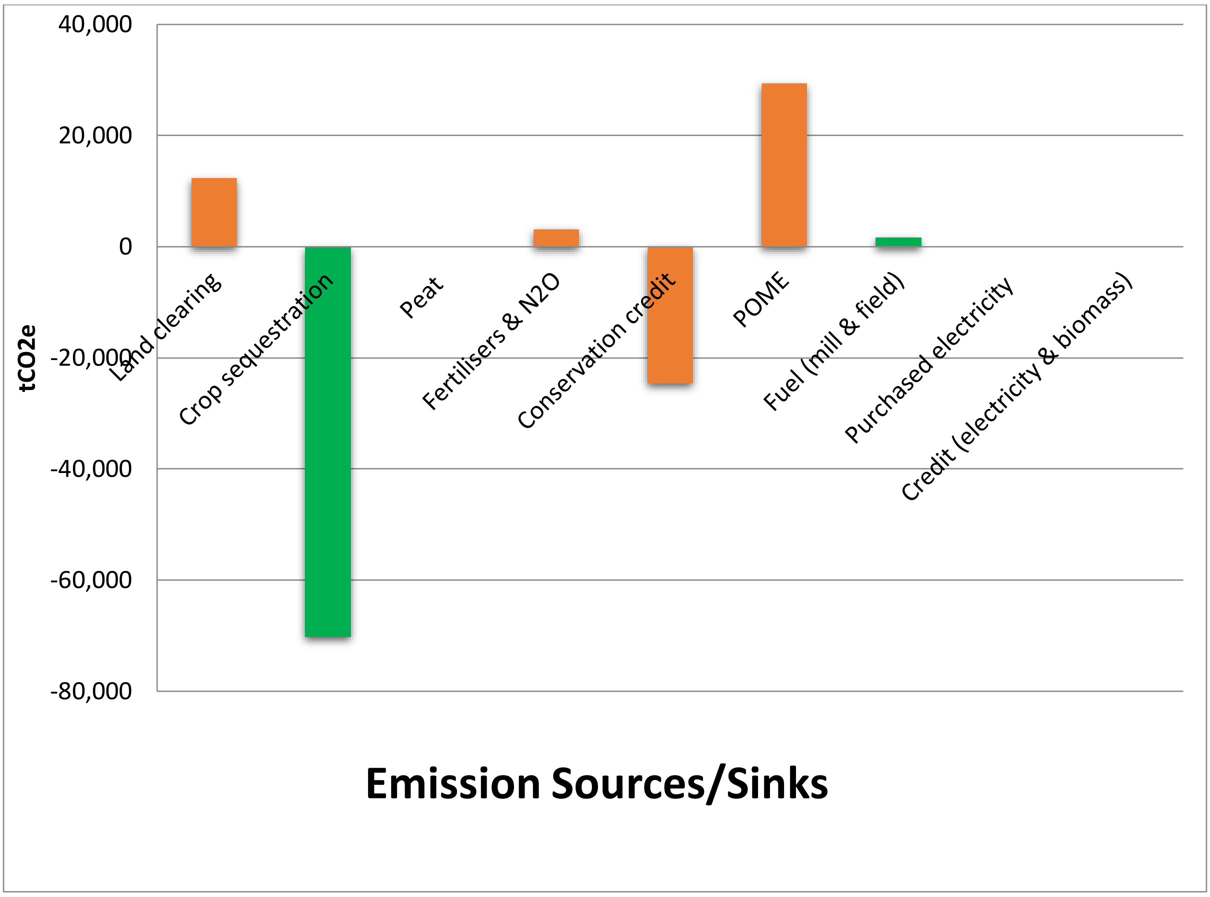
[16] Stage 3 is proposed independent outgrowers area.

3.2.2 FINAL GHG PROJECTION CHART

Table 7 Final GHG Projection Chart

Summary of results **Field emissions & sinks (Assumes vigorous growth for oil palm - for use by large scale operations)**			
	t CO_2e	t CO_2e/ha	t CO_2e/t FFB
Land clearing	12.341,08	1,65	0,08
Crop sequestration	-70.215,33	-9,36	-0,47
Fertilisers	395,30	0,05	0,00
N2O	2.740,13	0,37	0,02
Field fuel	1.474,25	0,20	0,01
Peat	0,00	0,00	0,00
Conservation credit	-24.545,85	-3,27	-0,16
Total	-77.810,43	-10,37	-0,52
Mill emissions & credit	tCO_2e	t CO_2e/ha	tCO_2e/tFFB
POME	29.403,52	3,92	0,20
Mill fuel	210,61	0,03	0,00
Purchased electricity	0,00	0,00	0,00
Credit (excess electricity exported)	0,00	0,00	0,00
Credit (sale of biomass for power)	0,00	0,00	0,00
Total	29.614,12	3,95	0,20
Total emissions, tCO_2e (field and mill)	-48.196		
Allocation:			
t CO_2e/t CPO	-1,46		

Graph 3 Showing Overall Emission Sources/Sinks of the Final Proposed Development Plan



4 GHG EMISSIONS MANAGEMENT AND MITIGATIONS PLANS

This new development project will only use open and shrubland areas. Thus, due to the low carbon stock used for the development, conversion to oil palm will result in the project being a net carbon sequestration project.

The NH Group is fully committed to not developing on peat land, high conversation areas, community set-asides, nor HCS forest. These areas have been determined/identified through our rigorous assessment and community engagement procedures.

NH will implement additional measures to reduce our overall emission sources as the project is designed and developed (e.g., using best available technology and following good international industry practice).

Strategies for reducing net emissions include:

- The use of organic materials as in-situ mulch, which has been generated through land clearing activities. This will return maximum amount of nutrients to the soil and avoid over-use of fertiliser. This will avoid carbon-emitting alternatives, such as burning residues.
- Limiting the use of generators operating on the site, and only using them for essential electricity generation purposes. Alternative sources of power include the use of hydro schemes, and solar power

generation (options will be investigated to determine potential impacts and an analysis of alternatives will be carried out so the best option is implemented).

- Machinery and equipment maintenance (carried out according to operators' recommendations and frequency) will result in optimal operating condition and avoid excessive emissions.
- Fuel consumption from vehicles (e.g., trucks, motorbikes, and lorries) will be monitored and trips will only be undertaken when necessary (taking the shortest route). Staff are trained on efficient fuel use strategies.
- Road maintenance is already done regularly (and will continue throughout the life of the project) to reduce potential negative effects on fuel consumption from driving over poor roads.
- High-efficiency equipment (such as boilers and chimney filters), will be chosen to reduce potential emissions from the mill's operation.
- POME will be piped from the mill through a series of six consecutive ponds equipped with nets to filter solids. Impellers will aerate ponds.
- 25% of the POME will be diverted from the ponds for use in compost-making, this will be an efficient way of increasing nutrient delivery to the fields, without increasing emissions through synthetic fertiliser use.

Specific measures to offset the emissions within the NH concession include:

- Increase sequestration potential of riparian areas, by supplying suitable indigenous tree seedlings from our tree nursery, to boost the number of trees and species. Therefore, increasing the carbon sequestration potential.

4.1 PROCESS FOR MONITORING THE IMPLEMENTATION OF THE PLAN

Strategies for Reducing Emissions	**Monitoring**	**Frequency**	**Person/s Responsible for Strategy Refinement**
Land clearing and biomass treatment.	During land clearing activities, organic material is mulched and evenly distributed. No materials will be burnt.	Every time a new area is cleared	Field Supervisors must report to the Plantation Manager. Plantation Manager in collaboration with Sustainability Manager to decide on any need for refinement.
Limit consumption of fuel for generators.	Fuel receipts will be used to analyse monthly consumption and investigate any cases of excessive use.	Every month	Plantation Manager and Finance Officer.
Electricity generation alternatives investigated, such as solar power generation.	During project set-up alternative energy sources will be considered.	During project design and implementation	Plantation Manager and Director of Operations.
Machinery and	Maintenance and	Every month	Plantation Manager and

equipment maintenance.	records are reviewed every month to ensure compliance to plan.		Mill Manager.
Fuel consumption from vehicles (e.g., lorries and motorbikes).	Fuel receipts are kept and analysed. Trips recorded and checked for compliance with management plan. Staff training on efficient fuel use strategies. Road maintenance is regularly done.	Every month	Plantation Manager.
Emission efficient mill equipment.	Information of emission potential of mill equipment will be assessed / analysed before purchasing.	Before mill equipment is purchased.	Mill Manager and Director of Operations.

Strategies for Offsetting Emissions	**Monitoring**	**Frequency**	**Person/s Responsible for Strategy Refinement**
Establish a tree nursey with suitable indigenous species.	At least 500 seedlings per year will be managed in a nursery for replanting in riparian and other designated areas.	Once per year (after planting season (May-August)).	HCV Manager

5 INTERNAL ROLES AND RESPONSIBILITIES

Table 8 Organisational Information and Contact Persons

Contact Persons	Position	Entity
Sam Mostyn	Group Director of Operations	Natural Habitats Group
Peter Pijpers	Country Manager	Natural Habitats Sierra Leone Ltd.
Jessenia Angulo	Group Sustainability Manager	Natural Habitats Group
Lilian Garcia	West Africa Sustainability Coordinator	Natural Habitats Group
Mustapha John Bull	Plantation Manager	Natural Habitats Sierra Leone Ltd.
Yufusu Moiwa	Sustainability Manager	Natural Habitats Sierra Leone Ltd.

Annual audits, undertaken by NH and/or independent consultants.

Natural Habitats has yet to begin GHG emissions audited, by a schedule will be implemented once RSPO NPP is approved. This will consist of six monthly reports that include the monitoring requirements detailed above and external auditing every five years (or as needed) by an external company to provide an updated Greenhouse Gas Assessment.

Statement of Acceptance of Responsibility for the Assessment

Signed on behalf of Montrose Environmental, Jersey,

Philip Patton (Pr.Sci.Nat.) Licensed HCV Assessor

Director

Montrose Environmental

Formal Sign Off of Management and Mitigation Plans

Signed on behalf of Natural Habitats Sierra Leone,

Signed on behalf of Natural Habitats Sierra Leone,

Jessenia Angulo,

Group Sustainability Manager.

Natural Habitats

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