

APRIL SALUMEI REDD PROJECT MONITORING REPORT

1ST PROJECT REPORTING PERIOD



Document Prepared By Environmental Accounting Services

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1 PROJECT DETAILS

1.1 Summary description of the Project

The April Salumei REDD Project ('the Project') is a pilot project located in the Wosera Gawi and Ambunti Drekiher Districts in East Sepik Province of Papua New Guinea. The Sepik River area has been identified as one of the least developed areas within Papua New Guinea (WWF, undated). The area is rich in traditional culture and possesses extraordinary levels of biodiversity. The Project is located approximately 122 kilometers (km) from the provincial town of Wewak within north-western Papua New Guinea. The location of the Project Area is shown in Figure 1.

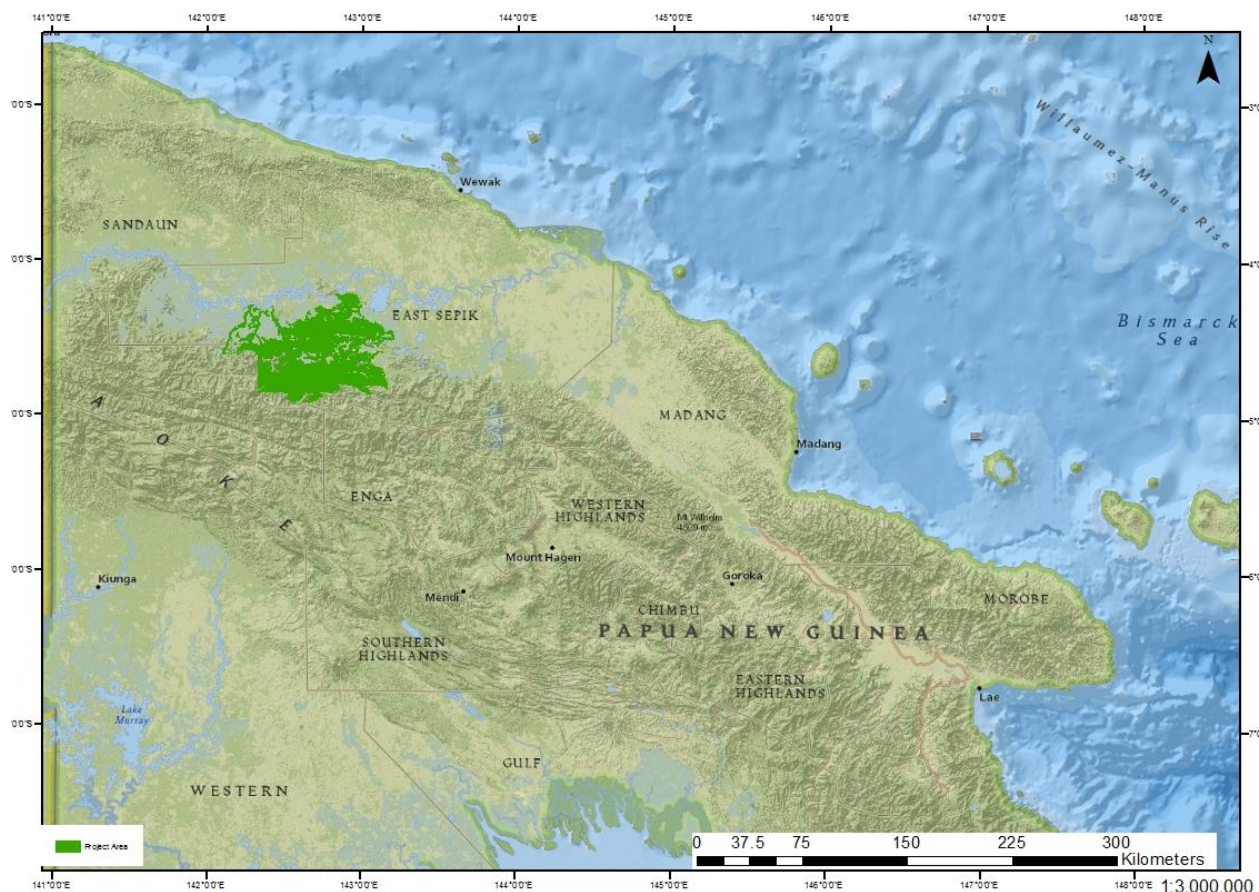


Figure 1: Location of the Project in relation to Papua New Guinea

Source: EAS for Rainforest Project Management, 2012.

The Project Area is defined by the area of forested land on mineral soils within the boundaries of two Forestry Management Agreements (FMA) namely; April Salumei (530,868 ha) and April River (75,313 ha) with a combined area of 606,181 hectares (ha)¹. An FMA is a legal agreement between the landowners and the Government (issued via the Papua New Guinea Forest Authority). Under the terms of the FMA, the landowners have authorised the issuance of a 50-year timber concession license, allowing harvesting

¹ The variation in total area between the FMA boundaries and the Project area boundaries have resulted due to the discovery of peat soils in the FMA. Areas of peat were mapped and excluded in accordance with the selected VCS methodologies.

of timber in the FMA. This normally involves the approval of a timber harvest plan for the first rotation (between 30 and 40 years), and then on approval by the Forest Authority, the FMA is extended for a second rotation.

The Project Area fits into two different VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Categories² depending on whether the forest is converted during the baseline crediting period. These categories are Reduced Emissions from Deforestation and Forest Degradation – Avoided Planned (Sanctioned) Deforestation (REDD-APD), and Improved Forest Management – Logged to Protected Forest (IFM – LtPF), as shown in Figure 2 below. For the remainder of this document, the boundaries of the two different Project categories are collectively referred to as the ‘Project Area’.

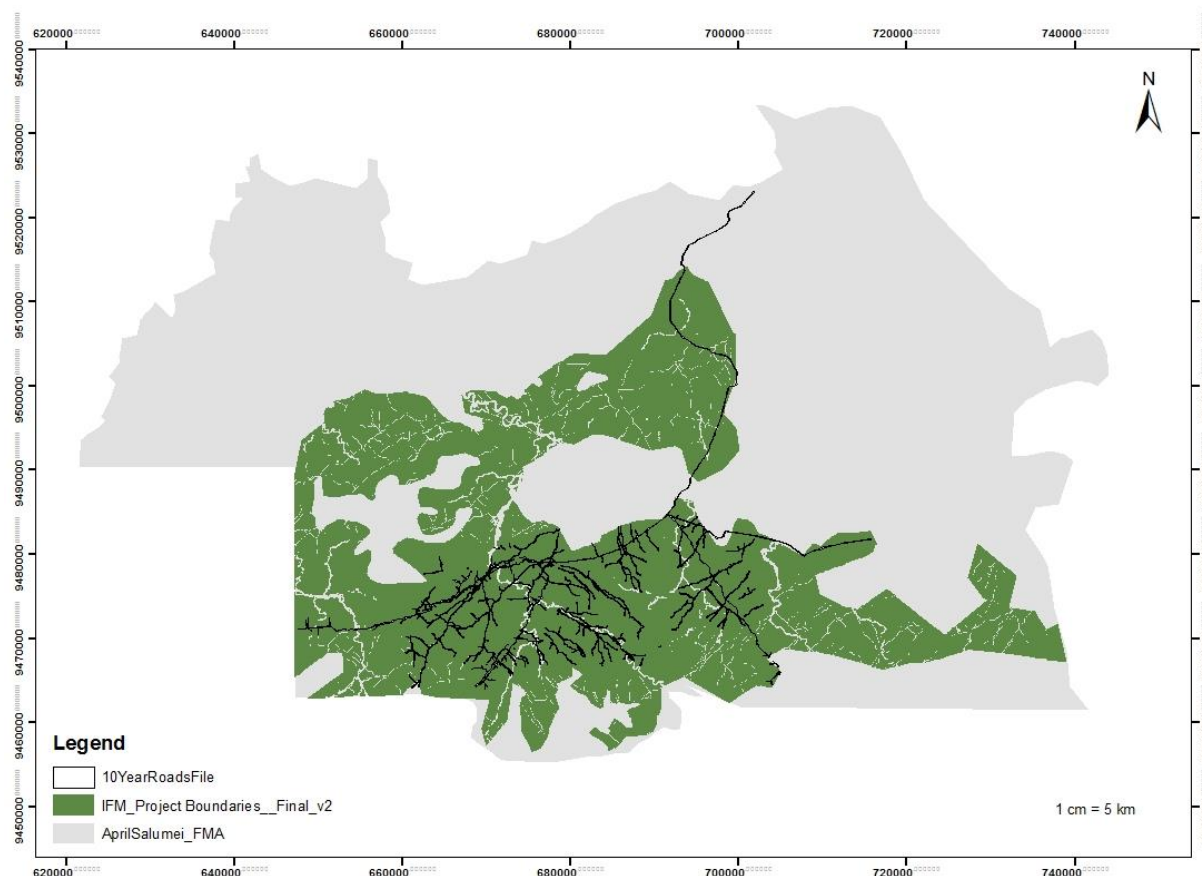


Figure 2: Project Boundaries for the two VCS Project Categories (APD & IFM)

Source: EAS for Rainforest Project Management, 2012

² VCS AFOLU Guidelines V3.3, Section 3.1.8 states that “Projects may include multiple project activities where the methodology applied to the project allows more than one project activity and/or where projects apply more than one methodology, as set out in the VCS Standard. Such projects shall comply with the respective project requirements of each included AFOLU category. For each activity covered by a different methodology, the geographic extent of the area to which the methodology is applied shall be clearly delineated.

The key project attributes for the two categories of the Project are summarised in Table 1 below.

Table 1: Summary of the key attributes of the Project

	REDD-APD	IFM - LtPF
Project Area (ha)	7,640	196,703
Geographical Position	Centroid: 4°33'31"S and 142°41'20"E	
Forest Type	Moist Tropical Rainforest - Low Altitude Forest	
Soil Type	Hydraquents and fluvaquents in wetlands and river banks. Humitropepets and dystropepts in higher elevations ³	
Baseline sequence of activities leading to deforestation or degradation	1. Construction of roads that are sanctioned and developed to allow timber extraction. 2. Planned road development was modeled as specified in the Forest Management and Development Proposal (FMDP), however road development regularly exceeds the code requirements and leads to more extensive and rapid road development.	1. Legal timber harvesting as permitted under a Forestry Management Agreement (FMA) in accordance with a valid and verifiable Forest Management and Development Proposal (FMDP) 2. Timber extraction rates were modeled to occur in accordance with the FMDP. In reality, extraction rates often exceed those in the plan.
Legal Land Use Classification	Primary intact forest	
Selected Methodology	REDD Methodology Modules, v1.3. VM0007	Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.2 VM0010 ⁴

The aim of this Project is to protect the forest and biodiversity of the Project Area whilst providing important source of income for the impoverished landowners that reside within it. The Project also aims to improve wellbeing of local communities in the Project Area through the development of viable sustainable agriculture opportunities; as well as by improving access to healthcare, education and infrastructure; while preserving the local communities' rich cultural traditions and customs.

³ Source: Development Option Study for April Salumei, 1996

⁴ As this methodology was on-hold at the time of writing, the updated but yet-to-approved version (v1.2) was used to prepare this PD and the associated calculations

1.2 Sectoral scope and project type

The April Salumei REDD Project falls under the 'AFOLU' sectoral scope of the VCS. Table 2 shows the Project scope, category, activity and grouping classification.

Table 2: VCS sectoral scope, project category, activity and grouping classification

Scope	Category	Activity	Grouped or Multiple Project
14 – Agriculture, Forestry and Other Land Use	Avoided (Sanctioned) Planned Deforestation	Protection without logging, fuel wood collection or charcoal production	Multiple
14 – Agriculture, Forestry and Other Land Use	Improved Forest Management	Conversion from Logged to Protected Forest	Multiple

1.3 Project Proponent

The Project Proponent is Rainforest Project Management Limited. Rainforest Project Management was granted the rights to develop and manage the project by the landowners and the Papua New Guinea National Government. Contact details for the Project Proponent are summarised in Table 3 below.

Table 3: Project Proponent details

Project Proponent	Address	Contact Person	Contact Details
Rainforest Project Management Limited (Company No 1-72274)	Po Box 3319, Boroko, NCD, Papua New Guinea	Stephen Hooper	Phone: +61 (0) 488 088 321 Email: shoop@p-f-a.org

1.4 Other entities involved in the Project

Rainforest Project Management has partnered with a number of organisations to assist with the design, development and operation of the April Salumei REDD Project, as described in Table 4 below.

Table 4 Summary of other entities involved in the Project

Name of project partner/stakeholder	Role in the project	Roles & responsibilities
Incorporated Land Groups (ILGs)	Land owners	Owners of the land. Project staff. Chairman of the ILGs has a seat on the April Salumei Group.
Pacific Forest Alliance	Implementation partner	Specifically established to manage the project. For more information see: http://www.pacificforestalliance.org
April Salumei Working Group	Implementation partner	Responsible for development of the Project Management Plan. Consists of members and representatives of the landowners within the Project Area
Environmental Accounting Services (EAS)	Lead technical & VCS consultant	Technical design and development of the carbon project elements including fieldwork, remote sensing analysis, and historical land use change analysis and technical project development. Also responsible for development of documentation and systems to achieve validation and verification against the VCS.
University of Papua New Guinea, School of Natural and Physical Sciences:	Technical support	Provision of expert advice on forestry, climate change, natural resources, geology, mining, GIS, geography, sustainable development, hydrology, biodiversity, community livelihoods, law and policy. Assisted with the collection of field inventory data
Papua New Guinea Forest Research Institute	Technical and implementation support	Provided expert advice in tropical forestry and REDD management in Papua New Guinea. Assisted with the collection of field inventory data. Conducted Government liaison for the Project.
Papua New Guinea Forest Authority	Government authorisation	Responsible for: official Government approval of the project; provision of forest inventory data and provincial land use planning; advice on REDD project implementation
Prime Minister and Office of Climate Change and Development	Policy support	Advice on REDD policy and implementation
Partners with Melanesia	Community development	Not for Profit (NGO) focused on conservation and community development programmes in Papua New Guinea

1.5 Project start date

The project start date is May 22, 2009. This is the date that the first agreement was signed between the Landowner Companies and a Project Developer to develop the April Salumei FMA into a Carbon Project.

The start and end dates for the historical reference period, fixed baseline period and the monitoring period are provided in Table 5 below.

Table 5: Temporal boundaries of the Project

Temporal boundary	Start Date	End Date
Fixed baseline period	22 May 2009	21 May 2019
First Monitoring period	22 May 2009	31 December 2012

1.6 Project crediting period

The crediting period for the project is 38 years (i.e. approved timber harvest plan is for 40 years) as shown in Table 6 below.

Table 6: Project crediting period

Time Period	Start Date	End Date	No of years
Project crediting period	22 May 2009	21 May 2047	38

1.7 Project scale and estimated GHG emission reductions or removals

Table 7 shows the GHG emissions reductions that are expected to be achieved by the Project over its first crediting period.

Table 7: Estimated GHG emission reductions from the project over the first ten years of the crediting period

Year ending	Estimated GHG emission reductions REDD-APD (tCO ₂ e)	Estimated GHG emission reductions IFM-LtP (tCO ₂ e)	Total Estimated GHG emission reductions (tCO ₂ e)
May 2010	96,001	146,619	242,620
May 2011	98,684	180,782	279,466
May 2012	101,367	214,948	316,315
May 2013	113,441	249,111	362,552
May 2014	106,733	283,278	390,011
May 2015	109,416	317,443	426,859
May 2016	112,099	351,608	463,707
May 2017	114,782	385,773	500,555
May 2018	117,465	419,938	537,403
May 2019	120,148	454,102	574,250
Total estimated ERs	1,090,453	3,003,602	4,093,738
Total number of crediting years	10	10	10
Average annual ERs	109,045.3	300,360.5	409,378.8

This demonstrates that the April Salumei REDD Project qualifies as a 'Large-Project' as shown in Table 8.

Table 8: Classification of Project scale

Project	
Large project	X

1.8 Project Location

The Project Area is located within the Wosera Gawi and Ambunti Drekiker Districts in the East Sepik province of Papua New Guinea. A map of this location in relation to Papua New Guinea can be seen in

Figure 1, while Figure 2 shows a more detailed image of Project Area. The Geographic boundaries of the Project Area are described in more detail in Table 9 below.

Table 9: Geographic boundaries of Project Area

Requirement	VM0007 Evidence	VM0010 Evidence
Project Area Name	Logging roads	Timber Area
Maps (digital) of the area	Figure 2	Figure 2
Geographic co-ordinates of each polygon vertex and documentation of their accuracy	Boundary of deforested area defined by series of vectors representing modelled roads occurring across the entire extent of the FMA.	Coordinates define the project area: Northern most point: 142°49'13.837" E; 4°28'51.249"S Western most point: 142°19'32.34" E; 4°43'57.781"S Southern most point: 142°33'39.457" E; 4°55'30.221"S Eastern most point: 143°8'41.874" E; 4°51'0.353"S
Total land area (ha)	7,640	196,703
Forest land right and user rights	Subject to a FMA	
Project Area and Proxy Areas	A shapefile & KML file of the project boundaries provided as supporting documentation. File name: April Salumei_Project Boundaries_VM0007_Roads (KML file), Project Boundaries_Roads_Dec 14_2012 (ArcGIS file).	A shapefile & KML file of the project boundaries provided in supporting documentation. File name: IFM_TotalHarvestableArea_March27_final (ArcGIS file).

1.9 Title and Reference of Methodology

As described previously, the Project Area is divided into two different VCS Project Categories with stratification of the Project Area used to delineate the spatial boundaries of each VCS Project Category for accounting purposes. These are:

- VM0007, 'REDD Methodology Modules Version 1.3' for areas of planned deforestation
- VM0010, 'Methodology for Improved Forest Management: Conversion from Logged to Protected Forest Version 1.2' for areas of logging in the baseline

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The Project has been in the development stage since 2009 and is now in the early stages of activity implementation. During the monitoring period 2009 -2012 the main activities undertaken by the Project have focused on the community and developing implementation plans through an on-going Participatory Rural Appraisal Approach.

The focus of this process has been to design operational objectives, frameworks and procedures combined with activity and development plans. These plans focus on how financial benefits from the Project will be distributed and the types of activities that are important to the communities who live within the Project Area. These activities were designed to mitigate deforestation and by default mitigate leakage and uphold project permanence.

This process has identified three primary development aims for the Project Area, categorised according to climate, community or biodiversity outcomes. These aims are:

- Climate: To avoid greenhouse gas emissions related to planned deforestation and timber harvest in the Project Area
- Community: To result in a net increase in the wellbeing of communities in the Project Area, via improved health standards, education, transportation, employment opportunities, community support for conservation, and equitable distribution of project benefits
- Biodiversity: To maximise biodiversity value of the Project Area by preventing habitat and therefore species loss

In order to achieve these objectives, the project has implemented (and will continue to implement) a number of activities as described below. It should be noted that project related activities do not lead to the clearance of any native ecosystems.

2.1.1 Climate related activities

There are two main activities targeted towards reducing greenhouse gas emissions, as described below.

Reclassification of the FMA as a REDD Project Area:

The Project Area is defined by an FMA that permits the Papua New Guinea Forest Authority to award forest harvesting rights to a company for fifty (50) years. In agreements signed by the landowners with the Project Developer the landholders have agreed to terminate the FMA upon validation to the VCS⁵. This is possible under clause 16.1 (a) of the FMA agreement which states that the FMA can be terminated “by agreement at any time by all parties”. The National Government is the other Party to the FMA agreement through the Papua New Guinea Forest Authority. With the National Governments approval of the FMAs being the REDD pilot project through the NEC decision clearly demonstrates that both parties are in agreement to convert this area from an FMA to a REDD conservation project. Removal of the Project Area from the Papua New Guinea land registry will ensure that commercial logging concessions cannot be awarded in the future.

⁵ This agreement can be made available on request to Third Party validators.

Pending cancellation of the FMA and its subsequent removal from the land registry, the Project Proponent has sought to protect the Project Area by formally delineating the area as a REDD pilot project. This was achieved on the 10th May 2012, when Papua New Guinea's authority for Climate Change, the National Executive Council (NEC) formally approved the project as a national level REDD pilot project. This is formally enshrined in a legally-binding National Decision (number 106/2012), which represents the highest level of a REDD Project approval possible in Papua New Guinea. A copy of this decision is available to the auditor in Annex 3.

Monitoring of land use change within the Project Area:

During the crediting period remote sensing was the primary activity undertaken to detect land use change in the Project Area.

Remote sensing will be combined with ground-based monitoring undertaken by project employees from the local area in future monitoring periods. These 'Community Rangers' will be given comprehensive training, including induction, communication skills, and computer training. In addition, 'Forest Stewards' will also be responsible for monitoring, observing and reporting of the forest at local level. They will be trained in measurement of key parameters like tree Diameter at Breast Height (DBH), tree height, tree count, classification of tree species, assessment of abnormalities (tree mortality, logging) and use of a GPS.

Forest Stewards will be required to report their observations on an immediate and/or annual basis, as outlined according to the schedule listed in Table 10 below. It is proposed that these field activities will commence the year following VCS validation.

Table 10: Field based reporting schedule

Reporting frequency	Observed activity
Immediate	Illegal logging
	Fire
	Any other loss of resource
Annual (commencing the year following validation)	Third party validation of the resource area by a qualified forester with Papua New Guinea Forest Authority
	Investigation of any irregularities identified in aerial surveys or satellite imaging as they become available
	Survey of timber used for traditional purposes (e.g. clearance for making gardens, harvesting for building canoes or homes).

2.1.2 Community related activities

Supporting sustainable projects and livelihoods for the local community is considered crucial towards the success of the Project. Community development activities will be tailored towards the specific community needs as well as being consistent with Papua New Guinea's Vision 2050 Goals (Papua New Guinea

Vision 2050, 2011), which aims to improve socio-economic conditions of its people.⁶ Seven key community development strategies are being implemented under the Project, as described below.

Strategy 1: Improved community infrastructure

Housing, community centres and other infrastructure is generally very poor in the Project Area. Examples of activities that are planned to be implemented to improve community infrastructure include:

- Renovation of housing at Yambi and Ambunti, including the establishment of fully equipped offices in the District Headquarters in Yambi. These headquarters will serve as the base for the Project field operations, as well as a community centre for project controls, pending establishment of a community centre inside the Project Area.
- Establishment of regional resource centres in each of the jurisdictions of the land owner companies. These will be multi-purpose, and be a place for the storage, dissemination and exchange of data, knowledge, skills and technology. They will also serve as a communication hub for the landowners.

Strategy 2: Improve community education quality and extent

Literacy levels in the area are low. The Project aims at improving literacy and general education of children and youth in the Project Area. Examples of early implementation activities include:

- Analysis of the education needs of the respective areas and their current schools in terms of facilities, human resources, and equipment
- Provision of education materials to existing schools, as per needs assessment conducted above
- Provision of secondary and tertiary scholarships to encourage local youths to continue their education and become future leaders in the region

Strategy 3: Improve healthcare quality and outreach

There is currently little or no access to health care in the area, resulting in a high mortality biased toward small children, infants and mothers. Examples of early implementation activities to address this issue include:

- Comprehensive review of the communities' needs and development of a prioritised Project health plan
- Support for the establishment of community health buildings in strategic locations to improve health care accessibility, in accordance with the Project health plan

Strategy 4: Improve mobility and transport

The local communities suffer from a lack of mobility along rivers within the Project Area and also isolation from the rest of the region due to a lack of access to transport. This has flow-on implications for the ability of local people to access healthcare and education. Examples of early implementation activities to address this issue include:

⁶ Papua New Guinea Vision 2050 activities (and their respective numbers in the policy document) considered relevant to the project include: Education activities: 1.17.2.1 free education; 1.17.2.2 100% literacy for adult population over 15yrs; 1.17.2.17 establish a public-private partnership in delivery of education; 1.17.2.18 introduce environmental sustainability and climate change into the curriculum. Health activities include: 1.17.3.1 reduce HIV-AIDS to 0.1% of the population aged 15-49yrs; 1.17.3.2 Reduce tuberculosis to 10/100,000 of population; 1.17.3.3 Reduce malaria deaths to 10/100,000; 1.17.3.5 Establish one aid post per ward area; 1.17.3.6 establish two health workers per ward area; 1.17.3.7 establish one basic health service centre with two doctors and support personnel per district; 1.17.3.8 improve the terms and conditions of employment of health officers More details can be found in the Papua New Guinea Vision 2050 report (Papua New Guinea Vision 2050, 2011).

- The initial purchase of five large (23 foot) dinghies with 40 horsepower outboard motors to support the transport needs of the communities. The dinghies will also be used in the provision of project programs and for dissemination of information.

Strategy 5: Improved communication networks

Communication networks in the area are not effective, being either erratic or non-existent. Examples of early implementation activities to address this issue include:

- Auditing of existing radio communication and immediately repair or replace faulty radios or components
- Set up of satellite communication for the entire Project Area

Strategy 6: Update the land owner database

Traditional landowners change frequently due to births and deaths but the cost of updating the ILG database is often too great for landowners to bear. Examples of early implementation activities to address this issue include:

- Arranging for real-time update of all ILG's and mapping their boundaries that will be completed consistently with the new ILG Act. It is estimated that this process will take 3 to 4 years for completion. Mapping of traditional landowner boundaries will help resolve disputes, and will also assist in the fair and transparent distribution of Project benefits.

Strategy 7: Generate employment opportunities

Local employment opportunities will arise from the Project itself, as Forest Stewards and Community Rangers. The project will trial the development of community policing in the Project Area, whereby community leaders develop culturally appropriate but effective ways to promote public safety and enhance the quality of life in their neighbourhoods. In addition, the leakage management activities such as improved agricultural productivity in existing agricultural areas will not only increase food production for subsistence purposes, but it may also result in excess food production that can be sold in local markets.

2.1.3 Project technologies, products and services

The April Salumei REDD Project is primarily a forest conservation project. The project design is focused on supporting activities that reduce the drivers of deforestation and forest degradation, focussing on proven technologies, products or services across three main areas; 1) forest conservation; 2) sustainable agriculture development; and 3) small enterprise development, as described below.

- Forest conservation – Activities primarily focused on supervision, monitoring, conservation research and other conservation based land management activities. These activities will be supported by technical experts in forest inventory and remote sensing where required.
- Sustainable agriculture development – The Project will employ agricultural experts to test and implement agricultural regimes that are culturally appropriate, but that will also improve productivity permitting excess production to be sold in markets. A broader range of agricultural products will also be produced, allowing the local people to generate produce across a broader range of seasons, while improving nutrition for the local communities.
- Small enterprise development – The Project aims to encourage and assist in the development of small enterprises to generate alternative sources of income and reduce the pressure on the forest

resource. These enterprises will be supported by the project and external expertise will be sought if and where required.

Progress towards the implementation of the proposed activities is presented in Table 11.

Table 11: Implementation Status of Project Activities in the April Salumei Area

Project Activities for the April Salumei REDD Project				
Strategy	Tasks	Achievements so far	Planned activities for the next year	Comments
1: Improved community infrastructure	Renovation of housing at Yembi and Ambunti	Identification and Selection of Site, Review of work to be undertaken.		Waiting for confirmation of land title from JDB&PPC. Confusion over ownership of land at Yembi so as a result of this we will concentrate on establishing resource at Ambunti.
	Establishment of offices in Ambuntii	Selected Site		Waiting for confirmation of land title. Office and accommodation to be built in Ambunti.
	Establishment of the regional resource centres in each of the jurisdictions of the land owner companies	Discussions and agreement with Traditional owners.		Pending funding.
2: : Improve community education quality and extent	Analysis of education needs	PRA process identified education as a priority for the project.		Landowner Chairman prioritised education as a key deliverable of the project. Preliminary survey indicates all communities have different development requirements. In some areas curriculum support materials are required and in others there may be no classroom or teacher.
	Provision of education materials to existing schools	Planned for 1 st quarter 2013		To be coordinated with District education officers. The O'Neil Government has committed to free education so we are understanding how we will link into this initiative
	Provision of secondary and tertiary scholarships	Planned only		It is evident the landowners want scholarship for the students to various institutions. These will be made available as budgets allow.
3: Improve health care quality and outreach	Comprehensive review of community health needs	PRA process identified health as a key priority for the project.	Review planned for 2013	Following the review of all Health Centres and facilities information sharing and planning will be undertaken with the District Health officer to ensure an alignment of our objectives.
	Development of a prioritised Project health plan		Will be undertaken in 2013	Integrated plan to be established in close consultation with the respective District health officers.
	Support the establishment of	Planned		Work closely with the District Health Office to implement the

	community health buildings in accordance with the Project health plan			activity.
4: Improve mobility and transport	Purchase offive large (23 foot) dinghies with 40 horsepower outboard motors	Ordered, paid for and delivered to each project area.	Nil	Boats have been purchased and have been delivered.
5: Improved communication networks	Auditing of existing radio communication to work in partnership with PIM.	LOC have been asked to advise requirements.		All Landowner Chairman have been asked to provide a list of broken and or missing parts on all radios. The Project will then purchase the required parts to ensure an efficient radio service. It is planned for the radio service to allow broadcast of the project travel plans, objectives and activities. Also provide opportunity for each LO chairmen to communicate among themselves.
	Immediately repair or replace faulty radios or components	Access need and costing.	Completed	Assessed and should commence shortly.
	Set up of satellite communication for the entire Project Area	Access suppliers and cost implications.		Communication was identified as important and LO chairmen want satellite V-Sat system established. Quarter 3 will see a review of existing options. Mobile networks are being rolled out quickly in PNG and this may be a better option than satellite.
6: Update the land owner database	Arranging for real-time update of all ILG's	164 ILG agreements signed and 2 x LANCO incorporated, B'nomo & Niksek Investments.	Has commenced	All Incorporated Land groups have been recorded and updated by landowner Company Chairman. This process will be overseen by the project Manager Mr Philip Ugu and ILG updates made with the Dept. of Community Development and Lands.
	Mapping of their boundaries	Identified as a major project activity.		This will follow the updating of all ILGs as it conforms to the revised ILG Act 2009.
7: Generate employment opportunities	Development of community policing in the Project Area	Need to consult relevant agencies and support activity.		In consultation with relevant agencies (police, youth, district services, law & justice sector) support community policing activities.
	Employment of Forest Stewards and Community Rangers by the Project	A priority in the implementation of the project & M&E.		Have employed the landowner Company Chairman to date. Community Stewards are planned to be employed as financial budgets allow.

	Development of culturally appropriate but effective ways to promote public safety by the community leaders		Completed.	Safety Policy has been developed and discussed with landowner Chairman. This has been discussed with all ILG Chairman at the village level.
	The Project aims to encourage and assist in the development of small enterprises to generate alternative sources of income	Discussions on going for chairmen to identify projects to be undertaken.		Policy developed to outline how communities can apply for funding sustainable projects. We have not yet encouraged landowners to apply for the funding however we have identified priority projects at the Landowner Company Chairman's level during the PRA.
8. Identify Training Needs to improve the Chairmen performance.	Training planned and delivered to improve landowner chairman decision making.	Training delivered on; - What is a leader? - Roles and responsibilities of leader. - Needs Analysis & projects identification. - Planning & Budgeting. - Workshop conducted on project.	Several training is planned for the year.	The chairmen acknowledge the training as important and are embracing it and want more training and workshops that will improve their leadership skills, management capacity and decision making. They acknowledge the importance of good governance, transparency and accountability in decision making.
9. Impact projects delivered to the landowners.	Impact projects worth K100,000.00 has been identified by landowner chairmen is planned to be delivered.	In the process of delivery of the impact project in respective geo-project areas.		Projects identified and nominated by landowner chairmen and their executives. Identified projects funded and to be delivered.
10. Mobilisation Funds Delivered.	Mobilisation of K100,000.00 has been paid to the landowner companies.	Landowner company accounts activated. Chairmen & their landowner executive have decided on where to spend the funds. Acquittals have been made.		Chairmen plan and budget for the expenditure of the funds on priority areas and acquittals submitted.

11. Stakeholder engagement with partners.	Work with stakeholders that have mutual interest in the development of the project.	Meetings held with LO chairmen's, JDP&BPC, District Administrator, Provincial Administration, ESPG, Central Agencies, NFA, Vision 2050, OCCD, PM&NEC, PWM etc. Also presentations made at various levels in meetings and workshops.		Various consultation meetings have been held at the landowner, local level, district, provincial and national level and NGOs in the development of the project.
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2.2 Project Description Deviations

Not applicable.

2.3 Grouped Project

Not applicable

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

3.1.1 VM0007

Table 12: M-MON Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	Project Forest Cover Benchmark Map
Data Unit:	
Description:	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event
Source of data:	Remote sensing in combination with GPS data collected during ground trothing.
Justification of choice of data or description of measurement methods and procedures applied:	The minimum map accuracy must be 90% for the classification of forest/non forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy.
Any comment:	Where forest land contains more than one forest class, the map must be stratified into forest classes using module X-STR.
Used in equations:	M-MON 3 and M-MON-8

Data / Parameter:	A_i
Data Unit:	ha
Description:	Area of stratum, i
Source of data:	
Justification of choice of data or description of measurement methods and procedures applied:	Frequency: At a minimum every ten years prior to baseline renewal.
Any comment:	Ex-ante it shall be assumed that strata area will remain constant
Used in equations:	M-MON 19

Table 13: BL-PL Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	$D\%_{\text{planned},i,t}$
Data Unit:	$\% \text{year}^{-1}$
Used in equations:	BL-PL 2,3
Description:	Projected annual proportion of land that will be deforested in stratum i at year t
Source of data:	Analysis of land use land change remote sensing data within six proxy areas over a period of nine years.
Value applied:	Over the fixed baseline period 22nd May 2009 – 21st May 2019 Infrastructure related deforestation was found to be 0.181% as a percentage of the entire Project Area.
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	These figures will be revisited at the time of the baseline revision.

Data / Parameter:	L-D
Data Unit:	%
Used in equations:	BL-PL 3
Description:	Likelihood of deforestation in stratum i
Source of data:	N/A
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied:	Areas subject to deforestation are not under Government control and are zoned for deforestation in accordance with classifying the area as a Forest Management Area (FMA).
Any comment:	

Data / Parameter:	PF _c
Data Unit:	Dimensionless
Used in equations:	7
Description:	Proportion of available area for production of commodity c that is currently forested
Source of data:	
Value applied:	LK-ASP 7
Justification of choice of data or description of measurement methods and procedures applied:	This value will be assumed to be 1 (i.e. displacement is to 100% forested areas), since displacement of logging activities dictates that the displacement area must be forested.
Any comment:	

Table 14: LK-ME Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF
Data Unit:	t C t d.m. ⁻¹
Used in equations:	LK-ME 4
Description:	Carbon Fraction of Dry Matter
Source of data:	IPCC Good Practice Guidance
Value applied:	Default value 0.47 t C t ⁻¹ d.m.
Justification of choice of data or description of measurement methods and procedures applied:	No species specific values available nor national specific information.
Any comment:	

Data / Parameter:	D_{mn}
Data Unit:	$t\ d.m.m^{-3}$
Used in equations:	LK-ME 4
Description:	Mean wood density of commercially harvested species
Source of data:	Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database. ⁷ Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0. Must use the same value in the CP-W module if this module is used.
Value applied:	0.60
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	Calculation is performed in Project calculation spreadsheet on tab labelled WdDensity.

Data / Parameter:	LDF
Data Unit:	$t\ C\ m^{-3}$
Used in equations:	LK-ME 4
Description:	Factor for calculating the biomass of dead wood created during logging operations per cubic meter extracted
Source of data:	Measured by Winrock International from 774 logging gaps in Bolivia, Belize, the Republic of Congo, Brazil and Indonesia (Annex 1 LK-ME)
Value applied:	Default value for broadleaf and mixed forests of $0.53\ t\ C\ m^{-3}$
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	This value will be updated if improved and/or locally specific data becomes available. This update may occur prior to the 10 year mandatory baseline revision.

⁷ <http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm>

Data / Parameter:	LIF
Data Unit:	t C m ⁻³
Used in equations:	LK-ME 4
Description:	Factor for calculating the emissions arising from the creation of logging infrastructure (roads, skid trails and decks) during logging operations per cubic meter extracted
Source of data:	Calculated from 1,839 hectares of logging concessions analysed by Winrock International in the Republic of Congo and Brazil, may be used for tropical broadleaf forests (Annex 1 LK-ME)
Value applied:	Conservative default value of 0.29 t CO ₂ -e m ⁻³
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	This value will be updated if improved and/or locally specific data becomes available. This update may occur prior to the 10 year mandatory baseline revision.

Data / Parameter:	PMLFT
Data Unit:	%
Used in equations:	
Description:	Mean merchantable biomass (annual allowable cut) as a proportion of total FMA Area
Source of data:	Forest Trends analysis of FMA operations in Papua New Guinea (Forest Trends, 2011)
Value applied:	0.46
Justification of choice of data or description of measurement methods and procedures applied:	National relevant information
Any comment:	

Data / Parameter:	PMPFT
Data Unit:	%
Used in equations:	
Description:	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data:	Forest Trends analysis of FMA operations in Papua New Guinea (Forest Trends, 2011)
Value applied:	0.30
Justification of choice of data or description of measurement methods and procedures applied:	National relevant information
Any comment:	

Data / Parameter:	$V_{BSL,EX,i,t}$
Data Unit:	m^3
Used in equations:	LK-ME 4
Description:	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t
Source of data:	The Forest Development and Management Plan (FDMP) prepared by Road Timber Co combined with the April River Timber Harvest Plan.
Value applied:	$460,000 m^3 ha^{-1} yr^{-1}$
Justification of choice of data or description of measurement methods and procedures applied:	Site specific information
Any comment:	This value will not be updated, as the plan is considered the best estimate of the logging practices that would have occurred in the Project Area.

Table 15: CP-AB Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF
Data Unit:	tC t ⁻¹ d.m.
Used in equations:	CP-AB 1, 10
Description:	Carbon fraction of dry matter
Source of data:	IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3
Value applied:	Default value 0.47 tC t ⁻¹ d.m. was used.
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	The default values should be used for all species.

Data / Parameter:	$f_j(X,Y)$
Data Unit:	t d.m. tree ⁻¹
Used in equations:	1,3
Description:	Allometric equation for species j linking measured tree variable(s) to aboveground biomass of living trees, expressed as t d.m. tree ⁻¹
Source of data:	In the absence of a National allometric equation specific to Papua New Guinea, an allometric was selected based on DBH and species specific wood density from Chave, J., C. Andalo, S. Brown, M. A. Cairns, J. Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.-P. Lescure, B. W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. <i>Oecologia</i> 145: 87-99. The equation was developed from 416 trees (42 of which were from Papua New Guinea), and is based on a statistically significant regression with an $r^2 = 0.99$
Value applied:	$f_j(DBH, \rho)_{ab} = \rho \times \exp(-1.239 + 1.98 \times \ln(DBH) + 0.207 \times (\ln(DBH))^3)$ Where: $f_j(DBH, \rho)_{ab} = \text{aboveground biomass kg d.m. ha}^{-1}$ $\rho = \text{species specific wood density g cm}^{-3}$ $DBH = \text{diameter at breast height (i.e. 1.3m) cm}$
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	Should allometrics for Papua New Guinea be available when the baseline is renewed, the Chave equation will be replaced by the locally developed equation.

Data / Parameter:	R
Data Unit:	t root d.m. t ⁻¹ shoot d.m.
Used in equations:	CP-AB 5, 13
Description:	Root to shoot ratio appropriate to species or forest type/biome. The root to shoot ratio is applied as belowground biomass per unit area:aboveground biomass per unit area (not on a per stem basis)
Source of data:	Table 4.4 of the IPCC Guidelines for AFOLU (2006).
Value applied:	A root:shoot ratio of 0.37 t root dm/t AGB was assumed, based on the value for tropical rainforest.
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	Global values from Table 4.4 of the AFOLU Guidelines were selected by choosing the climatic zone and forest type that most closely matches the April Salumei Project Area. The mean values of default values selected from Table 4.4 of the AFOLU Guidelines are considered conservative.

Table 16: CP-L Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF _j
Data Unit:	tC t ⁻¹ d.m.
Used in equations:	CP-L 1
Description:	Carbon fraction of dry matter in litter
Source of data:	CP-L Module
Value applied:	Default value 0.37 tC t ⁻¹ d.m. is used.
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	None

Table 17: CP- W Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF _j
Data Unit:	t C t ⁻¹ d.m.
Used in equations:	CP-W 1
Description:	Carbon fraction of dry matter in t C t ⁻¹ d.m. for species j
Source of data:	Default value is used.
Value applied:	0.47
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	None

Data / Parameter:	D _j
Data Unit:	t d.m.m ⁻³
Used in equations:	LK-ME 4
Description:	Mean wood density of commercially harvested species
Source of data:	Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database. ⁸ Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0. Must use the same value in the CP-W module if this module is used.
Value applied:	0.60
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	Calculation is performed in Project calculation spreadsheet on tab labelled WdDensity.

⁸ <http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm>

Data / Parameter:	SLF _{ty}												
Data Unit:	dimensionless												
Used in equations:	CP-W 2												
Description:	Fraction of wood products that will be emitted to the atmosphere within 3 years of production by class of wood product ty.												
Source of data:	Winjum et al. 1998, updated to reflect changes to the VCS Standard version 3, which defines the medium term fraction as all wood products that decay between 3 – 100 years after harvest.												
Value applied:	<table border="1"> <thead> <tr> <th>Wood Product Class</th><th>SLF</th></tr> </thead> <tbody> <tr> <td>Sawnwood</td><td>0.12</td></tr> <tr> <td>Woodbase Panel</td><td>0.06</td></tr> <tr> <td>Other industrial Roundwood</td><td>0.18</td></tr> <tr> <td>Paper and Paperboard</td><td>0.24</td></tr> <tr> <td>Other classes of wood products</td><td>1.0</td></tr> </tbody> </table>	Wood Product Class	SLF	Sawnwood	0.12	Woodbase Panel	0.06	Other industrial Roundwood	0.18	Paper and Paperboard	0.24	Other classes of wood products	1.0
Wood Product Class	SLF												
Sawnwood	0.12												
Woodbase Panel	0.06												
Other industrial Roundwood	0.18												
Paper and Paperboard	0.24												
Other classes of wood products	1.0												
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.												
Any comment:	Parameter values were updated in accordance with the new VCS Requirements for wood product accounting, as per the values reported in VCS Approved methodology, VM003												

Data / Parameter:	WW _{ty}
Data Unit:	dimensionless
Used in equations:	CP-W 2
Description:	Fraction of extracted biomass effectively emitted to the atmosphere during production by class of wood product ty.
Source of data:	Winjum et al. 1998
Value applied:	WW is therefore equal to CXB _{ty} multiplied by 0.24 for developing countries.
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	Parameter values to be updated if new empirically based peer-reviewed findings become available.

Table 18: E-BB Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	CF
Data Unit:	tC t ⁻¹ d.m.
Used in equations:	E-BB 2
Description:	Carbon fraction of dry matter
Source of data:	IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3
Value applied:	Default value 0.47 tC t ⁻¹ d.m. is used.
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.
Any comment:	None

Data / Parameter:	COMF _i			
Data Unit:	Dimensionless			
Used in equations:	E-BB 1			
Description:	Combustion factor for stratum i (vegetation type)			
Source of data:	Default values in Table 2.6 of IPCC, 2006 (Annex 2)			
Value applied:				
	Vegetation Type	Subcategory	Mean	SD
	Primary Tropical Forest	Primary Tropical Forest	0.32	0.12
	Secondary Tropical Forest (slash and burn)	Young Tropical Forest (3-5 years)	0.46	-
	Secondary Tropical Forest (slash and burn)	Intermediate Tropical Forest (6-10 years)	0.67	0.21
	Secondary Tropical Forest (slash and burn)	Advanced Tropical Forest (14-17 years)	0.50	0.10
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.			
Any comment:	The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (i.e., a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (i.e., intensity and rate of spread). Default values shall be updated whenever new guidelines are produced by the IPCC.			

Data / Parameter:	G _{gi}			
Data Unit:	g kg ⁻¹ dry matter burnt			
Used in equations:	E-BB 1			
Description:	Emission factor for stratum i for gas g			
Source of data:	Defaults sourced from Volume 4, Chapter 2 of the IPCC 2006 Inventory Guidelines, Table 2.5.			
Value applied:				
	Category	CO ₂	CH ₄	N ₂ O
	Tropical Forest	1580	6.8	0.20
Justification of choice of data or description of measurement methods and procedures applied:	In the absence of national specific data internationally recognised sources are acceptable.			
Any comment:	Default values shall be updated whenever new guidelines are produced by the IPCC.			

Table 19: X-UNC Data and Parameters not Monitored (default or measured one time)

Data / Parameter:	$C_{REDD,t}$
Data Unit:	tCO ₂ -e
Used in equations:	X-UNC 11
Description:	Net anthropogenic greenhouse emissions reductions at time t ;
Module parameter originates in:	REDD-MF
Any comment:	

Data / Parameter:	$D\%_{pn}$
Data Unit:	%
Used in equations:	Uncertainty in baseline rate
Description:	Percent of deforestation in land parcel pn etc of a proxy area as a result of planned deforestation as defined in this module
Module parameter originates in:	BL-PL
Any comment:	

Data / Parameter:	Yr_{Spn}
Data Unit:	Years
Used in equations:	Uncertainty in baseline rate
Description:	Number of years over which deforestation occurred in land parcel pn in proxy area;
Module parameter originates in:	BL-PL
Any comment:	

3.1.2 VM0010

Table 20: VM0010 Data and parameters not monitored (default values or measured one time)

Data / parameter:	$V_{l,j,i,sp}$
Data unit:	m^3
Used in equations:	VM0010 Equation 1
Description:	Merchantable volume for tree l of species j in sample plot sp in stratum i
Source of data:	Merchantable volume for all trees in each plot was calculated using a volume equation specified in the PNG Forest Inventory Planning System database. ⁹
Measurement procedures (if any):	Refer to Forest Carbon Stock report
Any comment:	Since our field inventory volume estimate was higher than the volume estimate as stated in the FDMP and April River Plan, the merchantable volume estimate from the FDMP and April River Logging Plan was used for the timber harvest schedule, as required under the Methodology (i.e.: $93.54 m^3 ha^{-1} yr^{-1}$, or $460,000 m^3 yr^{-1}$).

⁹ The equation is: $V (m^3 ha^{-1}) = 1.116 * 0.00007854 * (DBH^{2.4762})$

Data / Parameter:	CF _f
Data Unit:	tC t ⁻¹ d.m.
Used in equations:	VM0010 Equation 3, 4
Description:	Carbon fraction of dry matter
Source of data:	IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3
Value applied:	Default value 0.47 tC t ⁻¹ d.m. was used.
Measurement procedures (if any)	None
Any comment:	The default values should be used for all species.

Data / Parameter:	D_j
Data Unit:	t d.m.m ⁻³
Used in equations:	VM0010 Equation 4
Description:	Mean wood density of commercially harvested species
Source of data:	Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database. ¹⁰ Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.
Measurement procedures (if any):	None
Any comment:	

¹⁰ <http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm>

Data / Parameter:	$f_j(x, y, \dots)$
Data Unit:	t d.m. tree ⁻¹
Used in equations:	VM0010, equation 17
Description:	Allometric equation(s) for species <i>j</i> linking measured tree variable(s) to aboveground biomass of living trees
Source of data:	
Measurement procedures (if any):	NA
Any comment:	

Data / parameter:	PML _{FT}
Data unit:	%
Used in equations:	
Description:	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type.
Source of data:	
Measurement procedures (if any):	
Any comment:	

Data / parameter:	VEX,j,i BSL
Data unit:	m ³ .ha ⁻¹
Used in equations:	VM0010, equation 3, 4 and 22
Description:	Mean volume of extracted timber per unit area for species <i>j</i> in stratum <i>i</i>
Source of data:	The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory (<i>V_{j,i BSL}</i>), based on legal limits.
Measurement procedures (if any):	NA
Any comment:	

Data / parameter:	THi,p
Data unit:	Years
Used in equations:	
Description:	Number of years since timber harvest in stratum <i>i</i> in land parcel <i>p</i>
Source of data:	The timber harvest schedule specifies the year (1,2,3...) timber harvest in each land parcel is scheduled to occur and the number of years each land parcel is in a post harvest state during the project crediting period.
Measurement procedures (if any):	
Any comment:	

Data / parameter:	A i,p
Data unit:	Ha
Used in equations:	VM0010, equation 20
Description:	Area covered by stratum <i>i</i> over land parcel <i>p</i>
Source of data:	Geodetic coordinates and/or Remote Sensing data and/or legal parcel records
Measurement procedures (if any):	
Any comment:	It must be assumed ex-ante that land parcel boundaries and strata areas must not change through time

Data / parameter:	$A_{1,i,p}$
Data unit:	Ha
Used in equations:	VM0010, equation 11
Description:	The area of stratum i in land parcel p that was harvested 1 year ago
Source of data:	Geodetic coordinates, GIS Files or legal parcel records
Measurement procedures (if any):	
Any comment:	

Data / parameter:	$A_{2-10,i,p}$
Data unit:	Ha
Used in equations:	VM0010, equation 12
Description:	The area of stratum i in land parcel p that was harvested between 2 and 10 years ago
Source of data:	Geodetic coordinates, GIS Files or legal parcel records
Measurement procedures (if any):	
Any comment:	

Data / parameter:	$A_{11-20,i,p}$
Data unit:	Ha
Used in equations:	VM0010, equation 13
Description:	The area of stratum i in land parcel p that was harvested between 11 and 20 years ago
Source of data:	Geodetic coordinates, GIS Files or legal parcel records
Measurement procedures (if any):	
Any comment:	

Data / parameter:	A_{t^*}
Data unit:	Ha
Used in equations:	VM0010, equation 14
Description:	Cumulative area harvested until time t^*
Source of data:	Geodetic coordinates, GIS Files or legal parcel records
Measurement procedures (if any):	
Any comment:	

Data / parameter:	A_{sp}
Data unit:	Ha
Used in equations:	VM0010, equation 2 and 19
Description:	Area of sample plot sp
Source of data:	Recording and archiving of size of sample plots
Measurement procedures (if any):	Standard Operation Procedures for forest timber inventory is used.

Data / parameter:	$BCEF_R$
Data unit:	t.d.m m ⁻³
Used in equations:	VM0010 Equation 3, 18
Description:	Biomass conversion and expansion factor applicable to wood removals in the project area
Source of data:	In the absence of country specific data a BCEF of 1.67 t dm ⁻¹ m ³ was applied from the IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.5)
Measurement procedures (if any):	None
Any comment:	When selecting a $BCEF_R$ the minimum DBH must be compatible with the minimum DBH specified in the timber harvest plan. Default values shall be updated whenever new guidelines are produced by the IPCC

Data / parameter:	OF,SLF,WW																							
Data unit:	kg kg ⁻¹																							
Used in equations:	VM0010 Equation 7, 8, 9																							
Description:	OF = Fraction of wood products that will be emitted to the atmosphere between 3 and 100 years after production; SLF = Fraction of wood products that will be emitted to the atmosphere within 3 years of production; and WW = Fraction of extracted biomass effectively emitted to the atmosphere during production Wood waste fraction (WW): Winjum et al 1998 indicate that the proportion of extracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to 19% for developed countries, 24% for developing countries. Short-lived fraction (SLF) Winjum et al 1998 give the following proportions for wood products with short-term (<5 yr) uses (applicable internationally): Sawnwood 0.12 Woodbase panels 0.06 Other industrial roundwood 0.18 Paper and Paperboard 0.24 Additional oxidized fraction (OF) Winjum et al 1998 gives annual oxidation fractions for each class of wood products split by forest region (boreal, temperate and tropical). This methodology projects these fractions over 95 years to give the additional proportion that is oxidized between the 3rd and 100th years after initial harvest: <table><tr><th rowspan="2">Wood Product Class</th><th colspan="3">OF</th></tr><tr><th>Boreal</th><th>Temperate</th><th>Tropical</th></tr><tr><td>Sawnwood</td><td>0.39</td><td>0.62</td><td>0.86</td></tr><tr><td>Woodbase panels</td><td>0.62</td><td>0.86</td><td>0.98</td></tr><tr><td>Other industrial roundwood</td><td>0.86</td><td>0.98</td><td>0.99</td></tr><tr><td>Paper and paperboard</td><td>0.39</td><td>0.62</td><td>0.99</td></tr></table>	Wood Product Class	OF			Boreal	Temperate	Tropical	Sawnwood	0.39	0.62	0.86	Woodbase panels	0.62	0.86	0.98	Other industrial roundwood	0.86	0.98	0.99	Paper and paperboard	0.39	0.62	0.99
Wood Product Class	OF																							
	Boreal	Temperate	Tropical																					
Sawnwood	0.39	0.62	0.86																					
Woodbase panels	0.62	0.86	0.98																					
Other industrial roundwood	0.86	0.98	0.99																					
Paper and paperboard	0.39	0.62	0.99																					
Source of data:	The source of data is the published paper of Winjum et al. 1998																							
Measurement procedures (if any):	None																							

Any comment:	Parameters were updated in accordance with the requirements of the VCS Standard version 3.
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Data / parameter:	RGR_i
Data unit:	$tC.ha^{-1}.yr^{-1}$
Used in equations:	VM0010 Equation 9, 14
Description:	Forest regrowth rate post timber harvest for stratum i
Source of data:	Fox et al (2011), value for Southern Highlands
Measurement procedures (if any):	None
Any comment:	

Data / parameter:	$COMF_i$
Data unit:	Dimensionless
Used in equations:	VM0010 Equation 21
Description:	Combustion factor for stratum i (vegetation type)
Source of data:	Default values in Table 2.6 of IPCC, 2006
Measurement procedures (if any):	None
Any comment:	The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (i.e., a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (i.e., intensity and rate of spread). Default values shall be updated whenever new guidelines are produced by the IPCC

Data / parameter:	G_{gi}
Data unit:	g kg^{-1} dry matter burnt
Used in equations:	VM0010 Equation 21
Description:	Emission factor for stratum i for gas g
Source of data:	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5
Measurement procedures (if any):	None
Any comment:	Default values shall be updated whenever new guidelines are produced by the IPCC

Data / parameter:	PML, PMP
Data unit:	%
Used in equations:	STEP 5 - Leakage, Box 2.
Description:	Sustainable AAC as recommended by the Forest Trends review team, relative to total FMA area.
Source of data:	Forest Trends (2001). Available from http://www.forest-trends.org/documents/files/doc_161.pdf
Measurement procedures (if any):	None
Any comment:	

3.2 Data and Parameters Monitored

3.2.1 VM0007

REDD Methodology Framework (REDD-MF)

Data / Parameter:	Project Forest Cover Monitoring Map
Data Unit:	N/A
Used in equations:	3
Description:	Map showing the location of forest land within the project area at the beginning of each monitoring period. If some land is cleared within the Project Area, the benchmark map must show the deforested areas at each monitoring event.
Value applied	Ha
Source of data:	For the first monitoring period; remote sensing For subsequent monitoring periods: remote sensing in combination with GPS data collected during ground truthing. The minimum map accuracy must be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy. Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Justification of choice of data or description of measurement methods and procedures applied:	Spatial data selected for the development of the Forest Cover Monitoring Map shall be sourced from the LandsAT data files. Images shall be selected to minimize cloud cover issues.
QA/QC procedures to be applied:	
Any comment:	Where forest land contains more than one forest class, the map must be stratified into forest classes using module X-STR.

Data / Parameter:	Degradation PRA Results
Data Unit:	N/A verbal responses
Used in equations:	Section 5.2.2.1
Description:	Participatory Rural Appraisal
Value applied	N/A
Source of data:	Rapid Rural Appraisal documents and Questionnaires
Justification of choice of data or description of measurement methods and procedures applied:	The PRA shall consist of semi-structured interviews / questionnaires. The PRA evaluates the extent of the following activities within the project area: - Illegal commercial harvesting - harvesting of fuel wood - harvesting of wood for charcoal production - timber harvest - If $\geq 10\%$ of those interviewed/surveyed believe that degradation may be occurring within the project boundary then the limited on-the-ground degradation survey shall be triggered. An additional output of the PRA shall be a depth of penetration of degradation pressure. A maximum distance shall be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting fuel wood, charcoal and/or timber. It is likely that differing distances shall exist for each degradation pressure. If multiple pressures exist in the same stratum the deepest depth of penetration shall be used to define $A_{deg,i}$. Frequency: every two years
QA/QC procedures to be applied:	The person leading the PRA process shall be experienced/trained in conducting PRAs and all communications will be documented and stored.
Any comment:	

Data / Parameter:	Result of Limited Degradation Survey
Data Unit:	
Used in equations:	Section 5.2.2.1
Description:	
Value applied	
Source of data:	
Justification of choice of data or description of measurement methods and procedures applied:	Sampled by surveying several transects of known length and width across the access-buffer area (equal in area to at least 1% of $A_{Deg,i}$) to check whether new tree stumps are evident or not. Frequency: Must be repeated each time the PRA indicates a potential for degradation
QA/QC procedures to be applied:	
Any comment:	Ex-ante, an estimation shall be made of degradation in the with project case. If the belief is that zero degradation will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent deforestation.

Data / Parameter:	$A_{DefPA,i,u,t}$
Data Unit:	ha
Used in equations:	3
Description:	Area of recorded deforestation in the project area in stratum i converted to land use u at time t
Value applied	
Source of data:	Remote sensing imagery
Justification of choice of data or description of measurement methods and procedures applied:	Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC procedures to be applied:	
Any comment:	Ex-ante, an estimation shall be made of deforestation in the with project case. If the belief is that zero deforestation will occur within the project boundaries then this parameter may be set to zero.

Data / Parameter:	$A_{DegW,i}$
Data Unit:	ha
Used in equations:	8
Description:	Area potentially impacted by degradation processes in stratum i
Source of data:	GIS delineation and ground truthing
Justification of choice of data or description of measurement methods and procedures applied:	$A_{DegW,i}$ shall be composed of a buffer from all access points (access buffer), such as roads and rivers or previously cleared areas. The width of the buffer shall be determined by the depth of degradation penetration as defined as a PRA output. Frequency: Must to be repeated each time the PRA indicates a potential for degradation.
Any comment:	Ex-ante, a limited survey can be used to determine a likely depth of degradation penetration

Data / Parameter:	$A_{DistPA,q,l,t}$
Data Unit:	ha
Used in equations:	20
Description:	Area impacted by natural disturbance in the project stratum l converted to natural disturbance stratum q at time t; ha
Source of data:	Remote Sensing imagery combined with ground verification or GPS coordinates
Justification of choice of data or description of measurement methods and procedures applied:	Minimum monitoring unit shall be equal to a minimum of 11 Landsat pixels or one hectare. Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Any comment:	Ex-ante, estimations of emissions from natural disturbances shall be based on historic incidence of such event in the Project region

Data / Parameter:	AP_i
Data Unit:	ha
Used in equations:	8
Description:	Total area of degradation sample plots in stratum i
Source of data:	Ground measurement
Justification of choice of data or description of measurement methods and procedures applied:	The sampling plan must be designed using plots systematically placed over the buffer zone so that they sample at least 3% of the area of the buffer zone. Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Any comment:	Ex-ante an estimation must be made of area of plots. This must be set to exactly 3% of the buffer zone $A_{Deg,i}$

Data / Parameter:	$C_{DegW,i,t}$
Data Unit:	t CO ₂ -e
Used in equations:	8
Description:	Biomass carbon of trees cut and removed through illegal logging and fuelwood and charcoal extraction degradation process from plots measured in stratum i at time t
Source of data:	Field Measurement
Justification of choice of data or description of measurement methods and procedures applied:	The diameter of all tree stumps in the designated plots will be measured and conservatively assumed to be the same as the DBH. If the stump is a large buttress, identify several individuals of the same species nearby and determine a ratio of the diameter at DBH to the diameter of buttress at the same height above ground as the measured stumps. This ratio will be applied to the measured stumps to estimate the likely DBH of the cut tree. The above and below ground carbon stock of each harvested tree must be estimated using the same allometric regression equation and root to shoot ratio used in the module for estimating the carbon pool in trees (CP-AB) in the baseline scenario. See detailed guidance in CP-AB for aboveground biomass estimation. Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Any comment:	Ex-ante an estimation shall be made of likely degradation in the with-project case. Such an estimation shall be based on rates of degradation in surrounding areas and the degree of protection that will be in place (e.g. forest guards) in the with-project case.

Baseline Carbon Stock Changes and Greenhouse Gas Emissions from Planned Deforestation (BL-UP)

See parameters under CP-AB, E-BB, CP-LI

Carbon Stocks in the above-and belowground biomass of live trees and non-tree pools (CP-AB)

Data / Parameter:	A _{sp}
Data Unit:	ha
Used in equations:	CP-AB 2,6,14
Description:	Area of sample plots in ha
Monitoring Frequency:	Monitoring must occur at least every ten years for baseline renewal. Where carbon stock enhancement is included monitoring shall occur at least every five years
Source of data:	Recording and archiving of number and size of sample plots
Measurement procedures (if any):	See Carbon Field Inventory Manual
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	See Carbon Field Inventory Manual
Any comment:	Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante. This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Data / Parameter:	N
Data Unit:	Dimensionless
Used in equations:	CP-AB 4
Description:	Number of sample points
Value applied:	18
Source of data:	Recording and archiving of number of sample points
Measurement procedures (if any):	See Carbon Field Inventory Manual
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	See Carbon Field Inventory Manual
Any comment:	As carbon stock estimation occurs only for the determination of the baseline this parameter is known as <i>ex-ante</i> . This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Data / Parameter:	DBH
Data Unit:	cm
Used in equations:	CP-AB 1
Description:	Diameter at breast height of a tree in cm
Value applied:	
Source of data:	Field measurements in sample plots
Measurement procedures (if any):	Measured 1.3m aboveground. Measure all trees above minimum DBH of 10cm in the sample plots. Minimum DBH employed in inventories is held constant for the duration of the project.
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied.
Any comment:	Carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante. This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Data / Parameter:	A _{sf}
Data Unit:	m ⁻²
Used in equations:	CP-AB 10
Description:	Area of one sampling frame
Value applied:	400
Source of data:	Recording and archiving size of sampling frame plot
Measurement procedures (if any):	
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures to be applied:	
Any comment:	Shall be known <i>ex-ante</i>. This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Greenhouse Gas Emissions from Biomass Burning (E-BB)

Data / Parameter:	$A_{burn,i,t}$
Data Unit:	Ha
Used in equations:	E-BB 1
Description:	Area burnt in stratum i at time t
Value applied:	
Source of data:	
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$C_{AB,tree,i}$
Data Unit:	$t\ CO_2-e\ ha^{-1}$
Used in equations:	E-BB 2
Description:	Carbon stock in aboveground biomass in trees in stratum, i
Value applied:	
Source of data:	
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$C_{LI,i}$
Data Unit:	$t\ CO_2-e\ ha^{-1}$
Used in equations:	E-BB 2
Description:	Carbon stock in aboveground biomass in trees in stratum i
Value applied:	
Source of data:	
Measurement procedures (if any):	

Monitoring frequency:	
QA/QC procedures to be applied:	
Any comment:	

Carbon Stocks in the Long Term Wood Products Pool (CP-W)

Data / Parameter:	A_i
Data Unit:	ha.
Used in equations:	CP-W 1
Description:	Total area of stratum i
Source of data:	Direct forest inventory of the project area, distinguishing commercially viable stocks on the basis of species and tree size, referencing local expert knowledge or a participatory rural assessment (PRA) of harvest practices and markets.
Measurement procedures (if any)	This parameter is updated at baseline renewal when aboveground biomass is re-inventoried as per module CP-AB (at least every 10 years).
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures:	
Any comment:	Ex-ante it is assumed that the strata remains constant during the baseline period This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Data / Parameter:	$V_{ex,i}$
Data Unit:	m^3
Used in equations:	CP-W 1
Description:	The volume of timber in m^3 extracted from within the stratum (does not include slash left onsite), reported by wood product class and preferably species.
Source of data:	Timber harvest records and/or estimates derived from field measurements or remote assessments with aerial photography or satellite imagery.
Measurement procedures (if any)	
Monitoring frequency:	Monitoring must occur at least every ten years for baseline renewal.
QA/QC procedures:	
Any comment:	Note that this volume does not include logging slash left onsite. Data compilers must also make sure that extracted volumes reported are gross volumes removed (i.e. reported volume does not already discount for estimated wood waste, as is often the practice in harvest records). Assignment of volume extracted to wood product class(es), be substantiated on the basis of participatory rural appraisal (PRA) findings (also used to assess potential for degradation in module M-MON) or records of timber sales. Assignment of volume extracted to species, must be substantiated on the basis of either PRA findings, harvest records, or a commercial inventory. Baseline removals will be known ex-ante. With project removals are classed as project emissions and where expected shall be detailed ex-ante alongside evidence on expected harvested volumes. This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Estimation of Market-Effects (LK-ME)

Data / Parameter:	PML _{FT}
Data Unit:	%
Used in equations:	Not used directly in any equations, but input factor for LF, used in equation LK-ME 2.
Description:	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type
Source of data:	Ex ante estimate based on field inventory of all biomass. Merchantable biomass is assumed to be all biomass above 50cm DBH.
Measurement procedures:	
Monitoring frequency:	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years, examination must occur prior to any verification event.
Any comment:	

Estimation of Emissions from activity shifting (LK-ASP)

Data / Parameter:	ALK-peat,i
Data Unit:	Ha
Used in equations:	8
Description:	Area of leakage to peatland at time t
Source of data:	GPS coordinates and/or Remote Sensing data and/or legal parcel records
Measurement procedures (if any)	NA
Monitoring frequency:	Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Quality Assurance / Quality Control:	

Any comment:	ALK-peat is equal to the increase in deforestation of peatland by the specific agent relative to business-as-usual. So if historic data shows X hectares of peatland deforestation by the focal agent each year over the past five years than any deforestation in excess of those X hectares each year after project implementation shall be counted as leakage. Ex-ante evidence shall be presented to justify a projection of zero leakage to peatland. Such evidence can include contracts with the displaced agent of deforestation or evidence of the unsuitability of peatland for the projected land use.
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Data / Parameter:	$A_{planned,i}$
Data Unit:	Ha
Used in equations:	4
Description:	Total area of planned deforestation over the entire project lifetime for stratum i
Source of data:	GPS coordinates and/or Remote Sensing data and/or legal parcel records
Measurement procedures (if any)	NA
Monitoring frequency:	Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Quality Assurance / Quality Control:	
Any comment:	Ex-ante, $A_{planned,i}$ shall be determined as described in BL-PL

Data / Parameter:	$A_{defLK,i,t}$
Data Unit:	Ha
Used in equations:	5
Description:	The total area of deforestation by the baseline agent or class of agent of the planned deforestation in stratum i at time t
Source of data:	Analysis of Remote Sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent
Measurement procedures (if any)	This parameter is updated at baseline renewal when aboveground biomass is re-inventoried as per module CP-AB (at least every 10 years).
Monitoring frequency:	Must be reexamined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Quality Assurance / Quality Control:	
Any comment:	Legal records will include government permits to deforest including concession licenses Ex-ante, project proponents shall determine and justify the likelihood of leakage based on characteristics of the baseline agent or class of agent

Uncertainty for REDD Project Activities (X-UNC)

Data / Parameter:	$EB_{SL\ SS,i, pool\#}$
Data Unit:	t CO ₂ -e
Used in equations:	4, 5
Description:	Carbon stock or GHG sources (e.g. trees, dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the baseline case
Source of data:	The terms denoting significant carbon stocks, GHG sources or leakage emissions from baseline modules (BL-DFW, BL-PL, BL-UP) used to calculate net emission reductions.
Measurement procedures (if any)	
Monitoring frequency:	Monitored at least once every ten years (or when the baseline is revisited)
Quality Assurance / Quality Control:	
Any comment:	Baseline stocks and sources are estimated ex-ante for each baseline period. This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Data / Parameter:	$EP_{SS,i, Pool\#}$
Data Unit:	t CO ₂ -e
Used in equations:	7, 8
Description:	Carbon stock or GHG sources (e.g. trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the with-project case
Source of data:	The terms denoting significant carbon stocks, GHG sources or leakage emissions used in calculating net emission reductions from the following relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA.
Measurement procedures (if any)	
Monitoring frequency:	Monitored at least once every five years. Reported in the Project Monitoring report.
Quality Assurance / Quality Control:	
Any comment:	The <i>ex-ante</i> estimation shall be derived directly from the estimations originating in the relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA.

Data / Parameter:	$U_{BSL,SS,i,pool\#}$
Data Unit:	%
Used in equations:	4, 5
Description:	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case (1,2...n represent different carbon pools and/or GHG sources)
Source of data:	Calculations arising from field measurement data
Measurement procedures (if any)	Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level. For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest. For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero.
Monitoring frequency:	Monitored at least once every ten years (or when the baseline is revisited)
Quality Assurance / Quality Control:	
Any comment:	Baseline stocks and sources are estimated <i>ex-ante</i> for each baseline period. This parameter was not monitored <i>ex-post</i> and is therefore excluded from this monitoring period in accordance with the validated Project Description.

Data / Parameter:	$U_{P,SS,i,pool\#}$
Data Unit:	%
Used in equations:	7
Description:	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the with-project case (1,2...n represent different carbon pools and/or GHG sources) .
Source of data:	Calculations arising from field measurement data
Measurement procedures (if any)	Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level. For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest. For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero.
Monitoring frequency:	Monitored at least once every five years
Quality Assurance / Quality Control:	
Any comment:	<i>Ex-ante</i> the uncertainty in the with-project carbon stocks and sources shall be equal to the calculated baseline uncertainty.

3.2.2 VM0010

Data / Parameter:	Illegal Logging PRA results
Data Unit:	
Used in equations:	VM0010 Step 4
Description:	
Source of data:	PRA
Measurement procedures (if any)	The PRA shall evaluate whether timber harvest may be occurring in the project area and shall consist of semi-structured interviews / questionnaires. If $\geq 10\%$ of those interviewed/surveyed believe that illegal logging may be occurring within the project boundary then the limited on-the-ground illegal logging survey shall be triggered. An additional output of the PRA shall be a depth of penetration of illegal logging pressure. A maximum distance shall be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting timber.
Monitoring frequency:	Every two years from the first verification.
Quality Assurance / Quality Control:	
Any comment:	Ex ante estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent illegal logging.

Data / Parameter:	Result of Limited Illegal Logging Survey
Data Unit:	
Used in equations:	VM0010 Step 4
Description:	
Source of data:	Limited on-the-ground illegal logging survey
Measurement procedures (if any)	Sampled by surveying multiple transects of known length and width across the access-buffer area to check whether new tree stumps are evident or not. The access-buffer area shall be equal in area to at least 1% of $A_{DIST_IL,i}$
Monitoring frequency:	Must to be repeated each time the PRA indicates a potential for illegal logging.
Quality Assurance / Quality Control:	
Any comment:	Ex ante an estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero.

Data / Parameter:	$A_{burn,i,t}$
Data Unit:	Hectares
Used in equations:	VM0010 Equation 17
Description:	Area burnt in stratum i at time t
Source of data:	GPS coordinates and/or Remote Sensing data
Measurement procedures (if any)	N/A
Monitoring frequency:	Areas disturbed shall be monitored at in accordance with the monitoring and reporting schedule.
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Any comment:	Ex ante estimations of areas burned shall be based on historic incidence of fire in the Project region. Analysis of satellite imagery over a historical reference period of 2000-2009 presented no evidence of fire scars in the Project Area.

Data / Parameter:	$A_{dist,i,t}$
Data Unit:	hectares
Used in equations:	VM0010 Equation 17
Description:	Area disturbed in stratum i at time t
Source of data:	GPS coordinates and/or Remote Sensing data
Measurement procedures (if any)	N/A
Monitoring frequency:	Areas disturbed shall be monitored at in accordance with the monitoring and reporting schedule.
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the IPCC GPG LULUCF 2003, is recommended.
Any comment:	Ex ante estimations of areas disturbed shall be based on historic incidence of natural disturbance in the Project region. Analysis of satellite imagery over a historical reference period of 2000-2009 presented no evidence of natural disturbance in the Project Area.

Data / Parameter:	$A_{DIST_IL,i}$
Data Unit:	hectares
Used in equations:	VM0010 Equation 19
Description:	Area potentially impacted by illegal logging in stratum i
Source of data:	GIS delineation and ground truthing
Measurement procedures (if any)	$A_{DIST_IL,i}$ shall be composed of a buffer from all access points (access buffer), such as roads and rivers or previously cleared areas. The width of the buffer shall be determined by the depth of degradation penetration as defined as a PRA output.
Monitoring frequency:	Repeated each time the PRA indicates a potential for degradation
Quality Assurance / Quality Control:	
Any comment:	Ex ante a limited survey can be used to determine a likely depth of degradation penetration.

Data / Parameter:	$C_{DIST_IL,i,t PRJ}$
Data Unit:	tCO ₂ -e
Used in equations:	VM0010 Equation 20
Description:	biomass carbon of trees cut and removed through illegal logging in stratum i at time t
Source of data:	Field measurements in sample plots
Measurement procedures (if any)	The sampling plan must be designed using plots systematically placed over the buffer zone so that they sample at least 3% of the area of the buffer zone ($A_{DIST_IL,i}$). The diameter of all tree stumps will be measured and conservatively assumed to be the same as the DBH. Where the stump is a large buttress, several individuals of the same species nearby shall be located and a ratio of the diameter at DBH to the diameter of buttress at the same height above ground as the measured stumps shall be determined. This ratio will be applied to the measured stumps to estimate the likely DBH of the cut tree. The aboveground carbon stock of each harvested tree will be estimated using the allometric regression equations chosen for forest growth in the project scenario. The mean aboveground carbon stock of the harvested trees is conservatively estimated to be the total emissions and to all enter the atmosphere.
Monitoring frequency:	Repeated each time limited sampling of $A_{DIST_IL,i}$ indicates illegal logging.
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the <i>IPCC GPG LULUCF 2003</i> , is recommended.
Any comment:	If species-specific equations are used and species cannot be identified from stumps then it shall be assumed that the harvested species is the species most commonly harvested. A PRA shall be used to determine the most commonly harvested species.

Data / Parameter:	A_{Pi}
Data Unit:	hectares
Used in equations:	VM0010 Equation 19
Description:	Total area of illegal logging sample plots in stratum i
Source of data:	Ground measurement
Measurement procedures (if any)	A sampling plan must be designed using multiple sample plots systematically placed across the buffer zone so that they sample at least 3% of the area of the buffer zone.
Monitoring frequency:	Not more than five years
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the <i>IPCC GPG LULUCF 2003</i> , is recommended.
Any comment:	<i>Ex ante</i> estimation should be made of area of plots. This should be set to exactly 3% of the buffer zone $ADIST_{IL,i}$

Data / Parameter:	PMP_i
Data Unit:	%
Used in equations:	VM0010 STEP 5 - Leakage, Box 4.
Description:	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data:	Within each stratum divide the summed merchantable biomass (defined as total gross biomass of a tree 15cm DBH or larger) by the summed total of aboveground tree biomass.
Measurement procedures (if any)	
Monitoring frequency:	Not more than five years
Quality Assurance / Quality Control:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the <i>IPCC GPG LULUCF 2003</i> , is recommended.
Any comment:	<i>Ex-ante</i> a time zero measurement shall be made of this factor. The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory ($V_{j,i BSL}$), based on legal limits.

Data / Parameter:	A_i
Data Unit:	hectares
Used in equations:	VM0010 Equation 16
Description:	Area covered by stratum i
Source of data:	GPS coordinates and/or Remote Sensing data and/or legal parcel records
Measurement procedures (if any)	
Monitoring frequency:	
Quality Assurance / Quality Control:	
Any comment:	In the baseline scenario strata areas shall not change through time. In the project scenario it shall be assumed <i>ex-ante</i> that stand boundaries and strata areas shall not change through time. <i>Ex post</i> adjustments of the project scenario strata may be needed if unexpected disturbances occur during the project crediting period, severely affecting different parts of an originally homogenous stratum. This disturbance will be delineated as a separate stratum for the purpose of monitoring the carbon stock changes.

3.3 Description of the Monitoring Plan

The primary objective of the monitoring plan is to provide the information necessary to:

- Undertake periodic verification of the project against the VCS; and
- Revisit the baseline at the conclusion of each fixed baseline period (i.e. every 10 years).

The scope of the monitoring plan is to collect data for reporting on¹¹:

- The area of forest land converted to non-forest land and associated changes in carbon stocks within the Project Area.
- Confirmation of the project activity
- The area of forest land undergoing loss in carbon stock from degradation activities and associated changes in carbon stocks;
- The greenhouse gas emissions associated with project implementation.
- The area of forest land undergoing loss in carbon stocks resulting from natural disturbances and illegal logging and any associated changes in carbon stocks.

3.3.1 Required Information

Information required for verification of the Project includes:

- Actual carbon stock changes and GHG emissions within the Project Area;
- Net anthropogenic GHG emission reduction.

Information required for revisiting the baseline projections includes:

- Information on agents, drivers and underlying causes of deforestation;
- The area and location of baseline deforestation;
- Improved data on the carbon component of the baseline, if available.

Additionally, the monitoring activities will be used to collect and analyze information necessary to:

- Assess the success of the project scenario;
- Determine any variation between ex-ante and ex-post estimations of GHG emissions or carbon stocks; and
- Calculate and report net GHG reductions attributed to the project in accordance with the methodology requirements.

3.3.2 Overview of the Monitoring Process

The Monitoring Plan employs direct field monitoring patrols as well as indirect satellite images and analysis tools to systematically monitor land cover change in the Project Area. Any detection of change from direct or indirect monitoring will trigger a land use change assessment and increased patrols in identified vulnerable areas. Increased patrols would be aimed at reducing future impact on identified 'at

¹¹ Note that as there is no harvesting in the project scenario, there is no unsustainable firewood collection or charcoal production and regrowth of deforested/degraded lands is conservatively omitted.

risk areas' for more intense patrols. Figure 3 shows an overview of the Project monitoring and reporting process.

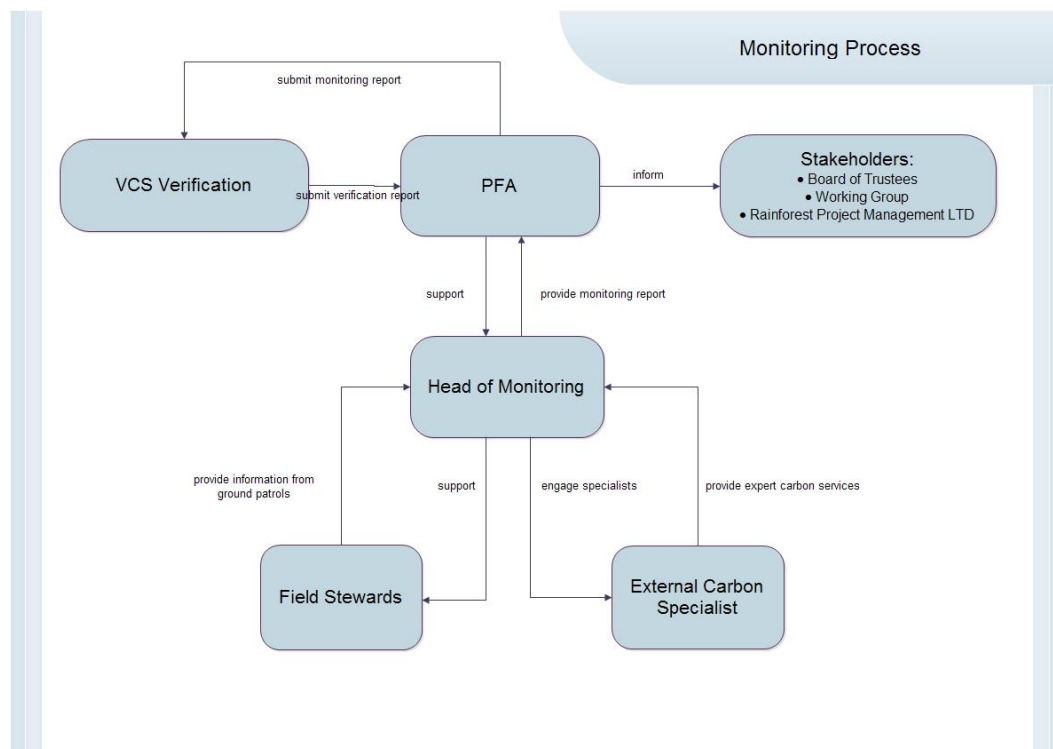


Figure 3: Overview of monitoring process

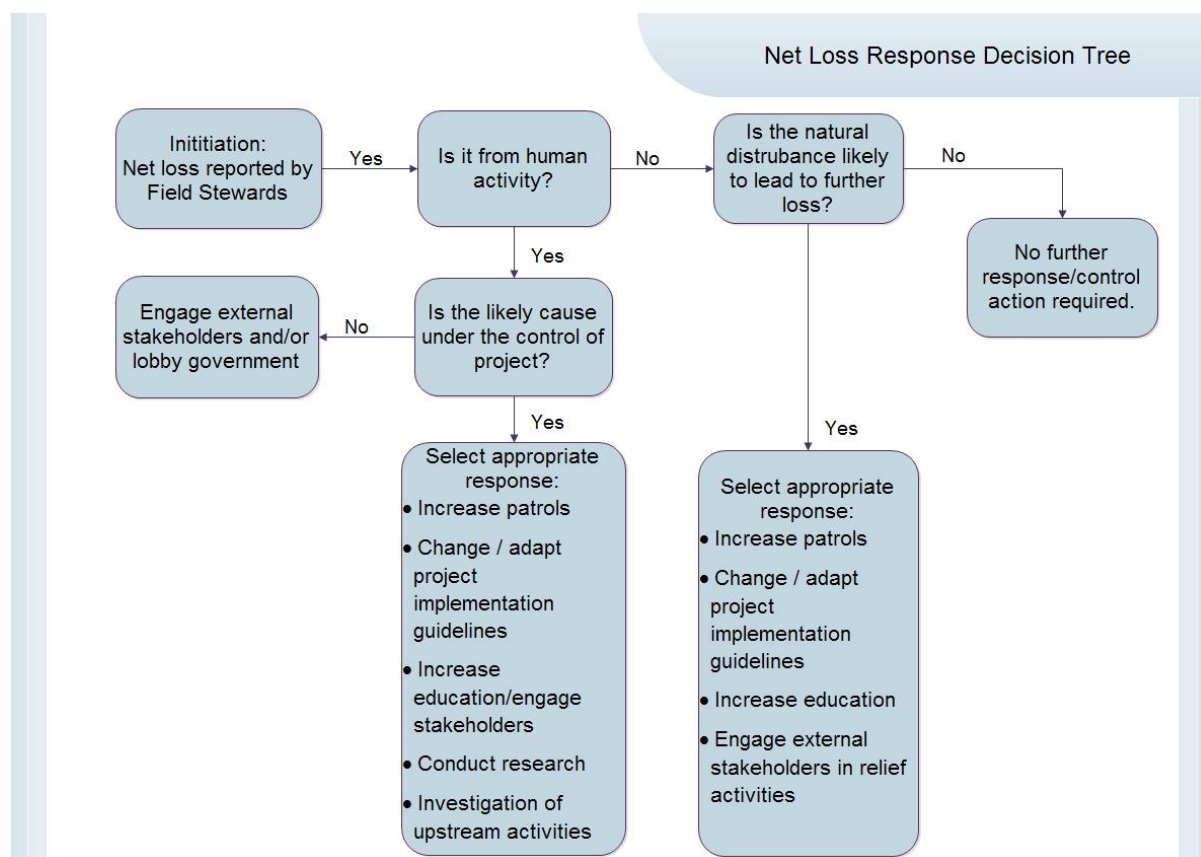
The monitoring reports developed by the Head of Monitoring will be used to identify project risks and non-conformances which will in turn trigger a corrective action plan (CAPs), if required, which is created between the Head of Monitoring and the Field Stewards. These CAPs inform of any necessary revision of the field standard operating procedures (SOPs), or additional training requirements, thereby enabling a process of continuous improvement through an adaptive management processes as illustrated in Figure 4



Figure 4: Continuous Improvement of monitoring process

If the monitoring and reporting process identifies disturbance which results in a net loss in the Project Area, then the decision tree in Figure 5 is used to guide responses to the issue.

Figure 5: Net Loss Response Decision Tree



3.3.3 Ground Surveys

Ground surveys will be conducted to gather information from the Project Area. Ground surveys may fall under the following categories:

- Routine Field Patrol
- Incident Based Non-Routine Patrol

Each field patrol requires completion of a field sheet or survey. The information required to be collected from the routine field patrols is detailed against each parameter listed in Section 3.2.

Routine field patrols will be conducted by the Field Stewards and reported to the Head of Monitoring. Incident based non-routine patrols will also be completed by the Field Stewards and reported to the Head of Monitoring; however the reporting of non-routine patrols will instigate the adaptive management procedures as seen in Figure 5.

3.3.4 Remote Sensing

Remote sensing techniques will be employed to assess deforestation in the Project Area. Both low and high resolution images may be assessed to detect changes in the project region related to indicators such as infrastructure development, clearing for gardening, fires and other natural disturbances. Changes at this scale are most likely detectable over a longer (12 month) temporal scale and as such this analysis will take place to coincide with the VCS reporting and verification events detailed in Table 23. The results will be collated into a monitoring report suitable for third party verification. A summary of identified monitoring components can be found in Table 21 below.

Table 21: Monitoring Activities

Monitoring Component		Activity	Monitoring Frequency	Method	Resources
1	Boundary	Detect integrity of Project Boundary	Annually	Remote Sensing	ALOS 50m or Landsat 30m
2	Stratification	Land Cover classification	Annually	Remote Sensing	ALOS 50m or Landsat 30m + field data
3	Land change	Detection and area calculation of deforestation	Annually	Remote Sensing	Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution) as needed to support analysis and field surveys
4	Logging	Detection and area calculation of degradation from illegal logging	Continual	Fieldwork Remote Sensing	High Resolution Imagery (5m satellite) Results of 2 yearly PRA process.
5	Fire	Detection of fire ignitions, calculation of burn areas (deforestation associated with fire)	Continual	Fieldwork Remote Sensing	MODIS imagery (1 km thermal band detects fires as small as 100m ² and imagery is collected and posted daily)
6	Forest Carbon Stock	Field measurement of biomass indicators (i.e. species, height, DBH)	10 yearly	Fieldwork	Project Field Inventory Guide and Data Sheets
7	Leakage	New logging or land conversion permit activity within region of project	Annually	Fieldwork Remote Sensing National Records	Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution)

3.3.5 Data Archiving

All data collected as part of the monitoring program will be archived electronically and kept at least for two years after the end of the project crediting period. All measurements will be conducted according to relevant standards as described in the parameter tables.

Data archiving shall take both electronic and paper forms, and copies of all data shall be provided to relevant project participants/stakeholders. All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are to be stored in multiple locations. One copy to be stored in the office of Head of Monitoring and one copy stored in the head office of PFA.

The archives will include:

- copies of all original field measurement data and data analysis spreadsheets;
- estimates of the carbon stock changes in all pools and non-CO₂ GHG and corresponding calculation spreadsheets;
- GIS products; and
- copies of the monitoring reports.

3.3.6 Organisation and Responsibilities

Table 22: Responsibilities of monitoring staff

Staff	Responsibilities
Pacific Forest Alliance	Third Party review process of monitoring report
	Managing the VCS verification process
	Maintaining and storage of records
	Reporting to project stakeholders
Project Manager/Head of Monitoring	Manage monitoring process
	Plan and coordinated field data collection
	Prepare reports
	Identify Issues
	Implement continual improvement processes
	Supervision of field stewards
	Identify training requirements
	Drafting of Standard Operating Procedures
	Procurement of required support from specialists
Field Steward	Field data collection
	Instrument calibration and maintenance
	Data uploading
	Communication of issues to Head of Monitoring
External Consultants	Delivery of required support as specified by the Head of Monitoring (largely remote sensing related activities).

3.3.7 Monitoring Frequency

The monitoring of parameters required for VM0007 and VM0010 will culminate in the development of a monitoring report for third party verification. This report will be produced annually up until 2015 and bi-annually after 2015 as reported in

Table 23 and consistent with the validated Project Description.

Should there be any loss identified in the Project Area the Net Loss Response procedure (Figure 5) will initiate immediate reporting to the Superintendent and an appropriate response to limit further loss.

The monitoring of parameters for the baseline renewal will culminate in the development of a revision of the baseline estimation of carbon stocks every 10 years. This is scheduled for 2019 (see

Table 23).

Table 23: Frequency of Monitoring and Reporting for VCS verification

Period	Activities	Duration (yrs)	Baseline status
22 May 2009 – 31 December 2012	First monitoring period	3.5	First baseline period
1 st January 2013 – 31 December 2014	Second monitoring period	1	
1 st January 2014 – 31 December 2015	Third monitoring period	1	
1 st January 2015 – 31 December 2016	Fourth monitoring period	1	
1 st January 2016 – 31 December 2018	Fifth monitoring period	2	
1 st January 2018 – 21 May 2019	Sixth monitoring period	1.5	Revised baseline
21 May 2019	Baseline Revision	NA	

3.3.8 Quality Assurance and Quality Control (QA/QC)

Monitoring related QA/QC requirements are documented in a series of Standard Operating Procedures (SOPs) which are summarised in Table 24.

Table 24: Standard Operating Procedures Relevant to VCS Monitoring and Reporting

QA/QC	Description
Data Collection SOP	The remote sensing data, will be verified by the field stewards through ground-truthing if required. QA/QC procedures for specific parameters are described in Section 3.2.
Data Capture and Storage SOP	The DCS SOP defines the data capture, storage (hard copy and digital format) and data retrieval framework.
Report Development and Release	Technical review or pre-verification of the data, SOP and monitoring report will be conducted by an independent 3rd party, such as the University of Papua New Guinea using a checklist specially developed for this purpose. This report will then be signed off by Pacific Forest Alliance prior to the commencement of the VCS verification process.
Continual Improvement Process	This process will be applied to ensure continuous improvement in all processes involved.
Information and Communication Systems (ICS) SOP	The ICS SOP defines communication methods including communication responsibilities, timing of communication, reporting requirements, events response and the flow in which the communication process should occur.

3.4 Monitoring and Reporting Tasks

Monitoring and reporting tasks are designed to collect and report the information required for periodic verification of the Project, and recalculation of the baseline at the end of the fixed baseline period.

Technical descriptions of monitoring tasks, data collection procedures, and QA/QC procedures are listed for each parameter in the tables presented in Section 3.

The monitoring plan is divided into two tasks:

- Task 1 – Monitoring and reporting of carbon stock changes and GHG emissions in areas defined as planned deforestation (VM0007)
- Task 2 - Monitoring and reporting for areas defined as conversion of logged to protected forest (VM0010)

3.4.1 Task 1 – Monitoring and reporting of carbon stock changes and GHG emissions in areas defined as planned deforestation (VM0007)

In accordance with VM0007 (M-MON) monitoring of the following parameters is required:

Table 25: Parameters produced from VM0007 monitoring

Parameter	SI Unit	Source	Description
ΔC_P	t CO ₂ -e	Calculated	Net greenhouse gas emissions within the project area under the project scenario
$A_{DefPA,i,t}$	ha	Satellite Images	Area of recorded deforestation in the project area in the project case in stratum <i>i</i> at time <i>t</i>
$A_{burn,i,t}$	ha	Satellite Images	Area burnt in stratum <i>i</i> at time <i>t</i>
$A_{DistPA,i,t}$	ha	Satellite Images	Area impacted by natural disturbance in stratum <i>i</i> at time <i>t</i>

For the Project Area, the net greenhouse gas emissions in the Project case is equal to the sum of stock changes due to deforestation and natural disturbance plus the total greenhouse gas emissions. Degradation is not applicable and regrowth is conservatively omitted.

$$\Delta C_P = \sum_{t=1}^{t^*} \sum_{i=1}^M (\Delta C_{P,DefPA,i,t} + \Delta C_{P,Deg,i,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t}) \quad \text{Equation (M-MON 1)}$$

Where:

ΔC_P Net greenhouse gas emissions within the project area under the project scenario; t CO₂-e

$\Delta C_{P,DefPA,i,t}$ Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; t CO₂-e

$\Delta C_{P,Deg,i,t}$ Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* at time *t*; t CO₂-e

$\Delta C_{P,DistPA,i,t}$ Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* at time *t*; t CO₂-e

$GHG_{P-E,i,t}$ Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; t CO₂-e

i 1, 2, 3 ... M strata

t 1, 2, 3, ... t^* years elapsed since the start of the REDD project activity

The basis of the calculations requires quantification of the area parameters:

$A_{DefPA,i,t}$	ha	Satellite Images	Area of recorded deforestation in the Project Area in the project case in stratum i at time t
$A_{burn,i,t}$	ha	Satellite Images	Area burnt in stratum i at time t
$A_{DistPA,i,t}$	ha	Satellite Images	Area impacted by natural disturbance in stratum i at time t

Quantification of these area parameters using remote sensing requires completion of the following four steps:

Step 1: Selection and analyses of sources of land-use and land-cover (LU/LC) change data

A land cover / land use change analysis for the years 2009 and 2012 was conducted based on Landsat-5 TM and Landsat-7 ETM+ satellite imagery, these images have a resolution of 30 meters and consist of 5 spectral bands. The Landsat images were acquired in Level 1T preprocessing format, which means that a very accurate geometric correction, including terrain correction has already been applied by the data provider (USGS). The images were checked for geometric alignment, and it was concluded that the geometric matching was very accurate, and no further correction required. The images were delivered in the UTM (Universal Transverse Mercator) projection, Zone 54 S.

The pixel information in the Landsat Level 1T imagery contains the at-sensor radiance, i.e. the radiation reflected from the earth surface at top of the atmosphere. This at-sensor-radiance contains atmospheric disturbances due to illumination, aerosols, water vapour etc. during image acquisition. In order to correct these disturbances, an atmospheric correction procedure has been applied, which removes these effects and converts the data into surface reflectance. The software ATCOR-2 has been used for this task, which makes use of the MODTRAN atmospheric transfer code. The atmospheric correction facilitates that differences between the images due to atmospheric disturbances are removed.

Additional preprocessing steps included spectral enhancement of the data by calculating the NDVI (Normalized Difference Vegetation Index) (Lillesand et al. 2004), and applying a MNF Transformation (Minimum Noise Fraction) (Green et al. 1988) in order to generate additional input bands for classification.

The preprocessing was conducted in the software package ENVI / IDL (ExelisVis) and the ATCOR-2 software (Green, 1988).

Table 26 lists the images used in this analysis and Table 27 provides a list of datasets delivered.

Table 26: Images used in analysis

Satellite	Path/ Row	Acquisition date
2009		
Landsat-5	099/063	2008-10-13
Landsat-7	099/063	2009-03-06
Landsat-5	099/063	2009-03-30
Landsat-5	099/063	2009-05-09
Landsat-5	099/063	2009-05-25
Landsat-5	099/063	2009-06-10
Landsat-5	099/063	2009-06-26
Landsat-5	099/063	2009-08-29
Landsat-5	099/063	2009-11-01
Landsat-5	099/063	2009-11-17
2012		
Landsat-7	099/063	2011-02-16
Landsat-7	099/063	2011-05-23
Landsat-7	099/063	2011-08-27
Landsat-7	099/063	2012-02-03
Landsat-7	099/063	2012-03-06
Landsat-7	099/063	2012-04-23
Landsat-7	099/063	2012-05-09
Landsat-7	099/063	2012-10-16
Landsat-7	099/063	2013-01-20

The Landsat imagery was procured in Level 1 T preprocessing format. This means that a very accurate ortho-correction has already been applied by the data provider (USGS). All used imagery was thoroughly checked for geometric matching, and it was found that no additional geometric correction was necessary.

Table 27: Datasets delivered:

Information	File name (s)	Comment
forest/non-forest cover shapefiles	Land_Cover_2009_final.shp	2009 Land Cover Classification
	Land_Cover_2012_final.shp	2012 Land Cover Classification
	Land_Cover_2009_final_CompleteNoData.shp	2009 Land Cover Classification with accumulate No Data areas from 2009 and 2012
	Land_Cover_2012_final_CompleteNoData.shp	2012 Land Cover Classification with accumulate No Data areas from 2009 and 2012
LULC change/deforestation shapefiles	Change_2009_2012_final.shp	Land Cover Change 2009 - 2012
	Change_2009_2012_final_CompleteNoData.shp	Land Cover Change 2009 – 2012, calculated based on the LC datasets with accumulate NoData
shapefiles of cloud obscured areas	Included in the respective LC shapefiles	
and a shapefile of points used for validation and their corresponding classification by an analyst	Validation_points_2009.shp	Points used for the validation of the classification; Attributes are: CID: Class code of the classification Valid: Class code assigned by the interpreter True: Are CID and Valid identical

		Random: Random number used for sorting the validation points during interpretation
--	--	--

All images were checked for geometric accuracy, in particular image to image matching. It was found that there was no mismatch between any of the images, so no further geometric correction was necessary.

Step 2: Processing LU/LC Change Data

The first step in the image preparation was the atmospheric correction, i.e. the removal of atmospheric distortions in the imagery due to differences in aerosols, water vapor, haze and illumination effects. This was done with the ATCOR-2 software. The output data was converted into surface reflectance.

The second step was the removal of clouds and cloud shadows. This was done by a semi-automated object-based image classification routine, developed by RSS, and executed in the Trimble eCognition software package. The clouds are detected based on the blue and thermal bands in the Landsat images, while cloud shadows are detected based on a brightness threshold in the Near Infrared and adjacency to clouds. The detected clouds and shadows were then masked out.

The next step of image preprocessing was the creation of a multi-image mosaic for each of the two observation times 2009 and 2012. Therefore, the images were ordered by quality (i.e. the ones with the lowest cloud cover on top) and mosaicked together by the ENVI mosaic tool. Gaps in one image were filled up by data from the images underneath. The mosaicking was conducted as a step-by-step procedure in order to facilitate an accurate color balancing between the individual images.

Land cover classification

The image mosaics were then classified into the following land cover classes listed by an object-based semi-automated processing routine in eCognition:

- Forest
- Non-Forest
- Water

The first step of the processes is the image segmentation, which accumulates spatially adjacent pixels with similar spectral properties into image objects.

A threshold-based classification rule-set was then used to assign the land cover classes to the image objects. . The rule-set follows a decision tree structure, assigning land cover classes to the image objects in a hierarchical manner. The workflow of the rule-set, including the decision rules and thresholds used is shown in Figure 6:

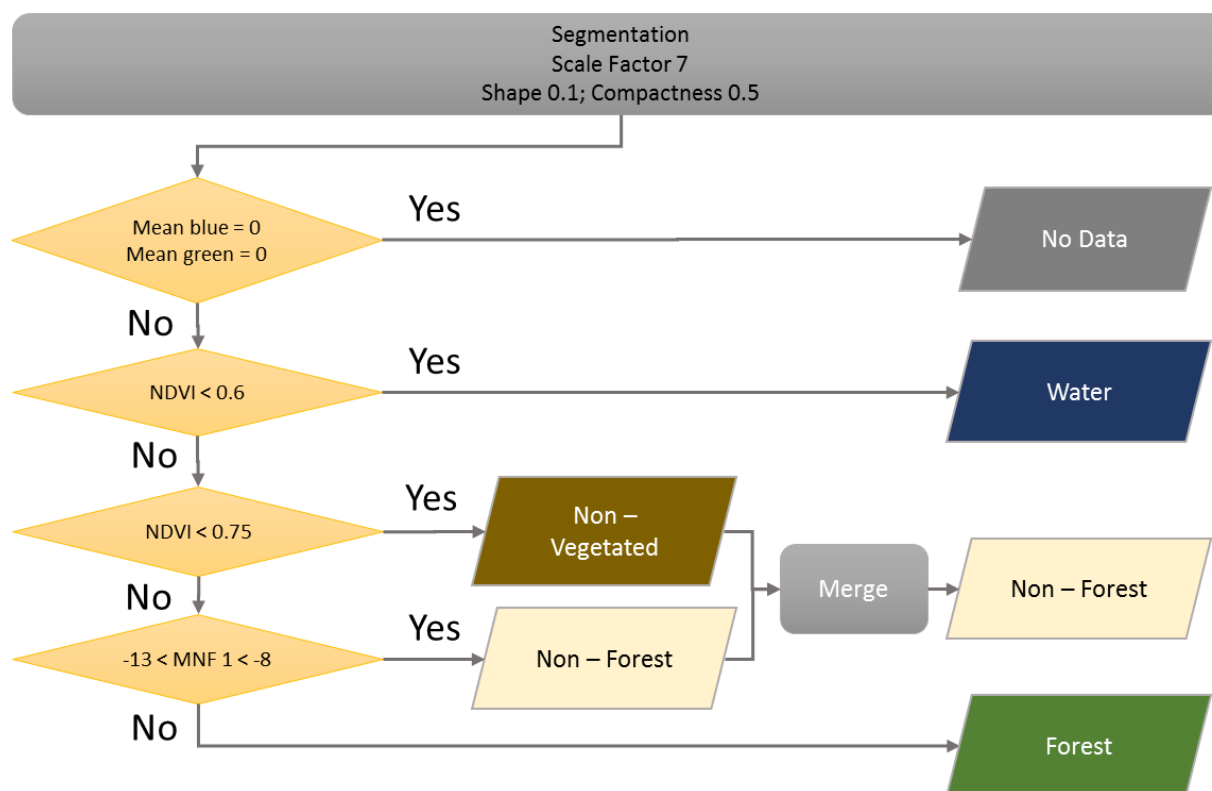


Figure 6: Threshold based classification rule set

Eventually, a visual screening of the classification results was conducted in order to reduce misclassifications and improve classification accuracy.

No ground truth data was collected for training purposes in land cover classification.

Change detection

Based on the classification results of the two observation times, a post classification change detection was applied. The two classifications were overlaid in the GIS, and the change vectors (from-to change) were determined. The different change vectors were then grouped into meaningful change classes, such as “Deforestation”, “Regeneration” or “Flooding”.

Step 3: Post-processing and accuracy assessment

An accuracy assessment was conducted for the two land cover maps based on confusion matrices. Reference land cover samples were generated based on a stratified random sampling scheme. An independent interpreter then assigned the land cover category to the samples based on interpretation of the satellite images.

A confusion matrix was then established comparing the classification result with the reference samples, and the overall classification accuracy, as well as the accuracy of the individual classes (producer’s and user’s accuracy) were calculated.

No ground truth data was collected for the accuracy assessment.

Estimating land-use and land-cover (LU/LC) change data in cloud-obscured areas

The land cover classifications of both observation times were overlaid and a common no data mask was generated in order to exclude areas from the change analysis which were cloud-obscured in one of the classifications. All land-cover change statistics, in particular the deforestation rate, were calculated exclusively on areas which contain data at both observation times. The deforestation rate was then calculated in percent per year.

Step 4: Calculation Approach

$$\Delta C_{P,DefPA,i,t} = \sum_{u=1}^U (A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t}) \quad \text{Equation (M-MON 3)}$$

Where:

$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t ; t CO ₂ -e
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum i converted to land use u at time t ; ha
$\Delta C_{pools,Def,u,i,t}$	Net carbon stock changes in all pools in the project case in land use u in stratum i at time t ; t CO ₂ -e ha ⁻¹
u	1,2,3,... U post-deforestation land uses
i	1, 2, 3 ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the REDD project activity

$$\Delta C_{pools,Def,i,t} = C_{BSL,i} - C_{P,post,i} - C_{WP,i} \quad \text{Equation (M-MON 5)}$$

Where:

$\Delta C_{pools,Def,u,t}$	Net carbon stock changes in all pools as a result of deforestation in the project case in land use u in stratum i at time t ; t CO ₂ -e ha ⁻¹
$C_{BSL,i}$	Carbon stock in all pools in the baseline case in stratum i ; t CO ₂ -e ha ⁻¹
$C_{post,u,i}$	Carbon stock in all pools in post-deforestation land use u in stratum i ; t CO ₂ -e ha ⁻¹
$C_{WP,i}$	Carbon stock sequestered in wood products from harvests in stratum i ; t CO ₂ -e ha ⁻¹
u	1,2,3,... U post-deforestation land uses
i	1, 2, 3 ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the REDD project activity

$$C_{post,u,i} = C_{AB_tree,i} + C_{BB_tree,i} + C_{AB_non-tree,i} + C_{BB_non-tree,i} + C_{LI,i} \quad \text{Equation (M-MON 6)}$$

Where:

$C_{post,u,i}$	Carbon stock in all pools in post-deforestation land use u in stratum i ; t CO ₂ -e ha ⁻¹
$C_{AB_tree,i}$	Carbon stock in aboveground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BB_tree,i}$	Carbon stock in belowground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{AB_non-tree,i}$	Carbon stock in aboveground non-tree vegetation in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BB_non-tree,i}$	Carbon stock in belowground non-tree vegetation in stratum i ; t CO ₂ -e ha ⁻¹
$C_{LI,i}$	Carbon stock in litter in stratum i ; t CO ₂ -e ha ⁻¹
u	1,2,3,... U post-deforestation land uses
i	1, 2, 3 ... M strata in the in the project case

Area of recorded deforestation ($A_{DefPA,i,t}$), Area burnt ($A_{burn,i,t}$) and Area impacted by natural disturbance ($A_{DistPA,i,t}$).

Figure 7 shows the land cover maps of the Forest Management Area (excluding peat areas) for the two observation times 2009 and 2012 and Table 28 shows quantitative change from these maps.

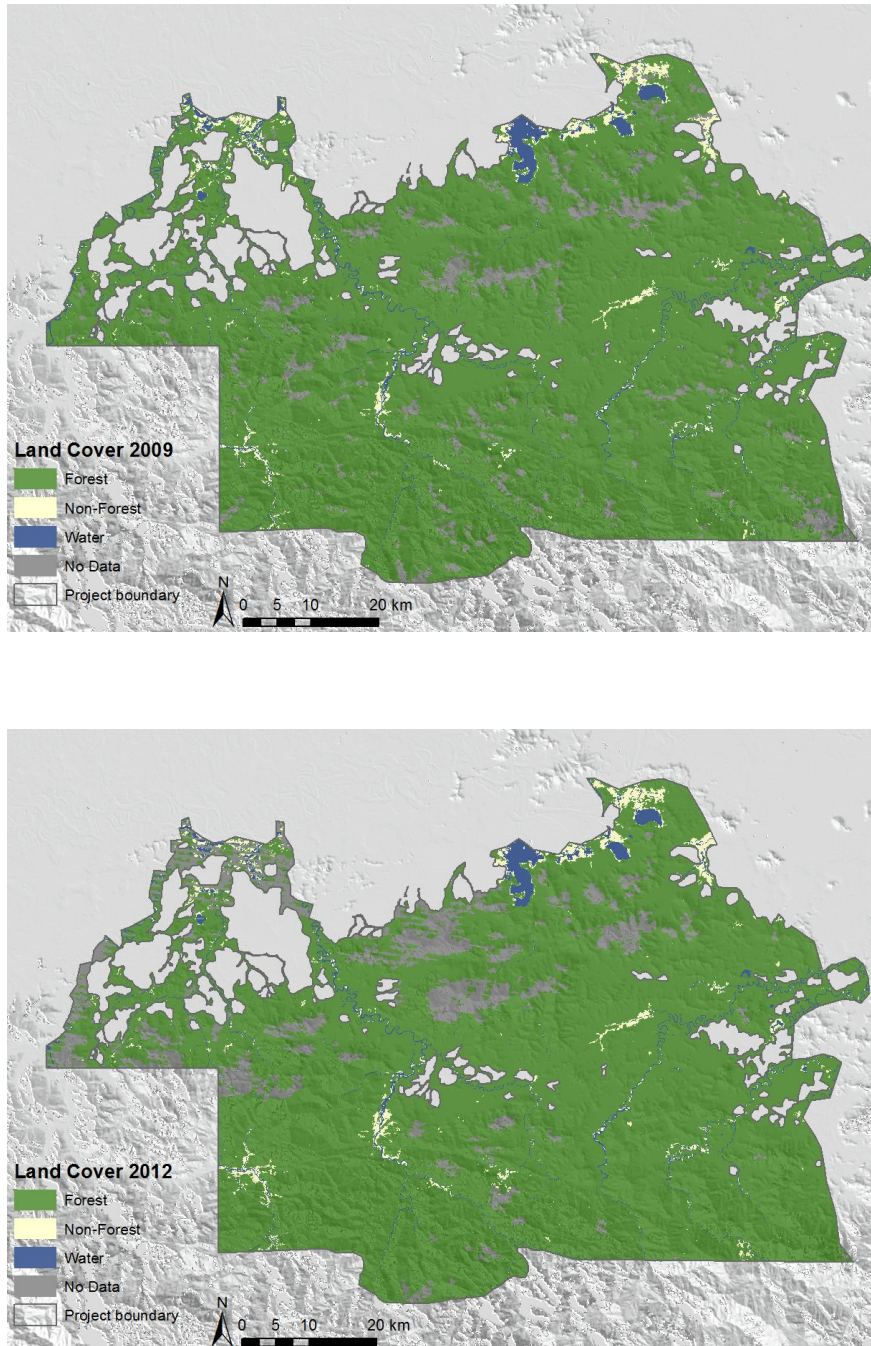


Figure 7: Land cover map of the study area 2009 and 2012.

Table 28: Change table for 2009 and 2012

Class Name	Full area			
	2009	2012	2009	2012
	Area [ha]		%	
Forest	476,337	461,940	89%	86%
Non-Forest	12,249	11,948	2%	2%
Water	15,056	14,289	3%	3%
No Data	30,764	46,229	6%	9%
Total	534,406	534,406	100%	100%

Accuracy assessment

An accuracy assessment was conducted for the two land cover maps based on confusion matrices.

Reference land cover samples were generated based on a stratified random sampling scheme, which uses the land cover classification as stratification. 50 sample points were created for each class.

An independent image interpreter then assigned the land cover category to the samples based on interpretation of the satellite images.

A confusion matrix was then established comparing the classification result with the reference samples, and the overall classification accuracy, as well as the accuracy of the individual classes (producer's and user's accuracy) were calculated. Details about the procedures can be found in Congalton and Green 1999¹²

Table 29: Confusion matrix of the 2009 Land Cover Classification

Classification	Validation			
	Forest	Non-Forest	Water	Total
Forest	49	4	1	54
Non-Forest	1	46	4	51
Water			45	45
Total	50	50	50	150

¹² R.G. Congalton and K. Green, "Assessing the accuracy of remotely sensed data: principles and practices", Boca Raton, FL (1999).

Table 30: Confusion matrix of the 2012 Land Cover Classification.

	Validation			
Classification	Forest	Non-Forest	Water	Total
Forest	49	2	2	53
Non-Forest	1	45	4	50
Water		3	44	47
Total	50	50	50	150

Table 31: Results of the accuracy assessment of the two land cover classifications.

	2009		2012	
Overall accuracy	93.3%		92.0%	
Class-wise accuracy	Producer's accuracy	User's accuracy	Producer's accuracy	User's accuracy
Forest	98.0%	90.7%	98.0%	92.5%
Non-Forest	92.0%	90.2%	90.0%	90.0%
Water	90.0%	100.0%	88.0%	93.6%

Land Cover Change

Figure 8 shows the land cover change map of the study area for the time period 2009 – 2012 and Table 32 shows the Land Cover Change Matrix.

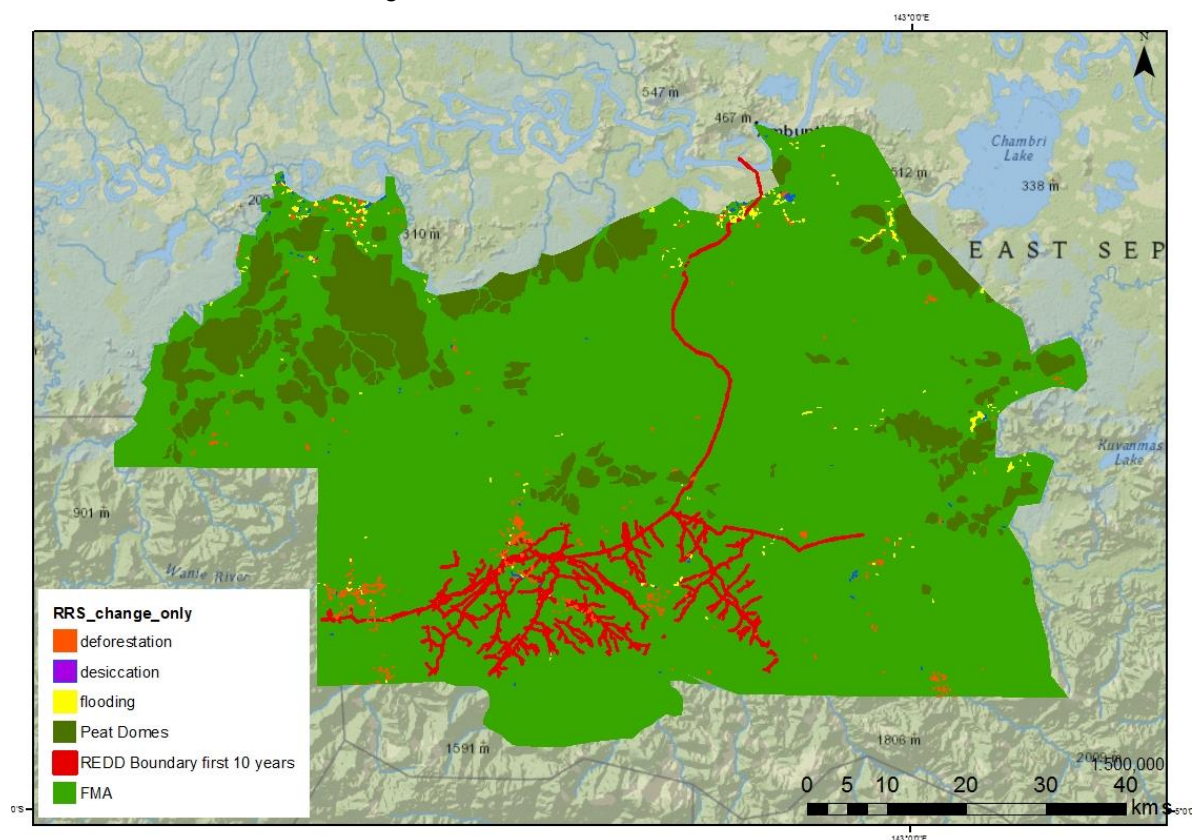


Figure 8: Land cover change map for the observation period 2009 – 2012.

Table 32: Land Cover Change Matrix

	Land Cover T2				
Land Cover T1	Forest	Non-Forest	Water	No Data	Total
Forest	440741	1613	153		442508
Non-Forest	771	9699	574		11044
Water	17	190	13475		13682
No Data				67172	67172
Total	441529	11502	14203	67172	534406

Table 33: Land cover change statistics for the different land cover classes in VM0007 boundary

Class Name	2009	2012	Change			
			2009 - 2012			
			Area [ha]	%	ha yr ⁻¹	% yr ⁻¹
Forest	3,233.42	3,292.93	59.51	1.84%	17.00	0.53%
Non-Forest	63.45	89.00	25.55	40.27%	7.30	11.51%
Water	73.34	73.58	0.24	0.33%	0.07	0.09%
No Data ¹³	133.79	48.49	85.30	63.76%	24.37	18.22%
Total	3,504	3,504	0.00	0.21	0.00	6.09%

Table 34: Land cover change statistics for the different land cover classes in VM0010 boundary

Change type	Change			
	2009 - 2012			
	Area [ha]	%	ha yr ⁻¹	% yr ⁻¹
Deforestation	539.46	0.3%	154.131	0.1%
No change	174,480.29	88.7%	49851.5	25.3%
No data	21,517.39	10.9%	6147.83	3.1%
Regrowth	161.35	0.1%	46.1	0.0%
Total	196698.49			

Area of recorded deforestation in the leakage belt ($A_{\text{DefLB},i,t}$)

Not Applicable.

Monitoring degradation

The Project has policies and procedures that require approvals for commercial activities to be established in the Project Area. These approaches require approval from the landowner companies. In addition there will be forest stewards who will be engaged to patrol the Project Area to educate the villagers in the Project operational procedures and to monitor and report any degradation activities.

The Project Area is extensive and remote and the population within the Project is very low. Subsistence activities such as building canoes, collecting firewood from the forest floor and building houses has not lead to degradation in the Project Area to date. Project monitoring will pick up any increases in disturbance and education programs will inform people and discourage them from degradation activities.

Monitoring areas undergoing natural disturbance

¹³ This data was derived from satellite imagery and no data represents continuous cloud cover over the project area.

Natural disturbance in the Project Area relate primarily to loss of forest cover from shifting rivers, landslide and fire. Buffering of rivers was conducted as a means of minimizing disturbance from shifting rivers.

In accordance with the methodology emissions resulting from natural disturbances may be omitted if they are deemed *de minimis* through the use of the module T-SIG¹⁴.

This Tool states that 'GHG emissions by sources are considered insignificant if there sum is lower than 5% of the of net anthropogenic removals by sinks when calculated according to

$$RC_{Ei} = \frac{E_i}{\sum_{i=1}^I E_i}$$

Where:

RC_{Ei} Relative contribution of each source I to the sum of project and leakage GHG emissions

E_i GHG emissions by sources pr project and possible decreases in carbon pools and leakage emissions

i = Index of individual sources of project and leakage GHG emissions (I = total number of sources considered).

All areas defined ex-post as a disturbance event in the Project Area were delineated to enable future tracking (Figure 8).

Equation M-MON 20 was used to determine the Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum I at time t .

$$\Delta C_{P,DistPA,i,t} = \sum_{q=1}^Q (A_{DisPA,q,i,t} \times \Delta C_{P,Dist,q,i,t} \quad \text{Equation (M-MON 20)}$$

Where:

$\Delta C_{P,DistPA,i,t}$ Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum i at time t ; t CO₂-e ha⁻¹

$A_{DustPA,q,i,t}$ Area impacted by natural disturbance in post natural disturbance stratum q in stratum i ; at time t ; t CO₂-e ha⁻¹

$\Delta C_{P,Dist,q,i,t}$ Net carbon stock changes in pools as a result of natural disturbance in post-natural disturbance stratum q in stratum i at time t ; CO₂-e ha⁻¹

q 1,2,3,... Q post-natural disturbance strata

i 1, 2, 3 ... M strata

t 1, 2, 3, ... t^* years elapsed since the start of the REDD project activity

¹⁴ EB31 - Tool for testing significance of GHG emissions in A/R CDM project activities. V01. Available at: <http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-04-v1.pdf>

The land use change analysis detected deforestation from shifting rivers. There was no deforestation detected from fire or landslide during the monitoring period. Only deforestation from shifting rivers was detected in the REDD project boundary.

As there was no deforestation from fire during the monitoring period Equations M-MON 21 and M-MON 22 were not applied.

Equation M-MON 23 was then applied to quantify net carbon stock changes in pools as a result of natural disturbance in the project case during the monitoring period.

$$\Delta C_{P,Dist,q,i,t} = C_{BSL,i} - C_{P,Dist,q,i} - C_{WP,q,i} \quad \text{Equation (M-MON 23)}$$

Where:

$\Delta C_{P,Dist,q,i,t}$	Net carbon stock changes in pools as a result of natural disturbance in the project case in post-natural disturbance stratum q in stratum i at time t ; t CO ₂ -e ha ⁻¹
$C_{BSL,i}$	Carbon stock in all pools in the baseline case in stratum i ; t CO ₂ -e ha ⁻¹
$C_{P,Dist,q,i}$	Carbon stock in pools in post-natural disturbance strata q in stratum i ; t CO ₂ -e ha ⁻¹
$C_{Dist,WP,q,i}$	Carbon stock sequestered in wood products from harvests following natural disturbance in post-natural disturbance stratum q , in stratum i ; t CO ₂ -e ha ⁻¹
q	1,2,3,... Q post-natural disturbance strata
i	1, 2, 3 ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the REDD project activity

M-MON 24 was not applied, as it was conservatively assumed that the post-natural disturbance of the live and dead vegetation pool is zero.

Monitoring areas undergoing carbon stock enhancement

Not Applicable

Monitoring project emissions

The remote sensing indicated 0 hectares of burning within the IFM and REDD project boundaries. Therefore module E_BB was not applied.

Monitoring requirements specific to baseline revision

Not required in this monitoring report.

Task 2 - Monitoring and reporting for areas defined as conversion of logged to protected forest (VM0010)

Monitoring and reporting activities shall cover the following aspects:

- project implementation;
- actual carbon stock changes from project activity; and
- estimation of ex-post net carbon stock changes from disturbance and illegal logging.

Parameters listed in Table 35 are monitored in accordance with VM0010:

Table 35: Parameters produced from VM0010 monitoring

Parameter	SI Unit	Description
Results of limited illegal logging survey	NA	PRA related to illegal logging activity
$A_{burn,i,t}$	Ha	Area burnt in stratum i at time t
$A_{DIST_IL, i}$	Ha	Area potentially impacted by illegal logging in stratum i
A_{Pi}	Ha	Total area of illegal logging sample plots in stratum i
PMP_i		Annual Allowable Cut as a proportion of total FMA area
A_i	Ha	Area covered by stratum i
DBH	Cm	Diameter at breast height of tree

These parameters are required at each verification and are used in equations 16, 17, 19 of VM0010.

$$\Delta C_{WP100,i,p|BSL} = A_{i,p} * (C_{EX,i|BSL} - C_{WP100,i|BSL}) \quad \text{Equation (VM0010 - 16)}$$

Where:

$\Delta C_{WP100,i,p|BSL}$ change in carbon stock resulting from wood product conversion and retirement from stratum i in land parcel p, tC;

$A_{i,p}$ the area of stratum i in land parcel p, ha;

$C_{EX,i|BSL}$ mean carbon stock of extracted timber per unit area in stratum i, tC ha⁻¹;

$C_{WP100,i|BSL}$ carbon stock sequestered in wood products in stratum i as a result of planned timber harvest in the baseline scenario, in tC ha⁻¹;

i 1, 2, 3 ...M strata; and

p 1, 2, 3 ...P land parcels.

$$\Delta C_{RG,i,p|BSL} = A_{i,p} * (RGR_i * TH_{i,p}) \quad \text{Equation (VM0010 - 17)}$$

Where:

$\Delta C_{RG,i,p BSL}$	carbon sequestration resulting from forest regrowth after timber harvest in stratum i in land parcel p, tC;
$A_{i,p}$	the area of stratum i in land parcel p, ha;
RGR_i	regrowth rate of forest post timber harvest for stratum i, tC ha ⁻¹ yr ⁻¹ ;
$TH_{i,p}$	number of years since timber harvest in stratum i in land parcel p, years;
i	1, 2, 3 ...M strata; and
p	1, 2, 3 ...P land parcels.

$$\Delta C_{NET|BSL} = \frac{(\sum_{p=1}^P \Delta C_{NET,p|BSL})}{IFMCP} * t^* \quad \text{Equation (VM0010 - 19)}$$

Where:

$\Delta C_{NET BSL}$	net change in carbon stock across all parcels in the baseline scenario since the start of the project activity, in tC;
$\Delta C_{NET,p BSL}$	net change in carbon stock in the baseline scenario in parcel p, in tC;
IFMCP	project crediting period for the IFM project, in years;
t^*	time elapsed since the start of the project, in years; and
p	1, 2, 3 ...P land parcels harvested within the crediting period.

Monitoring of Disturbance

Illegal PRA

The PRA conducted in the baseline assessment was completed in 2012. This PRA determined there was **no illegal logging occurring within the IFM Boundary**. This was consistent with patrols and remote sensing conducted between 2009 and 2012. The PRA will be repeated in 2014 as required by the methodology.

Area burnt ($A_{burn,i,t}$)

Remote sensing in the IFM boundary between 2009-2012 indicated that there was no areas burnt. Therefore **$A_{burn,2009-2012} = 0$ hectares**.

Area potentially impacted by illegal logging ($A_{DIST\ IL,i}$)

The PRA indicated **no likely disturbance from illegal logging**. Remote sensing detected only areas deforested and these have been quantified and deducted from the net GHG emissions. No evidence of illegal logging was detected with the remote sensing.

Total area of illegal logging (A_{PI})

As there was **no illegal logging** this parameter is equivalent to 0.

Annual Allowable Cut as a proportion of total FMA area (PMP_i)

This is to be assessed at 5 yearly intervals. As this was part of the 2012 Project Documentation PMP will be re-assessed in 2017 and incorporated in the relevant Monitoring Report.

Monitoring of actual carbon stock changes

Diameter at breast height of tree (DBH)

Not Applicable. The forest is Primary forest and is assumed to be in steady state. No monitoring or claim for forest growth will be included in this Project.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions for the current monitoring period were calculated in accordance with the Projects VM0010 and VM0007 validated Calculator. This approach assumed a linear deforestation and which resulted in cumulative gross and net emission reductions (20 May 1, 2009 to December 31, 2012) by year as listed in Table 36.

Table 36: Baseline Emissions for Monitoring Period M1

MON Period	Units Year	$\Delta C_{BSL,VM0007,t}$	$\Delta C_{BSL,VM0010,t}$	$\Delta C_{BSL,Total,t}$	$\Delta C_{BSL,Total,cumulative}$
		t CO ₂ -e	t CO ₂ -e	t CO ₂ -e	t CO ₂ -e
M1	May-10	96,001	146,619	242,620	242,620
	May-11	98,684	180,782	279,466	522,086
	May-12	101,367	214,948	316,315	838,401
	Dec-12	56,050	124,555	180,605	1,019,006
	May-13	57,361	124,556	181,917	1,200,923
	May-14	106,733	283,278	390,011	1,590,934
	May-15	109,733	317,443	427,176	2,018,110
	May-16	112,099	351,608	463,707	2,481,817
	May-17	114,782	385,773	500,555	2,982,372
	May-18	117,465	419,938	537,403	3,519,775
	May-19	120,148	454,102	574,250	4,094,025

Figures for $\Delta C_{BSL,VM0007,t}$ taken from tab VM0007-REDD-MF of the calculation tool.

Figures for $\Delta C_{BSL,VM0010,t}$ taken from tab VM0010-8.1.4-5 of the calculation tool.

The first monitoring period is for 3.5 years. Availability of remote sensing data restricted the full 4th year to be included.

The gross baseline emissions covered by this Monitoring Periods (M1) are equivalent to **1,019,006 tCO₂e**.

4.2 Project Emissions

The Project Emissions were calculated in the VCS_7_10_Calculator_PNG-M1.xlsx calculator. As a result the Project Emissions were determined to be **203,286 tCO₂e** (Table 37).

Table 37: Project Emissions from VM0007 and VM0010 areas

			$\Delta C_{P,VM0007,t}$	$\Delta C_{P,VM0010,t}$	$\Delta C_{P,Total,t}$	$\Delta C_{P,Total,cumulative}$
MON Period	Units		t CO ₂ -e	t CO ₂ -e	t CO ₂ -e	t CO ₂ -e
	Year					
M1	1	May-10	2,624	55,453	58,077	58,077
	2	May-11	2,624	55,453	58,077	116,154
	3	May-12	2,624	55,453	58,077	174,231
	4a	Dec-12	1,312	27,743	29,055	203,286

4.3 Leakage

As the project has taken the leakage factor deductions no leakage monitoring is required by either methodology. The Leakage deductions based on the default leakage factors and have already been incorporated into the baseline calculations.

4.4 Summary of GHG Emission Reductions and Removals (M1)

Table 38: Summary of net GHG emissions from VM0007 for M1 period

Units Year (ending)	$C_{REDD,t}$ t CO ₂ -e	ΔC_{BSL} t CO ₂ -e	ΔC_p t CO ₂ -e	ΔC_{LK} t CO ₂ -e	Buffer _{PLANNED} t CO ₂ -e	Buffer _{TOTAL} t CO ₂ -e	$C_{REDD,t}$ t CO ₂ -e cumulative	Adjusted $C_{REDD,t}$ t CO ₂ -e cumulative	VCU _t t CO ₂ -e
1	93,376	96,001	2,624	-	9,338	9,338	93,376	93,376	84,039
2	96,059	98,684	2,624	-	9,606	9,606	189,435	189,435	86,453
3	98,742	101,367	2,624	-	9,874	9,874	288,178	288,178	88,868
4a	54,737	56,050	1,312	-	5,474	5,474	342,915	342,915	49,264

The net GHG emission reductions and removals covered by this Monitoring Periods (M1) by VM0007 is equivalent to **308,624 tCO₂e VCUs** (Table 38).

Table 39: Summary of net GHG emissions from VM0010 for M1 period

	Total Credits	Total No. Buffer credits withheld	Total VCUs
Project Year (ending)			
1	61,842	6,184	55,658
2	89,174	8,917	80,256
3	116,506	11,651	104,855
4a	85,774	8,577	77,196

The net GHG emission reductions and removals covered by this Monitoring Periods (M1) by VM0010 is equivalent to **317,965 tCO₂e VCUs** (Table 39).

The combine net GHG emission reductions and removals from the entire Project Area covered by this Monitoring Periods (M1) is equivalent to **626,589 tCO₂e VCUs** (Table 40).

Table 40: Total combined net GHG emissions from period M1

			VCU _{VM0007,t}	VCU _{VM0010,t}	VCU _{Total,t}	VCU _{Total,cumulative}
MON Period	Units		t CO ₂ -e	t CO ₂ -e	t CO ₂ -e	t CO ₂ -e
	Year					
M1	1	2009/2010	84,039	55,658	139,696	139,696
	2	2010/2011	86,453	80,256	166,710	306,406
	3	2011/2012	88,868	104,855	193,723	500,129
	4a	2012	49,264	77,196	126,460	626,589

4.5 Additional Information

NA

REFERENCES:

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