

RIO BRAVO

CLIMATE ACTION PROJECT

Document Prepared By
 The Nature Conservancy,
 Programme for Belize, and
 Ecosystem Services Unit of Winrock International

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1 PROJECT DETAILS

1.1 Summary Description of the Project

This is an Avoided Planned Deforestation project. The project began in September 1994 and is located in north-west Belize and contains 6,296 hectares (ha). The area within the Project Boundary was purchased creating a clear land title held by the Program for Belize. The act of purchase removed the imminent threat of purchase by industrial scale agricultural farmers who would have proceeded to deforest the area.

1.2 Sectoral Scope and Project Type

This project is within sectoral scope 14 “Agriculture Forestry and Other Land Use” of the VCS. It is an Avoided Planned Deforestation project.

1.3 Project Proponent

Name	Role	Contact / Address
Programme for Belize	Project site manager; land owner.	Edilberto Romero PO BOX 749 # 1 Eyre Street Belize City Belize Tel: (501) 227-5616

1.4 Other Entities Involved in the Project

Entity	Role	Contact / Address
The Nature Conservancy	Project development; Financial Manager; Validation/Verification lead	Alex Martinez Alex Quintero 14A Garden City Plaza Belmopan, Cayo Belize Tel: (501) 822-0274
Winrock International	Validation & Verification technical advisor	Sarah Walker Felipe Casarim Sean Grimland 2121 Crystal Drive, Suite 500 Arlington, VA 22202 Tel: (703) 302-6556

1.5 Project Start Date

Project Start Date 01 January 1996

1.6 Project Crediting Period

Crediting Period 1 January 2002 – 31 December 2021

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project	X
Mega-project	

Total VCUs (t CO ₂ -e)		
Year	Annual Accrual	VCS Cumulative
2002	233,233	233,233
2003	233,178	466,411
2004	229,110	695,521
2005	229,600	925,121
2006	322,486	1,247,606
2007	322,489	1,570,095
2008	265,235	1,835,330
2009	-6,269	1,829,062
2010	-168,802	1,660,260

1.8 Description of the Project Activity

The project will reduce GHG emissions through the acquisition and protection of forest lands threatened by agricultural conversion. Over the life of the project, the area will continue to be protected from deforestation. Selective logging will take place within a restricted area of the project during the life of the project.

Avoidance of deforestation will take place through the purchase of land that would have been sold to industrial scale agricultural farmers. Program for Belize staff will monitor the area through ground surveys and communications with surrounding communities to prevent degradation through illegal logging.

Smartwood Certified selective logging will take place in the project scenario. Detailed logging plans will be created to minimize the impact of selective logging. No additional roads will be built within the project area. The selective logging conducted will be actively monitored and certified by Smartwood.

1.9 Project Location

The project is located in north-west Belize in the Orange Walk district. See Annex A: GIS & RS data for locations.

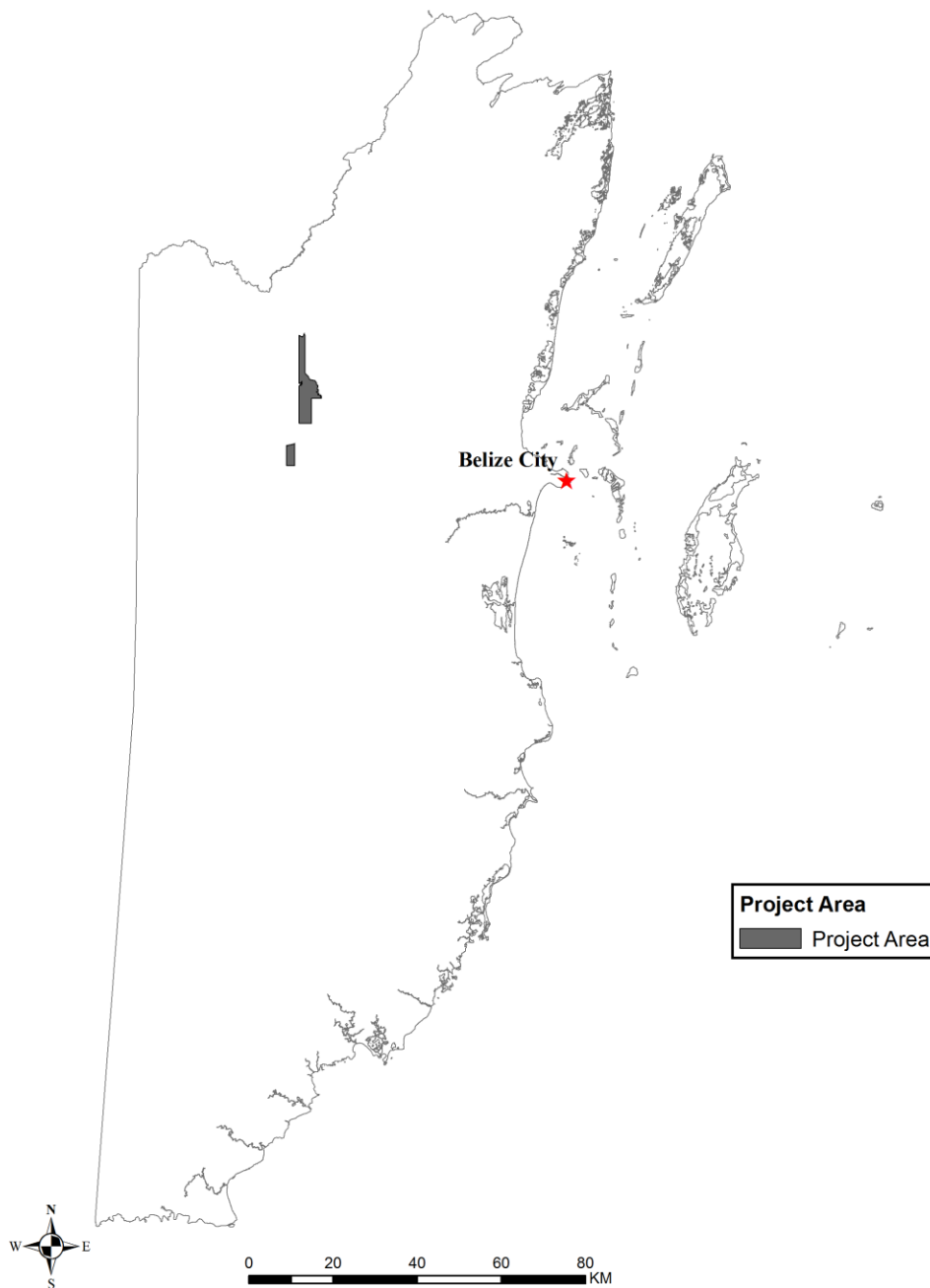


Figure 1. Rio Bravo Project Area

Table 1 List of titles held that make up the Rio Bravo Project.

Registration Section	Block	Parcel
Sierra de Agua South	14	3
Sierra de Agua Central	13	6

1.10 Conditions Prior to Project Initiation

1.10.1 Climate:

Weather data collected at La Milpa Field Station on the north-western Rio Bravo Conservation and Management Area (but outside the defined Project Area) has provided a good estimate of weather patterns. Since conditions alter across the Rio Bravo, those in the south and east can be assessed from observations from the weather stations at Tower Hill (near Orange Walk Town) and Spanish Lookout. Overall the area experiences a sub-tropical moist climate with marked wet and dry seasons, dominated by weather systems moving through the Gulf of Mexico and western Caribbean. The wet season is May – November and the dry season is December to April. Temperatures are fairly constant across inland northern Belize, averaging 27° C (81°F), but rainfall increases from north-west to south-east. Thus mean annual rainfall at La Milpa over the period 1995-2005 has been 1239 mm (49”) while that at Tower Hill is somewhat higher (1353 mm, 53”) and Spanish Lookout is higher again (1546 mm, 61”). These data suggest that the eastern RBCMA should receive 1440-1500 mm (57-59”) per annum. The La Milpa rainfall and that estimated for the eastern RBCMA is rather lower than those given in previous descriptions of the area. This conforms to a slight drying trend over the past decade (Meerman & Cherrington, 2005).

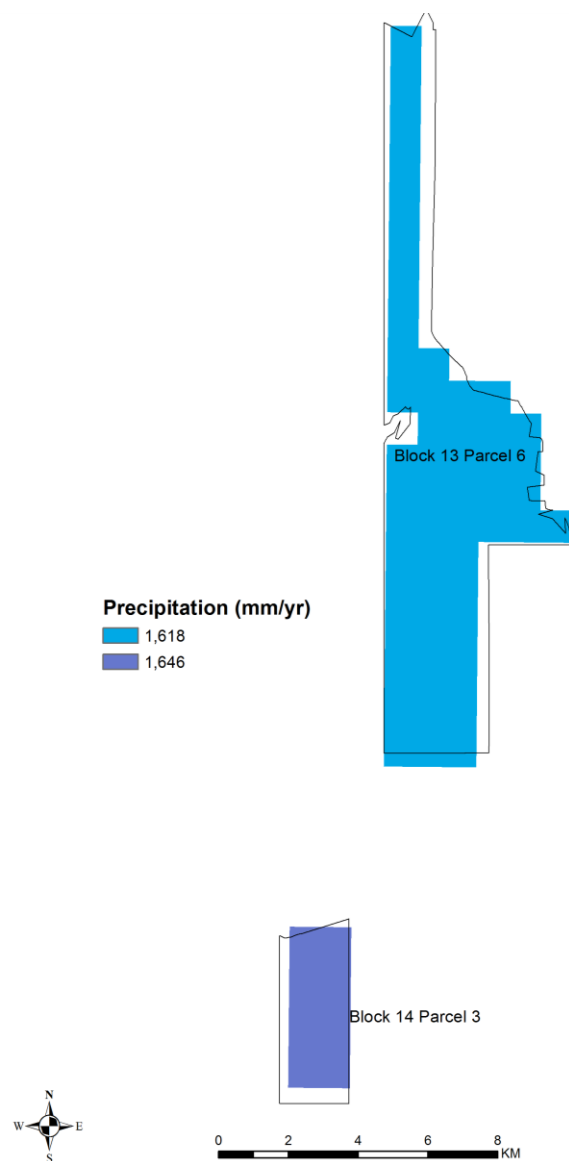


Figure 2. Average Yearly Precipitation¹ in Rio Bravo Project Boundary

¹ Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* 25: 1965-1978.

1.10.2 Relief and Soils:

The entire area forms part of the Yucatan Platform and is underlain by massive beds of limestone. Faulting on a NE-SW alignment has created a series of blocks that are slipping downwards to the east, resulting in a series of escarpments across the landscape – Lalucha, Rio Bravo, Booth's River and New River. The Booth's River escarpment divides the Rio Bravo between two land regions, the Bravo Hill and the Northern Coastal Plain, each with a number of land systems. The project area is within the Northern Coastal Plain which is characterized by flat and undulating plains and lower slopes of mostly not more than 246ft (75m) asl. There is one point in the extreme north of the project area with elevation of 475ft (145m). The terrain is generally flat with slight undulations. At times this results in lower areas being waterlogged during the wet season.

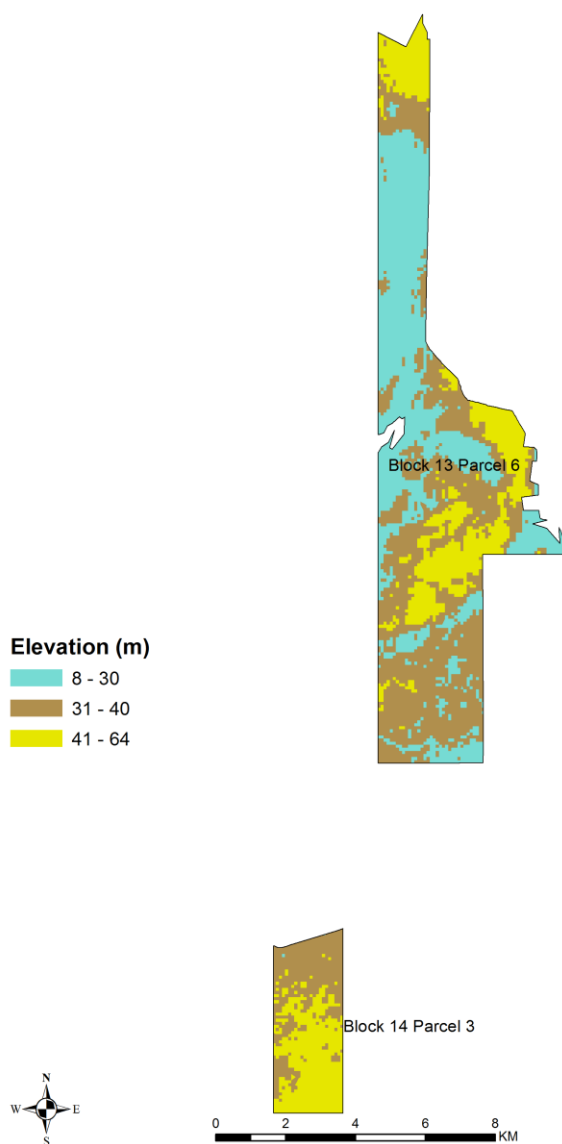


Figure 3. Elevation² Range within Rio Bravo Project Boundary

² Jarvis A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled seamless SRTM data V4, International Centre for Tropical Agriculture (CIAT), available from <http://srtm.csi.cgiar.org>.

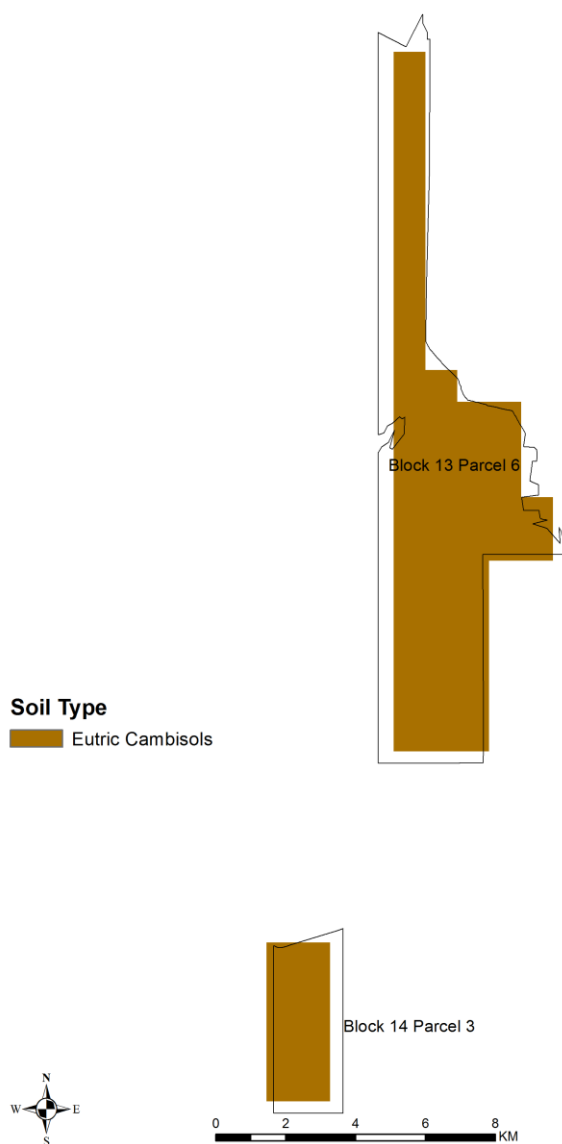


Figure 4. Soil³ Map of Rio Bravo Project Area

³ FAO/IIASA/ISRIC/ISSCAS/JRC, 2009. Harmonized World Soil Database (version 1.1). FAO, Rome, Italy and IIASA, Laxenburg, Austria.

1.10.3 Biodiversity:

Rio Bravo is an ecologically diverse area with extensive hardwood forests, pine savannah and wetlands. It is considered one of the most important areas in the region for mahogany, cedar, and other commercially valuable tree species. Abundant in wildlife, Rio Bravo is reputed to have the healthiest and most plentiful population of jaguars in all of Central America. The project area is home to 200 species of trees, 390 species of birds (25 migratory species), 70 species of mammals and 39 species of conservation concern including the Jaguar, Puma, Margay, Ocelot, the Howler and Spider Monkeys. Due to its rich diversity, efficient protection and a healthy prey base, the RBCMA was selected as the release site for the restoration of the globally threatened Harpy Eagle (*Harpia Harpyja*) in 2005.

1.10.4 Hydrology:

Parts of three watersheds lie within the Rio Bravo: Rio Hondo, New River, and Belize River basins. The Rio Hondo watershed is comprised of the mid-reaches of Booth's River and the Rio Bravo and the headwaters of Blue Creek/Rio Azul. The latter flow westwards before turning back through Guatemala and Mexico to form the international frontier. Sixty percent of the Rio Bravo is covered by the Rio Hondo basin and thus covers a significant part (about 22%) of the Belizean part of the basin although this is a small part of the whole – only 18% of the Hondo system lies within Belize and only about 4% on the Rio Bravo.

The project area lies in the New River basin, and together with other land of the Rio Bravo represents 21% of the entire system including most of the upper reaches of its main tributaries. The Rio Bravo also covers both banks of the southern third of the New River Lagoon, the largest inland water body in the country. The extreme south-eastern boundary of the Rio Bravo runs onto Labouring Creek, which is part of the Belize River system but represents an insignificant part of the total (Rio Bravo Management Plan 2006 -2010). Within these watersheds, numerous creeks converge to create the main rivers and the New River Lagoon.

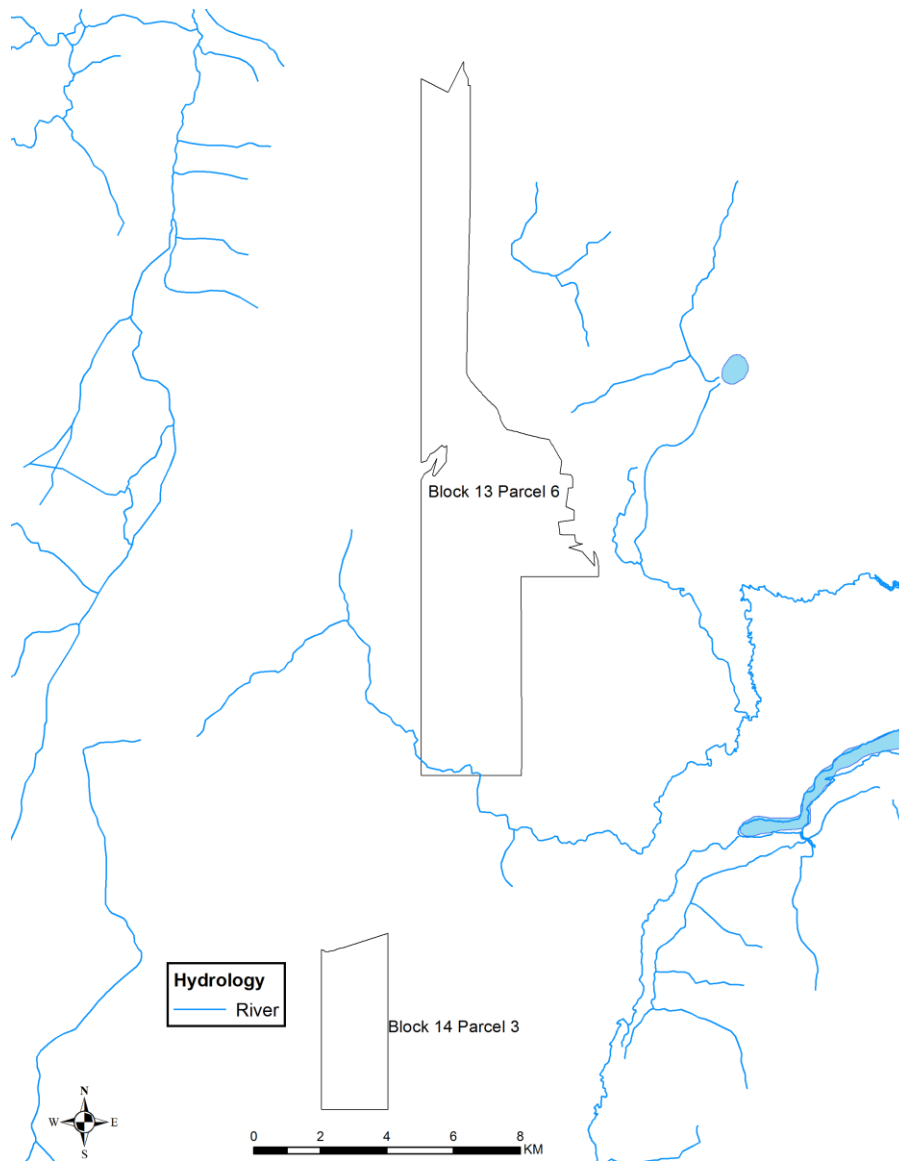


Figure 5. Hydrology⁴ of project area

⁴ Esselman, P., Boles, E. Meerman, J. Myvett, G. Higgins, J. Fitzhugh, T. Warner, A. (2005). Belize Aquatic Ecosystems Map. Belmopan, Belize.

1.10.5 Ecosystem and Vegetation:

The project area can be delineated into two strata: Upland forest and Lowland forest. However, due to differences in carbon stock measurement methods⁵, the upland forest area is divided into two strata for all carbon stock and emissions calculations.

Land type class	Size (ha)
Upland forest	3,258
Upland Forest - South	1107
Lowland forest	934
Total ha of forest	6,297

⁵ Rio Bravo - Baseline Carbon Pool Stocks Report

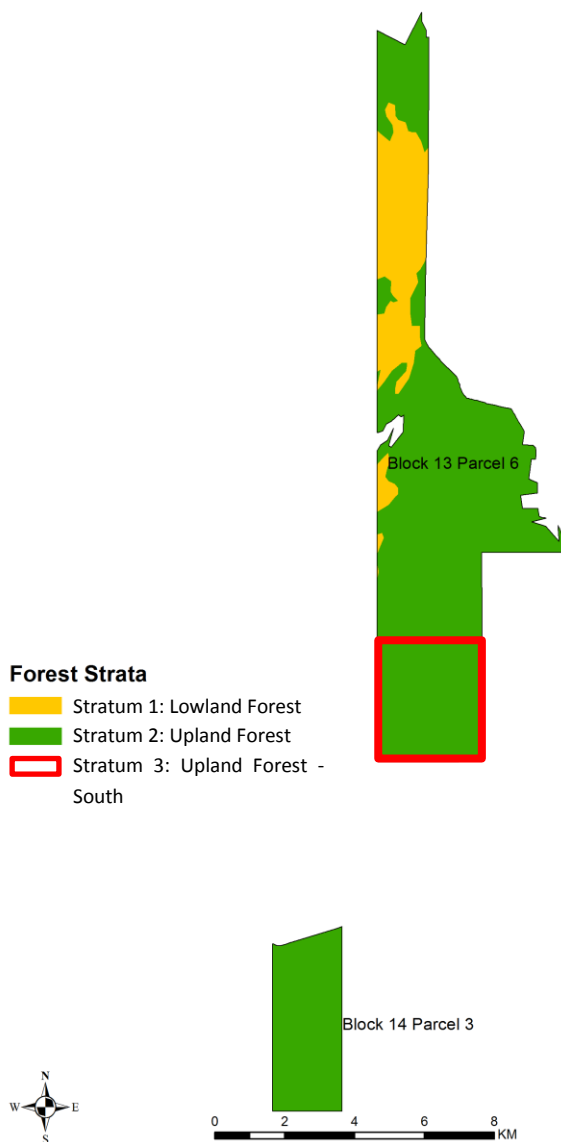


Figure 6. Forest Types⁶ within Rio Bravo Project Boundary

1.10.6 Land use:

Between 1989 and 1994, 61,727 acres of forest were lost annually in Belize due to population growth and a shift from small scale Milpa farming to extensive mechanized agriculture. The national protected areas lost 16,500 acres of forest annually. The Orange Walk district, along with Cayo and Toledo, showed the

⁶ Meerman, J. and W. Sabido. 2001. Central American Ecosystems: Belize. Programme for Belize, Belize City. 2 volumes 50 + 88 pp.

highest levels of forest loss. The principal vegetation type lost was the broad leafed hardwood forest (79%) where soils can be farmed for only a few years (GEO Publication 2010).

As of 1994, Belize had classified 30% of its land as protected areas, including the country's Forest Reserves. Nonetheless, a substantial area of the land that is classified as marginal for agriculture remains in private holdings or is held as national lands leased or leasable for agricultural settlement. Concessions and other leases have been granted on 98,400 ha. (BCES, 1991). In addition, the traditional mainstays of the Belizean agricultural export economy (citrus, sugar, bananas) appear to be in the process of retrenchment. This is being replaced by high-input mechanized farming principally of dry grain products and rice. The largest concentration of mechanized farming is in the north-west part of Belize. Smallholding is occurring throughout the rest of the country.

The trend of land conversion in the area has been perpetuated in recent years by the depletion of the forest reserves, a series of land transfers, and the growth of mechanized farming. From the 19th century through the 1980's the Belize Estate and Produce Company Ltd. (BEC) held some 283,286 ha of land in the area of the RBCMA. These areas constituted BEC's principal forest for mahogany extraction and were logged using selective high-grading. In the later stages of BEC management up to the time of acquisition by PFB, the intensity of high-grading exceeded sustainable levels, swiftly depleting the resource..

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Rio Bravo Carbon Project complies with all applicable local, regional, and national laws, specifically, all applicable environmental laws, including the Belize Environmental Protection Act Chapter 328, Revised Edition 2000. The project team conducted an exhaustive law review for REDD and PDD provisions in the following legislation: (i) Belize Private Forests (Conservation) Act, Chapter 217, Revised Edition 2000 by the Law Revision Commissioner under the authority of the Law Revision Act, Chapter 3 of the Laws of Belize, Revised Edition 1980 - 1990; (ii) Forests Act, Chapter 213, Revised Edition 2003 of the Subsidiary Laws, prepared by the Law Revision Commissioner under the authority of the Law Revision Act, Chapter 3 of the Substantive Laws of Belize, Revised Edition 2000; (iii) Forest Fire Protection Act, Chapter 212, Revised Edition 2000; (iv) Water and Sewage Act, Chapter 222, which defines riparian protection as "that the flow of the stream does not fall below the minimum quantity necessary to secure the interest of public health and the protection of the rights of riparian and other land-owners." (p. 46); (v) Belize Agricultural Health Authority Act, Chapter 211; (vi) Fisheries Act, Chapter 210; (vii) Timber Industry Act, Chapter 341; and the (viii) Land Utilization Act, Chapter 188.

Regarding Rio Bravo, specifically, the Belizean Ministry of Foreign Affairs issued a document on October 28, 2004, corroborating the then newly created UNFCCC which stated:

"(...)

The purpose of this letter is to express our support for a joint effort by the Programme for Belize, The Nature Conservancy and the Wisconsin Electric Power Company to develop a carbon sequestration pilot project at the Rio Bravo Conservation and Management Area (RBCMA) in north-west Belize. The Government of Belize also supports the formal registration of that pilot project under the United States' Initiative Joint Implementation.

The Belizean Government is fully committed to protecting its natural resource base and the environment, while providing sustainable economic development opportunities for our people, and believes that the

contemplated RBCMA joint implementation pilot project would be a significant step in this direction. The RBCMA pilot project would seek to protect a critically endangered forest region of our country, and to demonstrate the successful use of sustainable forestry practices. **The proposed pilot could, thus, be expected to result in measurable carbon sequestration and also advance the environmental and economic development interests of Belize.** It is, indeed, our hope that the project would serve as a model to be applied elsewhere.

(...)"

Letters of support from the Government of Belize can be found in Annex B: Government Letters of Support.

1.12 Ownership and Other Programs

1.12.1 Proof of Title

The Program for Belize maintains full ownership of all lands within the Project Area in accordance with (i) the Land Purchase Agreement entered into by New River Enterprises Limited (vendor) and Programme for Belize ("PfB") (purchaser) who, according to the registration of the Agreement, dated as of 1993, purchased Sierra de Agua Central (Block 13, Parcels 5 and 6) and Sierra de Agua South (Block 14, Parcel 3) free from any encumbrances and guaranteed by all warranties and representations (Annex C: Land Purchase Agreement).

The Cooperation Agreement entered into by the Government of Belize and PfB dated as of July 28, 1998 encumbers the land so as it can be only used to promote the proper management, utilization, conservation and development of its natural resources. Economic activities can only be engaged if environmentally friendly and sustainable. Thus, PfB takes title to the land in its absolute right as trustee for tax benefits (Annex B: Government Letters of Support).

Therefore, clear title for all lands exists and can be found in Annex D: Land Titles.

Table 2. List of Titles for all properties within the Rio Bravo Project.

Registration Section	Block	Parcel
Sierra de Agua South	14	3
Sierra de Agua Central	13	6

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable to project.

1.12.3 Participation under Other GHG Programs

On February 3, 1995, The Rio Bravo Carbon Sequestration project was accepted by the United States Initiative for Joint Implementation Secretariat. Project Proponents participated in the US Department of Energy's 1605(b) reporting program from 1997 – 2004.

While these programs were precursors to today's voluntary GHG reporting programs, they did not involve the crediting or issuance of instruments representing, or acknowledging, specific GHG emission reductions or removals.

1.12.4 Other Forms of Environmental Credit

The project is not seeking to generate any other environmental credits other than carbon credits associated with the VCS. Smartwood certification for project activities will not generate environmental credits.

1.12.5 Projects Rejected by Other GHG Programs

Not applicable to project.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

Under the VCS guidelines for a REDD project type, all areas within the project boundary must meet the definition of a forest at the project start date and for ten years prior to the project start date. The Belize CDM definition was used. The DNA of Belize has chosen the following criteria for its forest definition under the CDM⁷:

- A minimum tree crown cover value of 30 percent
- A minimum land area of 0.1 hectare
- A minimum tree height of 3 meters

The following information was used to demonstrate the forest cover, and thus eligibility, of all lands within the project boundary:

- Landsat imagery – 14 November 1980
- Landsat imagery – 27 December 1989
- Landsat imagery – 28 March 1994

All land within the project boundaries meets the Belize definition of a forest at the start of the project. All areas have also been continuously covered by forest for at least ten years prior to the project start date. See supplementary documents: Annex E: Maps of Rio Bravo and Landsat imagery within Annex A: GIS and RS Data.

⁷ <http://cdm.unfccc.int/DNA/allCountriesARInfos.html>

Leakage Management

The original carbon project was designed with two components: Component A involved the purchase of specific tracts of forested land to prevent the conversion of that land to agriculture (Project Activity); and Component B which refers to the implementation of a sustainable timber protocol for the broader Rio Bravo Conservation and Management Area (beyond the defined Project Boundaries). By maximizing timber values and implementing sustainable forest uses, the project reduced the threat of leakage by providing surrounding communities with the economic incentive to reverse current land-use trends and to maintain forest cover. To be conservative, the positive impact of Component B is not being included in this validation / verification.

The VCS Methodology applied to this project estimates leakage from activity shifting for avoided planned deforestation using a default value. This method is meant to reflect all possible leakage at a national level (throughout Belize), and thus also captures market driven leakage.

Commercially Sensitive Information

The following documents are considered commercially sensitive and cannot be shared publicly without express consent:

- Annex B: Government Letters of Support
- Annex K: Rio Bravo Carbon Sequestration Pilot Project Comprehensive Agreement
- Annex M: Participants Memorandum of Understanding: Programme for Belize, The Nature Conservancy and WEPCO
- Annex N: TNC Internal Memos: TNC Land Preservation Fund Policy; TNC Internal Memo: Request for Carbon Sequestration Loan for Programme for Belize

Further Information

No further information is foreseen required at this time.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

VM0007 REDD Methodology Modules (REDD-MF) (v1.2)

2.2 Applicability of Methodology

Table 3. Justification for why the project activity meets the applicability conditions of the methodology

Applicability Condition	Justification	Documentation
All Activity Types		
Land in the project area has qualified as forest at least 10 years before the project start date (VCS 2007.1, 2008 p 16)	Area is naturally covered by forest and has been forested historically	Land Cover Map See Annex A: GIS and RS Data
The project area can include forested wetlands ⁸ (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50 cm ⁹ . If the project area includes a forested wetlands growing on peat (e.g. peat swamp forests), this methodology is not applicable.	Project area does not include any peatland soils	Soil Map See Annex A: GIS and RS Data
Project proponents must be able to show control over the project area and ownership of carbon rights for the project area at the time of verification.	PfB owns all land	Land Titles See Annex D: Land Titles

⁸ Forested wetlands are defined as forests that are inundated or saturated by surface or ground water at such a frequency and duration that under natural conditions they support organisms (flora and/or fauna) that are adapted to poorly aerated and/or saturated soil (Lugo, AE, M Brinson, S Brown, Editors, 1990. Ecosystems of the World 15: Forested Wetlands. Elsevier Science Publishers, Amsterdam, The Netherlands.

⁹ Rieley, J.O. and S.E Page. 2005. Wise Use of Tropical Peatland: Focus on Southeast Asia. Alterra, Wageningen, The Netherlands. 237 p. ISBN 90327-0347-1. the definition used here has not been approved by the VCS. At such a future time when a definition for peat is approved and included in the VCS standard, the VCS definition shall be used.

Applicability Condition	Justification	Documentation
Baseline deforestation and baseline forest degradation in the project area fall within one or more of the following categories: Unplanned deforestation, Planned deforestation, Degradation through extraction of wood for fuel (fuelwood and charcoal production)	Planned Deforestation	Letter from previous owner and Land Use Survey See Annex F: Letter from New River Enterprises and Annex F: Letter from Land Surveyor, and Annex H: Land Use Management Survey
Baselines shall be renewed every 10 years after the start of the project except where triggers lead to a more frequent renewal.	This has been completed. Two baseline periods are presented in this VCS PD.	
All land areas registered under the CDM or under any other carbon trading scheme (both voluntary and compliance-orientated) must be transparently reported and excluded from the project area. The exclusion of land in the project area from any other carbon trading scheme shall be monitored over time and reported in the monitoring reports	No lands are registered under any other carbon trading scheme	
If land is not being converted to an alternative use but will be allowed to naturally regrow (i.e. temporarily unstocked), this framework shall not be used	Baseline land use would have been industrial agriculture. Lands converted to agriculture in the surrounding area have not been allowed to regrow	Landsat imagery from 1989 and 1994 Risk of abandonment analysis within 'Application of Baseline Report' See Annex A: GIS and RS data

Applicability Condition	Justification	Documentation
Where post-deforestation land use constitutes reforestation this framework shall not be used.	Baseline land use would have been industrial agriculture. Lands converted to agriculture in the surrounding area have not been allowed to regrow	Landsat imagery from 1989 and 1994 Risk of abandonment analysis within 'Application of Baseline Report' See Annex A: GIS and RS data
Leakage avoidance activities shall not include: Agricultural lands that are flooded to increase production (e.g. paddy rice), Intensifying livestock production through use of "feed-lots" ¹⁰ and/or manure lagoons ¹¹	Will not take place	
Uncertainty calculated using X-UNC must be ≤20% of net emission reductions at the 90% confidence level or this framework shall not be used	This will take place	
Planned Deforestation		
Conversion of forest lands to a deforested condition must be legally permitted	Conversion to agricultural land is legally permitted	Private Forest (Conservation) Act Cap 217 revised Ed. 2000 See section 2.5 of VCS PD

¹⁰ Feedlots are defined as areas in which naturally grazing animals are confined to an area which produces no feed and are fed on stored feeds

¹¹ Anaerobic lagoons that function as receptacles for animal waste flushed from animal pens. Anaerobic organisms naturally present in the manure and the environment decompose the waste in the lagoon

Applicability Condition	Justification	Documentation
Documentation must be available to clearly demonstrate with credible evidence and documentation that indeed the land would have been converted to non-forest use if not for the REDD project.	1. NRE letter states that Farmers sought purchase of land 2. Land Tenure Survey demonstrates that all other lands purchased in region during the time of land purchase by PfB were purchased by individuals or groups that practice mechanized cropping. A comparison of land titles and a time series of Landsat imagery between 1994 and 2005 show that where land that was in a forested state at land purchase, was subsequently deforested.	1. Letter from New River Enterprises. See Annex F: Letter from New River Enterprises 2. Prevailing practice and upward trend on land values See Annex F: Letter from Land Surveyor 3. Land Tenure Survey of local mechanized farming community See Annex H: Land Use Management Survey
If degradation is caused by either illegal or legal tree extraction for timber, this framework cannot be used.	None of these activities were taking place in the baseline since instead the project area would have undergone deforestation.	

2.3 Project Boundary

The geographic boundaries of the Rio Bravo Project are based on the land titles and on-the-ground delineation using a GPS. The geographic boundaries can be found in Annex I: Project Boundary Report.

Table 4. GHG Gases accounted for by the project

Sources	Gas	Included/Excluded	Justification / Explanation of choice
Biomass burning	CO ₂	Excluded	However, carbon stock decreases due to burning are accounted as a carbon stock change
	CH ₄	Included	Conservative to exclude in the baseline. Will be included in the project case if fire occurs
	N ₂ O	Included	
Combustion of fossil fuels	CO ₂	Excluded	Neglected from baseline and project accounting
	CH ₄	Excluded	Potential emissions are negligibly small
	N ₂ O	Excluded	Potential emissions are negligibly small
Use of fertilizers	CO ₂	Excluded	Potential emissions are negligibly small
	CH ₄	Excluded	Potential emissions are negligibly small
	N ₂ O	Excluded	Neglected from baseline and project accounting

Table 5. Carbon pools that are included in emission accounting

Carbon pools	Included / Excluded	Justification / Explanation of choice
Above-ground	Included	Major carbon pool subjected to the project activity.
Below-ground	Included	Below-ground biomass stock is expected to be maintained due to the implementation of the project activity.
Dead-wood	Excluded	Deadwood can be expected to decrease more or increase less in the baseline, relative to the project scenario. Therefore, based on the applicability conditions of the methodology, this pool can be conservatively omitted.
Harvested wood products	Included	Is greater in the baseline than in the project scenario, therefore it is included
Litter	Excluded	Litter can be expected to decrease more or increase less in the baseline, relative to the project scenario. Therefore, based on the applicability conditions of the methodology, this pool can be conservatively omitted.
Soil organic carbon	Included	Soil organic carbon is expected to decrease in the baseline. It is included since there will be significant soil carbon loss.

2.4 Baseline Scenario

The identified Baseline Scenario of Rio Bravo Climate Action Project consists of sanctioned deforestation caused by industrial scale agricultural communities conducting mechanized farming, thus planned deforestation.

See section 2.5 below for justification of baseline scenario. See section 3.1 for an overview of estimated baseline emissions.

2.5 Additionality

The VCS Tool: “Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities” is used to demonstrate additionality and identify the baseline scenario.

STEP 0: Preliminary screening based on the starting date of the REDD project activity

The project start date is prior to 1 January 2002. However, it can be demonstrated that the project was designed and implemented as a climate change mitigation project from its inception. The project proponent can also demonstrate that the project applied an externally reviewed methodology and engaged independent carbon monitoring experts to assess and quantify the project's baseline scenario and net GHG emissions reductions or removals.

The involvement of TNC, WEPCO (now WE Energies), and the other financial participants was predicated upon the project's acceptance as a United States Initiative on Joint Implementation project. As documented in the original USIJI Proposal dated November 4, 1994 (see Annex J: USIJI Proposal), TNC and WEPCO were engaged in a discussion about a joint pilot project to explore the potential benefit of carbon sequestration to mitigate climate change (the early days of Reduced Emissions from Deforestation and Degradation, or REDD).

In 1992, the prior land owner, New River Enterprises (a logging, sawmilling and wood carving company), placed several parcels adjacent to the already existing Rio Bravo Conservation Management Area up for sale. In an effort to stem the tide of conversion of forests to agriculture, Programme for Belize (PfB) entered into a purchase agreement with New River Enterprises. While PfB was able to secure the funding needed for the down-payment, they were unsuccessful to secure the necessary financing to secure the balance of the property that was up for sale.

TNC and WEPCO evaluated over 20 potential projects around the world, and identified the Rio Bravo project as the best potential candidate for the USIJI pilot project (see Annex N: TNC Internal Memos, USIJI Site Screening Criteria). TNC and WEPCO spearheaded the effort to recruit four other financial participants to share in the project financing. The group successfully executed the transaction by which The Nature Conservancy (TNC) financed the original land purchase as well as the project operations for the first 10 years, while the Financial Participants committed to a stream of cash payments to TNC to repay that original loan plus ongoing project management expenses. In return, the Financial Participants were assigned the ownership rights to any resulting carbon offset credits. This arrangement was documented via a Comprehensive Agreement (see Annex K: Rio Bravo Pilot Project Comprehensive Agreement). The Rio Bravo project was accepted into the USIJI on February 33, 1995.

Step 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity

Several potential baselines were identified:

Scenario 1. Continuation as unprotected forested area: The land is not sold and the original land owner does not implement any uses to land. The lands within the project boundary remain as forest.

Scenario 2. Conversion from unprotected area to government funded protected area: Government of Belize purchases land from previous land owner, changes legal protection on land, and provides funding to effectively protect forested areas.

Scenario 3. Conversion from unprotected area to selective logged forested area: The land is purchase by logging company. Additional logs are removed from forested lands for logging.

Scenario 4. Conversion from unprotected area to unplanned, small holder cultivation: Lands are sold over time to small holder agriculturalists who practice low-technology cultivation.

Scenario 5. Conversion from unprotected forested area to privately protected area: Conservation organization purchases lands and maintains forested area. Low level selective logging in small areas to fund resources required to continue forest protection.

Scenario 6. Conversion from unprotected area to high-technology agricultural lands: The project lands are converted from forest to agricultural lands using mechanized farming techniques or grazing lands.

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

Scenario 1. Continuation as unprotected forested area:

It is possible for landowners to keep their forested lands without implementing any uses to the land. However, the landowner would still be required to pay their land taxes which are significant and serve as a negative incentive for keeping unprotected forest lands without any use. The probability of the area continuing as unprotected forest area is low as evidenced by the landowner placing the land for sale and the interest by other parties in purchasing the land for agricultural use.

Scenario 2. Conversion from unprotected area to government funded protected area:

Under the National Park System Act Chapter 215, the Minister of Natural Resources has the authority to declare areas as protected areas. Lands can be declared as national monument, wildlife Sanctuary, nature reserve and national park. However, since the forested land has been under private ownership, the Government of Belize would have to purchase the land for a public purpose, and then declare it as a protected area and provide proper compensation to the

landowner. Given the national budgetary constraints, it is very unlikely that the Government of Belize would purchase private lands for protection purpose and fund its management. This is evidenced by the fact that the Government of Belize has delegated the management authority through co-management arrangements with Non-Governmental Organizations such as the Belize Audubon Society (National Protected Areas Policy and System Plan, 2005) for state lands that have been declared protected areas.

Scenario 3. Conversion from unprotected area to selective logged forested area:

Under the Private Forest (Conservation Act, Chapter 217, Revised Edition 2000, the Forest Act, Chapter 213, Revised Edition 2003), the landowners can apply and get permission for the cutting of trees from the forested area. However, the persons interested in purchasing the land were not involved in logging but were interested in converting the land to mechanized farming. Additionally, prior to the project start date the project area had been logged, therefore, at the project start date the volume of marketable timber within the project was low.

Scenario 4. Conversion from unprotected area to low technology cultivation:

For this alternative scenario to occur, the land would need to be subdivided and sold in smaller parcels to individuals involved and interested in small scale, low technology agriculture as these individuals do not have the necessary funding for the purchase of large parcels of lands. The Land Utilization Act, Chapter 188, Revised Edition 2000 allows for the landowner to apply to the Minister of Lands, through the Commissioner of Lands, to authorize the subdivision of lands into smaller parcels.

Scenario 5. Conversion from unprotected forested area to privately protected area:

This scenario is possible if moneys could be raised for the purchase of the lands for protection purpose. However, unless tax exemption is secured from the Government of Belize, the landowner would have to pay all the relevant taxes, secure grant funding or generate sufficient revenues to be able to pay for the land taxes as well as the management and protection cost of the lands.

Scenario 6. Conversion from unprotected area to high-technology agricultural lands:

The Land Utilization Act, Chapter 188, revised Edition 2000, the Private Forest (Conservation) Act, Chapter 217 Revised Edition 2000, and the Forest Act Chapter 213, Revised Edition 2003 allows for the subdivision of forested lands and their conversion to high technology agricultural lands. Evidence is provided that planned deforestation would have taken place in the baseline, including the legal permissibility to deforest, the suitability of project area for conversion and intent to deforest. Since this is part of the baseline section of the methodology, this evidence is presented in Annex L: Application of Baseline Report.

Sub-step 1c. Selection of the baseline scenario:

The methodology to be used provides the following table as a step-wise approach to determine the most plausible baseline scenario. In addition, the planned baseline section provides further steps:

Is the forest land expected to be converted to non-forest land in the baseline case?			
YES		NO	
Is the land legally authorized and documented to be converted to non-forest?		~~Is the forest expected to degrade by fuel wood extraction or charcoal production, in the baseline case~~	
YES	NO	YES	NO
Avoided planned deforestation	~~Avoided unplanned deforestation~~	~~Avoided forest degradation~~	~~Proposed project is not a VCS REDD activity currently covered by the module framework~~

Since the land is expected to be converted to non-forest land in the baseline and the land is legally authorized and documented to be converted to non-forest. Therefore, the following scenario is the most plausible baseline scenario:

Scenario 6. Conversion to high-technology agricultural lands:

This can be demonstrated by declaration by previous owner that land had been put up for sale and that the parties interested in the purchasing of the land were industrial scale farmers. See Annex F: Letter from New River Enterprises.

In addition the Tenure Survey demonstrates that all other lands purchased in region during the time of land purchase by PfB were purchased by individuals or groups that practice mechanized cropping. A comparison of land titles and a time series of Landsat imagery between 1994 and 2005 show that where land that was in a forested state at land purchase, was subsequently deforested. See Annex H: Land Use Management Survey.

Step 3. Barrier Analysis

Sub-step 3a. Identify barriers that would prevent the implementation of the type of proposed project activity

Investment Barriers

The threat to the project lands was brought about in 1992 when New River Enterprises (NRE) placed a 10,927 ha parcel of forested land up for sale on the open market. In short order, NRE received offers from various members of the local agricultural community. Given the ecological significance of the area, Programme for Belize (PfB), entered into an emergency agreement on January 1, 1993, to purchase the entire parcel (See Annex C: New River Enterprises Land Purchase Agreement). Under the terms of the agreement, PfB committed to purchasing incremental portions of the property over a period of eight years. The total sales price was US\$2.43 million plus interest, requiring a down payment of US\$992,000. The agreement gave PfB management control over the area, and provided that with each installment payment a portion of the land would be transferred to PfB free and clear. The NRE purchase could only be undertaken by PfB at a significant financial risk; PfB did not have the financial resources to

make the down payment or the annual payments required under the agreement. Furthermore, if PfB defaulted on its payments to NRE the balance of the property would be lost.

Nonetheless, PfB proceeded to secure the land. The down payment was financed with a three-year loan from TNC's revolving Land Preservation Fund (see Annex N: TNC Internal Memos). TNC and PfB anticipated that the remaining balance due TNC would be covered by fund-raising, as would be the annual payments to NRE. The fund-raising targets were not met, however, in time for PfB to meet the first installment of payments due to NRE and TNC. Instead, PfB was forced to divert mortgage income (donated by a third party) that was intended to repay the TNC loan to make the NRE payment, thereby defaulting on the TNC loan. TNC and PfB were unable to identify funds to cover the NRE acquisition.

As of June 1994 the remaining parcels of land were not secured. TNC and WEPCO (Wisconsin Electric Power Company) were evaluating potential pilot carbon projects for the US Initiative on Joint Implementation program. Rio Bravo was one of over 20 proposals assessed, and was ultimately chosen as the best candidate for the pilot carbon project. TNC and WEPCO then recruited additional investors who would commit the financing needed to secure the remaining 5,747 ha in exchange for the reporting rights to the carbon benefits arising from the protection of the at risk forest. TNC, PfB, and WEPCO proposed the protection of the 5,747 ha parcel as the Rio Bravo Carbon Sequestration Pilot Project to the USIJI on November 4, 1994. Additional corporate partners joined the project and the Comprehensive Agreement for Rio Bravo Carbon Sequestration Pilot Project was entered into on November 1, 1995, between PfB, TNC, WEPCO, Cinergy Services, Inc., Detroit Edison Corporation, Pacificorp, and later on Utilitree Carbon Company. The Comprehensive Agreement that established the commitments by the various parties can be found in Annex K: Comprehensive Agreement, and Annex M: Participant MOUs and Commitments.

Carbon-related finance was the only funding option available to the Programme for Belize (PfB) to execute the land purchase and fund related project development and management costs. All prior acquisitions in the Rio Bravo Conservation Management Area were accomplished through grants and other non-commercial financial terms (donations received from third parties). Other sources of funding such as debt funding, international capital markets, or credit were not viable options for a small NGO in a small – middle income country like Belize with limited options for collateral or dependable revenue streams.

Barriers due to prevailing practice

When first established in 1994 the Rio Bravo Carbon Sequestration project was the first carbon project of any kind in Belize. It was designed and implemented with the explicit goal of demonstrating how REDD projects could attract private capital through a market based incentive program (carbon offsets).

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios (except the proposed project activity):

As evidenced by the letter from New River Enterprises which can be found in Annex F: Letter from NRE, the landowner received offers from members of the local farming community who were interested in purchasing the land to convert it to high-technology agriculture (Scenario 6). These communities do not have the same revenue constraints related to debt or credit financing, as they would be able to use the land and future revenue streams as collateral.

Step 4. Common practice analysis

Activities similar to the one proposed as the VCS AFOLU project activity have been implemented in the surrounding area. These are activities of similar scale, take place in a comparable environment, and a relevant geographical area.

Other lands in the region were purchased by Program for Belize and transferred into a privately protected area (the Rio Bravo Conservation and Management Area or RBCMA). However, these areas received grants and / or donations to purchase the properties. Such sources were not available to purchase the project area.

The Massachusetts Audubon Society helped establish the Programme for Belize in 1988 with the purchase of 110,044 acres (44,533.2 hectares) of land from Gallon Jug Agroindustries. Two additional parcels of land in the RBCMA were donated by Coca Cola Food Inc (16,997 ha in 1990 and 20,235 ha in 1992) as they divested from their citrus operations in Belize. None of these options were available for the purchase of the 6,500 ha project area. Rather, The Nature Conservancy and WEPCO entered into an agreement with PfB to develop the Rio Bravo Carbon Sequestration Pilot Project under the USIJI, and solicited other financial participants to raise the money needed for the land purchase and to fund project implementation for the first 10 years. See Annex N: TNC Internal Memos: TNC Land Preservation Fund Policy, and Request for Carbon Sequestration Loan for Rio Bravo, Belize.

2.6 Methodology Deviations

Deviation request 1:

VMD0001 "Estimation of carbon stocks in the above and belowground biomass in live tree and non-tree pools".

'II Procedures, Frequency of measurement for baseline above and belowground biomass stocks'

"Measurements of initial stocks employed in the baseline must take place within ± 5 years of the project start date, for simplicity referred to here as stocks at $t=0$ "

"Above- and belowground biomass stock estimates are valid in the baseline (i.e. treated as constant) for 10 years, after which they must be re-estimated from new field measurements."

It is requested that years since the project start date be allowed to be increased to ± 6 years. The project start is date: 01 January 1996, and although field measurements were taken in 1995, the measurement methods in 2000 are more consistent with other field measurement methods used elsewhere. In addition, additional field measurements were taken in the area surrounding the project area, providing a better estimate of carbon stocks.

Deviation request 2:

VMD0001 "Estimation of carbon stocks in the above and belowground biomass in live tree and non-tree pools".

'II Procedures, Frequency of measurement for baseline above and belowground biomass stocks'

"Above- and belowground biomass stock estimates are valid in the baseline (i.e. treated as constant) for 10 years, after which they must be re-estimated from new field measurements. For each stratum, where the re-measured estimate is within the 90% confidence interval of the t=0 estimate, the t=0 stock takes precedence and is re-employed, and where the re-measured estimate is outside the 90% confidence interval of the t=0 estimate, the new stock estimate takes precedence and is used for the subsequent period."

The start date of the project is 01 January 1996. Field measurements were taken in 2000. No field measurements were at the 'baseline renewal period' in 2006 since this project took place prior to that rules existence. Therefore it is requested that the field measurement data taken in 2000 be allowed to be used for the second baseline period.

Deviation request 3:

VMD00015 V1.2 "Methods for Monitoring of GHG Emissions and Removals"

Section 5.2.2.1 Degradation through extraction of trees for illegal timber or fuelwood and charcoal

" $A_{Deg,i}$ shall be 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. If there is little to no evidence that trees are being harvested (see next paragraph on how to estimate emissions and use tool T-SIG to determine if significant or not) then degradation can be assumed to be zero and no monitoring is needed. This limited sampling must be repeated each time the PRA indicates a potential for degradation."

If the limited sampling does provide evidence that trees are being removed in the buffer area, then a more systematic sampling must be implemented. 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 ($A_{Deg,i}$). The diameter of all tree stumps 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 scenario¹². The mean above and below ground carbon stock of the harvested trees is conservatively estimated to be the total emissions and to all enter the atmosphere. This

¹² If species-specific equations are used in the baseline and species cannot be identified from stumps then it shall be assumed that the harvested species is the species most commonly harvested for the specific degradation purpose (e.g. fuelwood, charcoal or timber). A PRA shall be used to determine the most commonly harvested species

sampling procedure shall be repeated every 5 years and the results annualized by dividing the total emissions by five."

Since incomplete sampling of illegal logging existing from the start of the project, it is requested that a more conservative approach be implemented. Under this approach, using the forest inventory data, the average biomass of mahogany is estimated. It is then assumed that the biomass of all the mahogany trees within $A_{Deg,i}$ are harvested and emitted in the first year of the project. This is clearly a strongly conservative approach as in reality, only a small portion of mahogany trees have been harvested through illegal logging. Within current selective logging taking place, over 50% of the volume removed is from mahogany trees.

Deviation Request 4:

VMD0001 "Estimation of carbon stocks in the above and belowground biomass in live tree and non-tree pools".

II Procedures

Part 1: Aboveground tree biomass: Estimation of carbon stocks in aboveground tree biomass ($C_{AB_tree,i}$)

The mean carbon stock in aboveground tree biomass per unit area is estimated based on field measurements in sample fixed area plots or sample points using prisms employing representative random or systematic sampling.

It is requested that it be allowable to employ random sampling of clustered plots along transects. Analysis of the mean and uncertainty will then be estimated using clusters of plots. In addition, it is requested that it be allowable to conservatively estimate the biomass of areas within the project boundary where no biomass plots exist by assuming the mean biomass of such areas equates to 80% of the mean biomass found within the stratum where biomass plots have been placed. Additional documentation has been provided elaborating on the methods employed¹³.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Applying the chosen methodology, the baseline net GHG removals by sinks is determined as the sum of the carbon stock changes. At the start of the project, the project lands are covered by forest. Under the baseline scenario, this land would have been deforested over time.

Baseline GHG emissions were estimated by applying the steps outlined in BL-PL module:

1. Calculation of annual area of land deforested

¹³ Supplementary Documents\Annex Q Carbon Stock Data\Rio Bravo - Baseline Carbon Pool Stocks Report

2. Estimation of Baseline carbon stocks
3. Estimation of greenhouse gas emissions
4. Determination of frequency of baseline renewal.

Through application of BL-PL, the following equation and parameters were used to estimate the baseline greenhouse gas emissions that would have happened in the absence of the project. The detailed steps to estimate baseline emissions can be found in Annex L: Application of the Baseline. Below is a summary of the results.

Deforestation rate:

Since deforestation would have taken place by a class of deforestation agents, no deforestation plan exists. Therefore, the deforestation rates of six proxy areas were calculated to estimate baseline deforestation rates for the two baseline periods.

$$D\%_{planned,i,t} = \left(\sum_{pn=1}^{n^*} \left(\frac{D\%_{pn}}{Yrs_{pn}} \right) \right) / n \quad (1)$$

Where:

$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i during year t . If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; %
$D\%_{pn}$	Percent of deforestation in land parcel ¹⁴ pn etc of a proxy area as a result of planned deforestation as defined in this module; %
Yrs_{pn}	Number of years over which deforestation occurred in land parcel pn in proxy area; years
n	Total number of land parcels examined
pn	1, 2, 3 ... n^* land parcels examined in proxy area
i	1, 2, 3 ... M strata

To produce a conservative estimate of deforestation, the estimated deforestation rate within the project area is assumed to equal the proxy area with the lowest deforestation rate during the baseline period. As stated in VMD0017, using this conservative estimate results in an uncertainty estimate of zero.

¹⁴ Parcels are a unit of land area. A stratum may contain many parcels.

The resulting mean annual rate of deforestation was calculated for the first and second baseline periods:

Baseline Period 1996-2005: $D\%_{planned,i,t} = 7.19\%$, $Uncertainty_{BSL,RATE} = 0\%$

Baseline Period 2006-2015: $D\%_{planned,i,t} = 9.94\%$, $Uncertainty_{BSL,RATE} = 0\%$

Baseline carbon stocks

The Carbon Pool Modules within the Methodology were applied to estimate each of the carbon stock pools. However, accounting for the change in carbon stocks from deadwood and litter are excluded and therefore are accounted as zero in the baseline and the project case. The values of above and below ground carbon stocks are based on field work done inside the project area in the year 2000¹⁵. The aboveground non-tree biomass is estimated from field data collected within the project area in 1998. The root to shoot value of 0.5 for belowground non-trees was taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 4. Agriculture, Forestry and Other Land Use, table 6.1. The soil carbon stock is estimated from field data collected within the project area in 1998. See 'Baseline Carbon Pool Stocks Report' for details on field data collection¹⁶.

Table 6. Carbon stocks of relevant pools in each stratum at time=0

	Stratum 1: Lowland Forest			Stratum 2: Upland Forest			Stratum 3: Upland Forest - South		
Carbon Pool	Mean Stock	95% CI	95% CI as % of mean	Mean Stock	95% CI	95% CI as % of mean	Mean Stock	95% CI	95% CI as % of mean
	t CO ₂ ha ⁻¹			t CO ₂ ha ⁻¹			t CO ₂ ha ⁻¹		
C _{AB_tree}	270.31	41.93	16%	380.23	58.34	15%	304.18	46.67	15%
C _{BB_tree}	64.87	10.06	16%	91.25	14.00	15%	73.00	11.20	15%
C _{AB_non-tree}	1.17	0.24	20%	1.35	0.62	46%	1.08	0.50	46%
C _{BB_non-tree}	1.35	0.62	46%	0.68	0.31	46%	0.54	0.25	46%
C _{SOC}	452	180	40%	717	142	20%	573	114	20%
C _{BSL}	789	104	23%	1190	88	13%	952	70	13%

$$C_{BSL,i} = C_{AB_tree,i} + C_{BB_tree,i} + C_{AB_non-tree,i} + C_{BB_non-tree,i} + C_{DW,i} + C_{LI,i} + C_{SOC,i} \quad (2)$$

¹⁵ Annex Carbon Stock Data\Rio Bravo - Baseline Carbon Pool Stocks Report.docx

¹⁶ Annex Carbon Stock Data\Rio Bravo - Baseline Carbon Pool Stocks Report.docx

Where:

$C_{BSL,i}$	Carbon stock in all pools in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{AB_tree,i}$	Carbon stock in aboveground biomass in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BB_tree,i}$	Carbon stock in belowground biomass in the baseline 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
$C_{DW,i}$	Carbon stock in dead wood in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{LI,i}$	Carbon stock in litter in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{SOC,i}$	Carbon stock in soil organic carbon in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
i	1, 2, 3 ... M strata

Post-deforestation carbon stock estimates are assumed to be the long-term average stocks on the land following deforestation. Carbon pools excluded from the Project are accounted as zero (dead wood and litter). IPCC defaults are used to estimate the biomass of the post deforestation land cover. Post deforestation soil carbon stocks are estimated following Module CP-S and calculations can be found in the Baseline Carbon Stock Report.

Table 7. Post-deforestation long term average carbon stocks found in each stratum

Carbon Pool	Stratum 1: Lowland Forest	Stratum 2: Upland Forest	Stratum 3: Upland Forest - South
	Mean C Stock (t CO ₂ ha ⁻¹)	Mean C Stock (t CO ₂ ha ⁻¹)	Mean C Stock t CO ₂ ha ⁻¹
C_{AB_tree}	5	5	5
C_{BB_tree}			
$C_{SOC,PD-BSL}$	249	396	317
C_{BSL_post}	254	401	322

To calculate Harvested Wood Products, the VCS Module “Estimation of carbon stocks in the long-term wood products pool - CP-W” was used. Since no logging plans exist, Option 2: Commercial inventory estimation was implemented. The biomass of the commercial volume extracted prior to deforestation was first estimated and then the proportion of biomass carbon extracted that remains sequestered in long term

wood products after 100 years was estimated. The methods and calculations used can be found in the Baseline Carbon Pool Stock Report¹⁷.

Table 8. Carbon stocks of harvested wood products

Carbon Pool	Stratum 1: Lowland Forest	Stratum 2: Upland Forest	Stratum 3: Upland Forest - South
	Mean C Stock	Mean C Stock	Mean C Stock
	(t CO ₂ ha ⁻¹)	(t CO ₂ ha ⁻¹)	t CO ₂ ha ⁻¹
Wood Products	3.5	3.5	3.5

$$C_{BSL, post, i} = C_{AB_tree, i} + C_{BB_tree, i} + C_{AB_non-tree, i} + C_{BB_non-tree, i} + C_{DW, i} + C_{LI, i} + C_{SOC, PD-BSL, i} \quad (3)$$

Where:

$C_{BSL, post, i}$	Carbon stock in all pools in the baseline post-deforestation 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
$C_{DW, i}$	Carbon stock in dead wood 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
$C_{SOC, PD-BSL, i}$	Mean post-deforestation stock in soil organic carbon in the post deforestation stratum i ; t CO ₂ -e ha ⁻¹
i	1, 2, 3 ... M strata

Net baseline carbon stock changes in all pools were estimated through the following equation:

$$\Delta C_{BSL, i} = C_{BSL, i} - C_{BSL, post, i} - C_{BSL, wp, i} \quad (4)$$

Where:

¹⁷ Annex Carbon Stock Data\Rio Bravo - Baseline Carbon Pool Stocks Report.docx

$\Delta C_{BSL,i}$	Net carbon stock changes in all pools in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,i}$	Carbon stock in all pools in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,post,i}$	Carbon stock in all pools in the baseline post-deforestation in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,WP,i}$	Carbon stock sequestered in wood products in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
i	1, 2, 3 ... M_B strata in the baseline scenario

Greenhouse gas emissions

Baseline emissions within the project boundary were estimated as:

$$GHG_{BSL,E,i,t} = ET_{FC,t} + E_{BiomassBurn,t} + N_2O_{direct-N,t} \quad (5)$$

Where:

$GHG_{BSL,E}$	Greenhouse gas emissions as a result deforestation activities within the project boundary in the baseline stratum i at project year t ; t CO ₂ -e
$ET_{FC,t}$	CO ₂ emission from fossil fuel combustion in stratum i during year t in the baseline; t CO ₂ -e
$E_{BiomassBurn,t}$	Non-CO ₂ emissions due to biomass burning as part of deforestation activities in stratum i during the year t in the baseline; t CO ₂ -e
$N_2O_{direct-N,t}$	Direct N ₂ O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum i in year t in the baseline; t CO ₂ -e
t	1, 2, 3 ... t^* years elapsed since the start of the REDD VCS project activity

It is assumed that following removal of timber logs, all remaining biomass is burned. Emissions from fertilizers and fossil fuel consumption are conservatively neglected in the baseline and therefore, GHG emissions equate to the emissions from biomass burning.

Net cumulative GHG emission reductions

The baseline net GHG emission from planned deforestation was determined as:

$$\Delta C_{BSL,planned} = \sum_{t=1}^{t^*} \sum_{i=1}^M \left(\%_{planned,i,t} * A_{planned,i} * L - D_i \right) * \Delta C_{BSL,i} + GHG_{BSL-E,i,t} \quad (6)$$

Where:

$\Delta C_{BSL,planned}$	Net greenhouse gas emissions in the baseline from planned deforestation; t CO ₂ -e
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i during year t . If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; if not known, use Eq. 2 to calculate; %
$A_{planned,i}$	Total area of planned deforestation over the baseline period for stratum i ; ha
$L-D_i$	Likelihood of deforestation for stratum i ; %
$\Delta C_{BSL,i}$	Net carbon stock changes in all pools in the baseline stratum i ; t CO ₂ -e ha ⁻¹
$GHG_{BSL-E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum i during project year t ; t CO ₂ -e year ⁻¹
i	1, 2, 3 ... M strata
t	1, 2, 3, ... t^* years elapsed since the projected start of the REDD project activity

Table 9. Total Cumulative Baseline GHG Emissions per year

	Stratum 1: Lowland Forest	Stratum 2: Upland Forest	Stratum 3: Upland Forest - South	Stratum 1: Lowland Forest	Stratum 2: Upland Forest	Stratum 3: Upland Forest - South	Total Cumulative GHG Emission Reductions t CO ₂ -e	Total VCS Eligible Cumulative
	GHG Emission Reductions t CO ₂ -e			Cumulative t CO ₂ e			GHG Emission Reductions t CO ₂ -e	
1996	36,532	246,150	51,053	36,532	246,150	51,053	282,682	282,682
1997	36,532	246,150	51,053	73,064	492,300	102,105	282,682	565,365
1998	36,532	246,150	51,053	109,596	738,451	153,158	282,682	848,047
1999	36,532	246,150	51,053	146,128	984,601	204,210	282,682	1,130,729
2000	36,532	246,150	51,053	182,660	1,230,751	255,263	282,682	1,413,411
2001	36,532	246,150	51,053	219,192	1,476,901	306,315	282,682	1,696,094
2002	36,532	246,150	51,053	255,724	1,723,052	357,368	282,682	1,978,776
2003	36,532	246,150	51,053	292,256	1,969,202	408,420	282,682	2,261,458
2004	36,532	246,150	51,053	328,788	2,215,352	459,473	282,682	2,544,140
2005	36,532	246,150	51,053	365,320	2,461,502	510,525	282,682	2,826,823
2006	50,505	340,273	70,579	415,825	2,801,775	581,104	390,777	3,217,600

2007	50,505	340,273	70,579	466,330	3,142,048	651,683	390,777	3,608,378
2008	41,765	281,220	58,366	508,095	3,423,267	710,049	322,985	3,931,363
2009	0	0	0	508,095	3,423,267	710,049	0	3,931,363
2010	0	0	0	508,095	3,423,267	710,049	0	3,931,363
2011	0	0	0	508,095	3,423,267	710,049	0	3,931,363
2012	0	0	0	508,095	3,423,267	710,049	0	3,931,363
2013	0	0	0	508,095	3,423,267	710,049	0	3,931,363
2014	0	0	0	508,095	3,423,267	710,049	0	3,931,363
2015	0	0	0	508,095	3,423,267	710,049	0	3,931,363

3.2 Project Emissions

The estimates of emissions resulting from the project activity are based on following the steps delineated in the Monitoring Plan. Details of the estimate can be found in Annex O: Monitoring.

Emissions from all components will be monitored and estimated, the total project emissions are summed together based on the methods delineated in the Methodology Module.

$$\Delta C_p = \sum_{t=1}^{t^*} \sum_{i=1}^M \left(\Delta C_{P,DefPA,i,t} + \Delta C_{P,DefDistPA,i,t} + \Delta C_{P,DegW,i,t} + \Delta C_{P,DegF,i,t} + \Delta C_{P,DegDist,i,t} + \Delta C_{P,SelLog,i,t} \right) + GHG_{P-E,i,t} - \Delta C_{P,Enh,i,t} \quad (7)$$

Where:

ΔC_p	Net greenhouse gas emissions within the project area under the project scenario; t CO ₂ -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>i</i> at time <i>t</i> ; t CO ₂ -e
$\Delta C_{P,DefDistPA,i,t}$	Net carbon stock change as a result of deforestation caused by natural disturbance in the project area in the project case in stratum <i>i</i> at time <i>t</i> ; t CO ₂ -e
$\Delta C_{P,DegW,i,t}$	Net carbon stock change as a result of degradation through wood extraction in the project area in the project case in stratum <i>i</i> at time <i>t</i> ; t CO ₂ -e
$\Delta C_{P,DegF,i,t}$	Net carbon stock change as a result of fire induced degradation in the project area in the project case in stratum <i>i</i> at time <i>t</i> ; t CO ₂ -e
$\Delta C_{P,DegDist,i,t}$	Net carbon stock change as a result of degradation due to natural disturbance in the project area in the project case in stratum <i>i</i> at time <i>t</i> ; t CO ₂ -e
$\Delta C_{P,SelLog,i,t}$	Net carbon stock change as a result of degradation through third-party certified selective logging in the project area in the project case in stratum <i>i</i> at time <i>t</i> ; t CO ₂ -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>i</i> in year <i>t</i> ; t CO ₂ -e

$\Delta C_{P,Enh,i,t}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline ¹⁸ in stratum i at time t ; t CO ₂ -e
i	1, 2, 3 ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the REDD project activity

Table 10. Ex-ante estimates of Project GHG Emissions per year

Year	Net GHG Emissions (t CO ₂ -e)	Cumulative GHG Emissions (t CO ₂ -e)	VCS Eligible Cumulative GHG Emissions (t CO ₂ -e)
1996	42,554	42,554	
1997	42,580	85,133	
1998	6,502	91,635	
1999	12,831	104,466	
2000	6,502	110,968	
2001	201	111,169	
2002	110	111,280	110
2003	166	111,446	277
2004	4,670	116,115	4,946
2005	4,125	120,240	9,071
2006	72	120,312	9,143
2007	69	120,381	9,212
2008	1,474	121,856	10,686
2009	6,269	128,124	16,955
2010	168,802	296,926	185,757
2011	120	297,047	185,877
2012	120	297,167	185,998
2013	8,980	306,147	194,978
2014	5,982	312,130	200,960
2015	8,583	320,713	209,544

3.3 Leakage

The estimates of leakage resulting from the project activity are based on the steps delineated in the methodology module "Estimation of emissions from activity shifting for avoided planned deforestation."

¹⁸ For areas with a degradation baseline (i.e. using BL-DFW) this parameter shall be set to zero, for areas with baseline set by BL-UP and BL-PL this parameter may be conservatively set to zero.

Details of this analysis can be found in the supplementary document “Application of VMD0009 LK-ASP”¹⁹ in the Monitoring Plan. Details of the estimate can be found in Annex O: Monitoring.

Based on the analysis conducted, the project site is equal to the alternative lands because the four soil quality indicators for the project are within $\pm 15\%$ of the indicators in alternative lands. The result is that the leakage factor ($LK_{CP-ME,c,i}$) is 0.4.

The analysis is then used to calculate the amount of leakage that is assigned to the project.

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t^*} \sum_{i=1}^M \sum_{c=1}^C D\%_{planned,i,t} * A_{planned,i} * \Delta C_{BSL,i} * PF_c * LK_{CP-ME,c,i} \quad (8)$$

Where:

$\Delta C_{LK-AS,planned}$	Net CO ₂ emissions due to activity shifting leakage for projects preventing planned deforestation; t CO ₂ -e
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i at year t ; %
$A_{planned,i}$	Total area of planned deforestation over the baseline period for stratum i ; ha
$\Delta C_{BSL,i}$	Net carbon stock changes in all pools in baseline stratum i ; t CO ₂ -e ha ⁻¹
PF_c	Proportion of available area for production of commodity c that is currently forested; dimensionless
$LK_{CP-ME,c,i}$	Leakage factor for displacement of class of planned deforestation agents; dimensionless
c	1, 2, 3, ... C commodities
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the REDD project activity

Table 11. Ex-ante estimates of Leakage GHG Emissions per year

Year	Net GHG Emissions (t CO ₂ -e)	Cumulative GHG Emissions (t CO ₂ -e)	VCS Eligible Cumulative GHG Emissions (t CO ₂ -e)
1996	70,347	70,347	

¹⁹ Supplementary Documents\Annex Leakage\Application of VMD0009 LK-ASP.docx

Year	Net GHG Emissions (t CO ₂ -e)	Cumulative GHG Emissions (t CO ₂ -e)	VCS Eligible Cumulative GHG Emissions (t CO ₂ -e)
1997	67,028	67,028	
1998	67,028	134,056	
1999	67,028	201,084	
2000	67,028	268,112	
2001	67,028	335,140	
2002	67,028	402,167	
2003	67,028	469,195	67,028
2004	67,028	536,223	134,056
2005	67,028	603,251	201,084
2006	67,028	670,279	268,112
2007	92,664	762,944	360,776
2008	92,664	855,608	453,441
2009	76,630	932,238	530,071
2010	0	932,238	530,071
2011	0	932,238	530,071
2012	0	932,238	530,071
2013	0	932,238	530,071
2014	0	932,238	530,071
2015	0	932,238	530,071

3.4 Summary of GHG Emission Reductions and Removals

The total net GHG emissions reductions of the REDD project activity are calculated using the steps in the selected methodology. These result in a conservative *ex-ante* estimations of the total net GHG emissions reductions of the REDD project activity.

$$C_{REDD} = \Delta C_{BSL} - \Delta C_P - \Delta C_{LK} \quad (9)$$

Where:

$C_{REDD,t}$ Total net greenhouse emission reductions at time t ; t CO₂-e

ΔC_{BSL} Net greenhouse gas emissions under the baseline scenario; t CO₂-e

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

ΔC_{LK} Net greenhouse gas emissions due to leakage; t CO₂-e

$$\Delta C_{BSL} = \Delta C_{BSL,planned} + \Delta C_{BSL,unplanned} + \Delta C_{BSL,degrad-FW/C} \quad (10)$$

Where:

ΔC_{BSL}	Net greenhouse gas emissions under the baseline scenario; t CO ₂ -e
$\Delta C_{BSL,planned}$	Net greenhouse gas emissions in the baseline from planned deforestation; t CO ₂ -e
$\Delta C_{BSL,unplanned}$	Net greenhouse gas emissions in the baseline from unplanned deforestation; t CO ₂ -e
$\Delta C_{BSL,degrad-FW/C}$	Net greenhouse gas emissions in the baseline from degradation caused by fuelwood collection and charcoal making; t CO ₂ -e

$$\Delta C_{LK} = \Delta C_{LK-AS,planned} + \Delta C_{LK-AS,unplanned} + \Delta C_{LK-AS,degrad-FW/C} + \Delta C_{LK-ME} \quad (11)$$

Where:

ΔC_{LK}	Net greenhouse gas emissions due to leakage; t CO ₂ -e
$\Delta C_{LK-AS,planned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation; t CO ₂ -e
$\Delta C_{LK-AS,unplanned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing unplanned deforestation ; t CO ₂ -e
ΔC_{LK-ME}	Net greenhouse gas emissions due to market- effects leakage; t CO ₂ -e
$\Delta C_{LK-AS,degrad-FW/C}$	Net greenhouse gas emissions due to activity-shifting leakage for degradation caused by extraction of wood for fuel ; t CO ₂ -e

Since there is no unplanned deforestation or degradation from fuelwood/charcoal areas within the baseline, the following are set at zero:

$$\Delta C_{BSL,degrad-FW/C}$$

$$\Delta C_{BSL,unplanned}$$

$$\Delta C_{LK-AS,unplanned}$$

$$\Delta C_{LK-AS,degrad-FW/C}$$

Table 12. Total Net GHG Emission Reductions resulting from Rio Bravo Climate Action Project

	$\Delta C_{BSL,planned}$	$\Delta C_{P,Planned}$	ΔC_{LK}	C_{REDD}
	Net GHG Emissions under baseline	DeforestationAreas Net GHG emissions under project	Net GHG emissions due to leakage	Total Net GHG Emission Reductions
	Total VCS	Total VCS	Total VCS	Total VCS

	Cumul.	Eligible Cumul.	Cumul.	Eligible Cumul.	Cumul.	Eligible Cumul.	Cumul.	Eligible Cumul.
	t CO ₂ e							
1996	333,735	0	42,554	0	67,028	0	224,153	0
1997	667,470	0	85,133	0	134,056	0	448,280	0
1998	1,001,204	0	91,635	0	201,084	0	708,485	0
1999	1,334,939	0	104,466	0	268,112	0	962,361	0
2000	1,668,674	0	110,968	0	335,140	0	1,222,566	0
2001	2,002,409	0	111,169	0	402,167	0	1,489,072	0
2002	2,336,144	333,735	111,280	110	469,195	67,028	1,755,669	266,596
2003	2,669,879	667,470	111,446	277	536,223	134,056	2,022,210	533,137
2004	3,003,613	1,001,204	116,115	4,946	603,251	201,084	2,284,247	795,174
2005	3,337,348	1,334,939	120,240	9,071	670,279	268,112	2,546,829	1,057,757
2006	3,798,705	1,796,296	120,312	9,143	762,944	360,776	2,915,449	1,426,376
2007	4,260,061	2,257,652	120,381	9,212	855,608	453,441	3,284,072	1,794,999
2008	4,641,412	2,639,003	121,856	10,686	932,238	530,071	3,587,318	2,098,246
2009	4,641,412	2,639,003	128,124	16,955	932,238	530,071	3,581,050	2,091,977
2010	4,641,412	2,639,003	296,926	185,757	932,238	530,071	3,412,248	1,923,176
2011	4,641,412	2,639,003	297,047	185,877	932,238	530,071	3,412,127	1,923,055
2012	4,641,412	2,639,003	297,167	185,998	932,238	530,071	3,412,007	1,922,935
2013	4,641,412	2,639,003	306,147	194,978	932,238	530,071	3,403,027	1,913,954
2014	4,641,412	2,639,003	312,130	200,960	932,238	530,071	3,397,044	1,907,972
2015	4,641,412	2,639,003	320,713	209,544	932,238	530,071	3,388,461	1,899,389

The number of credits to be held in the permanence risk buffer (as per the VCS) is determined as a percentage of the total carbon stock benefits. This is equal to the net emissions in the baseline minus emissions from fossil fuel use and fertilizer use minus the net emissions in the project case minus emissions from fossil fuels and fertilizer use. Leakage emissions do not factor into the buffer calculations.

$$Buffer_{TOTAL} = Buffer_{PLANNED} + Buffer_{UNPLANNED} + Buffer_{DEGRAD-FW/C} \quad (12)$$

$$Buffer_{PLANNED} = \left(\left(\Delta C_{BSL,planned} - \sum_{t=1}^{t^*} \sum_{i=1}^M \epsilon_{FC,i,t} + N_2O_{direct,i,t} \right) - \left(\Delta C_{P.(PlannedDeforestationArea)} - \sum_{t=1}^{t^*} \sum_{i=1}^M \epsilon_{FC,i,t} + N_2O_{direct,i,t} \right) \right) * (-Buffer\%) \quad (13)$$

$$Buffer_{UNPLANNED} = 0$$

$$Buffer_{DEGRAD-FW/C} = 0$$

Where:

$Buffer_{PLANNED}$	Buffer withholding for planned deforestation project areas; t CO ₂ -e
$Buffer_{UNPLANNED}$	Buffer withholding for unplanned deforestation project areas; t CO ₂ -e
$Buffer_{DEGRAD-FW/C}$	Buffer withholding for degradation through extraction of fuelwood project areas; t CO ₂ -e
$\Delta C_{BSL,planned}$	Net greenhouse gas emissions in the baseline from planned deforestation; t CO ₂ -e
$\Delta C_{BSL,unplanned}$	Net greenhouse gas emissions in the baseline from unplanned deforestation; t CO ₂ -e
$\Delta C_{BSL,degrad-FW/C}$	Net greenhouse gas emissions in the baseline from degradation caused by fuelwood collection and charcoal making; t CO ₂ -e
ΔC_P	Net greenhouse gas emissions within the project area under the project scenario; t CO ₂ -e
$E_{FC,i,t}$	Emission from fossil fuel combustion in stratum i in year t ; t CO ₂ -e
$N_2O_{direct-N,i,t}$	Direct N ₂ O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum i in year t ; t CO ₂ -e
$Buffer\%$	Buffer withholding percentage; %
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the REDD VCS project activity

Information on the calculation of Buffer% can be found in Annex P: Risk Assessment.

Table 13. Risk Rating

Risk Category	Risk Rating
a) Internal Risk	0
b) External Risk	0
c) Natural Risk	3.5
Overall Risk Rating (a + b + c)	3.5

However, the VCS states that the minimum buffer level shall be 10%. Therefore a 10% buffer was applied. Years when the buffer is negative are not included in the cumulative buffer withholding values.

Table 14. Buffer Withholding

Year	Buffer _{planned,t}	Buffer _{planned}	
	Buffer W/holding	Total Cum. Buffer W/holding	VCS Eligible Cumulative
	(t CO ₂ -e)		
1996	29,126	29,126	
1997	29,126	58,252	
1998	32,734	90,985	
1999	32,117	123,103	
2000	32,734	155,836	
2001	33,362	189,198	
2002	33,364	222,562	33,364
2003	33,363	255,925	66,727
2004	32,927	288,852	99,653
2005	32,982	321,834	132,636
2006	46,134	367,968	178,770
2007	46,134	414,103	224,904
2008	38,011	452,114	262,916
2009	-603	452,114	262,916
2010	-16,854	452,114	262,916
2011	-2	452,114	262,916
2012	-2	452,114	262,916
2013	-872	452,114	262,916
2014	-572	452,114	262,916
2015	-832	452,114	262,916

To estimate the number of Verified Carbon Units (VCUs) for the monitoring period $T = t_2 - t_1$, the applied methodology uses the following equation:

$$VCU_t = \left(Adjusted_C_{REDD,t_2} - Adjusted_C_{REDD,t_1} \right) - Buffer_{TOTAL}$$

Where:

VCU_t Number of Verified Carbon Units at time $t = t_2 - t_1$; VCU

$Adjusted_C_{REDD,t_2}$ Cumulative total net GHG emissions reductions at time t_2 adjusted to account for uncertainty; t CO₂-e

$Adjusted_C_{REDD,t_1}$ Cumulative total net GHG emissions reductions at time t_1 ; t CO₂-e

$Buffer_{TOTAL}$ Total permanence risk buffer withholding; t CO₂-e

Table 15 Total Net GHG Emission Reductions resulting from Rio Bravo Climate Action Project

Year	VCU	
	Total Cum.	VCS Elig. Cum.
	(t CO ₂ -e)	
1996	195,027	
1997	390,029	
1998	617,500	
1999	839,259	
2000	1,066,730	
2001	1,299,874	
2002	1,533,107	233,233
2003	1,766,285	466,411
2004	1,995,395	695,521
2005	2,224,995	925,121
2006	2,547,481	1,247,606
2007	2,869,969	1,570,095
2008	3,135,204	1,835,330
2009	3,128,936	1,829,062
2010	2,960,134	1,660,260
2011	2,960,014	1,660,139
2012	2,959,893	1,660,019
2013	2,950,913	1,651,039
2014	2,944,930	1,645,056
2015	2,936,347	1,636,473

4 MONITORING

4.1 Data and Parameters Available at Validation

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:	<i>Ex-ante</i> it shall be assumed that strata area will remain constant
Used in equations:	19

Data / Parameter:	CF
Data Unit:	t C t ⁻¹ d.m.

Description:	Carbon fraction of dry matter
Source of data:	Default value 0.47 t C t ⁻¹ d.m. can be used, or species specific values from the literature (e.g. IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.3)
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	
Used in equations:	19

Data / Parameter:	CF_j
Data Unit:	t C t ⁻¹ d.m.
Description:	Carbon fraction of biomass for tree species j
Source of data:	Species- or family-specific values from the literature (e.g. IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.3) shall be used if available, otherwise default value of 0.47 t C t ⁻¹ d.m. can be used.
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	Where new species are encountered in the course of monitoring, new carbon fraction values must be sourced from the literature or otherwise use the default value.
Used in equations:	11, 35, 37

Data / Parameter:	D_j
Data Unit:	t d.m. m ⁻³
Description:	Basic wood density in t d.m. m ⁻³ for species j
Source of data:	The source of data shall be chosen with priority from higher to lower preference as follows: (a) National species-specific or group of species-specific (e.g. from National GHG inventory); (b) Species-specific or group of species-specific from neighboring countries with similar conditions. Sometimes (b) may be preferable to (a); (c) Global species-specific or group of species-specific (e.g. IPCC 2006 INV GLs AFOLU Chapter 4 Tables 4.13 and 4.14). Species-specific wood densities may not always be available, and may be difficult to apply with certainty in the typically species rich forests of the humid tropics, hence it is acceptable practice to use wood densities developed for forest types or plant families or species groups.

Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	Where using wood densities developed outside of the project country (cases (b) and (c) above under Source of data), wood densities must be validated with either limited destructive sampling or direct measurement of wood hardness (e.g. with a Pilodyn wood tester) in the field and correlating with wood density. Samples or measurements should be from 20-30 trees. For validation of mean forest type or species group wood densities, representation of species in the sample should be proportional to their occurrence in terms of basal area or volume in the project area (not abundance or stem density). Samples should provide representation across the length of the tree. Wood samples are cut in discs and thickness and diameter measured to calculate green volume. Samples are oven dried (70o C) to a constant weight in the laboratory, and density calculated as dry weight (g) per unit green volume (cm³). If the density of the samples/measurements (or mean density in the case of forest type or species group means) is within $\pm 10\%$ of the selected density values, then the selected density values may be used. Otherwise, a new density value must be developed with more extensive sampling, using the validation samples as a base. Where new species are encountered in the course of monitoring, new wood density values must be sourced from the literature and validated, if necessary, as per requirements and procedures above.
Used in equations:	11, 37

Data / Parameter:	D_{mn}
Data Unit:	t d.m.m ⁻³
Description:	Mean wood density of commercially harvested species
Source of data:	The source of data shall be chosen with priority from higher to lower preference as follows: (a) Averaged national and commercial species-specific (e.g. from National GHG inventory or site specific measurements); (b) Averaged commercial species-specific from neighboring countries with similar conditions. Sometimes (b) may be preferable to (a). (c) Averaged regional commercial species-specific (e.g. Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section). (d) Regional average (0.58 t d.m.m⁻³- tropical Africa; 0.60 t d.m.m⁻³-

	3- tropical America; 0.57 d.m.m-3- tropical Asia) from Brown, S. 1997. Estimating Biomass and Biomass Change of Tropical Forests: a Primer. For the Food and Agriculture Organization of the United Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	
Used in equations:	19

4.2 Data and Parameters Monitored

Data / Parameter:	<i>Project Forest Cover Monitoring Map</i>
Data Unit:	
Description:	<u>Map</u> 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 truthing
Justification of choice of data or description of measurement methods and procedures applied:	The minimum map accuracy should 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
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:	3

Data / Parameter:	<i>Degradation PRA Results</i>
Data Unit:	
Description:	
Source of data:	PRA

Justification of choice of data or description of measurement methods and procedures applied:	The PRA shall consist of semi-structured interviews / questionnaires. The PRA shall evaluate whether the following activities may be occurring in the project area: -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
Any comment:	<i>Ex-ante</i> , 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.
Used in equations:	Section 5.2.2.1

Data / Parameter:	$A_{DefPA,i,u,t}$
Data Unit:	Ha
Description:	Area of recorded deforestation in the project area in stratum i converted to land use u at time t
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
Any comment:	<i>Ex-ante</i> , 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 if clear infrastructure, hiring and policies are in place to prevent deforestation.
Used in equations:	<u>3</u>

Data / Parameter:	$A_{Deg,i}$
Data Unit:	Ha

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:	$A_{Deg,i}$ 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:	<i>Ex-ante</i> , a limited survey can be used to determine a likely depth of degradation penetration
Used in equations:	8

Data / Parameter:	$A_{DECKS,i,t}$
Data Unit:	Ha
Description:	Area of logging decks in stratum i at time t
Source of data:	Field measurements or reported measurements such as post-harvest assessment reports and post-harvest maps that are based on field measurements
Justification of choice of data or description of measurement methods and procedures applied:	Systematic sampling must take place to ensure all decks within the area logged are identified and a conservative estimate of area produced. 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:	<i>Ex-ante</i> , estimations of emissions from deck creation shall be based on logging management plans or average size of decks and number of decks produced due to logging in the region
Used in equations:	18

Data / Parameter:	$A_{DistPA,q,i,t}$
Data Unit:	Ha
Description:	Area impacted by natural disturbance in the project stratum i 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:	<i>Ex-ante</i> , estimations of emissions from natural disturbances shall be based on historic incidence of such event in the Project region
Used in equations:	20

Data / Parameter:	$A_{ROAD,i,t}$
Data Unit:	Ha
Description:	Area of roads in stratum i at time t
Source of data:	Field measurements or reported measurements such as post-harvest assessment reports and post-harvest maps that are based on field measurements
Justification of choice of data or description of measurement methods and procedures applied:	The area of roads created may be based on the length of roads multiplied by the average width of roads. The length of all roads created during selective logging within a stratum i at time t must be measured through systematically sampling the entire area logged to produce a conservative estimate of the length of roads created. The average width of the roads may be estimated through systematically sampling road width. Sufficient number of measurements of road width shall be measured to achieve a precision of equal or less than 15% of the mean at the 95% confidence interval. Where different categories of roads exist, different average road widths should be used. 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:	<i>Ex-ante</i> , estimations of emissions from road creation shall be based on logging management plans or average length of roads produced per unit area due to logging in the region
Used in equations:	17

Data / Parameter:	$C_{Deg,i,t}$
Data Unit:	t CO ₂ -e
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 is 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:	<i>Ex-ante</i> 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.
Used in equations:	8

Data Unit / parameter:	$C_{AB_tree_dest, i}$
Data Unit:	t CO ₂ -e ha ⁻¹
Description:	Carbon stock in aboveground tree biomass assumed to be killed per unit area resulting from the creation of the skid trail in stratum i
Source of data:	CP-AB and documentation stating maximum size tree able to be killed during skid trail creation
Justification of choice of data or description of measurement methods and procedures applied:	To calculate the aboveground tree biomass assumed to be killed, a subset of the field measurements collected to calculate the baseline CAB_{tree,i} shall be created. This subset shall include all trees below the maximum size tree assumed to be killed during the skid trail creation. The methods in CP-AB shall then be used to estimate the biomass of trees able to be killed during skid trail creation. Documentation must be provided to determine the maximum sized tree (based on the variables used to calculate aboveground biomass for a species in CP-AB, such as DBH) that are able to be destroyed during the creation of the skid trail. Documentation may include management plans or documented evidence of the maximum size tree the machinery used to create the skid trail is able to push over and kill. Alternatively, it can be assumed that $C_{tree_AB_dest,i} = C_{tree_AB,i}$ in the baseline Frequency: the maximum size tree assumed to be killed during skid trail creation 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:	
Used in equations:	15

Data Unit / parameter:	$C_{BB_tree_dest, i}$
Data Unit:	t CO ₂ -e ha ⁻¹
Description:	Carbon stock in belowground tree biomass assumed to be killed per unit area resulting from the creation of the d trail in stratum i
Source of data:	$C_{tree_AB_dest, i}$
Justification of choice of data or description of measurement methods and procedures applied:	See guidance in CP-AB for belowground biomass estimation. The same root-to-shoot ratio that is used in baseline carbon stock calculations shall used together with $C_{tree_AB_dest, i}$ 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:	
Used in equations:	15

Data / Parameter:	F_{LU}
Data Unit:	Dimensionless
Description:	Land use factor before or after conversion
Source of data:	Stock Change Factors are provided in Tables 5.5, 5.10, and 6.2 of the IPCC 2006GL Volume 4

Justification of choice of data or description of measurement methods and procedures applied:	Stock Change Factors as defined in IPCC 2006GL are equal to the carbon stock in the altered condition as a proportion of the reference carbon stock. The land use factor after conversion can be conservatively assumed to equate the default value for idle land that is set aside.
Any comment:	
Used in equations:	16

Data / Parameter:	F_{MG}
Data Unit:	Dimensionless
Description:	Management factor before or after conversion
Source of data:	Stock Change Factors are provided in Tables 5.5, 5.10, and 6.2 of the IPCC 2006GL Volume 4
Justification of choice of data or description of measurement methods and procedures applied:	Stock Change Factors as defined in IPCC 2006GL are equal to the carbon stock in the altered condition as a proportion of the reference carbon stock. The management factor after conversion can be conservatively assumed to equate to 1.0, the default value for full tillage.
Any comment:	
Used in equations:	16

Data / Parameter:	F_I
Data Unit:	Dimensionless
Description:	Input factor before or after conversion
Source of data:	Stock Change Factors are provided in Tables 5.5, 5.10, and 6.2 of the IPCC 2006GL Volume 4
Justification of choice of data or description of measurement methods and procedures applied:	Stock Change Factors as defined in IPCC 2006GL are equal to the carbon stock in the altered condition as a proportion of the reference carbon stock. The land use factor after conversion can be conservatively assumed to equate 1, the default value for medium input.
Any comment:	
Used in equations:	16

Data / Parameter:	L_{sk}
Data Unit:	m
Description:	Length of skid trail sk
Source of data:	Field measurements or reported measurements such as post-harvest assessment reports and post-harvest maps that are based on field measurements

Justification of choice of data or description of measurement methods and procedures applied:	The length of all skid trails within a stratum i at time t may be estimated through using systematic sampling with a random start of the entire area logged or within a sampled known logged area within the project boundary to produce a conservative estimate of the length of skid trails created. Where sampling is used, the total length of all skid trails can then be equal to the mean length of skid trails per unit area multiplied by the total area logged. 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:	
Used in equations:	13

Data / Parameter:	$V_{EXT,z,i,t}$
Data Unit:	m^3
Description:	Volume extracted from logging stratum z in stratum i at time t
Source of data:	Records and reports documenting amount of wood extracted within project boundary. Records must be based on field measurements to calculate this volume.
Justification of choice of data or description of measurement methods and procedures applied:	Documentation on the amount of wood extracted must include a delineation of the location and total area where logging took place within the project boundary each year. Documentation must provide a detailed description of the methods used to quantify the amount of wood extracted and how the volume of wood that is felled and extracted is calculated and cataloged. 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:	Supplementary documentation, such as government records, financial records, proof of timber sale may be presented as additional documentation of volume extracted.
Used in equations:	10

Data / Parameter:	$V_{EXT,j,z,i,t}$
Data Unit:	m^3
Description:	The volume of timber extracted of species j for logging stratum z , in stratum i at time t ;
Source of data:	Logging records of wood extracted
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
Any comment:	
Used in equations:	11

Data / Parameter:	W_{SKID}
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Data Unit:	m
Description:	Mean width of skid trails
Source of data:	Field measurements or reported measurements
Justification of choice of data or description of measurement methods and procedures applied:	The average width of skid trails created within a stratum i can be based on reported widths; a conservative estimate based on machinery used; or additional field measurements. Reported width: the average width of field measured skid trails within FSC Post Harvest Assessment reports from logging that has taken place within the project area; Conservative estimate: Width edge of tires on largest skidder type * 140% can only be used where skidder type(s) is known and used to create all skid trails. (skidder defined as heavy vehicle used in logging operation to create path and pull cut trees to logging road); Field measurements: average of field sampling based on systematic sampling with a random start. The width of the skid trail shall be equal to the distance between trees undamaged by skid trail creation on one side to trees undamaged by skid trail creation on the other side. Sufficient number of measurements of road width shall be measured to achieve a precision of equal or less than 15% of the mean at the 95% confidence interval. Frequency: The estimated mean width of skid trails shall be monitored and updated prior to each verification report.
Any comment:	<i>Ex ante</i> estimates may use the conservative estimate based on the width of the logging machinery wheels.
Used in equations:	14

4.3 Description of the Monitoring Plan

4.3.1 Monitoring of the Baseline

The Baseline is reassessed every ten years, based on the methods written in the Methodology Module VMD0006. The parameters that must be reassessed include the projected annual proportion of land that is deforested in the stratum per year during that baseline period ($D\%_{\text{planned},i,t}$), the pre-deforestation carbon stocks, the post-deforestation carbon stocks, and the GHG emissions resulting from deforestation activities.

Although the VMD0006 specifies the collection of forest carbon stock levels within the project boundary every ten years, because this project took place prior to the VMD0006 being created, a Methodology Deviation is requested to allow the carbon stock data from 2000 to be used.

4.3.2 Monitoring of actual carbon stock changes and greenhouse gas emissions

4.3.2.1 Monitoring Deforestation

The areas of deforestation are monitored using interpreted Landsat imagery.

Carbon stocks are monitored as part of the overall forest management plan of Rio Bravo. The project forest is stratified into two categories, lowland forest and upland forest. Protective patrols and aerial surveillance are conducted regularly to protect existing forest carbon stocks from deforestation or degradation.

Monthly patrols take place through the project area and biannual aerial flights. These methods help to quickly identify and respond to threats to forest carbon stocks.

GIS data of forest strata are kept on file and updated as needed. Locations of field plots will be recorded including GPS coordinates and kept on file.

4.3.2.2 Monitoring degradation through wood extraction

Protection work is carried out by a team of rangers, based at Hill Bank who will be responsible for manning the gates and mounting regular patrols. This work is backed by regular aerial flights to detect problems (use of trails, illicit logging gaps) from the air. The team cooperates with the Belize Defense Force and Forest Department when appropriate. Patrols are organized on a monthly basis to areas deemed to require oversight and the team responds to information of illicit activity as and when required.

The basic protection program is to:

- Permanently man the entrance gates in order to establish a visible presence at the main entry points
- The team will be able to react to emergencies (including fire) at any time
- One overnight patrol will be mounted per month during the wet season and two during the dry season
- Infractions will be strongly pursued through the legal system
- Regular trainings will be maintained, organized in conjunction with the police force

During the extra dry season attention is focused to detect and discourage or otherwise address wildfire and pine bark beetle infestations. The second patrol should cover areas deemed at risk. Throughout, the general aim is to integrate protection and resource management closely in order to make better use of available staff, equipment and transport. Annual and monthly planning must therefore be a joint activity, with strong input from the Forester as the most senior staff member with direct responsibility for field operations.

Monitoring through effective means therefore is extremely important, to ensure available resources are directed most strategically. Patrol reports are standardized to include date, time, personnel, route and specific objectives for the patrol. In forested areas, evidence of the following are recorded:

- Entry (e.g. vehicle and horse tracks, foot-prints, cut trails);
- Hunting (e.g. camps, torch batteries, cartridge cases);
- Logging (e.g. stumps, logs, extraction trails);

- NTFP extraction (e.g. cut sabal or palmetto, chicle slash-marks);
- Land clearance within the RBCMA boundaries.

In each case the type of illicit use or other observation is noted along with an estimate of its age (> 6 months, 6-1 month, < 1 month). Each separate incident is noted along with its location, by GPS if possible but otherwise as closely approximated as possible. Observations involving hunting will be points but other threats usually affect an area such as a patch of forest or stretch of road – in these cases both the location and the estimated area affected should be estimated. The evidence is removed where appropriate (e.g. cartridges and camp rubbish, camp shelters knocked down) to avoid ‘double-counting’ on later patrols.

The Program for Belize has monitored the occurrence of illegal wood extraction over time. This monitoring also include the location potentially impacted by this type of activity, as PfB monitors illegal harvesting within Rio Bravo Climate Action Project, and the species targeted in illegal wood extraction. However, due to the early start date of this project, the methods provided in the Monitoring Module VMD00015 to monitor and measure directly the trees that have been cut through sampling has not taken place consistently since the project start date. Therefore, an alternative and conservative approach to estimate the biomass lost due to illegal logging has been used.

A survey was conducted of the forest rangers to determine whether there is potential for illegal logging and the distance of degradation penetration from access points²⁰. Based on the results of the survey the area subject to degradation (Adeg) has been conservatively delineated with a 500m buffer surrounding all roads, old logging roads, and along the ‘RSM seismic line’²¹.

The only tree species that are removed by illegal loggers is mahogany and cedar. As part of project’s selective activities, the PfB has conducted timber surveys within the project boundary. Using this survey, the average biomass of mahogany and cedar were estimated. It was then conservatively assumed that the entire biomass of these two trees would be illegally extracted within Adeg and therefore emitted as illegal wood extraction.

4.3.2.3 Monitoring degradation due to selective logging of forest management areas possessing a FSC certificate

Selective logging is taking place within the project boundary during the with-project scenario. The area of selective logging is monitored using a GIS. GIS file of the timber management areas controlled by Program for Belize shows a grid of planned logging areas and included logging dates from 1997 to 2010 and planned locations for 2011.

Monitoring of emissions originating from commercial selective logging is conducted using the steps outlined in the monitoring moduel. The emissions from certified selective logging are monitored through

²⁰Supplementary Documents\Annex O Monitoring\Degradation Illegal Wood Extraction\RioBravo_IllegalLoggingSurvey.docx

²¹Supplementary Documents\Annex O Monitoring\Degradation Illegal Wood Extraction\RioBravo_IllegalLoggingSurvey-RangerResponses.pdf

the monitoring of volume of wood extracted overtime, and monitoring of the length of skid-trails, logging decks, and logging roads constructed to allowing for logging. The monitoring of such variables are requirements of the SmartWood verification system.

Through the application of the module emissions arising in the logging gap and emissions from logging infrastructure are estimated annually. Annual timber volumes reported by PfB, as well as data reporting lengths and widths of skid trail and roads and areas of decks collected under the SmartWood verification are used to estimate yearly emissions from degradation.

4.3.2.4 Monitoring natural disturbance events

4.3.2.4.1 Pest

Pine Bark Beetles (*Dendroctorus spp* and *Ips spp.*) are a native species and natural part of the ecosystem. Infestations occur when conditions allow – notably when stands become over-dense and/or with abundance of old, weakened and injured trees. They nonetheless are capable of significant damage to timber resources and a regional control program is already in effect. Outbreaks have been recorded in the early 20th century. A ground and aerial monitoring program is implemented to identify infected locations before serious damage can result. Regular thinning of pine is the most effective preventive measure. This will be supplemented by:

- Including coverage of the pine forests in the regular aerial flights to locate outbreaks
- Including reporting of outbreaks in routine patrol reports
- Prompt action to fell the affected trees plus an immediate buffer. If cost-effective, the felled material can be transported and sold. Otherwise it may be left on site.

However, pine trees are part of the savanna ecosystem type, a forest type not found within the project boundaries and therefore, this threat is very low.

4.3.2.4.2 Disease

Program for Belize monitors forest health for signs of disease outbreak through monthly ground patrols and biannual aerial flights. No major disease outbreaks have been recorded in or around the project location. If a disease outbreak occurs, experts will be consulted and measures taken to combat the disease.

4.3.2.4.3 Fire

Fires are a natural part of the ecosystem in Belize. During the warm dry season, from March to May wild fires are more prone to occur. March and April are the driest months and temperatures rise during this period, peaking in May. Fire risk in broad-leaved forest is usually low but becomes significant in drought years. Most fires are set by people whether by accident or design, though natural outbreaks due to lightning strikes also occur, both in upland forests and in lowland forests.

Program for Belize has designed and implemented fire management regimes that enhance carbon stocks and rehabilitate stands. Fire management training workshops are organized in collaboration with the

Forest Department. A fire management plan is developed that includes a list of needed equipment and an organizational structure for fire fighting. Fire prevention is done through a combination of prescribed burning in savannahs and monitoring for fires. First responses is done through ground patrols and when needed aerial flights.

The occurrence of fires is also monitored using MODIS. The MODIS Burned Area Monthly L3 Global 500m (MCD45A1) was used to investigate the risk of wildfire inside the project boundary. The MCD45A1 is a monthly Level-3 gridded 500-meter satellite imagery product, which contains burning and date information at a pixel level. The monthly MCD45A1 product is based on three months of atmospherically and geometrically corrected, cloud-screened daily reflectance data. The algorithm that creates the product analyzes daily imagery of surface reflectance dynamics to locate changes, uses that information to detect the approximate date of burning, and maps the spatial extent.

4.3.2.4.4 Hurricane

Periodic storms are a natural feature of the region. Most lose force once they make landfall. Two storms have tracked at hurricane force within 30 km of the RBCMA since records began in the late 19th century. The eye of the 1942 hurricane passed over Shipyard and Blue Creek, immediately to the north of the RBCMA while the 1892 hurricane passed directly through the south-eastern RBCMA and the forested land of the adjoining Yalbac and Gallon Jug properties. The centers of tropical storms have traversed the area in 1916 and 1931 while others have passed within 45 km of the RBCMA boundaries in 1889, 1898, 1921, 1924, 1931 (the second of the year), 1932 and 1945. All of these, but especially the two hurricanes, must have impacted the forest while more distant storms can also cause localized damage. The New River escarpment is the first significant break of slope on the northern coastal plain and appears particularly susceptible. Due to the debris, the risk of extensive forest fire is very high in the immediate aftermath of a hurricane, accentuating the impact on the forest.

When any hurricane or tropical storm hits the project site, little could be possibly done by the staff of PfB to prevent damages. In the aftermath of a hurricane, PfB works with appropriate government agencies and non-governmental organizations to quickly assess any damages to the forest stands inside the project area. Assessments are conducted through ground surveys, satellite imagery such as Landsat, and aerial flights over the project site. The extent of damages is recorded and if needed, field data collected, according to the SOP, to ascertain damage to carbon stocks.

All natural disturbances such as hurricanes are monitored over time and the impact on the carbon stocks catalogued.

4.3.2.5 Monitoring areas undergoing carbon stock enhancement

Since selective logging has taken place across the Project Area prior to the initiation of the project, the forest is continuing to increase its carbon stock over time.

However, this increase in carbon stocks is conservatively ignored and no strata are monitored for carbon stock enhancement.

4.3.2.6 Monitoring project emissions

Carbon emissions are also generated in the project scenario through usage of machineries and their byproduct emissions from fossil fuel consumption, incineration of potential residues from logging activities and/or any other type of biomass burning such as prescribed fires in remnant forests, and potential fertilization of remnant forest to increase productivity and timber yield.

Monitoring of emissions from fossil fuel consumption are conducted by estimating the annual amount of fuel consumed per fuel type and the type of machinery used. Biomass burning emissions is monitored by recording the total annual amount of biomass incinerated. As Rio Bravo Climate Action Project plans do not include fertilization of remnant forest, no emissions from fertilization is expected.

4.3.3 Monitoring Data generation, recording and storage

Program for Belize follows a set of standard procedures for the monitoring of the project area. Protective ground patrols will be conducted once a month except during the extra dry season when they will be conducted twice a month. Aerial flights over the project area will be conducted twice a year.

Data collected for this project is kept on file for the duration of the project. This includes inventory data on carbon stocks, monitoring plans, permanent plot names and locations (if any are used), and GIS data. Reports from protective patrols and aerial flights will be entered into a computer and kept on file for review. The data is kept in commonly used formats such as Microsoft Office formats for reports and tables, and for GIS data, shapefile or .tif format. Metadata, especially for GIS data, is maintained and updated as needed.

4.3.4 Organization and responsibilities

Program for Belize (Pfb) is responsible for implementation of the monitoring plan. The Pfb is one of the leading conservation NGOs in Belize, acting on a regional as well as national scale. The Pfb mission is *“to conserve the biodiversity and promote the sustainable development of Belize through the proper management of the RBCMA and other lands entrusted to it”*.

Program for Belize (Pfb) owns and manages the project area. They are responsible for monitoring of the project. Monitoring work is carried out by a team of rangers, based at Hill Bank who are responsible for manning the gates and mounting regular patrols. This work is backed by regular aerial flights to detect problems (use of trails, illicit logging) from the air. Several interventions are made each year. The team cooperates with the Belize Defense Force and Forest Department when appropriate. Patrols are organized on a monthly basis to areas deemed to require oversight and the team responds to information of illicit activity as and when required.

4.3.5 Monitoring of leakage carbon stock changes and greenhouse gas emissions

The methodology applied allows for the estimation of leakage through default analyses and therefore leakage monitoring is not required.

5 ENVIRONMENTAL IMPACT

A full environmental impact assessment was not conducted nor required on the property.

However, the environmental impacts of the Project Activity are positive. The project results in the maintenance of natural forested conditions by bridging the gap between two disjointed sections of the Rio Bravo area. This allows for the maintenance of the species diversity and more effective habitat protection resulting from forested areas as the length of boundary area is effectively reduced.

The RBCMA Management Plan, 3rd Ed, 1996 provides a comprehensive account of the biological diversity safeguarded within the Rio Bravo lands as a result of its protection status. The Rio Bravo does not only contribute significantly to the maintenance of threatened national biological attributes but also serves as an important biological corridor between Belize and the rest of the Maya Forest (Peten).

6 STAKEHOLDER COMMENTS

From its inception, PfB has been in constant consultation with communities in the area surrounding the Rio Bravo. These consultations have not only led to an understanding of the needs to safeguard the forest but also to improved livelihoods for the communities. Since 1992, PfB has implemented numerous community outreach projects, including the establishment of local community groups to manage income generating projects (RBCMA Management Plan, 3rd Ed., 1996, Section 3.4.4).

A project called the Northern Belize Biological Corridor implemented by PfB between 1999 and 2002 directly involved many communities in the north of Belize and specifically targeted communities near to the Rio Bravo. The addition of the Rio Bravo carbon sequestration lands made it possible for the Rio Bravo area to serve as an important node which maintains biological connectivity.

The consultations between PfB and stakeholders suggest that the social impacts of the Rio Bravo project continue to be neutral to positive going into the 2005 (PfB SFMP & OG 2005-10, Section 11).

7 ANNEX FOLDERS

Annex A:	GIS and RS Data
Annex B:	Government Letters of Support
Annex C:	New River Enterprises Land Purchase Agreement
Annex D:	Land Titles
Annex E:	Maps of Rio Bravo
Annex F:	Letter from New River Enterprises Letter from Land Surveyor Enterprises
Annex G:	Land tenure survey
Annex H:	Land Use Management Survey
Annex I:	Project Boundary Report
Annex J:	USIJI Proposal
Annex K:	Rio Bravo Carbon Sequestration Pilot Project Comprehensive Agreement
Annex L:	Application of the Baseline
Annex M:	Financial Participants Commitments
Annex N:	TNC Internal Memo: TNC Land Preservation Fund Policy TNC Internal Memo: Request for Carbon Sequestration Loan for Programme for Belize TNC Internal Memo: USIJI Site Screening Criteria
Annex O:	Monitoring
Annex P:	Risk Assessment
Annex Q:	Carbon Stock Data
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Annex S:	References Cited
Annex T:	Program for Belize Management
Annex U:	MoA between Government of Belize and PfB
Annex V:	Belize Governance Indicator