413 REDD Project

Document Prepared by 413 Environmental

Contact Information

Project Title	*413 REDD Project*
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1 PROJECT DETAILS

1.1 Summary Description of the Project

The 413 REDD Project (413 Project) will reduce emissions derived from planned deforestation and forest degradation in a large tract of privately owned Amazonian tropical rain forest. The project proponent is 413 Environmental, LLC. The project focuses on activities designated as Avoided Planned Deforestation (APD) and is built on the VCS VM0007 methodology.

The project's geographical boundary comprises a parcel named Mata-Mata, situated in the municipalities of Manicoré and Novo Aripuanã, State of Amazonas (060º 48' 45.82" W, 06º 02' 21.22" S). The project area is 496,342 hectares (ha) of primary ancient and undisturbed tropical rainforest. Of the total area, 476,995 ha is dense lowland forest, 17,705 hectares alluvial forest, and 5,914 ha dense sub-montane forest. Under Brazilian legislation, owners have the right to convert up to 20% (in this case, 91,608 ha) of their total land holdings into alternative uses, 87,692 ha of which are classified as dense forest. This constitutes the baseline condition. In that regard, the project will be conserving a large tract of intact forest in a region under severe threat of deforestation, primarily for logging followed by cattle-ranching, and to a lesser extent agriculture and other human activities (mining, road building, etc.). A total of 43,973,073 tonnes of CO_2e emission will be avoided over the 30-year project lifespan, representing an annual average emission reduction of 1,465,769 t CO_2e. For the first monitoring reporting, including January 1rst 2021 to December 31st, 2022, the total credits requested for issuance are 6,359,535 tCO2e.

1.2 Sectoral Scope and Project Type

The Project applies to VCS sectoral scope 14 – Agriculture, Forestry and Other Land Use (AFOLU). The project category is REDD+ (Reduced Emissions from Deforestation and Degradation), with project activities conducted in accordance with VM0007, v.1.6, Avoided Planned Deforestation (APD). This is not a grouped project.

1.3 Project Eligibility

The Scope of the VCS Program (VCS Standard v.4.2) includes:

- The six Kyoto Protocol greenhouse gases, one which (CO_2) is included here.
- Ozone-depleting substances. Not applicable here.
- Project activities supported by a methodology approved under the VCS Program through the methodology approval process. This project is subject to activities prescribed in the VCS REDD methodology VM0007, v.1.6, Avoided Planned Conversion (APD).

- Project activities supported by a methodology approved under an approved GHG program unless explicitly excluded. Not applicable here.
- Jurisdictional REDD+ programs and nested REDD+ projects. Not applicable here.

With respect to VCS Standard v.4.2. Appendix 1, REDD project category eligibility:

- The Project Area meets the FAO's forest definition: "*Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use*." (FAO, 2012).[1]
- The Project Area qualifies as forest for a minimum of 10 years prior to the project start date (see Section 1.12).
- The Project Activity reduces net GHG emissions by avoiding planned deforestation, an activity legally permissible under the Brazilian Forest Code on 20% of the project area (Law 12,651/2012).

1.4 Project Design

The Project has been designed to include a single location and so is not developed as a grouped project.

1.5 Project Proponent

Table 1 - Project Proponent Information

Organization name	413 Environmental, LCC
Contact person	Jay Rogers
Title	Chief Executive Officer (CEO)
Address	109 E. 17th Street, Suite 450 - Cheyenne, WY 82001 – United States of America
Telephone	+1-310-993-9952
Email	jay@fourthirteenllc.com

1.6 Other Entities Involved in the Project

[1] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO). FRA 2015 Terms and Definitions. Rome, 2012. 36p. Available at: FRA 2015 Terms and Definitions (fao.org)

Organization name	Radicle
Role in the project	Technical consultancy for baseline determination, additionality demonstration, calculations.
Contact person	
Title	
Address	Rua Cônego Eugênio Leite, 933 – Cj. 131 – Pinheiros – São Paulo – Brazil
Telephone	
Email	contato@radiclebrasil.com.br

1.7 Ownership

Project ownership is defined in accordance with VCS Standard v.4.2, item 6: "An enforceable and irrevocable agreement with the holder of the statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions or removals which vests project ownership in the project proponent".

Land ownership is attributed to Luiz Ernesto Pereira Taranto, through land tenure for the Mata property, according to Brazilian available documentation, issued by the Registry of Novo Aripuanã City.[2]

Proof of right is defined by agreements signed between 413 Environmental, LCC, Midiageo Group and the landowner, as described in Section 1.8. The documents are available for consultation during validation and verification.

A Due Diligence report on ownership is available in **Appendix 1**, prepared by the legal team of Vieira Rezende, which conclusion is: *"it is our opinion that the property has a valid registry with the proper Real Estate Registry Office showing Luiz Ernesto Pereira Taranto as the lawful owner".*

1.8 Project Start Date

VCS Standard v4.2. states that *"the project start date of an AFOLU project is the date on which activities that led to the generation of GHG emission reductions or removals are implemented".* In that regard, the project start date is January 1rst, 2021. The sequence of events with respect to the project start date and subsequent follow-up agreements is as follows:

- **May 28, 2020:** a 30-year agreement was signed between the "Mata Mata" landowner, Mr. Luis Ernesto Pereira Taranto and Midiageo Grupo Ltda., with the latter granted a right of extension for another 30-year term. As per the agreement, Mr. Taranto granted carbon rights

[2] Certificates available for Land Title no. 2941.

to Midiageo, in exchange for compensation and a promise that the allowable land use change would not be undertaken. Specifically, Mr. Taranto agreed to preserve the existing forested vegetation on the Mata Mata property in exchange for periodic payments and a share of the future carbon credit revenue anticipated from the project.

- The May 28, 2020 agreement was amended on **April 23, 2021**, however, maintaining those terms.
- **September 21, 2020:** an agreement was signed between MidiaGeo Grupo Ltda, MidiaGeo Technologia Ltda, and Anderson Alexandre (collectively, the “Seller”), and 413 Environmental LCC (the “Buyer”), whereby the seller agrees to transfer their carbon credit ownership certificates to the buyer for each vintage year from 2012 to 2020, and for each year thereafter through year 2050.
- The September 21, 2020 agreement was first amended on **April 21, 2021**, and again on **March 31, 2022.** The latter amendment grants 413 Environmental LCC (the “Buyer”) the exclusive right to generate, validate, purchase, and resell credits from a carbon project on the Mata Mata property.
- **June 23, 2022:** payment receipt issued by MidiaGeo Grupo Ltda and signed by Mr. Taranto documenting payments received by the latter as per the April 23, 2021 agreement.
- **August 01, 2022:** letter from Carlton Fields, legal counsel to 413 Environmental, LCC, confirming that payments were received by MidiaGeo Grupa Ltda, as per the April 21, 2021 agreement and amendments.

Since the initial agreements were signed in 2020, on different dates, the chosen start date was January 1rst, 2021, when evidence already showed the beginning of the activities, and also for better organization of the monitoring periods.

1.9 Project Crediting Period

The project crediting period is 30 years, starting January 1st, 2021 and ending December 31st, 2050.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Expected annual emissions reductions exceed 300,000 tCO_2e. This is a Large Project.

Project Scale	
Project	
Large project	x

Year	Estimated GHG emission reductions or removals (tCO_2e)
2021	3,123,313
2022	3,236,221
2023	3,346,986
2024	3,457,750
2025	3,568,515
2026	3,679,279
2027	3,790,044
2028	3,900,808
2029	4,011,573
2030	4,122,337
2031	2,500,973
2032	954,002
2033	850,660
2034	747,318
2035	643,976
2036	540,634
2037	437,291
2038	333,949
2039	230,607
2040	127,265
2041	70,358
2042	62,936
2043	55,513
2044	48,091
2045	40,668

Year	Estimated GHG emission reductions or removals (tCO_2e)
2046	33,246
2047	25,823
2048	18,401
2049	10,978
2050	3,556
Total estimated ERs	43,973,073
Total number of crediting years	30
Average annual ERs	1,465,769

1.11 Description of the Project Activity

The main purpose of the proposed project activity is the conservation of 87,692 ha of native rainforest located in private land in the Amazonian biome, through the avoided planned deforestation of the area, which will result in income generation for landowners and other projects participants, while promoting constant incentives for the continuance of the preservation actions (the "Project Activity").

The project baseline is in accordance with the Brazilian Forest Code (Law no. 12,165) on privately owned land which, in the Legal Amazon, allows for deforestation of 20% of the parcel. The region in which the property is located is under pressure from logging and cattle ranching, which comprise the baseline activity within the Project.

The core purpose of the Project Activity is the signing of agreements for forest conservation, along with the provision of financial resources for the landowner to not deforest. Luiz Ernesto Taranto is the landowner, and is represented by Midiageo group, a company with experience in the Amazon and has been providing land regulation services for Luiz Ernesto. Midiageo has signed contracts with Luiz Ernesto, who agreed to transfer credits rights to Midiageo. 413 Environmental is the investor of the Project and also Project Proponent, as it has agreements with Midiageo for any carbon offsets that can be generated from the conservation activities, in exchange for fixed payments, as well as the credits shares agreed to in the agreements.

The agreements also stipulate the use of a percentage of the carbon credit revenues for local development. During the Local Stakeholders Consultation Process, 31 communities were identified inside or in the surroundings of the Project Area. For that reason, the Project Activities will include shared benefits with those communities to be specified in the agreements to be signed.

413 Environmental has been working with a regional foundation (*Fundação Amazônia Sustentável – FAS)*, to identify the better ways to identify those community benefits. Prospective benefits include:

- Building and improving regional capacity for REDD.
- Building and improving regional capacity for sustainable use of natural resources.
- Training and environmental education for the stakeholders in the surroundings, such as the municipalities of Manicoré and Novo Aripuanã.
- Employment of locals when developing project monitoring activities, such as forestry inventories campaigns, social and environmental monitoring pools, etc.
- Partnerships with local institutions, such as the Manicoré and Novo Aripuanã City and its Departments, to facilitate current and new initiatives, such as sanitation, education, health, sustainable development, and sustainable agriculture.

1.12 Project Location

The Mata Mata land parcel is located in the municipalities of Manicoré and Novo Aripuanã, within the Madeira micro-region, in the State of Amazonas, Brazil (**Figure 1,** Table 2).

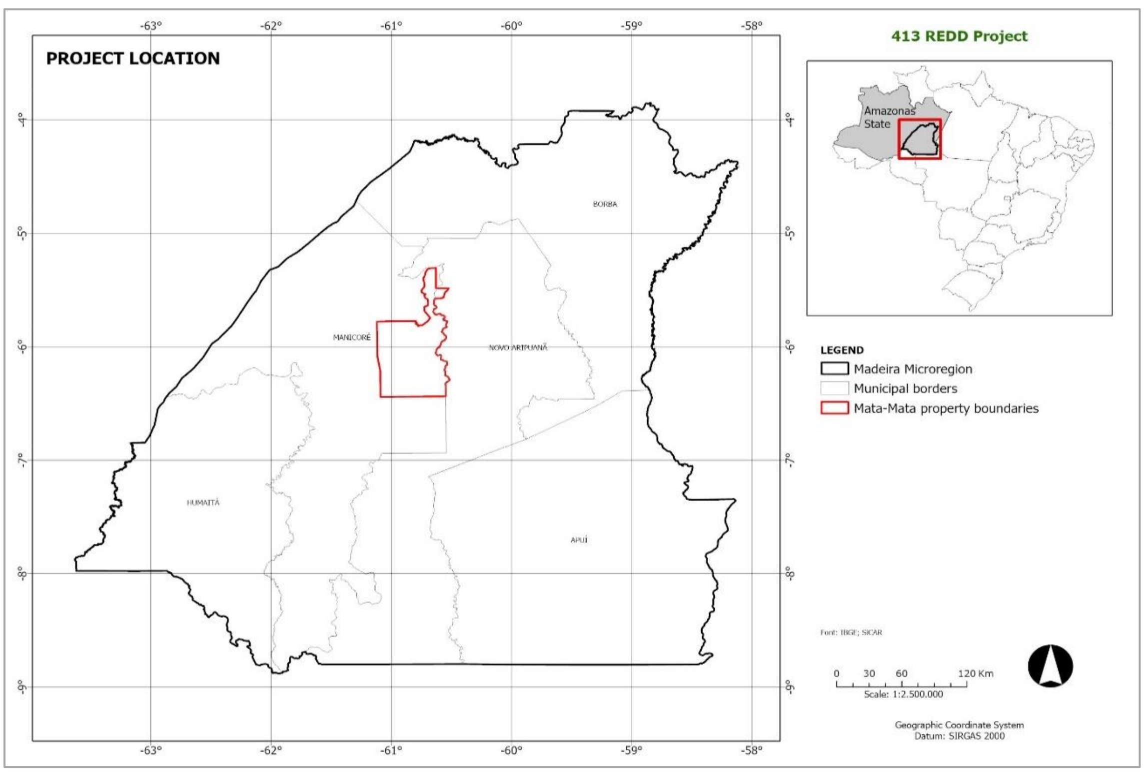

Figure 1 - Location of the Mata Mata land parcel, within which the project area is located

The total area of the Mata-Mata land parcel is 496,342 ha. As permitted by the Brazilian Forest Code (Law 12,651/2012), the eligible project area comprises the 20% of the property that the landowner can legally convert to other land uses, such as cattle grazing or agriculture, totaling 91,608 ha. This area is located at the northern part of the property, bounded to the east by the Mariepaua River and to the north by the Madeira River (Erro! Fonte de referência não e ncontrada., Table 2). The remainder of the parcel is comprised of Legal Reserve, Permanent Protection Areas, or permanent water bodies, as defined by the Environmental Rural Registry (CAR).

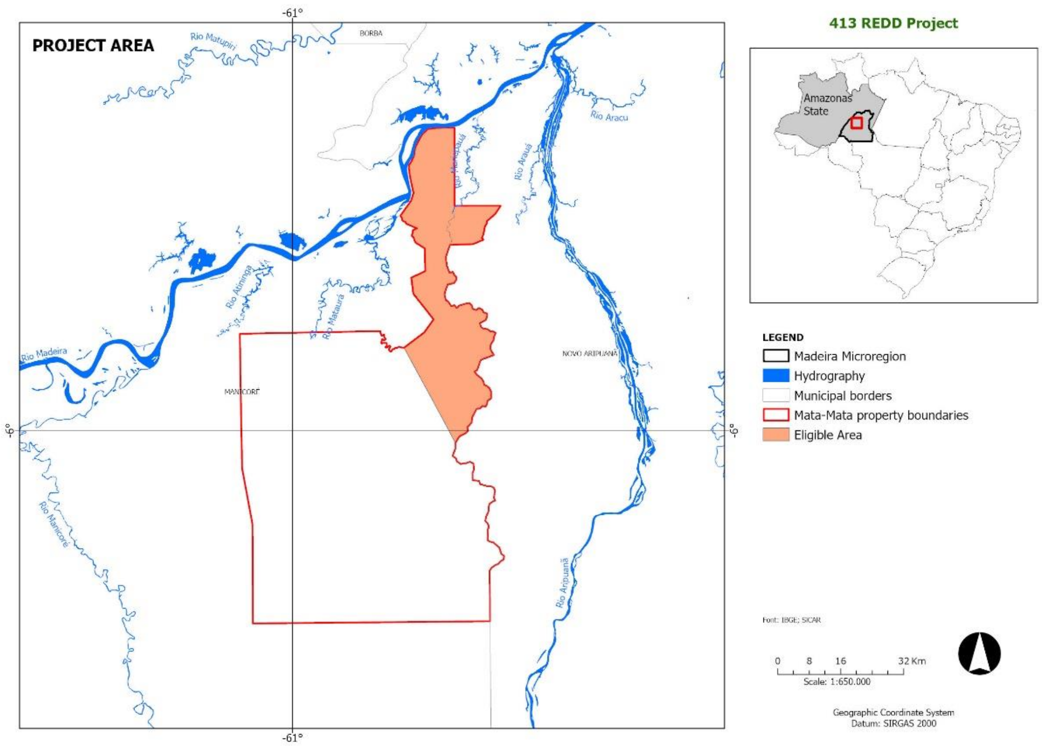

Figure 2 – The eligible area and its approximate location within Brazil

Table 2 - Central geodetic coordinates and total parcel area

Land Parcel	Coordinates (GCS SIRGAS 2000 – EPSG 4674)		Area (hectares)
	Long	Lat	
Mata-Mata	060° 48' 45.82" W	06° 02' 21.22" S	496,342

Project Area definition

To obtain the final Project Area, it was necessary to exclude the following layers from the eligible area:

- Hydrology layer from IBGE[3]
- Deforested areas from PRODES (2012-2021)[4]
- Non-Forest from MapBiomas col.6 classification (2012)[5]
- Non-Forest from land use classification using Google Earth Engine (2021)[6]
- Madeira River floodplain (federal patrimony, according to SPU), based on soil type (Entisols (Fluvents))[7]
- 2 km buffer from Madeira River to respect community use, defined after Local Stakeholders Consultation.

The objective of such exclusions was to exclusively consider dense forest cover existing for at least 10 years prior to project start date. The final Project Area is 87,692 ha (**Figure 3**).

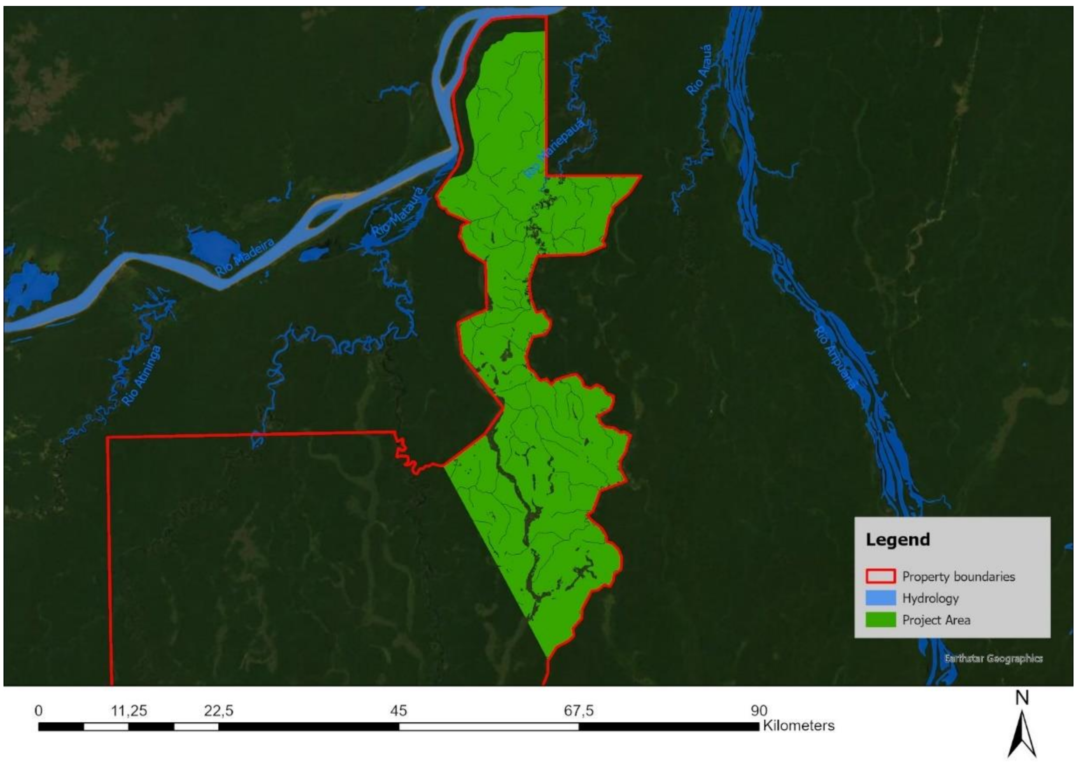

Figure 3 – Final Project Area after exclusions

1.13 Conditions Prior to Project Initiation

[3] Continuous Cartographic Base of Brazil, scale 1:250,000 - BC250: https://www.ibge.gov.br/geociencias/downloads-geociencias.html?caminho=cartas_e_mapas/bases_cartograficas_continuas/bc250/versao2021/

[4] http://terrabrasilis.dpi.inpe.br/en/download-2/

[5] MapBiomas Project- Collection 6 of the Annual Series of Land Use and Land Cover Maps of Brazil

[6] See attached Brazil 413 Carbon Project Landcover Classification Report.

[7] https://bdiaweb.ibge.gov.br/#/consulta/pedologia

Background information on the project area including environmental variables in and around the project region is provided in this section. The project has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction. This is substantiated by the landowner's commitment (and contractual obligation) to the conservation of the project area and implementation of activities which result in the preservation of forest within the property area.

Protected Areas

The project land parcel is situated in a region where several federal and state officially protected areas were formally created by law, some for integral protection and others for sustainable use, according to the Brazilian System of Protected Areas. Activities allowed in the integral protection units are much more limited when compared to sustainable use units. The surrounding protected areas are shown in Figure 4. The Mata-Mata land parcel borders the RDS Juma (Sustainable Development Reserve) to the east, where an ongoing REDD project carried out by Sustainable Amazon Foundation (FAS) exists.

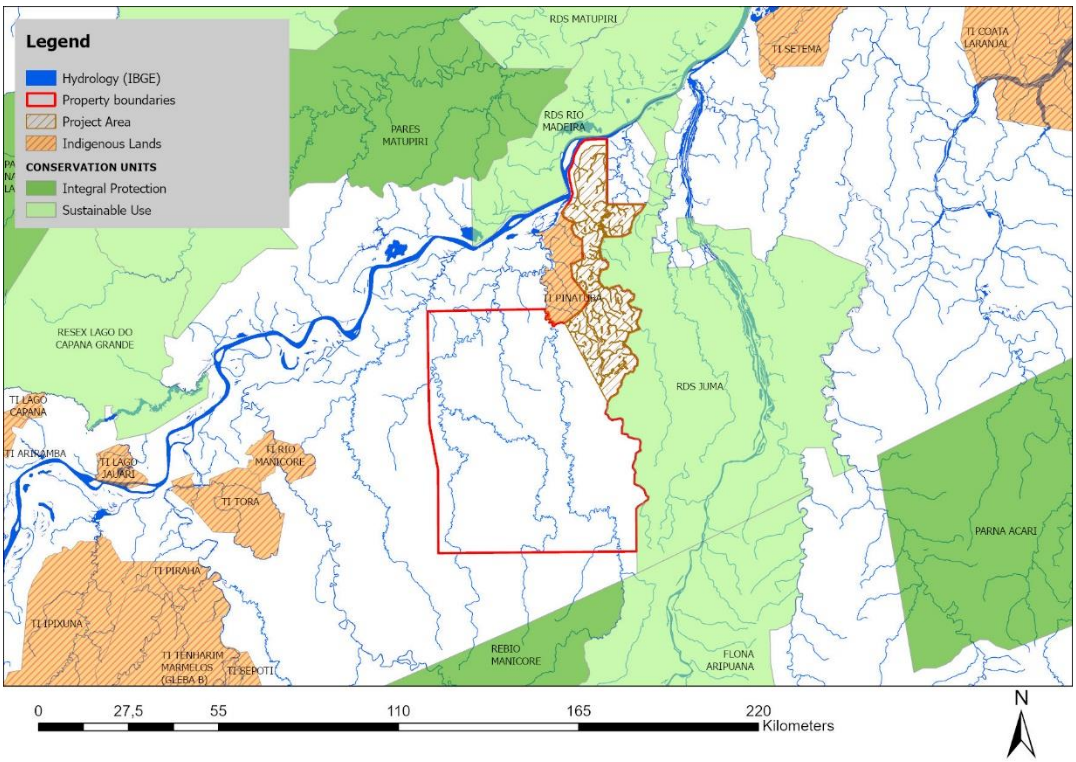

Figure 4 – Protected areas surrounding the Project Area

Even though the region comprises several protected areas, there are still many private or unofficially public areas that are highly vulnerable to deforestation and forest degradation. Protecting these areas is fundamental to creating a preserved continuum of native vegetation, maintaining the integrity of ecological processes, protecting biodiversity, climate stability, and guaranteeing traditional and indigenous communities' activities.

Land-use change and deforestation

The Madeira micro-region is highly threatened by deforestation and forest degradation due to land-use change from logging and cattle ranching. Four of the five municipalities that make up the micro-region, including Manicoré and Novo Aripuanã, are listed as priority municipalities for prevention, monitoring and deforestation control by the Ministry of Environment per a list established in 2007 by decree 6.321/2007, and updated in 2021 (Ministry of Environment)[8].

According to MapBiomas historical land-use classification, in the municipalities of Manicoré, Novo Aripuanã and Apuí, from 2010 to 2020 over 325,400 ha of forest was converted to anthropic land-use (pasture, agriculture and urban areas), 99% of which having pasture as the final land-use.

Figure 5 pictures the PRODES official deforestation data from 2012 to 2021[9], provided by the National Space Research Institute (INPE) in the Madeira micro-region. The deforestation surrounding the project area is mainly driven by roads or river access.

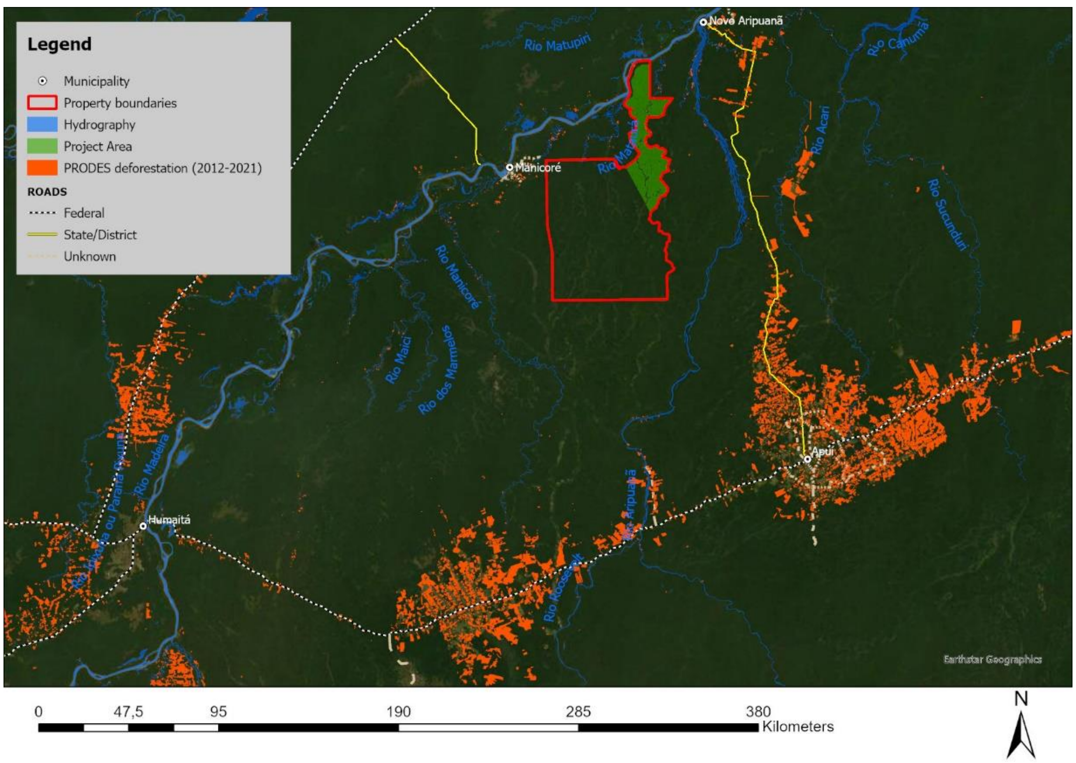

Figure 5 – Deforestation in the project region (2012 – 2021) - PRODES

Riverine Communities and Indigenous Lands

[8] https://www.gov.br/mma/pt-br/assuntos/servicosambientais/controle-de-desmatamento-e-incendios-florestais/municipios-prioritarios

[9] http://terrabrasilis.dpi.inpe.br/en/download-2/

The Sustainable Amazon Foundation (FAS) is the partner institution responsible for the socio-environmental mobilization by reaching out to the communities, collecting demographic information, GPS mapping, organizing the local stakeholders' consultations and keeping an open channel of communication, including physical presence in the area.

During the mobilization and consultation process, 45 riverine communities were identified inside or surrounding the Project Area (Figure 6). Of those communities, 31 stated they use the project territory for activities such as small subsistence agriculture (cassava, watermelon, vegetables, etc.), forest products extraction (Brazil nut, Copaíba oil, Açaí, wood and vines, game, fishing) and housing on the river banks.

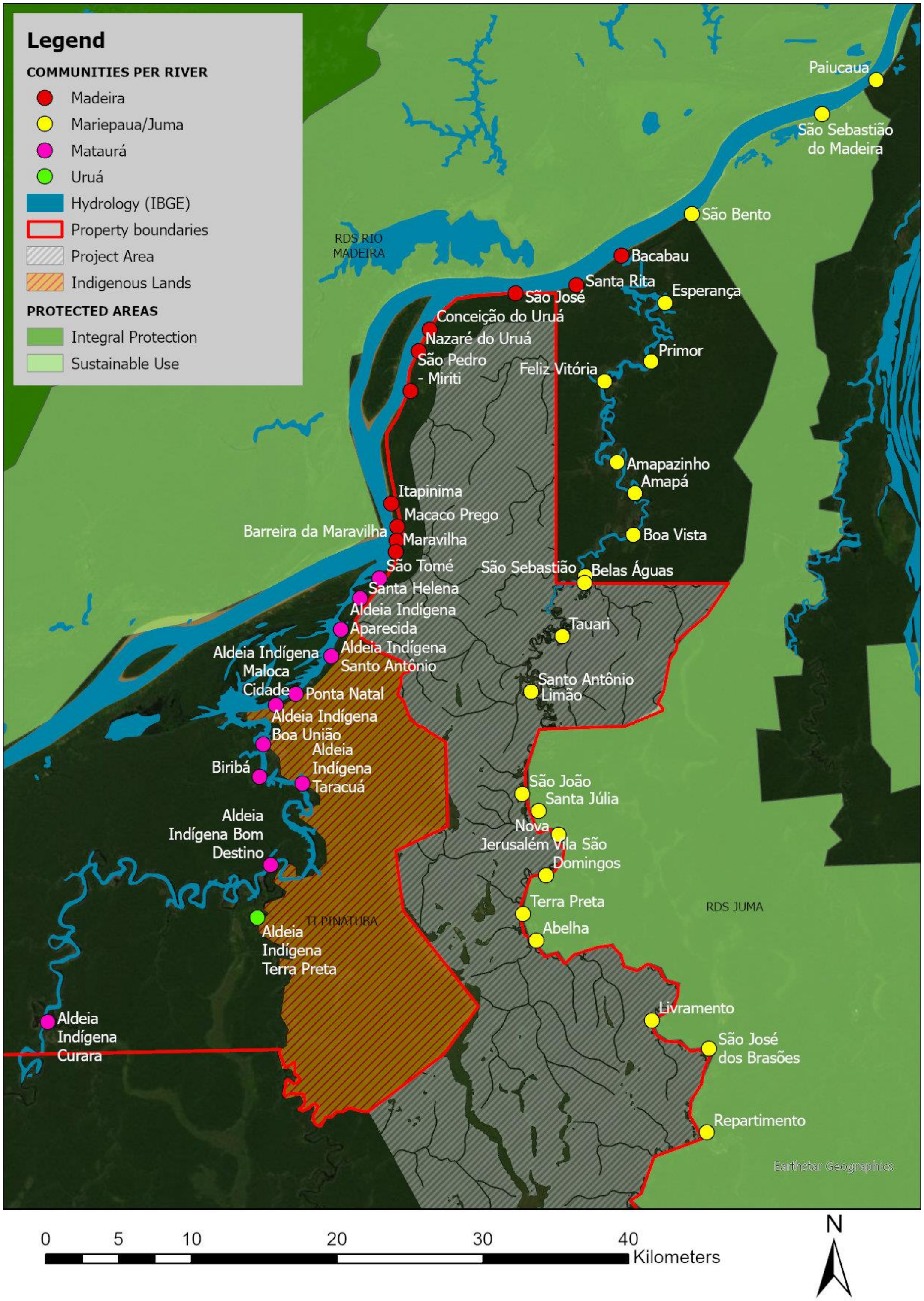

Figure 6 – Riverine and Indigenous communities surrounding the Project Area

According to data collected on the local stakeholders' consultation process, the Mariepaua River has 20 communities that already have some contact with REDD projects due to the Juma REDD project carried out by FAS, on the right bank of the river. From the communities that responded to the questionnaire, around 119 families use the project area for their subsistence activities along the Mariepaua River.

The Madeira River right bank hosts other 10 communities, with a total of 136 families[10] that directly use the project area for their needs. The main activities developed in the area are also small subsistence agriculture (cassava, watermelon, banana, cocoa, etc.), forest products extraction (açaí, Brazil nut, copaiba oil, game and fishing, wood, etc.) and housing. Some communities carry out artisanal mining in the Madeira River's riverbed.

Limiting the west border of the Project Area is the Pinatuba Indigenous Land. Although the majority of the settlements are located along the Mataurá river, which does not border the project area, their hunting and extractive activities can go deep into the forest. After the Local Stakeholder Consultation carried out by FAS, the indigenous leaders stated they would not use the project area.

According to the Socio-Environmental Institute (ISA), through their *Indigenous Lands in Brazil* database[11], the Pinatuba Land has approximately 30 thousand hectares, hosting 608 *Mura* people.

Hydrology

The project is located in the Madeira hydrographic sub-basin, one of the main tributaries on the right bank of the Amazon River. The project area is bounded to the north by the Madeira River and to the east by the Mariepaua River, a tributary of the Madeira River. These two rivers have relevant importance to the project for hosting more than 35 riverine communities, being the main transport route for people and goods in the region.

In addition to its local importance, the Madeira River is the second most important waterway in the Amazon region, connecting the capital of Rondônia State, Porto Velho, to its mouth in the Amazonas River, in the city of Itacoatiara. This waterway is the main way of transporting the grain production of the Brazilian Midwest, as well as products from recent deforestation in the Amazon such as wood and cattle. The river is navigable throughout the year, allowing the traffic of convoys of cargo barges with up to 18 thousand tonnes (DNIT)[12].

Many other streams can be found throughout the project area, being used for transport in medium and small size boats. The hydrographic features in the region can be seen in **Figure 7**.

[10] The community Itapinima did not responded to the questionnaire.

[11] https://terrasindigenas.org.br/en

[12] https://www.gov.br/dnit/pt-br/assuntos/aquaviario/old/hidrovia-do-madeira

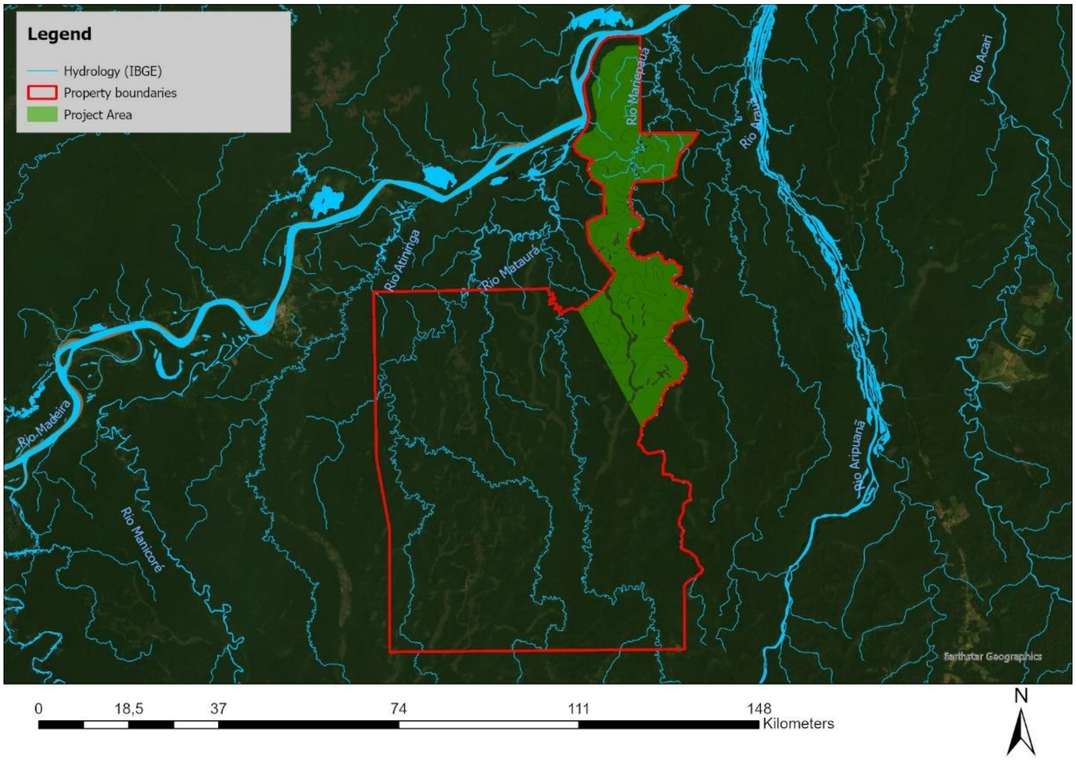

Figure 7 – Regional hydrology

Climate

According to the Brazilian Institute of Geography and Statistics (IBGE) 2002 classification[13], the Project Area is located in the Equatorial Climate Zone, characterized by warm temperatures, with an average temperature higher than 18°C throughout the year (**Figure 8**).

[13] https://www.ibge.gov.br/geociencias/cartas-e-mapas/informacoes-ambientais/15817-clima.html?=&t=downloads

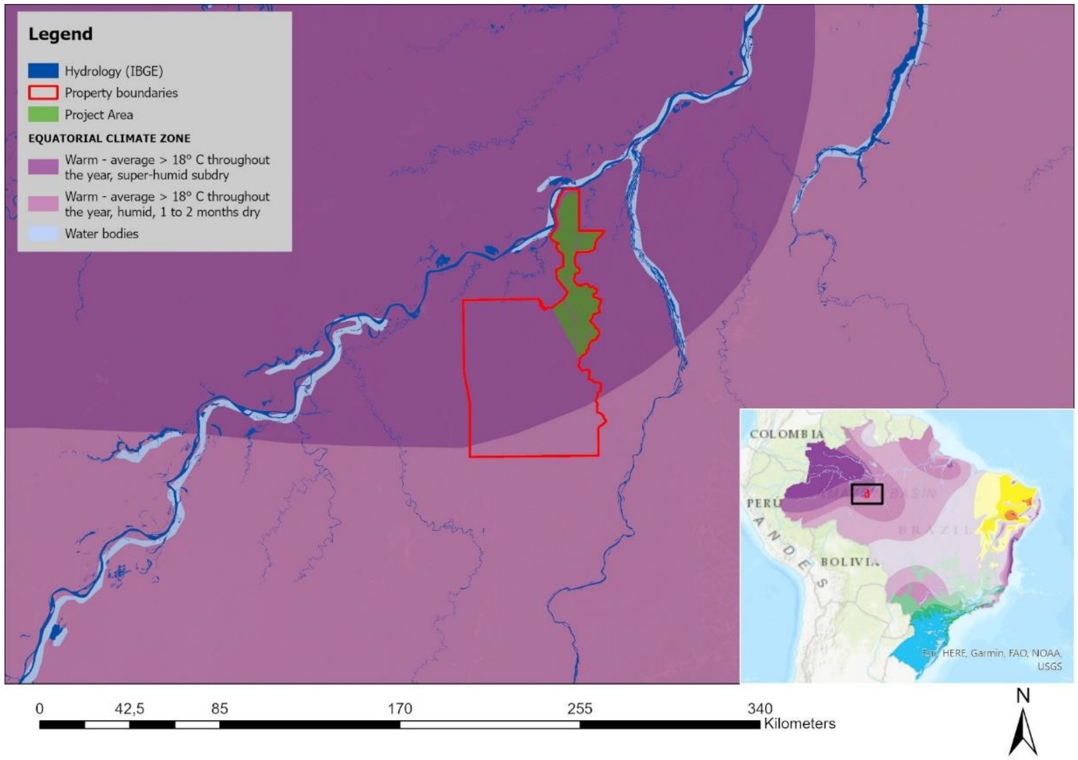

Figure 8 – Climate classification in the project region (IBGE)

The major part of the property is considered super-humid sub-dry, but its south is classified as humid with one or two months dry. For both climate classifications, seasonal precipitation variation can be noticed. According to the historical data registered by the Manicoré weather station from 1991 to 2020, the rainy season extends from November to April and the dry season from June to September (INMET)[14]. The average accumulated precipitation in the region reaches 2,500 mm.year^{-1} and the mean annual temperature is 26.6ºC with an average maximum of 32.8ºC and a minimum of 22.7ºC.

Soils

The predominant soil class in the project region is Yellow Oxisol (*Latossolo Amarelo* in the Brazilian Soil Classification System), according to the IBGE 1:250,000 scale soils mapping (2021)[15] (**Figure 9**).

[14] https://portal.inmet.gov.br/normais

[15] https://bdiaweb.ibge.gov.br/#/consulta/pedologia

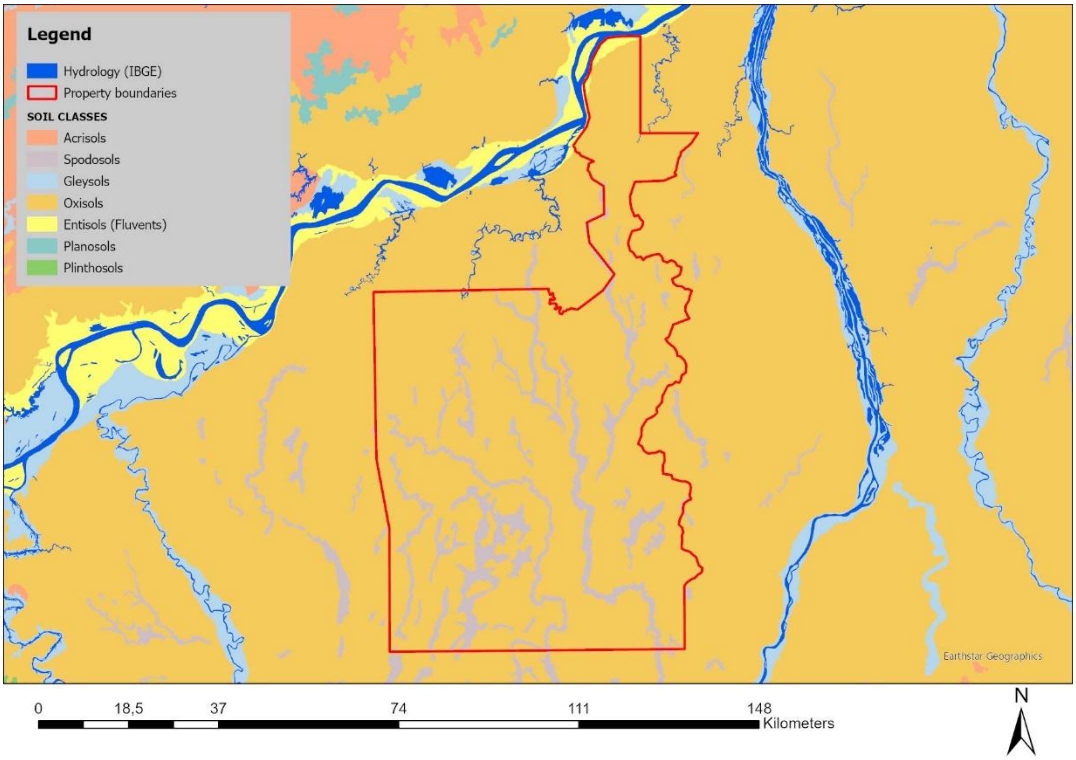

Figure 9 – Soils classification in the project region (IBGE 1:250,000 scale mapping)

Oxisols are formed in intense and prolonged weathering environments, which conditioned the substantial disintegration of the matrix rock and almost total decomposition of the primary minerals. Although they usually have a low saturation of exchangeable cations (Ca, Mg, K), they can still sustain exuberant forests, such as the Tropical Amazon Forest. This capacity resides in three factors: they exhibit an excellent physical structure, deep enough to provide robustness to rooting, good drainage to support aeration and water percolation (essential for root respiration), and reasonable retention of water on the surface of clay minerals (essential provision for plants).

Spodosols occur at a lower extent, especially along depressions in the terrain and riverbanks. Developed under conditions of high humidity, in flat or gently undulating relief, the spodosols present a sandy texture and, in the Amazon region, are associated with characteristic low cover vegetation known as *Campinarana* (EMBRAPA, 2018)[16].

Restricted to the north of the property, Entisols (Fluvents) – *Neossolos flúvicos*, according to the Brazilian Soil Classification System – can be found along the Madeira River floodplain zone. This type of soil is derived from alluvial sediments, is poorly evolved, and does not show significant changes in relation to the original material due to the low intensity of action of pedogenetic processes.

Elevation

[16] EMBRAPA. Sistema Brasileiro de Classificação de Solos. 5. ed. rev. e ampl. - Brasília, DF. 2018. 356 p.

Elevation data is derived from the SRTM mission with a spatial resolution of 30 m, made available by the Google Earth Engine platform. The rasters were downloaded with a 28km buffer from the total property area to better contextualize the region. Errors on negative elevation data were corrected and recalculated to zero.

The altimetric values in the region range from 0 to 122 m above sea level, with an average altitude of 47 m (**Figure 10**).

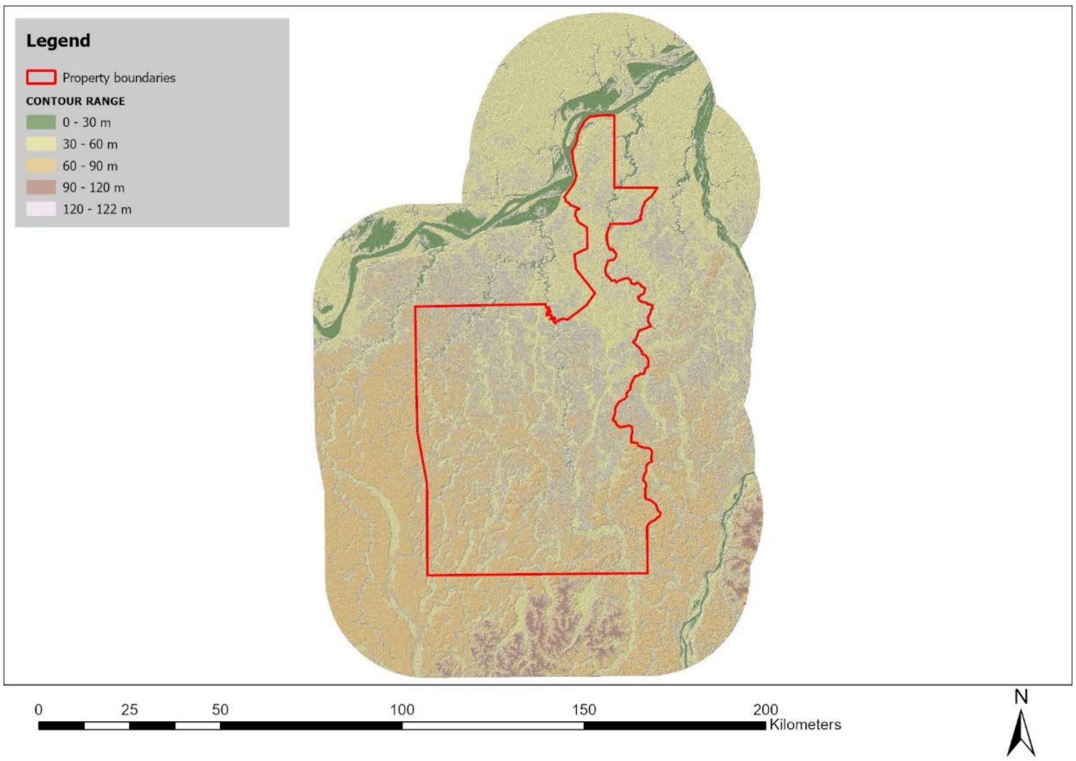

Figure 10 – Elevation in the project region (28 km buffer)

The higher altitudes are located to the south of the property, conditioning the drainage network of the main rivers to run in meanders in a south-north direction towards the Madeira River channel.

Slope

Even though the slope values range from 0 to 197%, as a consequence of the low altitude variation across the region, the distribution of values is concentrated between *plain* (< 3%) to *wavy* (8 – 20%). The average slope for the entire region is 6.23% (**Figure 11**), considered *smooth wavy* by the EMBRAPA slope classification for the national territory. The rare points with a slope greater than 20% are located on the banks of water courses.

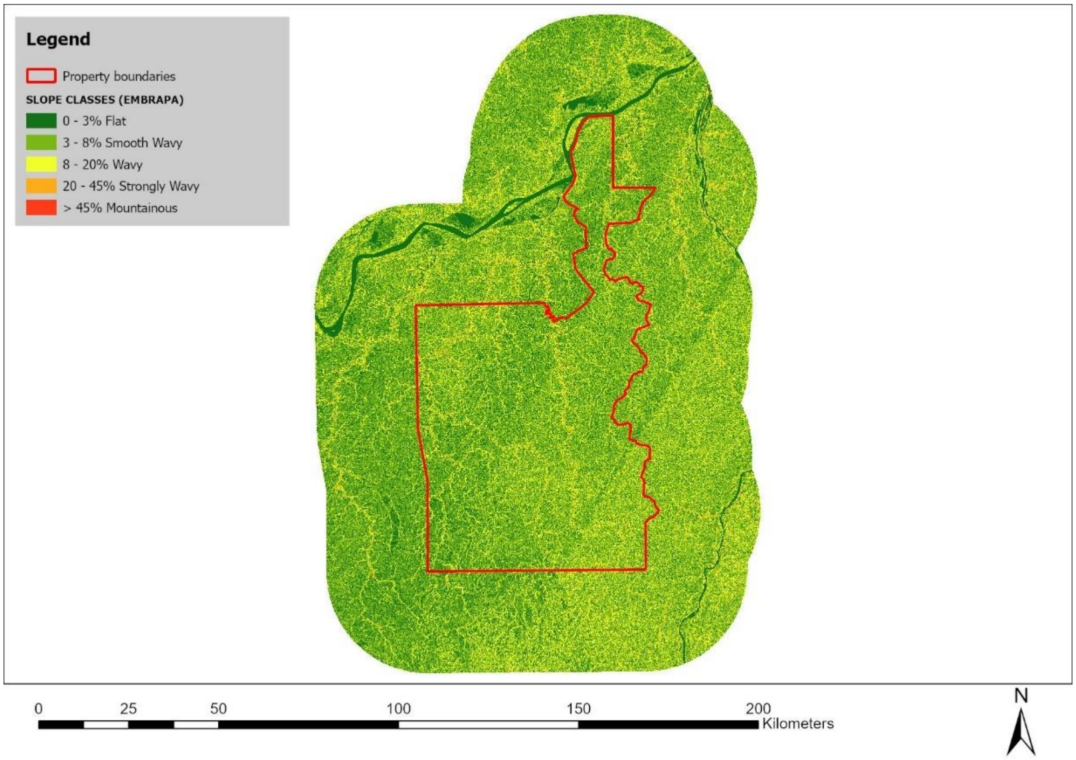

Figure 11 – Slope in the project region (28 km buffer)

Vegetation

Entirely located in the Amazon Biome, the predominant vegetation type in the project buffer area is the Lowland Ombrophyllous Dense Forest, according to the IBGE 1:250,000 scale mapping for the entire national territory (2021)[17]. Figure 12 shows that the vegetation distribution is strongly correlated to the IBGE soils classification.

[17] https://bdiaweb.ibge.gov.br/#/consulta/vegetacao

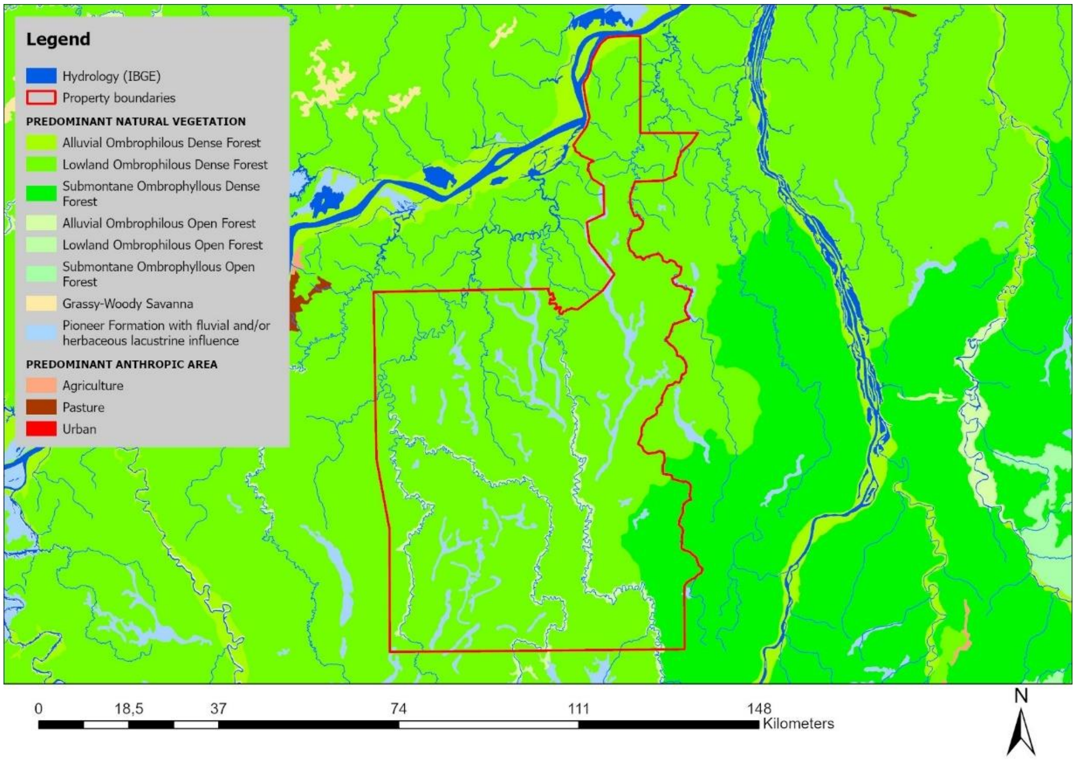

Figure 12 – Vegetation in the project region (IBGE 1:250,000 scale mapping)

In the property area, *Lowland Ombrophilous Dense Forest* and *Submontane Ombrophyllous Dense Forest* grow where Oxisols occur. Following the stains of Spodosols, low cover vegetation can be observed, classified as *Alluvial Ombrophillous Open Forest* and *Pioneer Formation with fluvial and/or herbaceous lacustrine influence*. Lastly, the Entisols (Fluvents) of the floodplains of the main rivers are occupied by *Alluvial Ombrophillous Dense Forest.*

For the stratification of the Project and Proxy Areas vegetation cover, the *Lowland Ombrophyllous Dense Forest* and *Submontane Ombrophyllous Dense Forest* were grouped into one stratum as *Dense Forest.* The *Pioneer Formation with fluvial and/or herbaceous lacustrine influence* was excluded from the accounting area and the forestry inventory.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Legal Amazon region

The Legal Amazon is more than five million square kilometers, comprising the states of Acre, Pará, Amazonas, Roraima, Rondônia, Mato Grosso, and Amapá as well as regions north of latitude 13° S in the states of Goiás and Tocantins, and west of longitude 44° W in the state of Maranhão. The region was created by Brazilian federal law in order to promote special protection and development policies for the Amazon.

All project activities are undertaken in conjunction with relevant environmental laws and regulatory frameworks. These are listed in **Table 3** along with details of project compliance.

Table 3 - Applicable laws to the Project and related compliance

Law	Context/Relevance	Compliance
Brazilian Constitution, Chapter 6, art. 225, Paragraph 4:	The Brazilian Amazonian Forest, the Atlantic Forest, the Serra do Mar, the Pantanal Mato-Grossense and the coastal zone are part of the national patrimony, and are applicable, as provided by law, under conditions which ensure the preservation of the environment.	The Project and its activities are in compliance with the Brazilian Constitution regarding preservation of the Amazon Forest.
Brazilian Constitution, Chapter 2, arts. 7- 11 and art. 243	The Constitution codifies a wide range of Social Rights: minimum wage, regular working hours, guidance on vacation and weekly leave, guidance on maternity leave, recognition of collective bargaining; prohibition of any form of discrimination.	The Project and its activities will meet, or exceed, all applicable labor laws and regulations and the Project Proponent will inform all workers of their rights.
National Policy of Environment ("PNMA") General Guidelines Law 6,938/81	Among the main guidelines of the PNMA, is the preservation and restoration of environmental resources, and their rational use and permanent availability. The PNMA also recognizes the compatibility of economic and social development with ecological preservation.	This Project reinforces the guidelines of the PNMA through the sale of carbon credits.
	PNMA establishes that responsible construction, installation, expansion and operation of establishments and activities that use environmental resources are subject to environmental licensing.	The Project Proponent and Landowners shall abide by, and satisfy, all environmental licensing requirements
Forest Code Chapter II: PPA: Section IV -CAR	All rural properties located in forest zones must have areas of permanent protection (APP). APPs are areas that are physically and ecologically fragile. They serve to preserve water resources, landscape features, geological stability, biodiversity, gene flow of plants and animals, and soil protection. Rural Environmental Registry (CAR): The central tool for rural properties to become compliant with Forest Code requirements. All rural property owners must register their lands in CAR, including the location of APPs, Legal Reserves, and other elements. CAR is regulated by the National System of Information on the Environment (SINIMA).	The APP is well defined, planned and respected. The property is registered within CAR.

Law	Context/Relevance	Compliance
Forest Code Chapter IV- LR:	All rural properties located in the Legal Amazon must keep at least 80% of the area as a Legal Reserve (LR; RL in Portuguese). LRs are areas where vegetation is protected. All rural properties must maintain an LR and register it in the CAR.	The Project has maintained 80% of forest cover as an LR.
Forest Code Chapter V-Alternative Land Use	Native vegetation removal in Amazonas as per any proposed land use change requires prior authorization from the Amazon Environmental Protection Institute (IPAAM).	Not applicable. The Project does not permit any deforestation.
Forest Code Chapter X – Program to support and encourage the preservation and recovery of the environment	The Forest Code allows payments or incentives, whether monetary or not, for the conservation and improvement of ecosystems and environmental services, as well as the conservation of biodiversity, climate regulation, preservation of APPs and LRs.	Project will provide financial payments to ensure permanent protection of the forest.
National Policy for Climate Change ("PNMC") Law 12,187/2009	The PNMC enables voluntary actions for the mitigation of greenhouse gas (GHG) emissions. Its main objectives are (i) preservation, conservation and recovery of environmental resources, with particular attention to the great natural biomes, such as the Amazon Forest; and the (ii) consolidation and expansion of legally protected areas. It also highlights the use of financial and economic instruments to promote climate change mitigation and adaptation.	The Project follows this law, given its contribution to emission reductions and deforestation.
National Policy of Payments for Environmental Services *("PNSPSA")* Law 14,119/2021	Under the PNPSA, those who benefit from environmental services, such as water supply, oxygen production, stability of climatic conditions, among others, must pay for them through a voluntary transaction. On the other hand, those who provide such services must be rewarded for their contribution. "Payers" can be public authorities, civil society organizations or private agents, individuals or legal entities, whether national or international. The "providers," of those services can be private individuals or legal entity established under public or private law, or even a family or community groups.	The project constitutes a provider of ecosystem services, particularly those related to carbon credit generation. The resulting credits benefit the payer.
Amazonas State Policy for Climate Change, Environmental	This Law and its amendments approve the State Policy on climate change, environment conservation and sustainable development.	The Project complies given its goals of reducing GHG emissions and avoiding

Law	Context/Relevance	Compliance
Conservation and Sustainable Development Law 3,135/2007 Amended: Law. No. 3.184/2007 Amended: Law No. 4.266 (2015)	Among its main purposes is the promotion and creation of market instruments that enable the execution of projects to reduce emissions from deforestation.	deforestation using market instruments.
Amazonas State Policy of the Amazon Environmental Services, their Management System, and creating the State Fund for Climate Change, Environmental Conservation and Environmental Services. State Law 4,266/2015	Broad ranging in scope, its principle objectives are the protection and conservation of forests and their environmental services while promoting socio-economic development and welfare of local populations.	Project goals of reducing GHG emissions and avoiding deforestation using market instruments are consistent with the principles of this State law.
ILO Convention No. 169 on Indigenous and Tribal Peoples Decree 6,040/2007	The International Labour Organization (ILO) is an agency of the United Nations dedicated to improving working conditions of the citizens of its member states. In 1957, the ILO developed and ratified Indigenous and Tribal Populations Convention, 1957 (No. 107), an international instrument dedicated to improving the living conditions of Indigenous peoples worldwide. In 1989, ILO Convention 107 was revised and renamed Indigenous and Tribal Peoples Convention, 1989 (No. 169). Convention 169 recognizes Indigenous peoples' right to self-determination within a nation-state, while setting standards for national governments regarding Indigenous peoples' economic, socio-cultural and political rights, including the right to a land base. The convention is law within the nation-states that have ratified it, one of which is Brazil.	The Project Proponent acknowledges and respects the provisions of ILO Convention 169. There is, however, no overlap with indigenous lands or land claims within or around the project area.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The Project is not registered or seeking registration under other GHG Programs.

1.15.2 Projects Rejected by Other GHG Programs

The Project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Brazil does not have a national, legally binding limit on greenhouse gas (GHG) emissions, nor does it possess, or is affiliated with, a compliance emissions trading program that accepts REDD credits.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received any other form of GHG-related environmental credit. It may be eligible for domestic JNR-related programs should they be developed.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The Project Activities will directly contribute to sustainable development (SD), as per **Table 4.** SD will be monitored within the project based on indicators proposed by the United Nations[18] Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development. Reports will be generated at each verification period.

Table 4 – Sustainable Development Goals and contributions of the Project

Sustainable Development Goal		Project Activities Related/Expected Results
	End poverty in all its forms, everywhere	The State of Amazonas has one of the lowest per capita incomes in Brazil (25 of 27 States). The Human Development Indexes (DHI) of both municipalities in which the Project Area is located are 0.582 (Manicoré) and 0.554 (Novo Aripuanã), positioning, respectively, on the 23rd and 39th places in the Amazonas State. Local

18 https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202022%20refinement_Eng.pdf

Sustainable Development Goal		Project Activities Related/Expected Results
		communities will receive a negotiated share of the carbon revenues.
2 ZERO HUNGER	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Zero Hunger. The proposed REDD project could address issues of hunger by contributing a fixed portion of its carbon revenue to the Bolsa Floresta program or alternative activities that would improve local communities' livelihoods and access to food via monthly stipends.
3 GOOD HEALTH AND WELL-BEING	Ensure healthy lives and promote well-being for all at all ages	Local stakeholder consultation and community outreach were conducted as part of the planning process to ensure project benefits contribute to healthy lives and promote community well-being.
4 QUALITY EDUCATION	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	The proposed REDD project could address the need for better educational opportunities for indigenous people by contributing a fixed portion of its carbon revenue to the Bolsa Floresta program or alternative activities that would improve local schools and hire more teachers.
5 GENDER EQUALITY	Achieve gender equality and empower all women and girls	It is widely acknowledged that gender equality and women's empowerment are catalysts for reaching sustainable development, including in REDD projects. As primary users and managers of forest products in many communities, women play a crucial role in the sustainable management of forests as well as in other productive and reproductive activities at the household and community levels. This project can contribute to SDG 5 by empowering women and girls in local communities through its project activities through the shared benefits contribution.
8 DECENT WORK AND ECONOMIC GROWTH	Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all	In rural areas, such as the Aripuanã River Valley, there is a scarcity of sustainable livelihood opportunities. The proposed REDD project can promote low emissions economic growth and diversification through hiring locals for forest monitoring.
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	The proposed REDD project could address issues of lack of infrastructure in rural areas of Amazonas poverty by contributing a fixed portion of its carbon revenue to the Bolsa Floresta program whose financial contributions would improve local communities' livelihoods which enables them to attract industry and to

Sustainable Development Goal		Project Activities Related/Expected Results
		develop the necessary infrastructure to support commerce.
13 CLIMATE ACTION	Take urgent action to combat climate change and its impacts	Forest protection is one of the most important means of mitigating the impacts of climate change. The project will protect over 90,000 hectares of the Amazon Rainforest.
15 LIFE ON LAND	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	The Amazon is the single largest remaining tropical rainforest in the world, and it is home to at least 10% of global biodiversity, including endangered flora and fauna. At over 90,000 hectares, the project protects and promotes sustainably managed forest, halts land degradation and biodiversity loss.
17 PARTNERSHIPS FOR THE GOALS	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	Private sector finance is a critical part of the SDG framework. By impacting all of the SDGs listed above through private sector finance and multi-stakeholder partnerships, the proposed REDD project contributes significantly to SDG 17.

1.17.2 Sustainable Development Contributions Activity Monitoring

Table 5 presents monitored SDGs during the Project monitoring period.

Table 5 - Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By conserving 87,692 hectares (ha) of tropical rainforest, 413 Project has prevented the release of 6,359,535 tonnes of carbon into the atmosphere during the monitoring period.	Prevented the release of 6,359,535 tonnes of carbon into the atmosphere
2)	15.0	Forest area as a proportion of total land area	Implemented activities to increase	Prevented the deforestation of 16,730 ha of the Amazon rainforest.	Prevented the deforestation of 16,730 ha of the Amazon rainforest.

1.18 Additional Information Relevant to the Project

Leakage Management

The landowner has no additional properties to which activity shifting leakage might occur. The proponents have no authority to directly regulate activities conducted outside the project boundaries regarding planned or unplanned deforestation. However, provisions for income generation and distribution from project activities will be implemented to reduce leakage risk. Outreach to local communities regarding project activities and benefits and avoidance of market leakage will be conducted.

Commercially Sensitive Information

Commercially sensitive information regarding financial amounts and conditions specified in signed agreements between Parties to the project has been excluded from the public version of the PD.

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

Project activities have the potential to displace local people from traditional land uses on the project area. However, the proponent has engaged a professional organization (FAS) to undertake an engagement process that includes socioeconomic and cultural surveys, and to make a concerted effort to obtain free, prior, and informed consent of the project's activities. Communities will be encouraged to discuss the perceived benefits, costs, and risks, of the project from their own perspectives. Efforts will be made to eliminate or mitigate potential negative impacts through dialogue and financial remuneration to impacted communities.

2.2 Local Stakeholder Consultation

Stakeholders Consultation

The Local Stakeholders Consultation (LSC) process was carried out through the assistance of FAS, a non-governmental organisation with almost 15 years of experience in the Amazon. FAS conducts activities that aim at the sustainable development of the area, while protecting the rainforest and promoting benefits to the traditional communities that live there.

The procedure for identifying the project stakeholders started with research for local communities directly or indirectly affected by the project area. This assessment was conducted initially throughout geo-analysis, in which evidence of human use were spotted and calculated in a straight-line distance. As previously described in **Section 1.13,** a total of 45 communities and indigenous people were identified in the area, from which 31 use the project area or its immediate surroundings (**Figure 6**).

That diagnosis phase (i.e. **Figure 13** and **Figure 14**) was carried out through the month of June, 2022, at 36 riverine communities and 9 indigenous lands. FAS conducted activities at each place, with a brief introduction of the project, by using printed material and verbal communication. Social economic diagnostic questionnaires were distributed throughout those visits. At the end of each activity, the communities did an exercise which indicated their immediate needs, with the goal of collecting information for future agreements on shared benefit.

Figure 13 - Record of diagnostic activity at Livramento Community

Figure 14 - Record of diagnostic activity at Aldeia Santo Antônio

Among the main necessities pointed out were:

- Solar panels.
- Internet access.
- Communitarian transportation.
- Agricultural production transportation.
- Agricultural mechanization.
- Agricultural assistance and tools.
- Water supply, treatment, and distribution.

- Improvement of communitarian spaces infrastructure and construction of new communitarian buildings.
- Fire brigades implementation.
- Training on REDD projects and activities.
- Construction of cassava flour houses.
- Equipment for the "*açaí*" production.
- Youth training.

After that first diagnostic phase, the formal consultations were organised, involving not only the communities, but also the other Stakeholders, such as public institutions, independent organisations, etc.

Consultations were held in three different cities and two communities.

For the municipalities of Novo Aripuanã, Manicoré and Manaus, the following stakeholders were invited:

- Townhall, City Council and Secretaries of Novo Aripuanã.
- Townhall, City Council and Secretaries of Manicoré.
- Institute of Sustainable Agriculture and Forestry – IDAM.
- Environmental Agency of the Amazonas State (IPAAM).
- State University of Amazonas (UEA).
- Federal University of Amazonas (UFAM).
- Environmental Police.
- Chico Mendes Institute of Conservation and Biodiversity (ICMBio).
- Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA).
- National Institute of Colonization and Land Reform (INCRA).
- State Secretary of Rural Production (SEPROR).
- National Institute of Amazon Research (INPA).
- Institute of the Amazon Sustainable Development (IDESAM).
- Social and Environmental Institute (ISA).
- Public Ministry.
- Association of Residents and Friends of the Sustainable Development Reserve of Juma (AMARJUMA).
- Association of the Agroextractive Producers of the Sustainable Development Reserve of Madeira River (APRAMAD).
- Cooperative of the Extractivists, Farmers and Producers of Cassava Flour and its Derivates of the Sustainable Development Reserve of Juma (COOPEA).

For the municipalities, the consultation dates, location and quorum were:

- Novo Aripuanã city - July 6th, 2022 - Municipal School "Dioneia Alves Mittouzo, from 9 a.m. to 1 p.m, 21 participants.
- Manicoré city - July 11th, 2022 - was held at the City Council, 08 participants.
- Manaus - July 12th, 2022 - FAS headquarters, 2 p.m. to 5 p.m., 13 participants.

Due to the distance between the communities, FAS proposed and implemented strategy was to reunite the Mariepaua River communities on one day and the Madeira River on another. To ensure that people could participate with no financial strain, FAS offered resources to cover fuel expenses, as well as provided meals for all the participants on the day of the consultations.
The consultation at the communities were scheduled as follows:

- Mariepaua River, Community of Belas Águas, July 7th, from 9 a.m. to 1 p.m.
- Madeira River, Community of São Pedro do Uruá-Miriti, July 8th, from 9 a.m. to 1 p.m.

In all cases, consultations were developed by using approachable visual resources, such as slides presentations and pressed banners, which included: project context, project description, ownership, preliminary quantification, explanations about the shared benefits, the process for carbon projects and overall questions.

The consultations were carried out by FAS team, along with Radicle team and Vieira Rezende, the law firm representing the Project Proponent. The summary of the results from those consultations are presented as follows. A complete report prepared by FAS, as well as signed lists, copies of the invitations and other documents are available for consultation (see **Appendix 3**).

<u>July 06 – Novo Aripuanã:</u>

The consultation at the municipality of Novo Aripuanã (**Figure 15**) had mostly institutional representants, such as city councelors, people from municipal secretaries and other organisations. Some landowners that had heard of the projects were also present.

Overall, the consultation served the purpose of explaing the projects and its benefits. Among the raised comments and concerns, were:

- The necessity of the project working along with existing State and Municipal initiatives, such as improving agricultural communitarian production in the area.
- The necessity of clarifying land ownership.

At the consultation, land title was the most stressed issue. Six individuals claimed to own parcels of land overlaping the Project Area. At the consultation, they did not present valid proof of title, but the team took their contact information for further discussion.

Figure 15 - Record from Novo Aripuanã Consultation

On the same day, the entire consultation team was invited to talk to the Mayor, Mr. Jocione Souza and the city counselors (**Figure 16**). They indicated to be in favor of the project, but also raised questions regarding land onwership and the benefits to be shared with the population.

Figure 16 - Record from meeting with the City of Novo Aripuanã

<u>July 07 – Belas Águas Community – Mariepaua River</u>

The consultation in Belas Águas (**Figure 17**) was focused on the discussion of the project with the riverine communities involved. Of the 23 communities identified at that River, only four did not send their representatives to the consultation: São Sebastião do Madeira, Paiucauá, São Bento e Feliz Vitória.

Overall, the day was very productive, and the project team was able to present the project and answer to the questions raised, which were:

- Is the project going to impose prohibitions to already implemented activities, such as small agricultural productions?
- What is the share of benefits with the communities and how is it going to be implemented?
- What are the next steps of the process?
- How can the communities be actively involved in the project?

For those points, the team pointed out that all ongoing activities would be respected, so long as they aligned with the project orientations, avoiding, for example, the use of extensive fire and other recommendations. As far as the shared benefits, the team explained that an independent institution would manage revenues from credits, in order for the process to be transparent.

Figure 17 - Record of the consultation at Belas Águas Community

<u>July 08 – São Pedro do Uruá-Miriti Community – Madeira River</u>

The consultation at the São Pedro do Uruá-Miriti community faced safety issues and could not occur. The team went to the location, as previously agreed with the leader of the community. Although the team was ready to explain the project and collect feedback at the start of the consultation, a group of people threatened the team, which had to leave the situation. The details of that event are available for consultation at the report of Appendix 3. The consultation at those communties will have to be rescheduled before validation.

<u>July 11 – City of Manicoré</u>

The consultation at the City of Manicoré (Figure 18) was to be held at the City Council. However, due to safety concerns after the events on July 8th, the consulation was a closed meeting at the Mayor's Office, in which only representantives of FAS were present representing the Project. The Project was presented for the Mayor and the City Counselors, which were mostly in favor of its implementation, although some had questions regarding the legality of the land ownership.

Figure 18 - Record of the meeting at Manicoré City

<u>July 12 – City of Manaus</u>

The consultation at Manaus (Figure 19) was very productive, with the participation of different institutions. The project was presented at the headquarters of FAS, using slides. From comments gathered, the summary was:

- IPAAM wanted to understand the safeguard metrics for the project, to which the response was that Verra's most updated methods were being used, as well as FAS expertise in the creation of indicators.
- Mr. Júlio César claimed to be representing a landowner, whose property overlapped the Project Area. The same procedure was applied, and his contact information was collected to be given to the Project Proponent legal representant.

Figure 19 - Record of the consultation in Manaus

The main takeaways from the consultations, along with FAS recommendations were:

- Discuss case by case regarding land dispute.
- Consider a 2km buffer from the Madeira River communities to their uses for agricultural reasons (measure already considered at the presented Project Area at this PD Version).
- Perform consultations at the communities where they could not happen.

Measures are being taken for each of those topics, as well as the preparation of agreements, to be signed with every community/organization participating in the project.

Regarding communication, the established procedure for ongoing communication with Stakeholders during the project crediting period involves three main channels:

- Written communication: printed copies of the PD, monitoring reports and supporting files will be made available in Portuguese for the Manicoré and Novo Aripuanã townhall, as well as the IPAAM agencies, and all the communities. Simplified reports will also be prepared and delivered to those locations.
- Online communication: project files and reports will be available for consultation at both the Verra website, and also a specific project website, where information such as project implementation status and credit generation will be transparent for stakeholders. A project e-mail will be available to receive any questions regarding the project.
- On-site communication: annual visits will occur at the sites, where the main stakeholders will be communicated with about the project status, as well as present results on carbon credits generation and activities implemented.

Any validation and verification activities will be communicated through the processes mentioned above.

2.3 Environmental Impact

An Environmental Management System (EMS) was designed during the Project Implementation phase in support of an environmental impact assessment, based on the principles of ISO 14,001/2015. Details are provided in **Table 6**, and the full 413 REDD Project EMS file is provided in **Appendix 2.**

Table 6 – Aspects, impacts and control measures of the project, as per the Environmental Management System

Aspect	Impact	Control Measures
Environmental Service and Support	Positive. Maintenance of biodiversity and genetic heritage.	Ensure preservation of the existing forest.
Environmental Service and Regulation	Positive. Maintain a stable ecosystem and ecosystem processes including, carbon sequestration, air purification, the	Ensure preservation of the existing forest.

Aspect	Impact	Control Measures
	hydrological cycle, flood mitigation and minimizing erosion.	
Environmental Service and Products	Positive. Sustainable supply of environmental goods and services used by locals.	Ensure preservation of the existing forest.
Environmental Service and Products	Negative. Displacement of activities to areas outside the project boundary causing pressure on forest resources.	Community engagement to ensure project benefits are articulated. Ongoing monitoring within and beyond the project boundary.
Culture	Positive. Co-benefits related to cultural identity, spiritual and aesthetic values.	Community engagement to ensure opportunities to maintain traditional practices and lifestyle.
Community	Positive overall. Positive community benefits and co-benefits. Potential conflict with competing landowners who may have misaligned competing interests.	Community engagement to articulate benefits and co-benefits. Communication with other local landowners as to project benefits and the advantages of their participation in future carbon projects.

The EMS will be used to structure internal audits of project performance, both remote (desktop review) and in the field. Audits will be performed against a checklist of ISO requirements. For each item on the checklist, the internal audit shall indicate whether the parameter is in conformance, non-conformance and/or requires specific attention. Internal Audit results will be taken to the Executive Manager who will coordinate Action Plans to resolve any issues.

2.4 Public Comments

This section will be concluded after the Public Comments period.

2.5 AFOLU-Specific Safeguards

Stakeholders’ consultation was explained at Section 2.3.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The Project is in accordance with VCS Standard, v.4.2.

The methodology used in the project scope:

- VM0007 REDD+ Methodology Framework (REDD+MF), v1.6

The following set of modules and tools is mandatory for the project activities:

- VMD0001 - Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB), v1.1.
- VMD0002 Estimation of carbon stocks in the dead-wood pool (CP-D), v1.0.
- VMD0005 Estimation of carbon stocks in the long-term wood products pool (CP-W), v1.1.
- VMD0006 - Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL), v1.3.
- VMD0009 Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP), v1.3.
- VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning (E-BPB), v1.2
- VMD0015 - Methods for monitoring of greenhouse gas emissions and removals (M-REDD), v2.2
- VMD0016 Methods for stratification of the project area (X-STR), v1.2.
- VMD0017 - Estimation of uncertainty for REDD project activities (X-UNC), v2.2.
- VT0001 Tool for the demonstration and assessment of additionality in VCS agriculture, forestry, and other land use (AFOLU) project activities (T-ADD), v3.0.
- VCS AFOLU Non-Permanence Risk Tool (T-BAR), v4.0
- CDM Tool for testing significance of GHG emissions in A/R CDM project activities (T-SIG) v1.0

3.2 Applicability of Methodology

The Project Activity is designed to reduce emissions from avoided planned deforestation (APD) and is defined as a REDD activity type, as per section 1.3. A description of how the Project activity meets the applicability conditions of VM0007 v1.6 and the associated tools and modules, is provided in **Table 7.**

Table 7 - Applicability of Project activities to the VM0007 methodology

Condition	Explanation
CDM or other GHG program	No land within the project area is registered under the CDM or any other GHG program.
Land in the project area has qualified as forest (following the definition used by VCS) for at least the 10 years prior to the project start date.	All lands located within the project areas are covered and qualified as forest for at least the 10 years prior to the project start date, as documented in sections 1.13 and 3.5.
If land within the project area is peatland or tidal wetlands and emissions from the SOC pool are deemed significant, the relevant WRC modules (see VM0007 v1.6 Table 3) must be applied alongside other relevant modules.	No applicable lands within the Project Area.
Baseline deforestation and forest degradation in the project area fall within one or more of the following categories: i. Unplanned deforestation (VCS category AUDD), ii. Planned deforestation/degradation (VCS category APD), iii. Degradation through extraction of wood for fuel (fuelwood and charcoal production) (VCS category AUDD).	The baseline in the project area is categorized as planned deforestation, VCS category APD (section 3.5).
Leakage avoidance activities must not include i. Agricultural lands that are flooded to increase production, ii. Intensifying livestock production through use of feed-lots and/or manure lagoons.	These leakage avoidance activities are not present on the project area (section 1.18).
For APD, the conversion of forest lands to a deforested condition must be legally permitted on the project area.	Conversion of forest lands to deforested condition as per the baseline scenario is legally permitted (section 3.5). This excludes any legal reserve and permanent preservation area requirements, in accordance with Brazilian legislation.

The applicability of the applied modules is described in **Table 8.**

Table 8 - Applicability of the modules

Module	Condition/Explanation
VMD0001, v1.1	**Condition:** This module is applicable to all forest types and age classes and is used to calculate the aboveground tree biomass pool. Non-tree aboveground biomass is not included as part of the project boundary. **Explanation:** Inclusion of the aboveground tree biomass pool as part of the project boundary is mandatory as per the framework module REDD-MF. Non-tree aboveground biomass is not included as part of the project boundary because: • Stocks of non-tree aboveground biomass will be lower in the baseline than in the project scenario, and • Non-tree aboveground biomass was determined to be non-significant using the T-SIG module (**Appendix 7**).
VMD0002, v1.0	**Condition:** Applicable to all forest types and age classes if the dead wood pool is included as part of the project boundary. **Explanation:** Dead wood is included in the project because: i. Dead wood stocks are greater in the baseline than in the project scenario (in conformance with REDD-MF), and ii. Dead wood was determined to be significant using the T-SIG module (**Appendix 7**).
VMD0005, v1.1	**Condition:** Applicable to all cases where wood is harvested for conversion to wood products *for* commercial markets. **Explanation:** This module is applicable in the baseline because the wood products pool is included as part of the project boundary as per applicability criteria in the framework module REDD-MF, specifically: i. Timber harvest occurs prior to or in the process of deforestation, and timber is destined for commercial markets, ii. The wood products pool is determined to be significant using T-SIG (**Appendix 7**).

Module	Condition/Explanation
VMD0006, v1.3	**Condition:** Estimating baseline emissions on forest lands (usually privately or government owned) that are legally authorized and documented to be converted to non-forest land. **Explanation:** The Project Area is defined as a private forest that can be legally converted to non-forest land (section 3.5).
VMD0009 v1.3	**Condition:** Estimating leakage emissions due to activity shifting from forest lands that are legally authorized and documented to be converted to non-forest land. **Explanation:** The Project Area is defined by forest that would be legally converted to non-forest land, as described under the BL-PL module. This module is mandatory.
VMD0013 v1.2	**Condition:** Applicable to REDD project activities with emissions from biomass burning. **Explanation:** The module is mandatory.
VMD0015, v2.2	**Condition:** Where selective logging is taking place in the project case: i. Emissions from logging may be omitted if it can be demonstrated the emissions are de minimis using Tool T-SIG; ii. If emissions from logging are not omitted as de minimis, logging may only take place within forest management areas that possess and maintain a Forest Stewardship Council (FSC) certificate for the years when the selective logging occurs; iii. Logging operations may only conduct selective logging that maintains a land cover that meets the definition of forest within the project boundary; iv. All trees cut for timber extraction during logging operations must have a DBH greater than 30 cm; v. During logging operations, only the bole/log of the felled tree may be removed. The top/crown of the tree must remain within the forested area;. vi. The logging practices cannot include the piling and/or burning of logging slash; vii. Volume of timber harvested must be measured and monitored. **Explanation:** Mandatory for REDD project activities. However, emissions from selective logging were demonstrated to be de minimis using Tool T-SIG (**Appendix 7**).

Module	Condition/Explanation
VMD0016, v1.2	**Condition:** Any module referencing strata must be used in combination with this module. In case of REDD, aboveground biomass stratification is only used for pre-deforestation forest classes, and strata are the same in the baseline and the project scenario. Post-deforestation land uses are not stratified. Instead, average post-deforestation stock values (e.g., simple or historical area-weighted approaches are used, as per Module *BL-UP*). **Explanation:** A single stratum was applicable to the 413 Project based on the vegetation types given by the official Brazilian Vegetation Map published by IBGE (2018)[19]. In the project, the planned deforestation baseline is applied exclusively to the dense rainforest.
VMD0017, v2.2	**Condition:** Applicable for estimating the uncertainty of estimates of emissions and removals of CO2-e generated from REDD project activities. The module focuses on the following sources of uncertainty: i. Determination of rates of deforestation and degradation, ii. Uncertainty associated with estimation of stocks in carbon pools and changes in carbon stocks, and iii. Uncertainty in assessment of project emissions. **Explanation:** Mandatory when using methodology REDD+ MF.
VT0001, v3.0	**Condition:** The tool is applicable under the following conditions: i. AFOLU activities which are the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced; ii. The use of this tool to determine additionality requires the baseline methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity. **Explanation:** The activities in the proposed project boundary do not lead to violation of any applicable law even if the law is not enforced. Section 3.6 provides a stepwise approach to justify determination of the most plausible baseline scenario.

[19] Derived from Instituto Brasileiro de Geografia e Estatística (IBGE) – Brazilian Vegetation.

Module	Condition/Explanation
AFOLU Non-Permanence Risk Tool, v4.0	**Condition:** Applicable in all circumstances. **Explanation:** The tool was used to determine the non-permanence risk rating, the number of buffer credits that an AFOLU project shall deposit into the AFOLU pooled buffer account (see appendix III for calculations).
CDM "Tool for testing significance of GHG emissions in A/R CDM project activities" (Version 01) T-SIG	**Condition:** This tool facilitates the determination of which GHG emissions by sources, possible decreases in carbon pools, and leakage emissions are insignificant. **Explanation:** The sum of decreases in carbon pools and increases in emissions that may be neglected shall be less than 5% of the total decreases in carbon pools and increases in emissions, or less than 5% of net anthropogenic removals by sinks, whichever is lower.

3.3 Project Boundary

The geographical boundary of the Project is a situated in the municipalities of Manicoré and Novo Aripuanã, southeastern Amazonas State, northern Brazil (Figure 1). The total area of the Mata-Mata property is 496,342 ha, of which 87,692 ha (17.7%) is delimited as the project area (see section **Erro! Fonte de referência não encontrada.**).

Proxy Areas

APD projects require a minimum of 6 proxy areas (PAs) in cases where a valid verifiable plan does not exist for the rate at which deforestation is projected to occur (as per VMD0006). PAs are not required to be managed by the same deforestation agent as the project area baseline.

The Madeira micro-region was selected as representing a suitable area for locating PAs. The rationale is that most deforestation activity is anticipated to come from east and north of the project area, having the Madeira River as an important access axis; the northern Madeira micro-region is protected by transport limitations and the existence of large, protected areas (see section **Erro! Fonte de referência não encontrada.** for supporting evidence).

A total of 7 PAs were identified within the reference area (**Figure 20)** after taking account of the following:

1. Must be located on private land. These were identified using the National Registry of Public Forests (Brazilian Forest Service), a regional, publicly available data layer, which identifies public forests along with protection status[20]. Private lands were identified as those remaining after public lands were removed.

[20] https://www.gov.br/agricultura/pt-br/assuntos/servico-florestal-brasileiro/cadastro-nacional-de-florestas-publicas

2. The size of a given PA should be within the range of the management areas identified in the project area.

3. Forest cover (with dense rainforest types) should be similar to the project management areas.

4. Proximity to roads and waters should be reasonably consistent between project areas and the PAs.

Once the initial proxy areas were identified, statistical summaries were created for each area. The following regional data were added to the reference region to ensure appropriate similarity and context:

a. Hydrology layers from IBGE.[21]

b. Transportation layers from IBGE.[22]

c. Cities and towns from IBGE.[23]

d. Municipal boundaries from IBGE.[24]

e. Forest vegetation mapping was added to identify areas with similar forest types to the project areas using the national vegetation data layer for Brazil[25]. Areas within the reference area that contained significant coverage of dense rainforest (*Floresta Ombrófila Densa*) were identified as eligible.

f. Elevation and Slope data: A digital elevation model (DEM) was downloaded for the reference region using Google Earth Engine based on the NASA NASADEM Digital Elevation 30m dataset.[26]

g. Regional soils data from IBGE.[27]

Figure 20 shows the location of proxy areas, and **Table 9** their similarity with vegetation, soil type, and topography compared to the project area.

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[21] Continuous Cartographic Base of Brazil, scale 1:250,000 - BC250: https://www.ibge.gov.br/geociencias/downloads-geociencias.html?caminho=cartas_e_mapas/bases_cartograficas_continuas/bc250/versao2021/

[22] *idem*

[23] *idem*

[24] *idem*

[25] https://bdiaweb.ibge.gov.br/#/consulta/vegetacao

[26] See more on GEE's NASA NASADEM datasets.

[27] https://bdiaweb.ibge.gov.br/#/consulta/pedologia

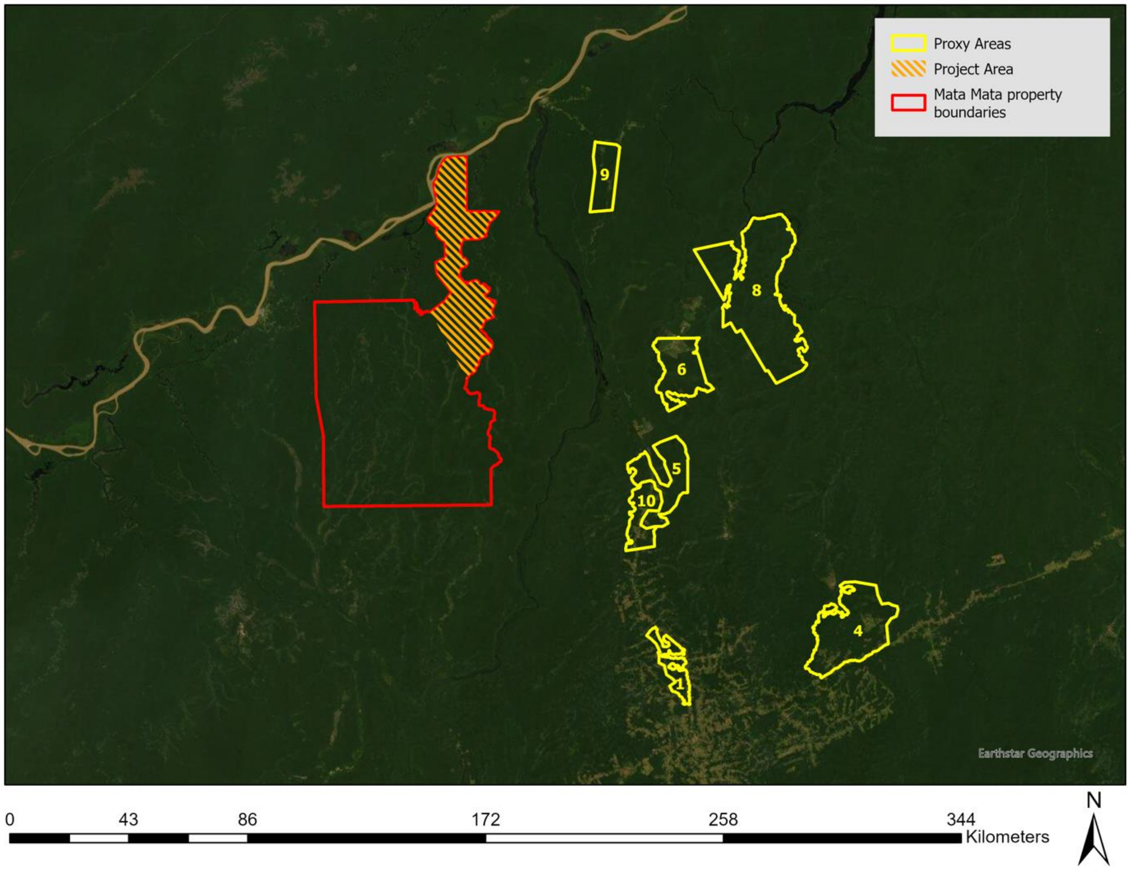
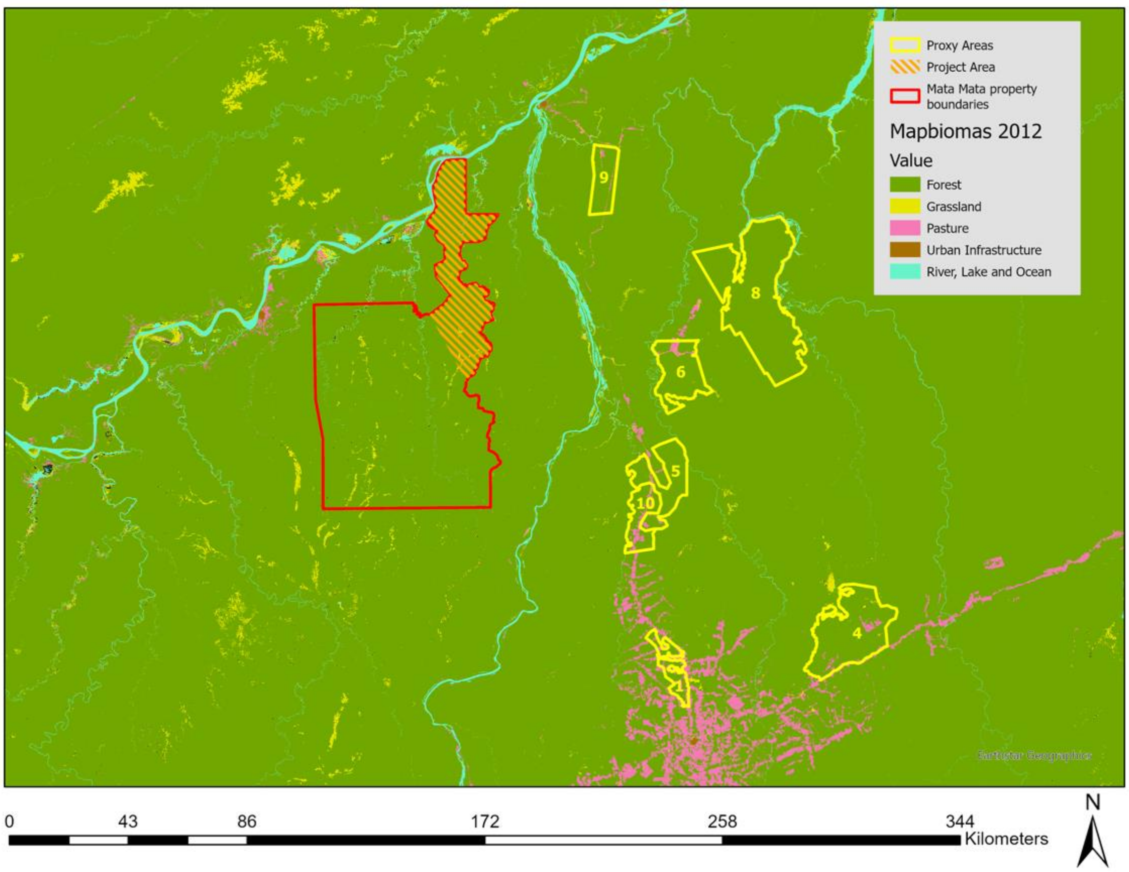


Figure 20 - Map of the project area and 7 proxy sites

Table 9 - Comparison of vegetation, soil type, and topography of the project area and proxy sites

Factors Assessed	Category	Project Area	P_1	P_4	P_5	P_6	P_8	P_9	P_10
Vegetation (%)									
	Dense Forest	94.2%	93.6%	96.9%	99.7%	99.3%	99.8%	100.0%	90.2%
	Other	5.8%	6.4%	3.1%	0.3%	0.7%	0.2%	0.0%	9.8%
Elevation (%)									
	0-500m	100%	100%	100%	100%	100%	100%	100%	100%
Slope Class (%)									
	Gentle (<15%)	95.8%	77.9%	95.1%	86.5%	91.4%	85.0%	94.3%	77.0%

Factors Assessed	Category	Project Area	P_1	P_4	P_5	P_6	P_8	P_9	P_10
	Steep (=>15%)	4.2%	22.1%	4.9%	13.5%	8.6%	15.0%	5.7%	23.0%
Soil Type (%)									
	ARGISSOLO	0%	49%	0%	3%	0%	0%	0%	15%
	ESPODOSSOLO	7%	0%	3%	0%	0%	0%	0%	0%
	GLEISSOLO	0%	0%	0%	4%	0%	0%	0%	5%
	LATOSSOLO	93%	51%	97%	93%	100%	99%	100%	80%



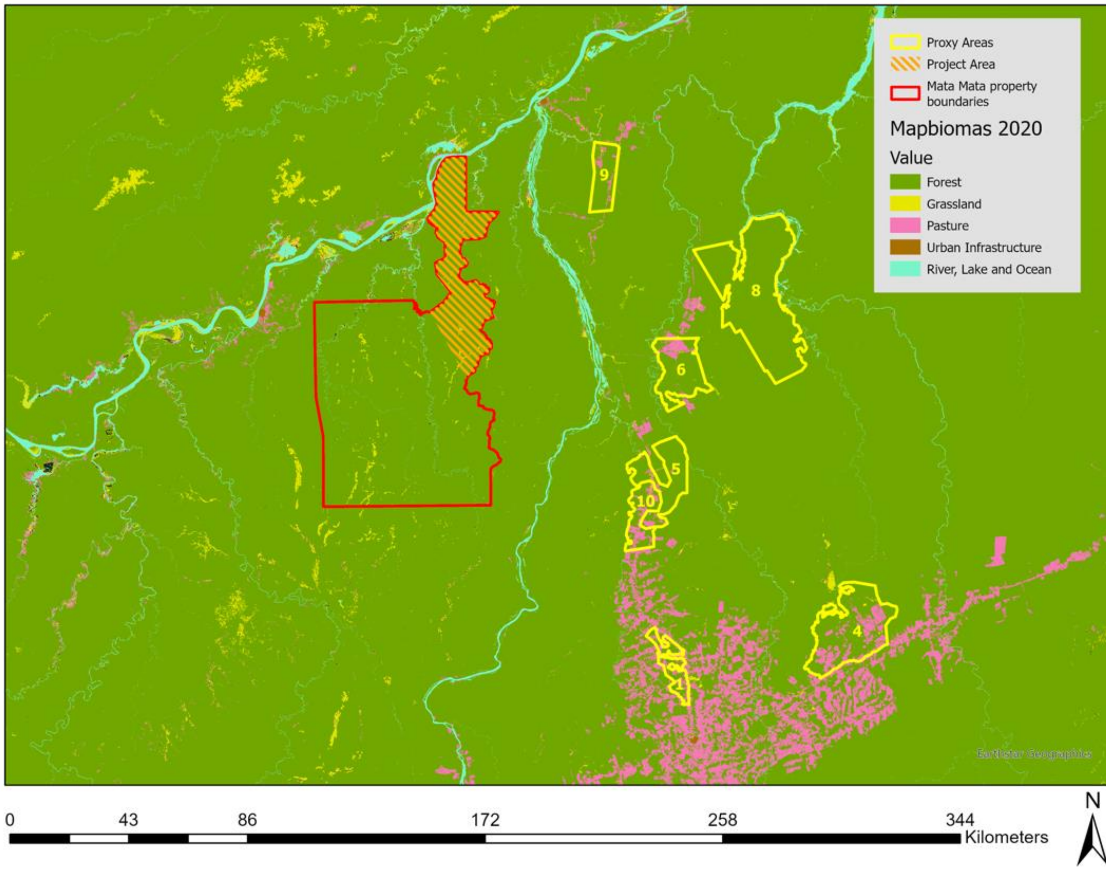


Figure 21 - MAPBIOMAS land use and land cover transitions in proxy areas

Figure 21 and Table 10 illustrate the land use changes that occurred between the years 2012 and 2020 on the proxy areas.

Table 10 - Land use change in proxy areas, according to MAPBIOMAS

Proxy areas land use transition 2012 - 2020	Area (ha)	Area (%)
Forest cover or non-forestry natural areas to agriculture or non-vegetated areas	24,545	8.1
Agricultural classes or non-vegetated areas to forest cover or non-forest natural areas	1,230	0.4

3.4 Carbon sinks and reservoirs

Carbon sinks and reservoirs included or excluded within the boundary of the proposed project activity are listed in **Table 11.**

Table 11 - Carbon sinks and reservoirs

Carbon Pool	Included/Excluded	Justification/Explanation
Aboveground tree biomass	Included	Mandatory as per VM0007 v1.6, Table 4.
Belowground tree biomass	Included	Mandatory as per VM0007 v1.6, Table 4.
Deadwood	Included	Mandatory for the given project activity if this carbon pool is greater in baseline (post-deforestation/degradation) than project scenario and significant.
Litter	Excluded	The litter pool is considered an insignificant source in REDD projects, and inclusion of the litter pool as part of the project boundary is optional, as per VM0007 v1.6, Table 4.
Soil Organic Carbon	Excluded	Optional, as per VM0007 v1.6, Table 4.
Harvested Wood Products	Included	Mandatory when the process of the deforestation involves timber harvesting for commercial markets, as per VM0007 v1.6, Table 4.

3.4.1. Sources of GHG Emissions

GHG sources within the boundary of the proposed APD project activity, as well as the respective justification/explanation, are listed in **Table 12.**

Table 12 - Sources and GHG included or excluded within the boundary of the APD project

Source		Gas	Included?	Justification/Explanation
Baseline	Carbon stock changes	CO_2	Yes	Stock changes were included since they are mandatory in the methodology
		CH_4	No	Not applicable.
		N_2O	No	Not applicable.
		Other	No	Not applicable
	Biomass burning	CO_2	No	CO_2 emissions are already considered in carbon stock changes.
		CH_4	Yes	CH_4 emissions are included because fire is often used for land preparation in cattle ranching in the region.
		N_2O	No	Not relevant
		Other	No	No relevant source identified.
	Fossil fuel combustion	CO_2	No	Fully optional for the given project activity, as per VM0007, Table 4. No significant fossil fuel combustion is anticipated.
		CH_4	No	
		N_2O	No	
		Other	No	
	Fertilizer use	CO_2	No	Fully optional for the given project activity, as per VM0007, Table 4. No fertilizer use is anticipated.
		CH_4	No	
		N_2O	No	
		Other	No	
	Enteric fermentation	CO_2	No	Excluded. GHG emissions from enteric fermentation in baseline scenario is not significant, based on the T-SIG module (less than 5% of baseline emissions).
		CH_4	No	
		N_2O	No	

Source		Gas	Included?	Justification/Explanation
		Other	No	
Project	Carbon stock changes	CO_2	Yes	Stock changes were included since they are mandatory in the methodology
		CH_4	No	Not applicable.
		N_2O	No	Not applicable.
		Other	No	Not applicable.
	Biomass burning	CO_2	No	Not expected to occur in the project case.
		CH_4	No	
		N_2O	No	
		Other	No	
	Fossil fuel combustion	CO_2	No	Not expected to occur in the project case.
		CH_4	No	
		N_2O	No	
		Other	No	
	Fertilizer use	CO_2	No	Not expected to occur in the project case.
		CH_4	No	
		N_2O	No	
		Other	No	
	Enteric fermentation	CO_2	No	Not expected to occur in the project case.
		CH_4	No	
		N_2O	No	
		Other	No	

3.5 Baseline Scenario

The baseline scenario was derived in accordance with VMD0006 v1.3 guidelines. This module provides a stepwise approach for estimating GHG emissions related to planned deforestation. Project additionality is then derived in section 3.6 as per the tool VT0001.

3.5.1. Agent of Planned Deforestation

The landowner, Mr. Luis Ernesto Pereira Taranto is identified as the agent of planned deforestation in the baseline.

3.5.2. Area of Deforestation

The area of deforestation ($A_{planned,i}$) is defined as follows:

Legal permissibility for deforestation: According to Brazil Federal Law N°12,651/2012, Art.12 every rural property must maintain an area with native vegetation coverage. That includes an area of native vegetation such as the Legal Reserve, in addition to the Permanent Preservation Area, observing minimum percentages in relation to the property area. For properties located in the Legal Amazon, this percentage is equal to 80%. Thus, the legal area permissible for deforestation is 20% of the project area.

Suitability of project area for conversion to alternative non forest land use: This analysis evaluates opportunities to implement alternative land use practices related to the livestock sector and timber harvesting, as opposed to conserving the area as a standing forest. The following three perspectives were evaluated: i. Environmental/legal feasibility assessment - the suitability of a particular crop or activity, livestock or timber harvesting in accordance with a Sustainable Forest Management Plan (PMFS[28]) in relation to climate, soils, and the legal framework in the region; ii. Logistical feasibility – if the region has facilities to support the production flow; and iii. Economic feasibility – a financial comparison between livestock activity and logging.

Environmental/legal feasibility:

The southern region of the State of Amazonas and the municipality of Novo Aripuanã have few limitations with respect to climate and soil regarding cattle production or harvesting. In fact, the region has become an important center for cattle production. According to the IBGE Agricultural Census, in Novo Aripuanã alone, the size of the herd grew 140% in the period from 2006 to 2017. In Manicoré, the herd increase was 107% over the same period[29].

According to IBGE, between 2018 and 2020 Novo Aripuanã and Manicoré were the main producers of wood products in the southern Amazonas region. There has been a significant

[28] According to Brazilian legislation (Annex II, Resolution 294/01), companies require a PMFS to operate legally in the Brazilian Amazon. The PMFS specifies harvest methods and activities that accord with ecological, economic, and social objectives to promote sustainability.

[29] Derived from IBGE - Census of Agriculture. For more information refer to Biodendro__Estudo_Viabilidade 02junho2022_Rev1.docx.pdf (p.21)

increase in annual deforestation rates in recent years, according to data from PRODES from INPE[30] and of the MAPBIOMAS data [31].

Logistical feasibility:

This element was evaluated by assessing the potential flow of goods across the region, both by river and overland. The Madeira River is the second most important transport route in the Amazon, and it is used extensively to transport a broad range of products, including timber. Transport by land is more precarious, with few roads and restricted traffic conditions, especially in the rainy season. This does not, however, constitute an insurmountable obstacle for agricultural activities such cattle production, because cattle can used roads even when they are impassable to vehicular traffic.

Economic viability:

The project area is located in the Amazonas state in a region dominated by livestock production, the main economic activity driving deforestation[32]. Cattle are raised with minimal investment in pastureland management or herd quality. No effort is made to preserve soil nutrients or feed nutritional value. Once the productive capacity of an area has been depleted, farmers simply deforest new areas and move their cattle, abandoning the old pastures. These extensive pastural systems are employed because, at R$ 200 to R$ 500 (~$38.5 to 96.3 USD) per ha[33], they are much cheaper than intensive systems (R$ 1,500 to 5,000 per ha; ~ $ 288.9 to 963.2 USD). Once established, the profitability of livestock farming is estimated at R$ 61.00 /ha/year (~$11.75 USD)[34]. Timber removal itself also has value; in 2021, the region produced 54,000 m^3 of round wood, with a value of R$ 4,428,000 (~$849,240 USD) (IBGE, 2022)[35].

Government approval for deforestation: The Mata-Mata property owner has government approval of the proposed baseline land use change.

"If government approval is required for deforestation to occur, the intention to deforest within the project area must be demonstrated by evidence:

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30 Deforestation rates were derived from PRODES - Desflorestamento nos Municipios - DPI/INPE.

31 Land use transition for the state of Novo Aripuanã, Manicoré and Apuí derived from Mapbiomas v6.0.

32 Veiga, J. B., Tourrand, J. F., Poccard-Chapuis, R., & Piketty, M. G. (2002). Cattle ranching in the amazon rainforest. In *Proc. Aust. Soc. Anim. Prod* (Vol. 24, pp. 253-256).

33 IDESAM, 2014. For more details, refer to Biodendro Estudo Viabilidade 02junho2022_Rev1.docx.pdf.

34 Cenamo and Carrero 2012. Reducing Emissions from Deforestation and Forest Degradation (REDD) in Apuí, Southern Amazonas: Challenges and Caveats Related to Land Tenure and Governance in the Brazilian Amazon

35 Brazilian Institute of Geography and Statistics. (2022, Sep 8).

Currency exchange rate of 1 USD to 5.21 R$, published on 2022-09-08

- *Recent approval from relevant government department (local to national) for conversion of forest to an alternative land use;*
- *Documentation that a request for approval has been filed with the relevant government department for permission to deforest and convert to alternative land use".*

In the 413 Project, this requested has been filled with IPAAM and it is available for consultation (Appendix 4).

Intent to deforest: Intent to deforest is demonstrated by the documented history of similar planned deforestation within the previous five years by this class of agents, as follows.

Under IBAMA Normative Instruction No. 21/2014: 7th, II (native forest; collection)[36], landowners with market access (i.e., access to major roads and navigable rivers) have deforested at least 20% of their properties. This is substantiated from the PRODES dataset of deforestation around the project area. The neighboring Alexandre III property was added into the analysis to further demonstrate recent deforestation activities on a nearby private property (Figure 22).

[36] Derived from CTF proof of registration.

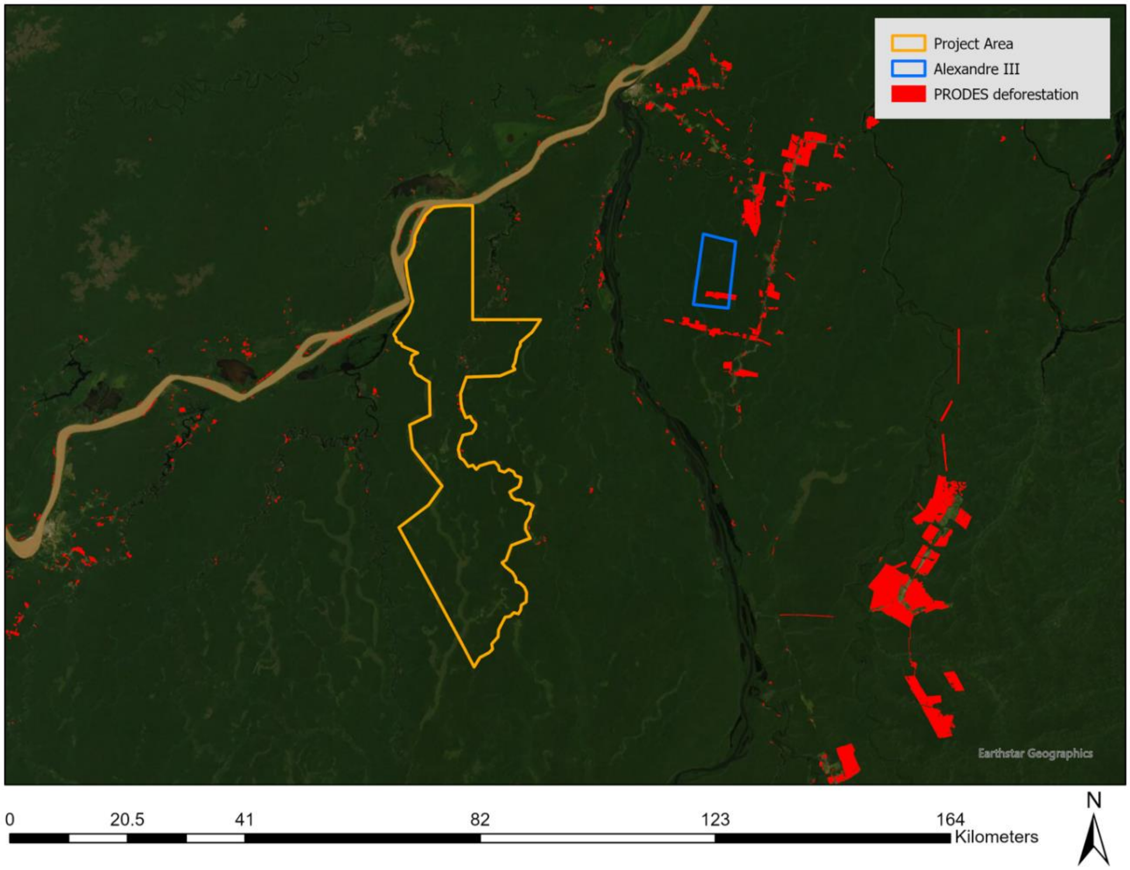

Figure 22 - PRODES deforestation areas with outline of Project Area and Alexandre III property

3.5.3. Rate of Deforestation

The deforestation rate was established from proxy areas (see section 3.4). Proxy areas were overlain with PRODES data to estimate their annual deforestation rates over the previous 10 years, from which an average deforestation rate was calculated. The expected loss rate was determined by multiplying the rate obtained from the proxy areas by the total area of dense forest in the project area (Table 13). The average deforestation rate per annum was 1.8%.

Table 13 - Annual proportion of land deforested (Def) on proxy areas

Proxy ID	Total Forest Area (ha)	Net Forest Area (ha)	Total Def (ha)	% Def	Years of Def	%Def/yr
P_1	13,615	12,932	2,736	21.2%	10	2.1%
P_4	61,270	59,796	17,282	28.9%	10	2.9%
P_5	32,771	32,114	2,206	6.9%	9	0.8%
P_6	32,784	31,680	5,910	18.7%	9	2.1%

Proxy ID	Total Forest Area (ha)	Net Forest Area (ha)	Total Def (ha)	% Def	Years of Def	%Def/yr
P_8	118,477	118,468	35	0.0%	1	0.0%
P_9	19,970	19,735	2,761	14.0%	10	1.4%
P_10	17,575	16,386	4,910	30.0%	10	3.0%
					Avg	**1.8%**

A graphical representation of land use conversion within proxy areas in years 2012 compared to year 2020 is shown in **Figure 5** (section 3.3).

3.5.4. Likelihood of Deforestation, L-Di

In accordance with VMD0006, v1.3, the likelihood of deforestation ($L\text{-}D_i$) is 100%, because the project area is not under government control and is zoned for planned deforestation.

3.5.5. Risk of Abandonment

Risk of abandonment is based on proxy areas that have had the same class of deforestation agent over the previous 10-year interval. **Table 14** shows the relative land use transition in the period of 2012-2020 from MAPBIOMAS land-use mapping for all proxy areas in Manicoré, Apuí and Novo Aripuanã.

Table 14 - Land abandonment in proxy areas

Proxy areas land use transition 2012 - 2020	Area (ha)	Area (%)
Forest cover or non-forestry natural areas to agriculture or non-vegetated areas	24,545	8.1
Agricultural classes or non-vegetated areas to forest cover or non-forest natural areas	1,230	0.4

3.5.6. Annual Area of Deforestation

The annual area of deforestation in the baseline and project case is in accordance with the rate of deforestation from proxy areas (**Table 15**).

Table 15 - Calculation of the annual area of planned deforestation in the baseline, based on a 1.8% average rate of deforestation

Baseline			Project		
Year	forest loss (ha/yr)	cumulative loss (ha)	Year	forest loss (ha/yr)	cumulative loss (ha)
2021	8,365	8,365	2021	52	52
2022	8,365	16,730	2022	52	104
2023	8,365	25,095	2023	52	156
2024	8,365	33,460	2024	52	208
2025	8,365	41,825	2025	52	260
2026	8,365	50,190	2026	52	312
2027	8,365	58,555	2027	52	364
2028	8,365	66,919	2028	52	416
2029	8,365	75,284	2029	52	468
2030	8,365	83,649	2030	52	520
2031	4,043	87,692	2031	52	572
2032	0	87,692	2032	0	572
2033	0	87,692	2033	0	572
2034	0	87,692	2034	0	572
2035	0	87,692	2035	0	572
2036	0	87,692	2036	0	572
2037	0	87,692	2037	0	572
2038	0	87,692	2038	0	572
2039	0	87,692	2039	0	572
2040	0	87,692	2040	0	572
2041	0	87,692	2041	0	572
2042	0	87,692	2042	0	572
2043	0	87,692	2043	0	572
2044	0	87,692	2044	0	572
2045	0	87,692	2045	0	572
2046	0	87,692	2046	0	572
2047	0	87,692	2047	0	572
2048	0	87,692	2048	0	572
2049	0	87,692	2049	0	572
2050	0	87,692	2050	0	572

3.6 Additionality

Additionality was assessed in accordance with the VCS tool VT0001 v3.0 “Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities”. It provides a stepwise approach to demonstrating additionality in VCS AFOLU projects, as follows.

3.6.1 Step 1. Identification of Alternative Land Use Scenarios to the proposed AFOLU Project Activity

Credible alternative land use scenarios are:

1. **Forest cover conservation on 20% of the property area, where land use conversion is allowed by law[37], resulting in financial returns other than from a REDD+ APD project.** The landowner has thus far retained the entire property as primary tropical rainforest. Ongoing avoidance of the 20% land use conversion on the project area, however, would be highly unlikely because this option has no real and consequential financial returns. Property ownership carries an annual fee and tax burden[38]. In addition, forest maintenance and protection against illegal activities (see Scenario 3) requires direct costs of surveillance, as well as wildfire monitoring and suppression. These direct costs, along with the opportunity cost incurred by revenue forgone from land use conversion (Scenario 2), is a strong disincentive to pursuing this option.

2. **Logging followed by conversion to pasture.** As per Brazil's Forest Code private property owners must set aside a minimum 80% of their land area for native vegetation in a protected legal reserve. As much as 20% then can be legally converted to an alternative land use. Conversion of native forest to pasture is common practice in the region. Large swathes of Legal Amazonia have been cleared, first for cattle, then later for soy (Barona et al., 2010, Zalles et al., 2019)[39].

3. **Continuation of the pre-project land use with an unabated threat of illegal deforestation exceeding 20% of the property area.** While the pre-project land use was tropical rainforest, this is unlikely to be sustained given current and historical land use change and deforestation pressures in the immediate area (see Figure 5). Evidence suggests that most deforestation in Brazil is illegal (Azevedo et al., 2020; Valdiones et al., 2019)[40]. Deforestation is illegal when

[37] As per Law 12.651, the landowner is allowed to convert up to 20% of forest from rural properties within the Amazon biome, to other land uses for economic purposes.

[38] Law No. 9,393 (December 19, 1996).

[39] Barona, Elizabeth & Ramankutty, Navin & Hyman, Glenn & Coomes, Oliver. (2010). The role of pasture and soybean in deforestation of the Brazilian Amazon. Environmental Research Letters. 5. 024002. 10.1088/1748-9326/5/2/024002. Viviana Zalles, Matthew C. Hansen, Peter V. Potapov, Stephen V. Stehman, Alexandra Tyukavina, Amy Pickens, Xiao-Peng Song, Bernard Adusei, Chima Okpa, Ricardo Aguilar, Nicholas John, and Selena Chavez. Near doubling of Brazil’s intensive row crop area since 2000. By Proceedings of the National Academy of Sciences Jan 2019, 116 (2) 428-435; DOI: 10.1073/pnas.1810301115

[40] AZEVEDO, T., ROSA, M. R., SHIMBO, J. Z., OLIVEIRA, M. G. 2020. RELATÓRIO ANUAL DO DESMATAMENTO NO BRASIL. Relatório Anual do Desmatamento no Brasil 2020 - São Paulo, Brasil - MapBiomas, 2021 - 93 páginas. VALDIONES, A.

its agents are not the legal landowner and/or do not possess the necessary documentation and permits. Unfortunately, illegal deforestation is rarely prosecuted by authorities making the likelihood of this scenario plausible.

All land use scenarios identified above are compliant with applicable legal and regulatory requirements, except Scenario 3, which represents illegal deforestation not undertaken by the landowners or project proponents. **Scenario 2 is considered the most plausible baseline scenario because of its positive economic returns and the fact that conversion is legally authorised.**

3.6.2 Step 2. Investment Analysis

The project area will be managed for conservation purposes only, rather than for commercial timber production, livestock, or crop production. As such, the proposed VCS AFOLU project activity produces no financial benefits other than VCS-related income. Costs to bring credits to issuance are significant and include project development, validation, verification, and registration and issues fees. Ongoing management will incur costs related to inventory updating, forest patrols, and community engagement.

As the project activity generates no financial benefit to the project proponents other than VCS-related income, a simple cost analysis is justified (VT0001, sub-steps 2a, 2b). The next step is therefore a common practice analysis (VT0001, step 4).

3.6.3 Step 4. Common practice analysis

Public land conservation in the Amazonas State occurs on national, state, and municipal properties, as well as indigenous reserves. Public Conservation Units (UCs – Unidades de Conservação in Portuguese) and Indigenous Reserves (Terras Indígenas in Portuguese - TI) belong to the official network of reserves aimed at protecting natural ecosystems and associated socio environmental attributes.

In terms of public land conservation units, the Amazonas State Government utilizes the Bolsa Floresta Program (2007) and the Federal Government Bolsa Verde Program (2011). Both are aimed at properties located within established Conservation Units (UCs), while Bolsa Verde also includes residents of agrarian reform settlements. These programs provide social assistance to individuals employed in formerly extractive occupations and to low-income traditional family farmers. They are not targeted to supporting conservation-based voluntary carbon projects. It is also important to note that while they have had success at maintaining forest cover, an essential distinction between these initiatives and the project area is that the latter is privately owned. As such, it is not eligible to access the government resources used to finance and manage these non-extractive land use programs.

P., SILGUEIRO, V., CARDOSO, B., BERNASCONI, P. THUAULT, A. 2019. CARACTERÍSTICAS DO DESMATAMENTO NA AMAZÔNIA MATO- GROSSENSE EM 2019. – Mato Grosso, Brasil – ICV, 2019, 08 páginas.

Conservation of privately owned forest land in the Amazonas State, including the project area and proxy areas, is limited to the system of legal reserves and designated areas of permanent protection (APP)[41]. To prevent legal deforestation within rural private properties, the rural environmental registry (CAR – cadastro ambiental rural) must be utilized, which requires all owners or "possessors" of rural properties to register their lands with the state environmental agency, delineating the georeferenced legal area and a management plan stipulating how they plan to comply with the environmental law, and to serve as the basis for monitoring compliance. One flexibility mechanism included in the 2012 law is the option for landowners to "compensate" for any legal reserve deficits on one property with legal reserve surpluses located on other properties. This compensation could be done directly by purchase of permanent or temporary forest easements on another property or through the acquisition of environmental reserve quotas (CRA – cotas de reserva ambiental). As these titles are a commercial product, the mechanism could be understood as incentives similar to a REDD APD project. However, CRAs can only be traded in the same biome and to specific stakeholders, which means they are very scarce. The CRA mechanism also applies only to forest cover and not forest carbon stocks per se, and thus has no pertinence with respect to offsetting GHG emissions. Finally, Brazil was the first country to introduce an ecological fiscal transfers program (ICMS-E) to compensate municipalities for land-use restrictions imposed by protected areas.[42] In the Amazonas State the ICMS-E came into force in 2021. Although it has been seen as an incentive to create new protected areas, the mechanism increases tax income for municipalities but does not serve to remunerate landowners for conservation of native vegetation on their properties.

3.6.4 Results of the Additionality Analysis

Without revenue from carbon credits, the project activity is highly unlikely to occur and is not a common practice in the region. The project therefore brings additionality.

3.7 Methodology Deviations

No methodology deviations were applied to the Project.

[41] For a more complete description, consult Annex II of Resolution 294/01, Section 4.

[42] Peter H. May, Maria Fernanda Gebara, Bruna Rançâo Conti, Guilherme Rodrigues Lima. 2012. The "Ecological" Value Added Tax (*ICMS-Ecológico*) in Brazil and its effectiveness in State biodiversity conservation: a comparative analysis. *Paper presented at 12th Biennial Conference of the International Society for Ecological Economics ISEE 2012: ECOLOGICAL ECONOMICS AND RIO +20. Panel session: "The role of economic instruments in the conservation policy mix"* (accessed from: https://www.isecoeco.org/conferences/isee2012-versao3/pdf/sp33.pdf)

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The baseline emissions calculated in the project are a result of the conversion of forest to pasture. In the Amazon biome, Brazilian law permits 20% of private property to be converted from forest to another land-use. The total area of the property parcel is 496,342 ha with 477,308 ha identified as dense forest. The defined managed area, selected for conversion in the baseline scenario has a total area of 91,608 ha with a total dense forest area of 87,692 ha at the project start date (Jan 1, 2021) (**Table 16**).

Table 16 - Areas of strata within the 413 Project area

Area	Acronym	Description	Area (ha)
1	Df	Dense forest*	477,308
2	Bs	Deforestation/Bare Soil	270
3	Lf	Low cover Forest	18,022
4	Wt	Water	742
		Total	**496,342**

*From satellite classified forest cover layer developed using supervised classification in Google Earth Engine (see attached Brazil 413 Carbon Project Landcover Classification Report)[43].

The VCS module, VMD0006-BL-PL, applied to an avoided planned deforestation activity requires knowledge of the rate at which the area will be deforested. The deforestation rate (1.8%) was determined from seven proxy areas, as outlined in section 3.5.3.

Baseline net GHG emissions for REDD planned deforestation are determined from module VMD006 v1.3, equation 1, as per below (Equation 1).

Equation 1 (Baseline net GHG emissions):

[43] Google Earth Engine link

$$\Delta C_{\mathrm{BSL,planned}} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left(\Delta C_{\mathrm{BSL},_{i,t}} + \mathrm{GHG}_{\mathrm{BSL-E,i,t}} \right)$$

Where:

$\Delta C_{\mathrm{BSL,planned}}$ = Net greenhouse gas emissions in the baseline from planned deforestation up to year $t*$; t CO_2-e

$\Delta C_{BSL,_{i,t}}$= Net carbon stock changes in all pools in the baseline stratum *i* in year *t*; t CO_2-e

$GHG_{BSL-E,i,t}$= Greenhouse gas emissions from deforestation activities within the project boundary in the baseline stratum *i* in year *t*; t CO_2-e yr^{-1}

i = 1, 2, 3, … *M* strata

t = 1, 2, 3, … $t*$ years elapsed since the projected start of the project activity.

These calculations are described in the following sections, and further details are provided in the supporting EXCEL file "413 C calcs v1.3.xlsx" and associated tabs.

4.1.1 Estimation of Carbon Stocks by Carbon Pools

Three carbon pools were used to calculate baseline emissions: 1. Aboveground biomass (stems, branches, and foliage - AGB), 2. Belowground biomass (roots - BGB), both from trees and non-tree vegetation, and 3. Dead wood (DW). Litter, soil and non-tree biomass pools were excluded, as per the APD methodology. This is a conservative measure from the perspective of carbon credit calculations.

Forest carbon values were derived from the inventory reports generated by the firm, Biondendro[44], while pasture values in the municipality of Novo Aripuanã were obtained from Nogueira et al. (2008)[45]. Values for AGB ,BGB, DW ($CAB_{tree+nontree_i}$, $CBB_{tree+nontree_i}$, CDW_i), respectively, and the corresponding land conversion (to pasture) values ($CAB_{post,i}$, $CBB_{post,i}$, $CDW_{post,i}$) are listed in **Table 17.**

[44] Brazilian consultant company http://www.biodendro.com.br/

[45] Nogueira, E. M., Fearnside, P. M., Nelson, B. W., Barbosa, R. I., & Keizer, E. W. H. (2008). Estimates of forest biomass in the Brazilian Amazon: new allometric equations and adjustments to biomass from wood-volume inventories. Forest Ecology and Management, 256(11), 1853-1867.

Table 17 - Carbon Pools for calculation of the baseline scenario

C_{pre} Baseline in the forest stratum			
Parameter	Description	Unit	Value
$C_{AB_{pre,i}}$	Aboveground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	526.9
$C_{BB_{pre,i}}$	Belowground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	125.0
$C_{DW_{pre,i}}$	Deadwood (DW)	$tCO_2\text{eha}^{-1}$	50.6
C_{preBSL}	Total	tCO_2eha^{-1}	702.5
C_{post} Baseline in pasture			
$C_{AB_{post,i}}$	Aboveground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	5.2
$C_{BB_{post,i}}$	Belowground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	6.3
$C_{DW_{post,i}}$	Deadwood (DW)	$tCO_2\text{eha}^{-1}$	7.4
$C_{postBSL}$	Total	tCO_2eha^{-1}	19.0
Difference between forest and pasture			
$C_{AB_{pre,i}} - C_{AB_{post,i}}$	Aboveground Biomass (AGB)	tCO_2eha^{-1}	521.7
$C_{BB_{pre,i}} - C_{BB_{post,i}}$	Belowground Biomass (AGB)	tCO_2eha^{-1}	118.7
$C_{DW_{pre,i}} - C_{DW_{post,i}}$	Deadwood (DW)	tCO_2eha^{-1}	43.2
ΔC_{BSL}	Total	tCO_2eha^{-1}	683.6

Carbon stock changes in the baseline were determined as per equation 2 (see VMD0006 v1.3, Equation 13).

Equation 2 (Carbon stock changes in the baseline):

$$\Delta C_{BSL_{i,t}} = AA_{planned_{i,t}} * \left(\Delta C_{ABtree_i} + \Delta C_{ABnon-tree_i} + \Delta C_{LI_i}\right) + \sum_{t-10}^{t} \left(AA_{planned_{i,t}} * \left(\Delta C_{BBtree_i} + \Delta C_{BBnon-tree_i} + \Delta C_{DW_i}\right) * \frac{1}{10}\right) + \sum_{t-20}^{t} \left(AA_{planned_{i,t}} * \left(C_{WP100_i} + \Delta C_{SOC_i}\right) * \frac{1}{20}\right)$$

Annual BGB stock change was calculated from Equation 3 (see VMD0006 v1.3, Equation 8).

Equation 3 (BGB stock change):

$$\Delta C_{BBtree+nontree_{i,t}} = AA_{planned_{i,t}} * \left(CBB_{tree+nontree_i} - CBB_{\text{post},i}\right) * {}^{1}/_{10}$$

Annual deadwood stock change was calculated using Equation 4 (see VMD0006 v1.3, equation 10).

Equation 4 (Deadwood stock change):

$$\Delta C_{DW_t} = AA_{planned_{i,t}} * \left(CDW_{tree+nontree} - CDW_{post,i}\right) * {}^{1}/_{10}$$

Annual baseline stock change from planned deforestation in aboveground and belowground biomass, deadwood, extracted biomass and its decomposition, are listed in **Table 18** (see "413 C calcs v1.3.xlsx, tab 'Baseline_stockchg GHG'", for calculations).

Table 18 - Annual baseline carbon stock change (ΔCBSL) from planned deforestation in aboveground and belowground biomass (AG+BB, respectively), deadwood (DW), extracted biomass (XBsawnwood), and its decomposition (XBsawnwood Decom)

Year	$AA_{planned}$ (ha/y)	ΔC_{AB} (tCO_2e)	ΔC_{BB} (tCO_2e)	ΔC_{DW} (tCO_2e)	$C_{XB_{sawnwood}}$ (tCO_2e)	$C_{XB_{sawnwood}}$ Decom (tCO_2e)	ΔC_{BSL} (tCO_2e)
2021	8,365	4,364,237	99,258	36,103	-222,890	9,718	4,286,426
2022	8,365	4,364,237	198,517	72,206	-222,890	19,436	4,431,506
2023	8,365	4,364,237	297,775	108,309	-222,890	29,154	4,576,585
2024	8,365	4,364,237	397,033	144,412	-222,890	38,872	4,721,665
2025	8,365	4,364,237	496,292	180,515	-222,890	48,590	4,866,744
2026	8,365	4,364,237	595,550	216,618	-222,890	58,308	5,011,823
2027	8,365	4,364,237	694,808	252,721	-222,890	68,026	5,156,903
2028	8,365	4,364,237	794,067	288,824	-222,890	77,744	5,301,982
2029	8,365	4,364,237	893,325	324,928	-222,890	87,462	5,447,062
2030	8,365	4,364,237	992,583	361,031	-222,890	97,180	5,592,141
2031	4,043	2,109,137	941,294	342,375	-107,718	101,877	3,386,965
2032	0	0	842,036	306,272	0	101,877	1,250,185
2033	0	0	742,777	270,169	0	101,877	1,114,823

Year	$AA_{planned}$ (ha/y)	ΔC_{AB} $(tCO_2\mathrm{e})$	ΔC_{BB} $(tCO_2\mathrm{e})$	ΔC_{DW} $(tCO_2\mathrm{e})$	$C_{XB_{sawnwood}}$ $(tCO_2\mathrm{e})$	$C_{XB_{sawnwood}}$ Decom $(tCO_2\mathrm{e})$	ΔC_{BSL} $(tCO_2\mathrm{e})$
2034	0	0	643,519	234,066	0	101,877	979,462
2035	0	0	544,261	197,963	0	101,877	844,101
2036	0	0	445,003	161,860	0	101,877	708,739
2037	0	0	345,744	125,757	0	101,877	573,378
2038	0	0	246,486	89,654	0	101,877	438,017
2039	0	0	147,228	53,551	0	101,877	302,655
2040	0	0	47,969	17,448	0	101,877	167,294
2041	0	0	0	0	0	92,159	92,159
2042	0	0	0	0	0	82,441	82,441
2043	0	0	0	0	0	72,723	72,723
2044	0	0	0	0	0	63,005	63,005
2045	0	0	0	0	0	53,287	53,287
2046	0	0	0	0	0	43,569	43,569
2047	0	0	0	0	0	33,851	33,851
2048	0	0	0	0	0	24,133	24,133
2049	0	0	0	0	0	14,415	14,415
2050	0	0	0	0	0	4,696	4,696

4.1.2 Estimation of GHG Emissions from burning in the Baseline

Burning remaining biomass after deforestation is a common practice. Emissions from biomass burning were calculated from procedures and equations listed in VMD0006 v1.3, as per Equation 5. See **Table 19** and **Table 20**, for equation input values, and **Table 21** for output values (see "413 C calcs v1.3.xlsx, tab 'Baseline Emissions burn'", for calculations).

Equation 5 (Emissions from biomass burning):

$$GHG_{BSL-E,i,t} = E_{BionmassBurn,i,t} = \sum_{g=1}^{G}\left(\left(\left(A_{Burn,i,t} * B_{i,t} * COMF_i * G_{g,i}\right) * 10^{-3}\right) * GWP_g\right)$$

Table 19 - Parameters values as per Equation 5

Parameter	Description	Unit	Justification
$GHG_{BSL-E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline	$t\ CO_2eyear^{-1}$	Calculated below.

Parameter	Description	Unit	Justification
	stratum *i* during project year *t*		
$E_{BionmassBurn,i,t}$	Greenhouse emissions due to biomass burning as part of deforestation activities in stratum *I* in year *t*	$t\ CO_2e$ of each $GHG\ (CO_2, CH_4, N_2O)$	Calculated below. Biomass burning is expected to occur in the project case.
$A_{Burn,i,t}$	Area burnt for stratum *i* in year *t*	ha	-
$B_{i,t}$	Average aboveground biomass stock before burning stratum *i* in year *t*	$tonnes\ d.m.ha^{-1}$	-
$COMF_i$	Combustion factor for stratum *i*	dimensionless	Default value derived from Table 2.6 of (IPCC, 2006)[46]
$G_{g,i}$	Emission factor for stratum *i* for gas g	$kg\ t^{-1}$ dry matter burnt	Default value derived from Table 2.6 of (IPCC, 2006)
GWP_g	Global warming potential for gas g	$t\ CO_2/t$ gas g	Default values from IPCC AR5 (IPCC, 2014)[47]: $CO_2 = 1$; $CH_4 = 25$; $N_2O = 298$
g	Number of greenhouse gases	-	-
i	Number of strata	-	-
t	Years elapsed since the start of the REDD	-	-

Table 20 - GHG-specific parameters values used to calculate baseline emissions from biomass burning

Gas	COMF	G	GWP
N_2O	0.59	0.2	273
CH_4	0.59	6.8	28

Source: IPCC (2006), AR6 Chap. Table 7.15

[46] IPCC (2006). Guidelines for National Greenhouse Gas Inventories. Chapter 4 AFOLU (Agriculture, Forestry and Other Land-use).
[47] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Table 21 - Calculation of EBiomassBurn,i,t emission from biomass burning for the baseline scenario accounting for N2O and CH4

Year	$A_{Burn,i,t}$ (ha)	$B_{i,t}$ $(tdma/ha)$	E_{BurnCH_4} (tCO_{2e})	E_{BurnN_2O} (tCO_{2e})	$GHG_{BSL,E}$ (tCO_{2e})
2021	8,365	285.2	267,996	76,852	344,848
2022	8,365	285.2	267,996	76,852	344,848
2023	8,365	285.2	267,996	76,852	344,848
2024	8,365	285.2	267,996	76,852	344,848
2025	8,365	285.2	267,996	76,852	344,848
2026	8,365	285.2	267,996	76,852	344,848
2027	8,365	285.2	267,996	76,852	344,848
2028	8,365	285.2	267,996	76,852	344,848
2029	8,365	285.2	267,996	76,852	344,848
2030	8,365	285.2	267,996	76,852	344,848
2031	8,365	285.2	129,517	37,141	166,657
2032	0	285.2	0	0	0
2033	0	285.2	0	0	0
2034	0	285.2	0	0	0
2035	0	285.2	0	0	0
2036	0	285.2	0	0	0
2037	0	285.2	0	0	0
2038	0	285.2	0	0	0
2039	0	285.2	0	0	0
2040	0	285.2	0	0	0
2041	0	285.2	0	0	0
2042	0	285.2	0	0	0
2043	0	285.2	0	0	0
2044	0	285.2	0	0	0
2045	0	285.2	0	0	0
2046	0	285.2	0	0	0
2047	0	285.2	0	0	0
2048	0	285.2	0	0	0
2049	0	285.2	0	0	0
2050	0	285.2	0	0	0

4.1.3 Estimation of Carbon Sequestered in Long-Lived Wood Products

Carbon sequestered in long-lived wood products is calculated using module VMD0005 v1.1 CP-W Option 2, Commercial Inventory Estimation. This option is applicable when an approved harvest plan is not available. Estimate of carbon stocks in the long-term wood products pool is estimated in four steps.

Step 1. Calculate the biomass carbon of the commercial volume extracted prior to or in the process of deforestation:

$$C_{XB_i} = CAB_{tree_i} * {}^{1}/_{BEF} * Pcom_i \qquad \text{Equation 6}$$

Step 2. Identify the wood product class(es) (*ty*; defined here as sawnwood, wood-based panels, other industrial roundwood, paper and paper board, and other) that are the anticipated end use of the extracted carbon calculated in Step 1. Harvested trees would have been turned into sawnwood as is typical practice for the tropical hardwood species in the region (IBGE, 2022). Hence, only one product class (sawnwood, "s") is extracted due to harvesting in the baseline. Harvested trees would have been turned into sawnwood as is typical practice for the tropical hardwood species in the region (IBGE, 2022). Hence, only one product class (sawnwood, "s") is extracted due to harvesting in the baseline.

Step 3: Calculate the biomass carbon entering the wood products pool at the time of deforestation.

$$C_{WP_i} = \sum_{ty=s,w,oir,p,o} C_{XB_{tyi}} * \left(1 - WWs_{ty}\right) \qquad \text{Equation 7}$$

Step 4: Calculate the amount of wood products entering the pool at the time of deforestation (*CWP,i*, calculated in C-WP) that is expected to be emitted over a 100-year timeframe.

$$C_{WP100_i} = C_{WP_i} - C_{WP_i} * (1 - SLFp) * \left(1 - OF_p\right) \qquad \text{Equation 8}$$

Variable descriptions for equations 6-8 and associated values are described in **Table 22**; see "413 C calcs v1.3.xlsx, tabs 'HWP_initial' and HWP_base'", for detailed calculations).

Table 22 - Parameters and values used to estimate carbon stocks entering the long-term wood products pool

Parameter	Description	Unit	Value	Justification
CAB_{tree_i}	Carbon stock in aboveground biomass tree in stratum *i;*	$t\,CO_2e/ha$	526.9	Calculated from forest inventory data.
BEF	Biomass Expansion Factor for conversion of volume to total	dimensionless	1.79	BEF Calculated using data from Goodman et al. 2014[48]

[48] Goodman, R.C., Phillips, O.L., Baker, T.R., 2014. The importance of crown dimensions to improve tropical tree biomass estimates. Ecol. Appl. 24, 680–698. https://doi.org/ 10.1890/13-0070.1.

Parameter	Description	Unit	Value	Justification
	aboveground tree biomass			
$Pcom_i$	Commercial volume as a percent of total aboveground volume in stratum *i*	dimensionless	0.120	1.Commercial portion of a tree (0.56 x 104.9 tonnes aboveground biomass for commercial species, forest, inventory; 2. 526.9 tonnes, average t CO2e/ha aboveground biomass, forest inventory
$C_{XB_{sawnwood}}$	Mean stock of extracted biomass carbon by class of wood product $t_y$from stratum	$t\,CO_2e/ha$	35.4	Equation 6
WW_s	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product	dimensionless	0.24	default value for developing countries from CP-W module, VMD0005
C_{WP_i}	Carbon stock entering the wood products pool from stratum *i*	$t\,CO_2e/ha$	26.9	Equation 7
$SLFs$	SLFty Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product *ty*	dimensionless	0.2	Default for sawnwood from CP-W module, From VMD0005, pg 13
OF_{ty}	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product *ty*	dimensionless	0.84	Default for sawnwood in Tropical forests from previous version of methodology module CP-W (VMD0005 Version 1.0 REDD Methodological Module)
C_{WP100_i}	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum *i*	$t\,CO_2e/ha$	23.5	Equation 8

4.2 Project Emissions

Estimates of the net carbon stock change and GHG emissions in the project scenario were derived from Module *M-REDD*, as per VM0007 specifications. Ex-ante projections of deforestation in the project case assume no planned deforestation and forest degradation have taken place once the project proponent has committed to not undertake these activities. An assumption of unplanned (illegal) deforestation at a rate of 52 ha $year^{-1}$ for 11 years (to year 2031), along with associated biomass burning, is included in the carbon balance.

For REDD project activities (non-wetland), the net GHG emissions in the project case are equal to the sum of stock changes due to deforestation and forest degradation plus the total GHG emissions minus any eligible forest carbon stock enhancement (Equation 9).

Equation 9 (Net GHG emissions in the REDD project scenario (see VMD0015 v2.2, equation 1.)):

$$\Delta C_{WPS-REDD} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left(\Delta C_{P,DefPA_{i,t}} + \Delta C_{P,Deg_{i,t}} + \Delta C_{P,DitPA_{i,t}} + GHG_{P-E_{i,t}} - \Delta C_{P,Enh_{i,t}} \right)$$

Where:

$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD project scenario up to year t^*; tCO_{2e};
$\Delta C_{P,DefPA_{i,t}}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* within the project area in year *t*; tCO_{2e};
$\Delta C_{P,Deg_{i,t}}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* within the project area in year *t*; tCO_{2e};
$\Delta C_{P,DitPA_{i,t}}$	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* within the project area in year *t*; tCO_{2e};
$GHG_{P-E_{i,t}}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; tCO_{2e};
$\Delta C_{P,Enh_{i,t}}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline[2] in stratum *i* in year *t*; tCO_{2e};
i	1, 2, 3, ...*M* strata;
t	1, 2, 3, ...t^* years elapsed since the start of the REDD VCS project activity.

When significant, non-CO_2 gas greenhouse emissions, $GHG_{P,E_{i,t}}$, occurring within the project boundary must be evaluated. For example, where deforestation or degradation occur within the project boundaries or in the leakage belt and fire is used as a means of forest clearance the non-CO_2 emissions may be significant. The Tool T-SIG was used to determine which emissions were included in the calculations as a minimum. Emissions were then calculated through applying Modules E-BPB, E-FCC and E-NA.

Equation 10 (Non-CO2 gas greenhouse emissions):

$$GHG_{P,E_{i,t}} = E_{FC_{i,t}} + E_{BiomassBurn_{i,t}} + N_2O_{direct-N_{i,t}}$$

Where:

$GHG_{P,E_{i,t}}$	Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum *i* in year *t*; t CO_{2e}
$E_{FC_{i,t}}$	Emission from fossil fuel combustion in stratum *i* within the project area in year *t*; t CO_{2e}
$E_{BiomassBurn_{i,t}}$	Non-CO_2 emissions due to biomass burning in stratum i in year t; t CO_{2e}
$N_2O_{direct-N_{i,t}}$	Direct N_2O emission as a result of nitrogen application on the alternative land use in stratum *i* within the project area in year *t*; t CO_{2e}
i	1, 2, 3, …*M* strata
t	1, 2, 3, …$t*$ years elapsed since the start of the REDD VCS project activity

Net GHG emissions under the project scenario (as per equation 9) are zero.

One component of net GHG emissions are non-CO_2 GHG emissions occurring in the project case within the project boundary (as per equation 10). These are shown in Table 23. Complete calculations are provided in ""413 C calcs v1.3, tab '10b. Proj Emissions burn'".xlsx.

Table 23 - Non-CO_2 GHG emissions occurring in the project case within the project boundary

Year	$A_{Burn,i,t}$ (ha)	$B_{i,t}$ $(tdma/ha)$	E_{BurnCH_4} (tCO_{2e})	E_{BurnN_2O} (tCO_{2e})	E_{FC} (tCO_{2e})	N_2O_{Direct} (tCO_{2e})	$GHG_{P,E}$ (tCO_{2e})
2021	0	285.2	0	0	0	0	0
2022	0	285.2	0	0	0	0	0
2023	0	285.2	0	0	0	0	0
2024	0	285.2	0	0	0	0	0
2025	0	285.2	0	0	0	0	0
2026	0	285.2	0	0	0	0	0
2027	0	285.2	0	0	0	0	0
2028	0	285.2	0	0	0	0	0
2029	0	285.2	0	0	0	0	0
2030	0	285.2	0	0	0	0	0
2031	0	285.2	0	0	0	0	0
2032	0	285.2	0	0	0	0	0

Year	$A_{Burn,i,t}$ (ha)	$B_{i,t}$ $(tdma/ha)$	E_{BurnCH_4} (tCO_{2e})	E_{BurnN_2O} (tCO_{2e})	E_{FC} (tCO_{2e})	N_2O_{Direct} (tCO_{2e})	$GHG_{P,E}$ (tCO_{2e})
2033	0	285.2	0	0	0	0	0
2034	0	285.2	0	0	0	0	0
2035	0	285.2	0	0	0	0	0
2036	0	285.2	0	0	0	0	0
2037	0	285.2	0	0	0	0	0
2038	0	285.2	0	0	0	0	0
2039	0	285.2	0	0	0	0	0
2040	0	285.2	0	0	0	0	0
2041	0	285.2	0	0	0	0	0
2042	0	285.2	0	0	0	0	0
2043	0	285.2	0	0	0	0	0
2044	0	285.2	0	0	0	0	0
2045	0	285.2	0	0	0	0	0
2046	0	285.2	0	0	0	0	0
2047	0	285.2	0	0	0	0	0
2048	0	285.2	0	0	0	0	0
2049	0	285.2	0	0	0	0	0
2050	0	285.2	0	0	0	0	0

4.3 Leakage

Leakage emissions from displacement of planned deforestation are estimated as per the VCS REDD methodology VM0007, LK-ASP and LK-ME modules. These modules account for activity shifting leakage resulting from displacement of deforestation activities by the agent of deforestation, and GHG emissions caused by market-effects resulting from the cessation of timber harvesting.

Activity Shifting Leakage

Activity shifting leakage due to displacement of planned deforestation was assessed using the equations provided in the LK-ASP tool, as per VM007 requirements (equation XX). Parameters, values used, and their justification are given in **Table 24.**

Equation 11 (Leakage from displacement of planned deforestation; VMD0007 v1.6, equation 1):

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t*}\sum_{i=1}^{M}(LKA_{planned,i,t} \times \Delta C_{BSL,i}) + GHG_{LK,E,i,t} \quad (1)$$

Where:

$\Delta C_{LK\text{-}AS,planned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation up to year t^* (t CO_2e)
$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i in year t (ha)
$\Delta C_{BSL,i}$	Net carbon stock changes in all pre-deforestation pools in baseline stratum i (t CO_2e ha^{-1})
$GHG_{LK,E,i,t}$	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum i in year t (t CO_2e)
i	1, 2, 3, … M strata (unitless)
t	1, 2, 3, … t^* time elapsed since the start of the project activity (years)

No activity shifting leakage is anticipated to occur because the deforestation agent does not own any additional lands. Hence, $LKA_{planned,i,t}$, and $GHG_{LK,E,i,t}$ are set to zero, and activity shifting leakage is as per **Table 24.**

Table 24 - Activity shifting leakage

Year	$LKA_{planned}$ (ha)	$\Delta C_{BSL,i}$ (tCO_{2e}/ha)	$GHG_{LK\text{-}E,i,t}$ (tCO_{2e})	LK_{peat} (tCO_{2e})	$\Delta C_{LK-AS_{planned}}$ (tCO_{2e})
2021	0	683.55	0	0	0
2022	0	683.55	0	0	0
2023	0	683.55	0	0	0
2024	0	683.55	0	0	0
2025	0	683.55	0	0	0
2026	0	683.55	0	0	0
2027	0	683.55	0	0	0
2028	0	683.55	0	0	0
2029	0	683.55	0	0	0
2030	0	683.55	0	0	0
2031	0	683.55	0	0	0
2032	0	683.55	0	0	0
2033	0	683.55	0	0	0
2034	0	683.55	0	0	0
2035	0	683.55	0	0	0
2036	0	683.55	0	0	0
2037	0	683.55	0	0	0

Year	$LKA_{planned}$ (ha)	$\Delta C_{BSL,i}$ (tCO_{2e}/ha)	$GHG_{LK-E,i,t}$ (tCO_{2e})	LK_{peat} (tCO_{2e})	$\Delta C_{LK-AS_{planned}}$ (tCO_{2e})
2038	0	683.55	0	0	0
2039	0	683.55	0	0	0
2040	0	683.55	0	0	0
2041	0	683.55	0	0	0
2042	0	683.55	0	0	0
2043	0	683.55	0	0	0
2044	0	683.55	0	0	0
2045	0	683.55	0	0	0
2046	0	683.55	0	0	0
2047	0	683.55	0	0	0
2048	0	683.55	0	0	0
2049	0	683.55	0	0	0
2050	0	683.55	0	0	0

4.3.1 Market-effects Leakage

Total leakage due to market effects is equal to the sum of market effects leakage through decreased timber harvest and decreased harvest for fuelwood / charcoal production. In this project, the latter is not practiced on the project area to any significant degree. Hence, market-effects leakage is calculated as (from VMD0011-LK-ME, equation 2):

Equation 12 (Market-effects leakage calculation):

$$LK_{ME,T} = \sum_{i=1}^{M} \left(LF_{ME} * AL_{T,i}\right)$$

Where:

$LK_{ME,T}$ Total GHG emissions due to market- effects leakage through decreased timber harvest; t CO_2-e

LF_{ME} Leakage factor for market-effects calculations; dimensionless

$AL_{T,I}$ Summed emissions from timber harvest in stratum *i* in the baseline case potentially displaced through implementation of carbon project; t CO_2-e

Each project must calculate within each stratum the proportion of total biomass in commercial species that is merchantable (*PMPi*). This shall then be compared to mean proportion of total biomass that is merchantable for each forest type (*PMLFT*). Merchantable biomass is defined as

"*Total gross biomass (including bark) of a tree 40 cm DBH or larger from a 30 cm stump to a minimum 10 cm top of the central stem*". The following deduction factors (LFME) must be used:

PML_{FT} is equal (± 15%) to PMP_i	$LF_{ME} = 0.4$
PML_{FT} is > 15% less than PMP_i	$LF_{ME} = 0.7$
PML_{FT} is > 15% greater than PMP_i	$LF_{ME} = 0.2$

Where:

PML_{FT}	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type; %
PMP_i	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries; %
LF_{ME}	Leakage factor for market-effects calculations; dimensionless

The next step was to estimate the emissions associated with the displaced logging activity. This was based on the total volume that would have been logged in the baseline in the project area across strata and time periods:

$$AL_{T,i} = \sum_{t=1}^{t} \left(C_{BSL,XBT_{i,t}} \right)$$

Where:

$AL_{T,i}$	Summed emissions from timber harvest in stratum i in the baseline case potentially displaced through implementation of carbon project; t CO2-e
$C_{BSL,XBT_{i,t}}$	Carbon emission due to displaced timber harvests in the baseline scenario in stratum i in time t; t CO2-e
i	1, 2, 3, …M strata
t	1, 2, 3, … t* years elapsed since the projected start of the REDD project activity

Carbon emission due to the displaced logging has two components: the biomass carbon of the extracted timber (see also module CP-W which uses the same equation) and the biomass carbon in the forest damaged in the process of timber extraction (see VMD0011 v1.0 equation 4):

$$C_{BSL,XBT_{i,t}} = \left(\left[V_{BSL,XE_{i,t}} * D_{mn} * CF \right] + \left[V_{BSL,XE_{i,t}} * LDF \right] + \left[V_{BSL,XE_{i,t}} * LIF \right] \right)$$

Where:

$C_{BSL,XBT_{i,t}}$	Carbon emission due to timber harvests in the baseline scenario in stratum i at time t; t CO2-e
$V_{BSL,XE_{i,t}}$	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t; m³
D_{mn}	Mean wood density of commercially harvested species; t d.m.m-3. The value must be the same as that used in the module CP-W if this pool is included in the baseline.
CF	Carbon fraction of biomass for commercially harvested species j; t C t d.m.-1 . The value must be the same as that used in the module CP-W if this pool is included in the baseline.
LDF	Logging damage factor; t C m-3 (default 0.53 t C m^{-3} for broadleaf and mixed forests; 0.25 t C m^{-3} for coniferous forests)
LIF	Logging infrastructure factor; t C m^{-3} (default 0.29 t C m^{-3})
i	1, 2, 3, …M strata
t	1, 2, 3, … t* years elapsed since the projected start of the REDD project activity

Market leakage from decreased timber harvest and its component values is shown in Table 25, and total annual combined leakage (activity-shifting and market leakage) in **Table 26**Table 25. Detailed calculations underpinning **Table 25** are reported in "413 C calcs v1.3, tab '12b. Leakage_ME'".xlsx.

Table 25 - Market leakage

Year	C_{XB_t} (tCO2e)	$V_{BSL,XE_{i,t}}$ (m³)	$C_{BSL,XBT_{i,t}}$ (tCO2e)	$AL_{T,i}$ (tCO2e)	$LK_{ME,T,i}$ (tCO2e)	$LK_{ME,FW}$ (tCO2e)	$\Delta C_{LK-ME,t}$ (tCO2e)
2021	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2022	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2023	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2024	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2025	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2026	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933

Year	C_{XB_t} (tCO2e)	$V_{BSL,XE_{i,t}}$ (m³)	$C_{BSL,XBT_{i,t}}$ (tCO2e)	$AL_{T,i}$ (tCO2e)	$LK_{ME,T,i}$ (tCO2e)	$LK_{ME,FW\&}$ (tCO2e)	$\Delta C_{LK-ME,t}$ (tCO2e)
2027	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2028	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2029	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2030	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2031	141,734	119,194	500,112	500,112	200,045	0	200,045
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
2042	0	0	0	0	0	0	0
2043	0	0	0	0	0	0	0
2044	0	0	0	0	0	0	0
2045	0	0	0	0	0	0	0
2046	0	0	0	0	0	0	0
2047	0	0	0	0	0	0	0
2048	0	0	0	0	0	0	0
2049	0	0	0	0	0	0	0
2050	0	0	0	0	0	0	0

Table 26 - Total net GHG emissions due to activity-shifting and market leakage

Year	$\Delta C_{LK-AS,planned}$ (tCO2e)	$\Delta C_{LK-ME,t}$ (tCO2e)	$\Delta C_{LK,t}$ (tCO2e)
2021	0	413,933	413,933
2022	0	413,933	413,933
2023	0	413,933	413,933

Year	$\Delta C_{LK-AS,planned}$ (tCO2e)	$\Delta C_{LK-ME,t}$ (tCO2e)	$\Delta C_{LK,t}$ (tCO2e)
2024	0	413,933	413,933
2025	0	413,933	413,933
2026	0	413,933	413,933
2027	0	413,933	413,933
2028	0	413,933	413,933
2029	0	413,933	413,933
2030	0	413,933	413,933
2031	0	200,045	200,045
2032	0	0	0
2033	0	0	0
2034	0	0	0
2035	0	0	0
2036	0	0	0
2037	0	0	0
2038	0	0	0
2039	0	0	0
2040	0	0	0
2041	0	0	0
2042	0	0	0
2043	0	0	0
2044	0	0	0
2045	0	0	0
2046	0	0	0
2047	0	0	0
2048	0	0	0
2049	0	0	0
2050	0	0	0

4.4 Estimated Net GHG Emission Reductions and Removals

Uncertainty

Uncertainties were calculated for the baseline and project scenarios based upon the VMD0017 v2.2 X-UNC module. There are two sources of uncertainty in the baseline, the rate of deforestation, and emissions and removals. For the project case, only uncertainty in emissions and removals was considered because no deforestation is expected to occur.

Per the X-UNC module, uncertainty in the projected baseline rate of deforestation, $Uncertainty_{BSL-RATE}$, equals 1.01%. This value is the 95% confidence interval as a percentage of the mean of the area deforested in each proxy (*D%pn*) divided by the number of years over which deforestation occurred in each proxy (*Yrspn*)(see "413 C calcs v1.3, tab '13. Uncertainty'".xlsx. for calculations).

Total uncertainty in emissions and removals ($Uncertainty_{BSL-SS}$) is estimated as per VMD0017 v2.2 X-UNC equation 4, and is expressed as the 95% confidence interval half width as a percentage of the mean carbon stock or GHG source for each pool. $Uncertainty_{BSL-SS}$ is estimated to be 6.91% (calculations detailed in "413 C calcs v1.3, tab '10b. Proj Emissions burn'".xlsx.).

Total uncertainty is calculated as per Equation 13 and equals 6.99%.

Equation 13. Total uncertainty (see VMD0017 v2.2 equation 5):

$$Uncertainty_{REDD-BSL,t^*} = \sqrt{Uncertainty_{BSL-RATE,t^*}{}^2 + Uncertainty_{REDD-BSL,SS}{}^2}$$

Where:

$Uncertainty_{REDD-BSL,t^*}$	Cumulative uncertainty in REDD baseline scenario up to year t^* (%);
$Uncertainty_{BSL-RATE,t^*}$	Cumulative uncertainty in the baseline rate of deforestation up to year t (%);
$Uncertainty_{REDD-BSL,SS}$	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario (%);
t	1, 2, 3, … t^* time elapsed since the start of the project activity (years).

The allowable uncertainty in methodology *REDD+ MF* is +/- 15% of *NERREDD+* at the 95% confidence level. Where this precision level is met then no deduction should result for uncertainty, which is the case here (6.99%).

To estimate the number of Verified Carbon Units (VCUs) for the monitoring period *T* = *t2*-*t1*, the following equation is used as per VM0007, equation 19:

$VCU_t = Adjusted\_NER_{REDD+,t2} - Adjusted\_NER_{REDD+,t1}) - Buffer_{Total}$

Where:

VCU_t	Number of Verified Carbon Units at year $t = t_2 - t_1$ (VCU)

$Adjusted\_NER_{REDD+,t2}$	Total net GHG emission reductions of the REDD+ project activity up to year t_2 and adjusted to account for uncertainty (t CO_2e)
$Adjusted\_NER_{REDD+,t1}$	Total net GHG emission reductions of the REDD+ project activity up to year t_1 and adjusted to account for uncertainty (t CO_2e):

Over its 30-year project length (2021-2050), the 413 project is expected to generate net GHG emission reductions of 43,973,073 tonnes of CO_{2e} (**Table 27** and **Table 28**).

Table 27 - Ex-ante annual estimation of net emission reduction credits

2050 Year	Estimated baseline emissions or removals $\Delta C_{BSL,planned}$ (tCO_2e)	Estimated project emissions or removals $\Delta C_{WPS,REDD}$ (tCO_2e)	Estimated leakage emissions $\Delta C_{LK,t}$ (tCO_2e)	Risk buffer (%)	AFOLU pooled buffer account (tCO2e)	GHG credits eligible for issuance as VCUs (tCO_2e)
2021	4,631,275	28,835	413,933	23	1,065,193	3,123,313
2022	4,776,354	27,638	413,933	23	1,098,561	3,236,221
2023	4,921,433	28,584	413,933	23	1,131,930	3,346,986
2024	5,066,513	29,531	413,933	23	1,165,298	3,457,750
2025	5,211,592	30,478	413,933	23	1,198,666	3,568,515
2026	5,356,672	31,424	413,933	23	1,232,034	3,679,279
2027	5,501,751	32,371	413,933	23	1,265,403	3,790,044
2028	5,646,830	33,318	413,933	23	1,298,771	3,900,808
2029	5,791,910	34,264	413,933	23	1,332,139	4,011,573
2030	5,936,989	35,211	413,933	23	1,365,508	4,122,337
2031	3,553,622	35,271	200,045	23	817,333	2,500,973
2032	1,250,185	8,641	0	23	287,542	954,002
2033	1,114,823	7,754	0	23	256,409	850,660
2034	979,462	6,868	0	23	225,276	747,318
2035	844,101	5,982	0	23	194,143	643,976
2036	708,739	5,096	0	23	163,010	540,634
2037	573,378	4,209	0	23	131,877	437,291
2038	438,017	3,323	0	23	100,744	333,949
2039	302,655	2,437	0	23	69,611	230,607
2040	167,294	1,551	0	23	38,478	127,265
2041	92,159	604	0	23	21,196	70,358
2042	82,441	544	0	23	18,961	62,936

2050 Year	Estimated baseline emissions or removals $\Delta C_{BSL,planned}$ (tCO_2e)	Estimated project emissions or removals $\Delta C_{WPS,REDD}$ (tCO_2e)	Estimated leakage emissions $\Delta C_{LK,t}$ (tCO_2e)	Risk buffer (%)	AFOLU pooled buffer account (tCO2e)	GHG credits eligible for issuance as VCUs (tCO_2e)
2043	72,723	483	0	23	16,726	55,513
2044	63,005	423	0	23	14,491	48,091
2045	53,287	362	0	23	12,256	40,668
2046	43,569	302	0	23	10,021	33,246
2047	33,851	242	0	23	7,786	25,823
2048	24,133	181	0	23	5,550	18,401
2049	14,415	121	0	23	3,315	10,978
2050	4,696	60	0	23	1,080	3,556

Table 28 - Total emissions reductions (tCO2e) and deductions

Estimated emissions and reductions of the 413 Project	tCO2e
Baseline GHG emissions and reductions	63,257,871
Project emissions and reductions	396,108
Leakage emissions	4,339,380
Buffer pool discount	14,549,310
Total Net Emission Reductions (VCUs)	43,973,073

5 MONITORING

5.1. Data and Parameters Available at Validation

Data / Parameter	$AA_{planned,i,t}$
Data unit	ha
Description	Annual area of baseline planned deforestation for stratum i in year t.
Source of data	Calculated based on VMD0006 v1.3 equation 5.
Value applied	See the values applied in the table 13.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on total area of planned deforestation over the baseline period for stratum I ($A_{planned,i}$), the projected annual proportion of land that will be deforested in stratum i during year t ($D_{\%planned,i,t}$) and the Likelihood of deforestation for stratum I (L-Di).
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$A_{planned,i}$
Data unit	ha
Description	Total area of planned deforestation over the fixed baseline period for stratum i.
Source of data	Remote sensing
Value applied	477,308
Justification of choice of data or description of measurement methods and procedures applied	Determined according to what is recognized as an immediate site-specific threat of deforestation, which is a function of the legal permissibility for deforestation, the suitability of the project area for conversion to alternative non-forest land use, the government approval for deforestation and an intention to deforest the project area. See section 3.5 for a complete description of measurement methods and procedures applied.
Purpose of Data	Calculation of baseline emissions.

Comments	Identified as dense forest area of the project property.

Data / Parameter	$D_{\%planned,i,t}$
Data unit	% $year^{-1}$
Description	Projected annual proportion of land that will be deforested in stratum i at year t.
Source of data	Proxy areas
Value applied	See the values applied in the table 11.
Justification of choice of data or description of measurement methods and procedures applied	Where a valid verifiable plan exists for rate at which deforestation is projected to occur, this rate must be used. In this case, no verifiable plan exists, and so the rate was established by examining proxy areas (see section 3.4).
Purpose of Data	Determination of baseline scenario.
Comments	-

Data / Parameter	$L\text{-}D_i$
Data unit	%
Description	Likelihood of deforestation in stratum i.
Source of data	Analysis of Land Tenure.
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	L-Di is equal to 100% for all planned deforestation areas that are not both under Government control and zoned for deforestation, according to VMD0006 v1.3, section 1.4.
Purpose of Data	Determination of baseline scenario.
Comments	-

Data / Parameter	$\Delta C_{AB\_tree+non\text{-}tree,i}$
Data unit	t CO2e ha^{-1}

Description	Baseline carbon stock change in aboveground tree biomass in stratum i;
Source of data	Calculated based on VMD0006 v1.3 equation 6
Value applied	See the values applied in the Table 15.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the forest carbon stock in aboveground tree biomass in stratum i ($C_{AB_{pre,i}}$) and the post-deforestation carbon stock in aboveground tree biomass in stratum i ($C_{AB_{post,i}}$).
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$\Delta C_{BB\_tree+non\text{-}tree,i}$
Data unit	t CO2e ha^{-1}
Description	Baseline carbon stock change in belowground tree biomass in stratum i.
Source of data	Calculated based on VMD0006 v1.3 equation 8.
Value applied	See the values applied in the Table 15.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the forest carbon stock in aboveground tree biomass in stratum I ($C_{BB_{pre,i}}$) and the post-deforestation carbon stock in aboveground tree biomass in stratum I ($C_{BB_{post,i}}$).
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$\Delta C_{DW,i}$
Data unit	t CO2e ha^{-1}
Description	Baseline carbon stock change in dead wood in stratum i.
Source of data	Calculated based on VMD0006 v1.3 equation 10.
Value applied	See the values applied in the Table 15.

Justification of choice of data or description of measurement methods and procedures applied	Estimated based on forest carbon stock in deadwood in stratum ($C_{DW_{pre,i}}$) and post-deforestation carbon stock in deadwood in stratum i ($C_{DW_{post,i}}$).
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$C_{AB\_tree+nontree,i}$
Data unit	t CO_2e ha^{-1}
Description	Carbon stock in aboveground tree biomass in the baseline in stratum i
Source of data	Forest inventory with field data and direct measurement. The mean carbon stock in aboveground tree biomass per unit area per stratum is estimated using sample fixed area plots and regional allometric equation for tree component.
Value applied	See values applied in Table 15.
Justification of choice of data or description of measurement methods and procedures applied	Forest Inventory is performed according to VMD0001 v1.1 and VMD0016 v1.6 criteria
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{BB\_tree+nontree,i}$
Data unit	t CO_2e ha^{-1}
Description	Carbon stock in belowground tree biomass in the baseline in stratum i
Source of data	Inventory (0.24). IPCC, 2006[49].

[49] Guidelines for National Greenhouse Gas Inventories. Volume 4: Agriculture, Forestry and Other Land Use. Chapter 4: Forest Land

Value applied	See values applied in Table 15.
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{DW,i}$
Data unit	t CO_2e ha^{-1}
Description	Carbon stock in deadwood in the baseline in stratum i
Source of data	Inventory
Value applied	See values applied in Table 15.
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{AB_{post,i}}$
Data unit	t CO_2e ha^{-1}
Description	Post-deforestation carbon stock in aboveground tree biomass in stratum i.

Source of data	Secondary data from peer-reviewed literature (Nogueira et al. 2008)[50]
Value applied	See values applied in Table 15.
Justification of choice of data or description of measurement methods and procedures applied	Post-deforestation carbon stocks can be measured in proxy areas or values can be taken from credible and representative literature sources (e.g., the peer-reviewed literature or data published by the IPCC or the FAO), according to methodology VMD0006, version 1.3.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{BB_{post,i}}$
Data unit	t CO_2e ha^{-1}
Description	Post-deforestation carbon stock in belowground tree biomass in stratum i.
Source of data	Secondary data from peer-reviewed literature (Nogueira et al. 2008)
Value applied	See values applied in Table 15.
Justification of choice of data or description of measurement methods and procedures applied	Post-deforestation carbon stocks can be measured in proxy areas or values can be taken from credible and representative literature sources (e.g., the peer-reviewed literature or data published by the IPCC or the FAO), according to methodology VMD0006, version 1.3.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{DW_{post,i}}$

[50] Nogueira, E. M., Fearnside, P. M., Nelson, B. W., Barbosa, R. I., & Keizer, E. W. H. (2008). Estimates of forest biomass in the Brazilian Amazon: new allometric equations and adjustments to biomass from wood-volume inventories. Forest Ecology and Management, 256(11), 1853-1867.

Data unit	t CO_2e ha^{-1}
Description	Post-deforestation carbon stock in deadwood in stratum i.
Source of data	Secondary data from peer-reviewed literature (Nogueira et al. 2008)
Value applied	See values applied in Table 15.
Justification of choice of data or description of measurement methods and procedures applied	Post-deforestation carbon stocks can be measured in proxy areas or values can be taken from credible and representative literature sources (e.g., the peer-reviewed literature or data published by the IPCC or the FAO), according to methodology VMD0006, version 1.3.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\Delta C_{BSL,i,t}$
Data unit	t CO2e
Description	Sum of the baseline carbon stock change in all terrestrial pools in stratum i in year t
Source of data	Calculated based on VMD0006 v1.3 equation 13.
Value applied	See the values applied in the Table 15.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the annual area of baseline planned deforestation for stratum i in year t ($AA_{planned,i,t}$), the baseline carbon stock change in aboveground tree biomass in stratum i ($\Delta C_{AB\_tree+nontree}$,i), the baseline carbon stock change in belowground tree biomass in stratum I ($\Delta C_{BB\_tree+nontree}$,i), the baseline carbon stock change in wood products in stratum I ($\Delta C_{WP,i}$), the baseline carbon stock change in dead wood in stratum i ($\Delta C_{DW,I}$).
Purpose of Data	Calculation of baseline emissions.
Comments	The baseline carbon stock change in litter and the baseline carbon stock change in soil organic carbon in stratum were excluded from the analysis due to lack of significance.

Data / Parameter	$\Delta C_{BSL,planned}$
Data unit	t CO2e
Description	Net greenhouse gas emissions in the baseline from planned deforestation.
Source of data	Calculated based on VMD0006 v1.3 equation 1
Value applied	See the values applied in the Table 16.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the net carbon stock changes in all pools in the baseline ($\Delta C_{BSL,i,t}$) and GHG emissions as a result of deforestation activities within the project boundary in the baseline stratum i in year t ($GHG_{BSL-E,i,t}$)
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$C_{wp,i}$
Data unit	t CO2e ha^{-1}
Description	Baseline carbon stock change in in wood products in stratum i
Source of data	Calculated based on VMD0005 v1.1 equation 2
Value applied	See the values applied in the Table 19.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on mean stock of extracted biomass carbon by class of wood product ty from stratum I ($C_{XB_{sawnwood}}$) and the wood waste (the fraction immediately emitted through mill inefficiency by class of wood product) (WW_s).
Purpose of Data	Calculation of leakage emissions.
Comments	-

Data / Parameter	$\boldsymbol{C_{XB_{sawnwood}}}$
Data unit	t CO2-e
Description	Carbon emission due to displaces timber harvests in the baseline scenario in stratum in time t
Source of data	Calculated based on VMD0005 v1.1 equation 4.

Value applied	See the values applied in the Table 16 and Table 19.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on commercial volume extracted prior to or in the process of deforestation by mean aboveground biomass carbon stock in stratum I $\Delta C_{AB\_tree,I}$, biomass conversion and expansion factor (BEF) for conversion of merchantable volume to total aboveground tree biomass, and commercial volume as a percent of total aboveground volume in stratum (P_{com_i}).
Purpose of Data	Calculation of leakage emissions.
Comments	0.56 is the proportion of commercial stem of aboveground biomass (Goodman et al. 2014)[51]

Data / Parameter	BEF
Data unit	Dimensionless
Description	Biomass expansion factor for conversion of volume to total aboveground tree biomass
Source of data	Calculated using data from Brown & Lugo (1992)[52]
Value applied	1.79
Justification of choice of data or description of measurement methods and procedures applied	BEF calculated using data from the Brazilian Amazon (i.e., country and ecoregion specific).
Purpose of Data	Calculation of baseline emissions Calculation of leakage emissions.
Comments	-

Data / Parameter	$\boldsymbol{P_{com_i}}$
Data unit	Dimensionless

[51] Derived from Goodman, R.C., Phillips, O.L., Baker, T.R., 2014. The importance of crown dimensions to improve tropical tree biomass estimates. Ecol. Appl. 24, 680–698. https://doi.org/ 10.1890/13-0070.1.

[52] Derived from Brown, S., & Lugo, A. E. (1992). Aboveground biomass estimates for tropical moist forests of the Brazilian Amazon. Interciencia. Caracas, 17(1), 8-18.

Description	Commercial volume as a percent of total aboveground volume in strata I
Source of data	Calculated using data from Feldpausch et al. (2006)[53]
Value applied	0.12
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions Calculation of project emissions Calculation of leakage emissions.
Comments	-

Data / Parameter	WW_s
Data unit	Dimensionless
Description	Wood waste, the fraction immediately emitted through mill inefficiency by class of wood product
Source of data	CP-W module
Value applied	0.24
Justification of choice of data or description of measurement methods and procedures applied	Default value from the CP-W module
Purpose of Data	Calculation of baseline emissions Calculation of project emissions Calculation of leakage emissions.
Comments	-

[53] Derived from Feldpausch, T. R., McDonald, A. J., Passos, C. A., Lehmann, J., & Riha, S. J. (2006). Biomass, harvestable area, and forest structure estimated from commercial timber inventories and remotely sensed imagery in southern Amazonia. Forest Ecology and Management, 233(1), 121-132.

Data / Parameter	CWP100,i
Data unit	t CO2-e ha^{-1}
Description	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i;
Source of data	Calculated based on VMD0005 v1.1 equation 3.
Value applied	See the values applied in the Table 19.
Justification of choice of data or description of measurement methods and procedures applied	Estimated base on carbon stock entering wood products pool at time of deforestation from stratum I (C_{WP_i}), fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product ty (SLF), and Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product ty(OF_s).
Purpose of Data	Calculation of baseline emissions Calculation of project emissions Calculation of leakage emissions.
Comments	-

Data / Parameter	OFts
Data unit	Dimensionless
Description	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest for sawn wood
Source of data	*CP-W module* for tropical sawnwood product class
Value applied	0.84
Justification of choice of data or description of measurement methods and procedures applied	Default value from the CP-W module
Purpose of Data	Calculation of baseline emissions Calculation of project emissions Calculation of leakage emissions.
Comments	-

Data / Parameter	SLF
Data unit	Dimensionless
Description	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest for sawn wood.
Source of data	*CP-W module* for tropical sawnwood product class
Value applied	0.2
Justification of choice of data or description of measurement methods and procedures applied	Default value suggested by VMD0005 v1.1.
Purpose of Data	Calculation of baseline emissions Calculation of project emissions Calculation of leakage emissions.
Comments	-

Data / Parameter	$GHG_{BSL-E,i,t}$
Data unit	t CO2e yr-1
Description	Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum i in year t.
Source of data	Calculated based on VMD0006 v1.3 equation 15.
Value applied	See the values applied in the Table 18.
Justification of choice of data or description of measurement methods and procedures applied	Calculated based on the non-CO2 emissions due to biomass burning in stratum i in year t ($E_{BionmassBurn,i,t}$)
Purpose of Data	Calculation of baseline emissions.
Comments	Net CO2e emission from fossil fuel combustion in stratum i in year t (EFC,i,t) and direct N2O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum i in year t ($N2O_{direct-N,i,t}$) are conservatively excluded from the project scope and the calculation of the baseline estimates following VM0007 v1.6 section 5.4 criteria.

Data / Parameter	$E_{BionmassBurn,i,t}$
Data unit	t CO2e
Description	Greenhouse gas emissions due to biomass burning in stratum i in year t of each GHG (CH_4).
Source of data	Calculated based on VMD0013 v1.3 equation 1.
Value applied	See the values applied in the Table 18.
Justification of choice of data or description of measurement methods and procedures applied	Calculated based on area burnt for stratum i in year t (Aburn,i,t), average aboveground biomass stock before burning stratum i, in year t ($B_{i,t}$), combustion factor for stratum i (unitless) ($COMF_i$), emission factor for stratum i for gas g ($G_{g,i}$) and the Global warming potential for gas g (GWP_g)
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$A_{Burn,i,t}$
Data unit	ha
Description	Area burnt for stratum i in year t.
Source of data	Equal to $AA_{planned,i,t}$ in the baseline case.
Value applied	See the values applied in the Table 18.
Justification of choice of data or description of measurement methods and procedures applied	For the calculation of baseline emissions, the burned area is considered equivalent to the annual deforested area, assuming that all deforestation is preceded by a fire to clear the land in the baseline case.
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$B_{i,t}$
Data unit	tonnes d.m. ha^{-1}
Description	Average aboveground biomass stock before burning for stratum i, year t.

Source of data	Calculated based on VMD0013 v1.3 equation 2.
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Calculated based on carbon stock in aboveground biomass in trees in stratum i in year t ($C_{AB\_tree,i,t}$), Mean stock of extracted biomass carbon by class of wood product ($C_{XB_{sawnwood}}$), and Carbon fraction of biomass (CF).
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$COMF_i$
Data unit	Dimensionless
Description	Combustion factor for stratum i.
Source of data	IPCC (2006)[54]
Value applied	0.59
Justification of choice of data or description of measurement methods and procedures applied	Default values from IPCC (2006), available on Chapter 2, Table 2.5.
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$G_{g,i}$
Data unit	kg t^{-1} d.m. burnt
Description	Emission factor for stratum i for gas g
Source of data	IPCC (2006)
Value applied	CH_4=6.8
Justification of choice of data or description of	Default value from IPCC (2006), available on Table 2.5.

[54] Available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	GWP_g
Data unit	Dimensionless
Description	Global warming potential for gas g.
Source of data	Default values from IPCC (2022)[55], available at IPCC AR6.
Value applied	CH_4=28
Justification of choice of data or description of measurement methods and procedures applied	Default factor from the latest IPCC Assessment Report.
Purpose of Data	Calculation of baseline emissions.
Comments	-

5.2. Data and Parameters Monitored

Data / Parameter	$A_{DefPA,i,u,t}$
Data unit	ha
Description	Area of recorded deforestation in the project
Source of data	Monitored at each monitoring/verification event through the use of classified satellite imagery and PRODES dataset.
Description of measurement methods and procedures to be applied	Detailed procedures are provided below under monitoring plan description. Monitoring responsibilities are listed in section 5.3, below.

[55] Available at https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Full_Report.pdf

Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See Table 11.
Monitoring equipment	ArcGIS, Google Earth Engine
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description
Purpose of data	Calculation of project emissions
Calculation method	Classified images with information about the area of annual deforestation in Brazil are downloaded from PRODES websites and clipped with the project area spatial limits. Images from Sentinel are downloaded from Google Earth Engine.
Comments	-

Data / Parameter	$C_{post,u,i}$
Data unit	t CO2-e
Description	Carbon stock in all pools in post-deforestation land use u in stratum i.
Source of data	Calculated according to VMD0015 v2.2, equation 6
Description of measurement methods and procedures to be applied	Calculated based on carbon stock in aboveground tree biomass in stratum I ($C_{AB\_tree+nontree,i}$), carbon stock in belowground tree biomass in stratum I ($C_{BB\_tree+nontree,i}$), carbon stock in dead wood in stratum I (CDW,i). Carbon stock in litter and mean post-deforestation stock in soil organic carbon in the post deforestation stratum are excluded from the analysis.
Frequency of monitoring/recording	10 years (in each baseline revalidation)
Value applied	See Table 15.
Monitoring equipment	N/A
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions

Calculation method	See VMD0015 v2.2, equation 6.
Comments	-

Data / Parameter	$C_{WP,i}$
Data unit	t CO2e ha^{-1}
Description	Carbon stock sequestered in wood products from harvests in stratum i
Source of data	Calculated
Description of measurement methods and procedures to be applied	See section 5.1.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 10 years.
Value applied	26.9
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions Calculation of project emissions Calculation of leakage emissions
Calculation method	Uses Equation 2 in the CP-W module
Comments	

Data / Parameter	$\Delta C_{pools,Def,u,i,t}$
Data unit	t CO2-e
Description	Net carbon stock changes in all pools as a result of deforestation in the project case in land use u in stratum i at time t.
Source of data	Calculated according to VMD0015 v2.2, equation 5.
Description of measurement methods	Calculated based on carbon stock in all pools in the baseline case in stratum I ($C_{BSL,i}$), carbon stock in all pools in post-deforestation land

and procedures to be applied	use u in stratum I ($C_{P,post,u,i}$) and carbon stock sequestered in wood products from harvests in stratum I ($C_{WP,i}$)
Frequency of monitoring/recording	10 years (in each baseline revalidation)
Value applied	See the values applied in the Table 16.
Monitoring equipment	N/A
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method	See VMD0015 v2.2, equation5.
Comments	-

Data / Parameter	$\Delta C_{P,DefPA,i,t}$
Data unit	t CO2-e
Description	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t.
Source of data	Calculated according to VMD0015 v2.2, equation 3
Description of measurement methods and procedures to be applied	Calculated based on the area of recorded deforestation in the project area stratum i converted to land use u at time t ($A_{DefPA,u,i,t}$) and the net carbon stock changes in all pools in the project case in land use u in stratum i at time t ($\Delta C_{pools,Def,u,i,t}$)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in the Table 16
Monitoring equipment	N/A
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	See VMD0015 v2.2, equation 3.
Comments	-

Data / Parameter	$A_{DegW,i}$
Data unit	ha
Description	Area potentially impacted by degradation processes in stratum i
Source of data	Measured
Description of measurement methods and procedures to be applied	Remote sensing
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0
Monitoring equipment	N/A
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	

Data / Parameter	$C_{DegW,i,t}$
Data unit	t CO2-e
Description	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i in year t.
Source of data	Remote sensing
Description of measurement methods and procedures to be applied	Detailed procedures provided below under monitoring plan description. Monitoring responsibilities are listed in section 5.3, below.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0

Monitoring equipment	N/A
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of data	Calculation of project emissions.
Calculation method	As the agent of deforestation, have committed to not deforest, not harvest fuelwood, and not timber in forests in the project area, ex-ante degradation is estimated as zero.
Comments	

Data / Parameter	APi
Data unit	ha
Description	Total area of degradation sample plots in stratum i.
Source of data	Remote sensing
Description of measurement methods and procedures to be applied	PRODES data will be used to monitor forest degradation ($A_{DegW,I}$, $A_{DistPA,i,t}$, $A_{burn,i,t}$) in the project case. Net carbon stock change as a result of degradation in the project area in the project case will be calculating taking in consideration the extraction of trees for illegal timber or fuelwood and charcoal ($\Delta C_{P,DegW,i,t}$), according to VMD0015 v2.2 equation.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	N/A
Monitoring equipment	ArcGIS
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of data	Calculation of project emissions.
Calculation method	N/A
Comments	-

Data / Parameter	$\Delta C_{P,DegW,i,t}$

Data unit	t CO2-e
Description	Net carbon stock changes as a result of degradation in stratum i in the project area in year t.
Source of data	Calculated according to VMD0015 v2.2, equation 8.
Description of measurement methods and procedures to be applied	Calculated based on area potentially impacted by degradation processes in stratum I ($A_{DegW,i}$) and biomass carbon of trees cut and removed through degradation process in stratum i in year t ($C_{DegW,i,t}$) and total area of degradation sample plots in stratum I (APi) estimated using remote sensing.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	See VMD0015 v2.2, equation 8.
Comments	-

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 in year t; ha
Source of data	Monitored at each monitoring/verification event through the use of classified satellite imagery
Description of measurement methods and procedures to be applied	Detailed procedures provided below under monitoring plan description. Monitoring responsibilities are listed in section 5.3, below.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0

Monitoring equipment	ArcGIS
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description
Purpose of data	Calculation of project emissions.
Calculation method	N/A
Comments	-

Data / Parameter	$A_{burn,i,t}$
Data unit	ha
Description	Area burnt in post-natural disturbance in stratum i at time t;
Source of data	Equal to $A_{DistPA,q,i,t}$ + $A_{DefPA,i,u,t}$ in the project case.
Description of measurement methods and procedures to be applied	For the calculation of project emissions, the burned area is considered equivalent to burn scars monitored plus annual deforested area monitored, assuming that all deforestation is preceded by a fire to clear the land in the project case.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	N/A
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	$C_{P,Dist,q,i}$
Data unit	t CO2-e ha^{-1}
Description	Carbon stock in all pools in post-natural disturbance in baseline stratum i.

Source of data	Calculated according to VMD0015 v2.2, equation 24.
Description of measurement methods and procedures to be applied	Calculated based on the carbon stock in aboveground tree biomass in stratum I ($C_{AB\_tree+nontree,i}$), carbon stock in belowground tree biomass in stratum I ($C_{BB\_tree+nontree,i}$), carbon stock in dead wood in stratum I ($C_{DW,i}$). Carbon stock in litter and mean stock in soil organic carbon in stratum I (CSOC,i) are excluded from the analysis.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	Use equations as stated in the forest inventory, including allometric equations as found in Brown (1997)[56] and a volumetric based palm equation, Cairns et al. (1997)[57], Van Wagner (1968)[58]. Carbon stocks must be measured and estimated using the methods given in module CP-AB and CP-D.
Comments	It can be conservatively assumed that a post-natural disturbance live and dead vegetation pool is equal to zero.

Data / Parameter	$\Delta C_{P,Dist,q,i,t}$
Data unit	t CO2-e ha^{-1}
Description	Net carbon stock changes in pools as a result of natural disturbance in the project case in post-natural disturbance in stratum i in year t.
Source of data	Calculated according to VMD0015 v2.2, equation 23.
Description of measurement methods and procedures to be applied	Calculated based on the carbon stock in all pools in the baseline case in stratum I ($C_{BSL,i}$), carbon stock in pools in post-natural disturbance strata q in stratum I ($C_{P,Dist,q,i}$) and carbon stock sequestered in wood products from harvests following natural disturbance in post-natural

[56] Brown, S., 1997. Estimating biomass and biomass change of tropical forests: A primer. FAO Forestry Paper: vii, 55p.

[57] Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world's upland forests. Oecologia 111, 1-11.

[58] Van Wagner, C.E. (1968). The line intersect method in forest fuel sampling. Forest Science 14: 20-26.

	disturbance stratum q, in stratum I ($C_{Dist, WP,q,i}$), according to VMD0015 v2.2, equation 23.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	Use equations as stated in the forest inventory, including allometric equations as found in Brown (1997) and a volumetric based palm equation, Cairns et al. (1997), Van Wagner (1968). Carbon stocks must be measured and estimated using the methods given in module CP-AB and CP-D.
Comments	-

Data / Parameter	$\Delta C_{P,DistPA,i,t}$
Data unit	t CO2-e
Description	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum i in year t.
Source of data	Calculated according to VMD0015 v2.2, equation 20.
Description of measurement methods and procedures to be applied	Estimated based on the Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i, in year t ($A_{DistPA,q,i,t}$), and the net carbon stock changes in pools as a result of natural disturbance in post-natural disturbance in stratum i in year t ($\Delta C_{P,Dist,q,i,t}$),according to VMD0015 v2.2, equation 20.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions

Calculation method	Calculated according to VMD0015 v2.2, equation 20.
Comments	-

Data / Parameter	$GHG_{P,E,i,t}$
Data unit	t CO2e yr^{-1}
Description	Greenhouse gas emissions as a result of deforestation activities within the within the project area in the project case stratum i in year t.
Source of data	Calculated based on VMD0006 v1.3 equation 15.
Description of measurement methods and procedures to be applied	Calculated based on the non-CO2 emissions due to biomass burning in stratum i in year t ($E_{BiomassBurn,i,t}$)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in Table 21.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions.
Calculation method	Calculated based on VMD0006 v1.3 equation 15.
Comments	Net CO2e emission from fossil fuel combustion and direct N2O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum i in year t are conservatively excluded from the project scope and the calculation of the baseline estimates following VM0007 v1.6 section 5.4 criteria.

Data / Parameter	$E_{BiomassBurn,i,t}$
Data unit	t CO2e
Description	Greenhouse gas emissions due to biomass burning in stratum i in year t of each GHG (CH_4)
Source of data	Calculated based on VMD0013 v1.3 equation 1.

Description of measurement methods and procedures to be applied	Calculated based on area burnt for stratum i in year t ($A_{burn,i,t}$), average aboveground biomass stock before burning stratum i, in year t ($B_{i,t}$), combustion factor for stratum i (unitless) ($COMF_i$), emission factor for stratum i for gas g ($G_{g,i}$) and the Global warming potential for gas g (GWP_g)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in Table 21.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions.
Calculation method	Calculated based on VMD0013 v1.3 equation 1.
Comments	-

Data / Parameter	$\Delta C_{WPS-REDD}$
Data unit	t CO2-e
Description	Net GHG emissions in the REDD project scenario up to year t.
Source of data	Calculated according to VMD0015 v2.2, equation 01.
Description of measurement methods and procedures to be applied	Calculated based on net carbon stock change as a result of deforestation in the project area in the project case in stratum i in year t ($\Delta C_{P,DefPA,i,t}$), Net carbon stock change as a result of degradation in the project area in the project case in stratum i in year t ($\Delta C_{P,Deg,i,t}$), Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum i in year t ($\Delta C_{P,DistPA,i,t}$) and Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum i in year t ($GHG_{P-E,i,t}$)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in the table 20.
Monitoring equipment	N/A

QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	See VMD0015 v2.2, equation 01.
Comments	-

Data / Parameter	$\Delta C_{LK\text{-}REDD}$
Data unit	t CO2e
Description	Net GHG emissions due to leakage from the REDD project activity up to year t
Source of data	Calculated according to VMD0007 v1.6 equation 4.
Description of measurement methods and procedures to be applied	Calculated based on net GHG emissions due to activity shifting leakage for projects preventing planned deforestation up to year t ($\Delta C_{LK\text{-} AS,planned}$), and the Net GHG emissions due to market-effects leakage up to year t*($\Delta C_{LK\text{-}ME}$)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in the table 24.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage.
Calculation method	Calculated according to VMD0007 v1.6 equation 4.
Comments	-

Data / Parameter	$\Delta C_{LK\text{-}AS,planned}$
Data unit	t CO2e
Description	Net GHG emissions due to activity shifting leakage for projects preventing planned deforestation up to year t
Source of data	Calculated according to VMD0009 v1.3, equation 1.

Description of measurement methods and procedures to be applied	Calculated based on the area of activity shifting leakage in stratum i in year t ($LK_{Aplanned,i,t}$), the net carbon stock changes in all pre-deforestation pools in baseline stratum I, ($\Delta C_{BSL,i}$) and the Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum i in year t ($GHG_{LK,E,i,t}$)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage.
Calculation method	Calculated according to VMD0009 v1.3, equation 1.
Comments	-

Data / Parameter	$LK_{Aplanned,i,t}$
Data unit	ha
Description	The area of activity shifting leakage in stratum i in year t.
Source of data	Calculated according to VMD0009 v1.3, equation 6.
Description of measurement methods and procedures to be applied	Calculated according to the total area of monitored deforestation by the baseline agent of the planned deforestation in stratum i in year t ($A_{defLK,i,t}$), and the New calculated forest clearance by the baseline agent of the planned deforestation in stratum i in year t where no leakage is occurring ($NewR_{i.t}$).
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage.
Calculation method	Calculated according to VMD0009 v1.3, equation 6.

Comments	-

Data / Parameter	$GHG_{LK,E,i,t}$
Data unit	t CO2e
Description	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum i in year t.
Source of data	Calculated according to VMD0009 v1.3, equation 7.
Description of measurement methods and procedures to be applied	Calculated based on Non-CO2 emissions due to biomass burning in stratum i in year t ($E_{biomassburn,i,t}$)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	Calculated according to VMD0009 v1.3, equation 7
Comments	-

Data / Parameter	ΔC_{LK-ME}
Data unit	t CO2-e
Description	Net greenhouse gas emissions due to market- effects leakage
Source of data	Calculated according to VMD0011 v1.0 equation 1.
Description of measurement methods and procedures to be applied	Calculated based on Total GHG emissions due to market- effects leakage through decreased timber harvest ($LK_{MEf,ti}$). Total GHG emissions due to market leakage through decreased harvest of fuelwood and charcoal sold into regional and/or national markets ($LK_{ME,FW/C}$) excluded from the analysis.

Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in the table 24.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	Calculated according to VMD0011 v1.0 equation 1.
Comments	-

Data / Parameter	$LK_{MEf,ti}$
Data unit	t CO2-e
Description	Total GHG emissions due to market- effects leakage through decreased timber harvest
Source of data	Calculated according to VMD0011 v1.0 equation 2
Description of measurement methods and procedures to be applied	Calculated according to leakage factor for market-effects calculations (LF_{ME}) and summed emissions from timber harvest in stratum i in the baseline case potentially displaced through implementation of carbon project ($AL_{T,i}$)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in the table 23.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	Calculated according to VMD0011 v1.0 equation 2
Comments	-

Data / Parameter	LF_{ME}
Data unit	Dimensionless
Description	Leakage factor for market-effects calculations.
Source of data	Default data from VMD0011 v1.0
Description of measurement methods and procedures to be applied	A comparison between the proportion of total biomass in commercial species that is merchantable (PMP_i) and the mean proportion of total biomass that is merchantable (PML_{FT}) was performed based on the wood volume to be extracted in project area. The species that would be extracted in the project area are Amazonian species, and could only be sourced from other native forest sites in the Brazilian Amazon. They would also need to be sourced from relatively mature forests where millable size trees (> 40 cm DBH) can be readily found. Stem (merchantable portion) biomass as a percent of total aboveground biomass is fairly constant in mature Amazonian forests, averaging around 66% (Higuchi et al 1998), and is not expected to differ between those mature native forests in the project area and in other parts of the Brazilian Amazon.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0.4
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	-
Comments	-

Data / Parameter	PMP_i
Data unit	%
Description	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data	
Description of measurement methods	Within each stratum divided the summed merchantable biomass (defined as “Total gross biomass (including bark) of a tree 30 cm

and procedures to be applied	DBH or larger from a 30 cm stump to a minimum 10 cm top DOB of the central stem") by the summed total aboveground tree biomass. Merchantable biomass is equal to merchantable volume multiplied by wood density (Dmn)
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	0.12
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	-
Calculation method	NA
Comments	Ex-ante a time zero measurement shall be made for this factor.

Data / Parameter	$AL_{T,i}$
Data unit	t CO2-e
Description	Summed emissions from timber harvest in stratum i in the baseline case potentially displaced through implementation of carbon project
Source of data	Calculated based on VMD0011 v1.0 equation 2.
Description of measurement methods and procedures to be applied	Calculated based on Carbon emission due to displaced timber harvests in the baseline scenario in stratum i in time t ($C_{BSL,XBT,i,t}$), according to VMD0011 v1.0 equation 2.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	According to VMD0011 v1.0 equation 2.
Comments	-

Data / Parameter	$C_{BSL,XBT,i,t}$
Data unit	t CO2-e
Description	Carbon emission due to timber harvests in the baseline scenario in stratum i at time t
Source of data	Calculated according to VMD0011 v1.0 equation 4
Description of measurement methods and procedures to be applied	Calculated based on the volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t ($V_{BSL,EX,i,t}$), the mean wood density of commercially harvested species (same as that used in the module CP-W) (Dmn), the carbon fraction of biomass for commercially harvested species j (CF), the logging damage factor (LDF), and the logging infrastructure factor (LIF), according to VMD0011 v1.0 equation 4.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	Calculated according to VMD0011 v1.0 equation 4.
Comments	-

Data / Parameter	$V_{BSL,EX,i,t}$
Data unit	m^3
Description	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t
Source of data	Pre-exploratory inventories
Description of measurement methods	The volume of commercial wood found in previous inventories carried out to request the deforestation of the project area and the

and procedures to be applied	deforestation in the baseline scenario are considered to estimate market leakage effects.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	-
Comments	-

Data / Parameter	LDF
Data unit	t C m-3
Description	Logging damage factor.
Source of data	Default value provided by VMD0011 v1.0.
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	-
Value applied	0.53
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage.
Calculation method	-
Comments	See VMD0011 v1.0 equation 4.

Data / Parameter	LIF
Data unit	t C m-3
Description	Logging infrastructure factor.
Source of data	Default value provided by VMD0011 v1.0.
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	-
Value applied	0.29
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage.
Calculation method	-
Comments	See VMD0011 v1.0 equation 4.

Data / Parameter	$LK_{MarketEffects,FW/C}$
Data unit	t CO2-e
Description	Total GHG emissions due to market leakage through decreased harvest of fuelwood and charcoal sold into regional and/or national markets
Source of data	Calculated according to VMD0011 v1.0 equation 5.
Description of measurement methods and procedures to be applied	Calculated based on Leakage factor for market effects calculations (LF_{ME}), and the summed emissions from fuelwood/charcoal harvests in stratum i in the baseline case potentially displaced through implementation of carbon ($ALFW/C,i$), according to VMD0011 v1.0 equation 5.

Frequency of monitoring/recording	
Value applied	See the values applied in the table 23.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of leakage
Calculation method	Calculated according to VMD0011 v1.0 equation 5.
Comments	-

Data / Parameter	$Buffer_{planned}$
Data unit	t CO2e
Description	Buffer withholding for avoiding planned deforestation project activities
Source of data	Calculated according to VM0007 v1.6 equation 8.
Description of measurement methods and procedures to be applied	Calculated based on the net greenhouse gas emissions in the baseline from planned deforestation up to year t ($\Delta C_{BSL,planned}$) and the buffer withholding percentage (Buffer%), according to VM0007 v1.6 equation 8.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	See the values applied in the table 25.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of VCUs
Calculation method	Calculated according to VM0007 v1.6 equation 8.
Comments	-

Data / Parameter	$Uncertainty_{REDD-BSL,SS}$
Data unit	%
Description	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario
Source of data	NA
Description of measurement methods and procedures to be applied	Total Baseline Uncertainty is estimated using the UC Module. Uncertainty is determined for the baseline deforestation rate based on proxy areas. For the baseline pools, it is derived from inventory uncertainties. The total uncertainty is within the threshold of +/- 15% so no deduction is made to offsets
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 5 years.
Value applied	6.99%
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of VCUs
Calculation method	NA
Comments	

Data / Parameter	VCUt
Data unit	VCU
Description	Number of Verified Carbon Units at year t
Source of data	Calculated according to VMD0017 v2.2 equation 19.
Description of measurement methods and procedures to be applied	Calculated based on the total net GHG emission reductions of the REDD+ project activity up adjusted to account for uncertainty (Adjusted_NERREDD+), and the total permanence risk buffer withholding ($Buffer_{Planned}$), according to VMD0017 v2.2 equation 19.
Frequency of monitoring/recording	Before every verification event with a minimum frequency of 05 years.
Value applied	See the values applied in the table 25.

Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of VCUs
Calculation method	Calculated according to VMD0017 v2.2 equation 19.
Comments	The allowable uncertainty in methodology REDD+ MF is +/- 15% of NERREDD+ at the 95% confidence level. Where this precision level is met then no deduction should result for uncertainty.

5.3. Monitoring Plan

This monitoring plan has been developed based on module VMD0015 of the REDD Methodological Module, "Methods for monitoring of greenhouse gas emissions and removals (M-MON)."

5.3.1. Estimation of Ex-Post Net Carbon Stock Changes and Greenhouse Gas Emissions

Monitoring will follow VMD00015 v2.1 criteria, which established procedures for monitoring deforestation, illegal degradation, natural disturbance, and project emissions *ex-post* in the project and leakage areas. For accounting purposes, the project conservatively assumes stable stocks and no biomass monitoring is conducted in areas undergoing carbon stock enhancement, as permitted in the methodology monitoring module VMD0015. Hence, $C_{P,Enh,i,t}$ is set to 0. Further as no commercial harvest of timber (including FSC selective logging) occurs in the project case, the degradation due to harvest of timber will not be monitored, thus parameter $C_{P,SelLog,i,t}$ is set to 0.

Monitoring of emissions in the project area focuses on:

- Net carbon stock change as a result of deforestation and natural disturbance in the project area;
- The net carbon stock change as a result of illegal degradation in the project area;
- The greenhouse gas emissions as a result of deforestation and degradation activities within the project area

Procedures and responsibilities for monitoring each of the above sources of emissions are detailed below.

1. Monitoring Deforestation and Natural Disturbance

Forest cover change due to deforestation and natural disturbance is monitored through periodic assessment of satellite imagery covering the project area. Emissions ($\Delta C_{P,Def,i,t}$ and $\Delta C_{P,DistPA,i,t}$ for deforestation and natural disturbance, respectively) are estimated by multiplying area of forest loss detected ($A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$, for deforestation and natural disturbance, respectively) by average forest carbon stock per unit area. Note that $A_{DistPA,q,i,t}$,, is limited to the area where credits have been issued. Stock estimates from the initial field inventory completed in 2022 are valid for 10 years (per VM0007). Post 2027, forest carbon stock estimates will be updated for any strata where deforestation or natural disturbance is detected.

For each monitoring/verification date, changes in forest cover ($A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$) will be monitored using PRODES (Program to Calculate Deforestation in the Amazon) data from INPE. Forest cover benchmark maps will be generated and updated as soon as the data are available (in port. Instituto de Pesquisas Espaciais)[59]. The PRODES project carries out satellite monitoring of clear-cut deforestation in the Legal Amazon and produces annual deforestation rates in the region, which are used by the Brazilian government to establish public policies. PRODES uses satellite images of the LANDSAT class (20 to 30 meters spatial resolution and 16-day revisit rate) in a combination that seeks to minimize cloud coverage and ensure interoperability criteria. PRODES estimates are considered reliable by national and international scientists (Kintish, 2007)[60], and has proven to be of great value for planning of public policies in the Amazon. Results from independent expert analyses indicate a level of data accuracy close to 95%. Additional details on pre-processing can be found in the PRODES methodology[61].

Deforestation and natural disturbance will be distinguished using ancillary data which may include but is not limited to high resolution imagery, digital elevation models (to identify steep areas prone to landslides), information from local land managers, etc. In the case deforestation is confirmed by PRODES data it will be used to estimate GHG emissions due to project area deforestation ($A_{DefPA,i,u,t}$) or activity shifting leakage ($A_{DefLK,i,u,t}$) in the project scenario. Net carbon stock change as a result of deforestation in the project area and leakage will be calculated taking in consideration the net carbon stock changes in all pools in the project case ($\Delta C_{pools,Def,u,i,t}$), according to VMD0015 v2.2 equations 3 to 6 (see section 4.2) and VMD0009 v1.3 equations 1 to 7 (see section 4.3).

Should this dataset not be available, ex-post deforestation will be determined by classification of remote sensed imagery and land use change detection procedures. The baseline data used in this case will be Sentinel-2 satellite imagery. A Sentinel-2 cloud free composite was developed in Google Earth Engine (GEE) using a cloud masking algorithm recommended for Sentinel imagery (Google, 2022a)[62]. Additional details can be found in the Brazil 413 Carbon Project Landcover Classification Report.

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[59] Derived from INPE.

[60] Improved Monitoring of Rainforests Helps Pierce Haze of Deforestation.

[61] Availalbe at http://www.inpe.br/amazonia1/en/uses_applications.php

[62] Google. (2022a). *Sentinel-2 MSI: MultiSpectral Instrument, Level-1C*. https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2

Quality Assurance/Quality Control and Data Archiving Procedures

To ensure consistency and quality results, spatial analysts carrying out the imagery processing, interpretation, and change detection procedures will strictly adhere to best practices and good practice guidelines. In addition, all data sources and analytical procedures will be documented and archived.

Overall classification accuracy is set at a 90% minimum. A confusion matrix was generated comparing each land cover map class for the year 2021, the project's start date. A set of 177 random points were distributed within the reference region, with 30 points for each map class, and 50m buffer around each point. Evaluation at each point was carried out using images from Sentinel-2 imagery 2-8a bands, with 20m spatial resolution. The global accuracy of the reference map was on average above 90% (further details in 'Brazil 413 Carbon Project Landcover Classification Report').

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive maintained by 413.

Information related to monitoring deforestation maintained in the archive will include:

- Forest / non-forest maps;
- Documentation of software type and procedures applied (including all pre-processing steps and corrections, spectral bands used in final classifications, and classification methodologies and algorithms)
- Data used in accuracy assessment - ground-truth points (including GPS coordinates, identified land-use class, and supporting photographic evidence) and/or sample points of high resolution imagery

The data archive will be maintained for at least two years beyond the end of the project crediting period. Given the extended time frame and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

Updating forest carbon stock estimates

The following steps will be undertaken to limit errors in field sampling and data analysis:

1. Trained field crews will carry out all field data collection and adhere to standard operating procedures. Pilot sample plots shall be measured before the initiation of formal measurements to appraise field crews and identify and correct any errors in field measurements. Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurements.
2. Field measurement data will be recorded on standard field data sheets and entered into a spreadsheet database for data management and quality control. Potential errors in data

entry (anomalous values) will be verified or corrected by consulting the original data sheets. Original data sheets will be permanently archived in a dedicated long-term electronic archive.

2. Monitoring Illegal Degradation

An initial participatory rural appraisal (PRA) of the communities inside and surrounding the project area was performed to determine the potential for illegal extraction of trees. Evidence suggests that the few families living inside the project area conducted low impact activities driven by subsistence purposes. No timber or fuel wood economic activity was perceived by the project proponent. As opposed to conducting a PRA every two years, as required in VMD0015 v2.2, the project proponent will monitor annually using the protocols established in this monitoring plan. This will generate more accurate estimates of timber and fuel wood extraction.

In the event the remote sensing assessment indicates that illegal logging (degradation) is occurring in the project area, supplemental plots will be allocated to achieve a 3% sample of the area. Biomass will be estimated from measured stump diameters (this is conservative because it assumes stump diameter is equivalent to diameter at breast height) and applying the allometric equations of Higuchi et al (1998). The goal is to maintain consistency with analytical procedures applied in the original inventory. Emissions due to illegal logging ($\Delta C_{P,DegW,i,t}$) will be estimated by multiplying area ($A_{DegW,i}$) by average biomass carbon of trees cut and removed per unit area ($C_{DegW,i,t}$ / AP_i).

The same quality assurance/quality control and archiving procedures as detailed above for updating estimates of forest carbon stocks will be adhered to in the field surveys of potential degradation areas.

3. Monitoring Project Emissions

Project emissions are calculated as the sum of emission from fossil fuel combustion (EFC,i,t), non-CO_2 emissions due to biomass burning ($E_{BiomassBurn,i,t}$), and direct N_2O emissions as a result of nitrogen application ($N_2O_{direct-N,i,t.}$). As stipulated in the methodology, fossil fuel combustion is an optional emission source and was conservatively omitted. Furthermore, no nitrogen is applied in the project case. Project emissions are thus a consequence of $E_{BiomassBurn}$ only. These will be calculated using the VMD0013 module, “Estimation of greenhouse gas emissions from biomass burning (E-BB)”.

The CO_2e emissions from biomass burning are a result of deforestation, and so the total area burnt is equal to the area deforested, $A_{DefPA,u,i,t}$. Area burnt due to natural disturbance is not considered in the analysis since wildfire is not a common natural disturbance within the Amazon region[63].

[63] Natural fires occur only rarely in undisturbed tropical rain forests. (Goldammer 1990) Goldammer, J. G. (ed). 1990. Fire in the tropical biota. Springer-Verlag, New York

5.3.2. Revising the baseline for future project crediting periods

The baseline will be revised every 10 years from the project start date. As the entire project area will have been deforested during the initial baseline period, no new areas will be deforested post 2032 in the baseline. From 2033 onward then, baseline emissions will be a result of decay in the dead wood, below ground biomass, and wood product pools that were generated from the initial baseline period. Should an analysis of proxy areas be warranted to estimate a rate of deforestation, the BL-PL module will be consulted.

5.3.3. Organization and Responsibilities

For all aspects of project monitoring, 413 staff will ensure that data collection, processing, analysis, management, and archiving are conducted in accordance with the monitoring plan.

Table 29 - Monitoring and responsibilities for actual emissions in the project area

Variables to be monitored	Responsible	Frequency
Monitoring deforestation and natural disturbance	413 Environmental	Prior to each verification
Monitoring illegal degradation	413 Environmental	Annually
Monitoring project emissions	413 Environmental	Prior to each verification
Activity shifting leakage assessment	413 Environmental	Prior to each verification
Updating forest carbon stocks estimates	413 Environmental	At least every 10 years.
Revision of the baseline	413 Environmental	At least every 10 years.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Monitored parameters are the same as the ones presented at Tables as per section 5.2

6.2 Baseline Emissions

6.2.1 Estimation of Carbon Stocks by Carbon Pools

Three carbon pools were used to calculate baseline emissions: 1. Aboveground biomass (stems, branches, and foliage - AGB), 2. Belowground biomass (roots - BGB), both from trees and non-tree vegetation, and 3. Dead wood (DW). Litter, soil and non-tree biomass pools were excluded, as per the APD methodology. This is a conservative measure from the perspective of carbon credit calculations.

Forest carbon values were derived from the inventory reports generated by Biondendro[64], while pasture values in the municipality of Novo Aripuanã were obtained from Nogueira et al. (2008)[65]. Values for AGB ,BGB, DW $(CAB_{tree+nontree_i}, CBB_{tree+nontree_i}, CDW_i)$, respectively, and the corresponding land conversion (to pasture) values $(CAB_{post,i}, CBB_{post,i}, CDW_{post,i})$ are listed in **Table 42.**

Table 30 - Carbon Pools for calculation of the baseline scenario

C_{pre} Baseline in the forest stratum			
Parameter	Description	Unit	**Value**
$C_{AB_{pre,i}}$	Aboveground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	526.9
$C_{BB_{pre,i}}$	Belowground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	125.0
$C_{DW_{pre,i}}$	Deadwood (DW)	$tCO_2\text{eha}^{-1}$	50.6
C_{preBSL}	Total	tCO_2eha^{-1}	702.5
C_{post} Baseline in pasture			
$C_{AB_{post,i}}$	Aboveground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	5.2

[64] Brazilian consultant company http://www.biodendro.com.br/

[65] Nogueira, E. M., Fearnside, P. M., Nelson, B. W., Barbosa, R. I., & Keizer, E. W. H. (2008). Estimates of forest biomass in the Brazilian Amazon: new allometric equations and adjustments to biomass from wood-volume inventories. Forest Ecology and Management, 256(11), 1853-1867.

$C_{BB_{post,i}}$	Belowground Biomass (AGB)	$tCO_2\text{eha}^{-1}$	6.3
$C_{DW_{post,i}}$	Deadwood (DW)	$tCO_2\text{eha}^{-1}$	7.4
$C_{postBSL}$	Total	tCO_2eha^{-1}	19.0
Difference between forest and pasture			
$C_{AB_{pre,i}} - C_{AB_{post,i}}$	Aboveground Biomass (AGB)	tCO_2eha^{-1}	521.7
$C_{BB_{pre,i}} - C_{BB_{post,i}}$	Belowground Biomass (AGB)	tCO_2eha^{-1}	118.7
$C_{DW_{pre,i}} - C_{DW_{post,i}}$	Deadwood (DW)	tCO_2eha^{-1}	43.2
ΔC_{BSL}	Total	tCO_2eha^{-1}	683.6

Carbon stock changes in the baseline were determined as per Equation 2 (see VMD0006 v1.3, Equation 13).

Equation 2 (Carbon stock changes in the baseline):

$$\Delta C_{BSL_{i,t}} = AA_{planned_{i,t}} * \left(\Delta C_{ABtree_i} + \Delta C_{ABnon-tree_i} + \Delta C_{LI_i}\right) + \sum_{t-10}^{t}\left(AA_{planned_{i,t}} * \left(\Delta C_{BBtree_i} + \Delta C_{BBnon-tree_i} + \Delta C_{DW_i}\right) * \frac{1}{10}\right) + \sum_{t-20}^{t}\left(AA_{planned_{i,t}} * \left(C_{WP100_i} + \Delta C_{SOC_i}\right) * \frac{1}{20}\right)$$

Annual BGB stock change was calculated from Equation 3 (see VMD0006 v1.3, Equation 8).

Equation 3 (BGB stock change):

$$\Delta C_{BBtree+nontree_{i,t}} = AA_{planned_{i,t}} * \left(CBB_{tree+nontree_i} - CBB_{\text{post},i}\right) * {}^{1}/_{10}$$

Annual deadwood stock change was calculated using Equation 4 (see VMD0006 v1.3, equation 10).

Equation 4 (Deadwood stock change):

$$\Delta C_{DW_t} = AA_{planned_{i,t}} * \left(CDW_{tree+nontree} - CDW_{post,i}\right) * {}^{1}/_{10}$$

Annual baseline stock change from planned deforestation in aboveground and belowground biomass, deadwood, extracted biomass and its decomposition, are listed in **Table 31** (see "413 C calcs v1.3.xlsx, tab 'Baseline_stockchg GHG", for calculations).

Table 31 -Annual baseline carbon stock change (∆CBSL) from planned deforestation in aboveground and belowground biomass (AG+BB, respectively), deadwood (DW), extracted biomass ($XB_{sawnwood}$), and its decomposition ($XB_{sawnwood}$ Decom)

Year	$AA_{planned}$ (ha/y)	ΔC_{AB} (tCO_2e)	ΔC_{BB} (tCO_2e)	ΔC_{DW} (tCO_2e)	$C_{XB_{sawnwood}}$ (tCO_2e)	$C_{XB_{sawnwood}}$ Decom (tCO_2e)	ΔC_{BSL} (tCO_2e)
2021	8,365	4,364,237	99,258	36,103	-222,890	9,718	4,286,426
2022	8,365	4,364,237	198,517	72,206	-222,890	19,436	4,431,506

6.2.1 Estimation of GHG Emissions from burning in the Baseline

Burning remaining biomass after deforestation is a common practice. Emissions from biomass burning were calculated from procedures and equations listed in VMD0006 v1.3, as per Equation 5. See **Table 32** and **Table 33,** for equation input values, and **Table 34** for output values (see "413 C calcs v1.3.xlsx, tab 'Baseline Emissions burn'", for calculations).

Equation 5 (Emissions from biomass burning):

$$GHG_{BSL-E,i,t} = E_{BionmassBurn,i,t} = \sum_{g=1}^{G}\left(\left(\left(A_{Burn,i,t} * B_{i,t} * COMF_i * G_{g,i}\right) * 10^{-3}\right) * GWP_g\right)$$

Table 32 - Parameters values as per Equation 5

Parameter	Description	Unit	Justification
$GHG_{BSL-E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum *i* during project year *t*	$t\ CO_2eyear^{-1}$	Calculated below.
$E_{BionmassBurn,i,t}$	Greenhouse emissions due to biomass burning as part of deforestation activities in stratum *I* in year *t*	$t\ CO_2e$ of each $GHG\ (CO_2, CH_4, N_2O)$	Calculated below. Biomass burning is expected to occur in the project case.
$A_{Burn,i,t}$	Area burnt for stratum *i* in year *t*	ha	-

Parameter	Description	Unit	Justification
$B_{i,t}$	Average aboveground biomass stock before burning stratum *i* in year *t*	$tonnes\ d.m.ha^{-1}$	-
$COMF_i$	Combustion factor for stratum *i*	dimensionless	Default value derived from Table 2.6 of (IPCC, 2006)[66]
$G_{g,i}$	Emission factor for stratum *i* for gas g	$kg\ t^{-1}$ dry matter burnt	Default value derived from Table 2.6 of (IPCC, 2006)
GWP_g	Global warming potential for gas g	$t\ CO_2/t$ gas g	Default values from IPCC AR5 (IPCC, 2014)[67]: $CO_2 = 1$; $CH_4 = 25$; $N_2O = 298$
g	Number of greenhouse gases	-	-
i	Number of strata	-	-
t	Years elapsed since the start of the REDD	-	-

Table 33 - GHG-specific parameters values used to calculate baseline emissions from biomass burning

Gas	COMF	G	GWP
N_2O	0.59	0.2	273
CH_4	0.59	6.8	28

Source: IPCC (2006), AR6 Chap. Table 7.15

Table 34 - Calculation of $E_{BiomassBurn,i,t}$ emission from biomass burning for the baseline scenario accounting for N_2O and CH_4

Year	$A_{Burn,i,t}$ (ha)	$B_{i,t}$ $(tdma/ha)$	E_{BurnCH_4} (tCO_{2e})	E_{BurnN_2O} (tCO_{2e})	$GHG_{BSL,E}$ (tCO_{2e})
2021	8,365	285.2	267,996	76,852	344,848
2022	8,365	285.2	267,996	76,852	344,848

[66] IPCC (2006). Guidelines for National Greenhouse Gas Inventories. Chapter 4 AFOLU (Agriculture, Forestry and Other Land-use).
[67] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

6.2.2 Estimation of Carbon Sequestered in Long-Lived Wood Products

Carbon sequestered in long-lived wood products is calculated using module VMD0005 v1.1 CP-W Option 2, Commercial Inventory Estimation. This option is applicable when an approved harvest plan is not available. Estimate of carbon stocks in the long-term wood products pool is estimated in four steps.

Step 1. Calculate the biomass carbon of the commercial volume extracted prior to or in the process of deforestation:

$$C_{XB_i} = CAB_{tree_i} * {}^{1}/_{BEF} * Pcom_i$$ **Equation 6**

Step 2. Identify the wood product class(es) (*ty*; defined here as sawnwood, wood-based panels, other industrial roundwood, paper and paper board, and other) that are the anticipated end use of the extracted carbon calculated in Step 1. Harvested trees would have been turned into sawnwood as is typical practice for the tropical hardwood species in the region (IBGE, 2022). Hence, only one product class (sawnwood, “s”) is extracted due to harvesting in the baseline. Harvested trees would have been turned into sawnwood as is typical practice for the tropical hardwood species in the region (IBGE, 2022). Hence, only one product class (sawnwood, “s”) is extracted due to harvesting in the baseline.

Step 3: Calculate the biomass carbon entering the wood products pool at the time of deforestation.

$$C_{WP_i} = \sum_{ty=s,w,oir,p,o} C_{XB_{tyi}} * \left(1 - WWs_{ty}\right)$$ **Equation 7**

Step 4: Calculate the amount of wood products entering the pool at the time of deforestation (*CWP,i*, calculated in C-WP) that is expected to be emitted over a 100-year timeframe.

$$C_{WP100_i} = C_{WP_i} - C_{WP_i} * (1 - SLFp) * \left(1 - OF_p\right)$$ **Equation 8**

Variable descriptions for equations 6-8 and associated values are described in **Table 35**; see “413 C calcs v1.3.xlsx, tabs ‘HWP_initial’ and HWP_base”, for detailed calculations).

Table 35 - Parameters and values used to estimate carbon stocks entering the long-term wood products pool

Parameter	Description	Unit	Value	Justification
CAB_{tree_i}	Carbon stock in aboveground biomass tree in stratum *i;*	$t\,CO_2e/ha$	526.9	Calculated from forest inventory data.
BEF	Biomass Expansion Factor for conversion of	dimensionless	1.79	BEF Calculated using data from Goodman et al. 2014[68]

[68] Goodman, R.C., Phillips, O.L., Baker, T.R., 2014. The importance of crown dimensions to improve tropical tree biomass estimates. Ecol. Appl. 24, 680–698. https://doi.org/ 10.1890/13-0070.1.

Parameter	Description	Unit	Value	Justification
	volume to total aboveground tree biomass			
$Pcom_i$	Commercial volume as a percent of total aboveground volume in stratum *i*	dimensionless	0.120	1.Commercial portion of a tree (0.56 x 104.9 tonnes aboveground biomass for commercial species, forest, inventory; 2. 526.9 tonnes, average t CO2e/ha aboveground biomass, forest inventory
$C_{XB_{sawnwood}}$	Mean stock of extracted biomass carbon by class of wood product $t_y$from stratum	$t\,CO_2e/ha$	35.4	Equation 6
WW_s	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product	dimensionless	0.24	default value for developing countries from CP-W module, VMD0005
C_{WP_i}	Carbon stock entering the wood products pool from stratum *i*	$t\,CO_2e/ha$	26.9	Equation 7
$SLFs$	SLFty Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product *ty*	dimensionless	0.2	Default for sawnwood from CP-W module, From VMD0005, pg 13
OF_{ty}	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product *ty*	dimensionless	0.84	Default for sawnwood in Tropical forests from previous version of methodology module CP-W (VMD0005 Version 1.0 REDD Methodological Module)
C_{WP100_i}	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum *i*	$t\,CO_2e/ha$	23.5	Equation 8

6.3 Project Emissions

Estimates of the net carbon stock change and GHG emissions in the project scenario were derived from Module *M-REDD*, as per VM0007 specifications. Ex-ante projections of deforestation in the project case assume no planned deforestation and forest degradation have taken place once the project proponent has committed to not undertake these activities. No unplanned (illegal) deforestation is assumed to occur in the project case.

For REDD project activities (non-wetland), the net GHG emissions in the project case are equal to the sum of stock changes due to deforestation and forest degradation plus the total GHG emissions minus any eligible forest carbon stock enhancement (Equation 9).

Equation 9 (Net GHG emissions in the REDD project scenario (see VMD0015 v2.2, equation 1.)):

$$\Delta C_{WPS-REDD}=\sum_{t=1}^{t^*}\sum_{i=1}^{M}\left(\Delta C_{P,DefPA_{i,t}}+\Delta C_{P,Deg_{i,t}}+\Delta C_{P,DitPA_{i,t}}+GHG_{P-E_{i,t}}-\Delta C_{P,Enh_{i,t}}\right)$$

Where:

$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD project scenario up to year $t*$; tCO_{2e};
$\Delta C_{P,DefPA_{i,t}}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* within the project area in year *t*; tCO_{2e};
$\Delta C_{P,Deg_{i,t}}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* within the project area in year *t*; tCO_{2e};
$\Delta C_{P,DitPA_{i,t}}$	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* within the project area in year *t*; tCO_{2e};
$GHG_{P-E_{i,t}}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; tCO_{2e};
$\Delta C_{P,Enh_{i,t}}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline[2] in stratum *i* in year *t*; tCO_{2e};
i	1, 2, 3, …*M* strata;
t	1, 2, 3, …$t*$ years elapsed since the start of the REDD VCS project activity.

When significant, non-CO_2 gas greenhouse emissions, $GHG_{P,E_{i,t}}$, occurring within the project boundary must be evaluated. For example, where deforestation or degradation occur within the project boundaries or in the leakage belt and fire is used as a means of forest clearance the non-CO_2 emissions may be significant. The Tool T-SIG was used to determine which emissions were included in the calculations as a minimum. Emissions were then calculated through applying Modules E-BPB, E-FCC and E-NA.

Equation 10 (Non-CO2 gas greenhouse emissions):

$$GHG_{P,E_{i,t}}=E_{FC_{i,t}}+E_{BiomassBurn_{i,t}}+N_2O_{direct-N_{i,t}}$$

Where:

$GHG_{P,E_{i,t}}$	Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum *i* in year *t*; t CO_{2e}
$E_{FC_{i,t}}$	Emission from fossil fuel combustion in stratum *i* within the project area in year *t*; t CO_{2e}
$E_{BiomassBurn_{i,t}}$	Non-CO_2 emissions due to biomass burning in stratum i in year t; t CO_{2e}
$N_2O_{direct-N_{i,t}}$	Direct N_2O emission as a result of nitrogen application on the alternative land use in stratum *i* within the project area in year *t*; t CO_{2e}
i	1, 2, 3, …*M* strata
t	1, 2, 3, …*t** years elapsed since the start of the REDD VCS project activity

Net GHG emissions under the project scenario (as per equation 9) are shown in **Table 36.** Complete calculations are provided in “413 C calcs v1.3, tab ‘9b. Project GHG’”.

Table 36 - Net GHG emissions under the project scenario

Year	$\Delta C_{P,DefPA,,i,t}$ (tCO_{2e})	$\Delta C_{P,Deg,i,t}$ (tCO_{2e})	$\Delta C_{P,DistPA,i,t}$ (tCO_{2e})	$\Delta C_{P,Enh,i,t}$ (tCO_{2e})	$GHG_{P-E,i,t}$ (tCO_{2e})	$\Delta C_{WPS-REDD}$ (tCO_{2e})
2021	26,691	0	0	0	2,144	28,835
2022	27,638	0	0	0	2,144	27,638

One component of net GHG emissions are non-CO_2 GHG emissions occurring in the project case within the project boundary (as per equation 10). These are shown in **Table 37.** Complete calculations are provided in “413 C calcs v1.3, tab ‘10b. Proj Emissions burn’”.xlsx.

Table 37 - Non-CO_2 GHG emissions occurring in the project case within the project boundary

Year	$A_{Burn,i,t}$ (ha)	$B_{i,t}$ $(tdma/ha)$	E_{BurnCH_4} (tCO_{2e})	E_{BurnN_2O} (tCO_{2e})	E_{FC} (tCO_{2e})	N_2O_{Direct} (tCO_{2e})	$GHG_{P,E}$ (tCO_{2e})
2021	52	285.2	1,666	478	0	0	2,144
2022	52	285.2	1,666	478	0	0	2,144

6.4 Leakage

Leakage emissions from displacement of planned deforestation are estimated as per the VCS REDD methodology VM0007, LK-ASP and LK-ME modules. These modules account for activity shifting leakage resulting from displacement of deforestation activities by the agent of deforestation, and GHG emissions caused by market-effects resulting from the cessation of timber harvesting.

Activity Shifting Leakage

Activity shifting leakage due to displacement of planned deforestation was assessed using the equations provided in the LK-ASP tool, as per VM007 requirements (equation XX). Parameters, values used, and their justification are given in **Table 38.**

Equation 11 (Leakage from displacement of planned deforestation; VMD0007 v1.6, equation 1):

$$\Delta C_{LK-AS_{planned}} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left(LKA_{planned,i,t} \times \Delta C_{BSL,i}\right) + GHG_{LK,E,i,t}$$

Where:

$C_{LK-AS_{planned}}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation up to year t^*; t CO_{2e}
$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum *i in year t*; ha
$\Delta C_{BSL,i}$	Net carbon stock changes in all pre-deforestation pools in baseline stratum *i*; t CO_{2e} ha^{-1}
$GHG_{LK,E,i,t}$	Greenhouse gas emission as a result of leakage of avoiding deforestation activities in stratum *i* in year *t*; t CO_{2e}
i	1, 2, 3, …*M* strata; unitless
t	1, 2, 3, …t^* time elapsed since the start of project activity; years

No activity shifting leakage is anticipated to occur because the deforestation agent does not own any additional lands. Hence, $LKA_{planned,i,t}$, and $GHG_{LK,E,i,t}$ are set to zero, and activity shifting leakage is as per **Table 38.**

Table 38 - Activity shifting leakage

Year	$LKA_{planned}$ (ha)	$\Delta C_{BSL,i}$ (tCO_{2e}/ha)	$GHG_{LK-E,i,t}$ (tCO_{2e})	LK_{peat} (tCO_{2e})	$\Delta C_{LK-AS_{planned}}$ (tCO_{2e})
2021	0	683.55	0	0	0
2022	0	683.55	0	0	0

Activity Shifting Leakage

Total leakage due to market effects is equal to the sum of market effects leakage through decreased timber harvest and decreased harvest for fuelwood / charcoal production. In this project, the latter is not practiced on the project area to any significant degree. Hence, market-effects leakage is calculated as (from VMD0011-LK-ME, equation 2):

Equation 12 (Market-effects leakage calculation):

$$LK_{ME,T} = \sum_{i=1}^{M} \left(LF_{ME} * AL_{T,i} \right)$$

Where:

$LK_{ME,T}$	Total GHG emissions due to market- effects leakage through decreased timber harvest; t CO_2-e
LF_{ME}	Leakage factor for market-effects calculations; dimensionless
$AL_{T,I}$	Summed emissions from timber harvest in stratum *i* in the baseline case potentially displaced through implementation of carbon project; t CO_2-e

Each project must calculate within each stratum the proportion of total biomass in commercial species that is merchantable (*PMPi*). This shall then be compared to mean proportion of total biomass that is merchantable for each forest type (*PMLFT*). Merchantable biomass is defined as "*Total gross biomass (including bark) of a tree 40 cm DBH or larger from a 30 cm stump to a minimum 10 cm top of the central stem*". The following deduction factors (LFME) must be used:

PML_{FT} is equal (± 15%) to PMP_i	$LF_{ME} = 0.4$
PML_{FT} is > 15% less than PMP_i	$LF_{ME} = 0.7$
PML_{FT} is > 15% greater than PMP_i	$LF_{ME} = 0.2$

Where:

PML_{FT}	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type; %
PMP_i	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries; %
LF_{ME}	Leakage factor for market-effects calculations; dimensionless

The next step was to estimate the emissions associated with the displaced logging activity. This was based on the total volume that would have been logged in the baseline in the project area across strata and time periods:

$$AL_{T,i} = \sum_{t=1}^{t} \left(C_{BSL,XBT_{i,t}}\right)$$

Where:

$AL_{T,i}$	Summed emissions from timber harvest in stratum i in the baseline case potentially displaced through implementation of carbon project; t CO2-e
$C_{BSL,XBT_{i,t}}$	Carbon emission due to displaced timber harvests in the baseline scenario in stratum i in time t; t CO2-e
i	1, 2, 3, …M strata
t	1, 2, 3, … t* years elapsed since the projected start of the REDD project activity

Carbon emission due to the displaced logging has two components: the biomass carbon of the extracted timber (see also module CP-W which uses the same equation) and the biomass carbon in the forest damaged in the process of timber extraction (see VMD0011 v1.0 equation 4):

$$C_{BSL,XBT_{i,t}} = \left(\left[V_{BSL,XE_{i,t}} * D_{mn} * CF\right] + \left[V_{BSL,XE_{i,t}} * LDF\right] + \left[V_{BSL,XE_{i,t}} * LIF\right]\right)$$

Where:

$C_{BSL,XBT_{i,t}}$	Carbon emission due to timber harvests in the baseline scenario in stratum i at time t; t CO2-e
$V_{BSL,XE_{i,t}}$	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t; m^3
D_{mn}	Mean wood density of commercially harvested species; t d.m.m-3. The value must be the same as that used in the module CP-W if this pool is included in the baseline.
CF	Carbon fraction of biomass for commercially harvested species j; t C t d.m.-1 . The value must be the same as that used in the module CP-W if this pool is included in the baseline.
LDF	Logging damage factor; t C m-3 (default 0.53 t C m^{-3} for broadleaf and mixed forests; 0.25 t C m^{-3} for coniferous forests)
LIF	Logging infrastructure factor; t C m^{-3} (default 0.29 t C m^{-3})

i	1, 2, 3, …M strata
t	1, 2, 3, … t* years elapsed since the projected start of the REDD project activity

Market leakage from decreased timber harvest and its component values is shown in **Table 39**, and total annual combined leakage (activity-shifting and market leakage) in **Table 40.** Detailed calculations underpinning **Table 39** are reported in “413 C calcs v1.3, tab ‘12b. Leakage_ME’”.xlsx.

Table 39 - Market leakage

Year	C_{XB_t} (tCO2e)	$V_{BSL,XE_{i,t}}$ (m³)	$C_{BSL,XBT_{i,t}}$ (tCO2e)	$AL_{T,i}$ (tCO2e)	$LK_{ME,T,i}$ (tCO2e)	$LK_{ME,FW\&}$ (tCO2e)	$\Delta C_{LK-ME,t}$ (tCO2e)
2021	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933
2022	293,277	246,638	1,034,834	1,034,834	413,933	0	413,933

Table 40 - Total net GHG emissions due to activity-shifting and market leakage

Year	$\Delta C_{LK-AS,planned}$ (tCO2e)	$\Delta C_{LK-ME,t}$ (tCO2e)	$\Delta C_{LK,t}$ (tCO2e)
2021	0	413,933	413,933
2022	0	413,933	413,933

6.5 Net GHG Emission Reductions and Removals

Uncertainty

Uncertainties were calculated for the baseline and project scenarios based upon the VMD0017 v2.2 X-UNC module. There are two sources of uncertainty in the baseline, the rate of deforestation, and emissions and removals. For the project case, only uncertainty in emissions and removals was considered because no deforestation is expected to occur.

Per the X-UNC module, uncertainty in the projected baseline rate of deforestation, $Uncertainty_{BSL-RATE}$, equals 1.01%. This value is the 95% confidence interval as a percentage of the mean of the area deforested in each proxy (*D%pn*) divided by the number of years over which deforestation occurred in each proxy (*Yrspn*)(see “413 C calcs v1.3, tab ‘13. Uncertainty’”.xlsx. for calculations).

Total uncertainty in emissions and removals ($Uncertainty_{BSL-SS}$) is estimated as per VMD0017 v2.2 X-UNC equation 4 and is expressed as the 95% confidence interval half width as a percentage of the mean carbon stock or GHG source for each pool. $Uncertainty_{BSL-SS}$ is estimated to be 6.91% (calculations detailed in "413 C calcs v1.3, tab '10b. Proj Emissions burn'".xlsx.).

Total uncertainty is calculated as per Equation 13 and equals 6.99%.

Equation 13 (Total uncertainty (see VMD0017 v2.2 equation 5)):

$$Uncertainty_{REDD-BSL,t^*} = \sqrt{Uncertainty_{BSL-RATE,t^*}{}^2 + Uncertainty_{REDD-BSL,SS}{}^2}$$

Where:

$Uncertainty_{REDD-BSL,t^*}$	Cumulative uncertainty in REDD baseline scenario up to year t^* (%);
$Uncertainty_{BSL-RATE,t^*}$	Cumulative uncertainty in the baseline rate of deforestation up to year t (%);
$Uncertainty_{REDD-BSL,SS}$	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario (%);
t	1, 2, 3, … t^* time elapsed since the start of the project activity (years).

The allowable uncertainty in methodology *REDD+ MF* is +/- 15% of *NERREDD+* at the 95% confidence level. Where this precision level is met then no deduction should result for uncertainty, which is the case here (6.99%.

To estimate the number of Verified Carbon Units (VCUs) for the monitoring period $T = t2\text{-}t1$, the following equation is used as per VM0007, equation 19:

$VCU_t = Adjusted\_NER_{REDD+,t2} - Adjusted\_NER_{REDD+,t1}) - Buffer_{Total}$

Where:

VCU_t	Number of Verified Carbon Units at year $t = t_2 - t_1$ (VCU)
$Adjusted\_NER_{REDD+,t2}$	Total net GHG emission reductions of the REDD+ project activity up to year t_2 and adjusted to account for uncertainty (t CO_2e)
$Adjusted\_NER_{REDD+,t1}$	Total net GHG emission reductions of the REDD+ project activity up to year t_1 and adjusted to account for uncertainty (t CO_2e):

During the first monitoring period (2021-2022) length (2021-2050), the 413 project is expected to generate net GHG emission reductions of 6,359,535tonnes of CO_{2e} (**Table 41** and **Table 42**).

Table 41 - Ex-post annual estimation of net emission reduction credits

2050 Year	Estimated baseline emissions or removals $\Delta C_{BSL,planned}$ (tCO_2e)	Estimated project emissions or removals $\Delta C_{WPS,REDD}$ (tCO_2e)	Estimated leakage emissions $\Delta C_{LK,t}$ (tCO_2e)	Risk buffer (%)	AFOLU pooled buffer account (tCO2e)	GHG credits eligible for issuance as VCUs (tCO_2e)
2021	4,631,275	28,835	413,933	23	1,065,193	3,123,313
2022	4,776,354	27,638	413,933	23	1,098,561	3,236,221

Table 42 - Total emissions reductions (tCO2e) and deductions – monitored period

Estimated emissions and reductions of the 413 Project	tCO2e
Baseline GHG emissions and reductions	9,407,629
Project emissions and reductions	56,472
Leakage emissions	827,867
Buffer pool discount	2,163,755
Total Net Emission Reductions (VCUs)	6,359,535

APPENDIX:

Appendix 1: Ownership Due Diligence Legal Opinion

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VIEIRAREZENDE
ADVOGADOS

São Paulo, December 08, 2022.

To

413 Environmental LLC

Ref.: Fazenda Mata Mata. Legal Aspects

This legal opinion has been prepared by Vieira Rezende Advogados upon request of 413 Environmental LLC, in connection with the property ownership of the so-called Fazenda Mata Mata property, located in the Municipality of Novo Aripuanã, State of Amazonas, duly registered under No. 2,941 before the Real Estate Registry of Novo Aripuanã, State of Amazonas ("Property"). The Property is set to be developed for a carbon credit project.

This legal opinion also provides for all the activities and due diligence carried out since 2020 to attest and confirm the Property ownership.

In connection with of our review, we have made the following assumptions:

1. The authenticity of all undermentioned documents and copies;
2. The veracity of all signatures and legal capacity of all signatories on all the undermentioned documents;
3. The representations and information contained in the undermentioned documents are correct, and have undertook our own due diligence for expressing the opinions set forth herein.

Our legal opinion has been given in light of and in line with Brazilian laws, and we express no legal opinion in connection with the laws of any jurisdiction outside of the Federative Republic of Brazil. This legal opinion and its exhibits contain all relevant information, contingencies and potential litigation regarding the Property and its landowner until December 8, 2022.

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DS DS

VIEIRAREZENDE
ADVOGADOS

Based on and subject to the foregoing, we are of the opinion that, so far as the current laws of Brazil are concerned:

I. Real Estate Ownership

In Brazil, according to article 1,245 of the Brazilian Civil Code, the ownership of a given real estate property is formalized by a deed of acquisition duly registered with the relevant Real Estate Registry. The registry of the deed of acquisition grants full ownership to the title holders, and legally protects them from any trespassing or violation of rights.

Moreover, real estate property registration provides third parties with all significant land data, such as: (i) identification and description of the area, to include its size, boundaries, land description, geographical coordinates and total area reflected in the title transfer to the current owners; (ii) liens; (iii) lease agreements; (iv) easement or condemnation; and (v) constructions and improvements made to the property. In short, the registry provides relevant data in connection with the rights, obligations, and limits which may affect the property owner and guarantor.

The Real Estate Registry offices are the official depositories of information regarding the legal situation of properties located in Brazil. According to article 172 of the Public Registry Law (Federal Law 6.015/73), the Real Estate Registry Office is responsible for: *the registration and general information of titles or constitutive, declaratory, translative and extinct rights in rem over real estate recognized by law, "inter vivo" or "mortis causa" either for its constitution, transfer and extinction, or for its validity in relation to third parties, or for its availability.*" Each territory has a Real Estate Registry Office which is the official depository of real estate registrations.

DS DS

The Property is located in Nova Aripuanã and therefore, our firm obtained directly from the Real Estate Registry Office of Nova Aripuanã - AM, the Property's full content of the real estate registration, as well as the certificates of the chain of ownership, in order to confirm all the title holders since the Property was transferred from the state of Amazonas to a private owner (that is, from the original issue of the title by the State of Amazonas). **Exhibit I**

After reviewing all of the Property's official registration documentation, it is our opinion that the Property is lawfully owned by Luiz Ernesto Pereira Taranto, bearer of identity card n. 7708922 SSP/SP and registration with CPF/ME 016.232.028-09, and the person with whom 413 Environmental LLC has valid and current agreements for the development of carbon credit projects on that real estate property.

II. Activities carried out since 2020 to attest who owns the Property.

As part of the ongoing Corporate, Contractual, Environmental and Real Estate due diligence of the Property, our firm reviewed updated court certificates and registrations for the years 2020 and 2021. Based on our due diligence we surmised, (i) the property was free and clear of any liens, (ii) the landowner, Luiz Ernesto Pereira Taranto, had been paying the Property taxes since the acquisition, (iii) the Property was in compliance with laws, (iv) there were no lawsuits involving the Property or any third party claiming ownership and (v) the documents did not contain any information that could indicate any risk to the intended carbon project as provided in the reports attached hereto as **Exhibit II**. Accordingly, we concluded that Luiz Ernesto Pereira Taranto's title is still valid.

In July 2022, community meetings were held as part of the carbon credit development of the Property, and during the meetings, 7 individuals claimed that they were the owners/lived in some areas inside the Property. Subsequently the 7 individuals were contacted via their provided mobile phone numbers and were asked to present documents regarding their claim

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for further review. Subsequently, contact was again made to the 7 people claiming ownership of portions of the Property as provided in **Exhibit III.** Despite these attempts, only one individual, Julio Cesar, representing Raimundo Ferreira, Lourival Ferreira and Tereza Ferreira, the owners of the property so-called "Não Esmorece", registered under No. 605 before the Real Estate Registry of Manicoré, State of Amazonas, answered and sent a title and map of an area of approximately 15,000HA (out of the Property's 500,996 HA).

After an initial review, our legal team requested additional documentation, including the chain of title documents proving the area was transferred from the state of Amazonas to the first owner in ownership's chain of title, and the certificates (CAR and CCIR) confirming the property is in regular condition, in compliance with all laws, and is in fact owned by the abovementioned person. Our last contact with Julio Cesar was on November 25th, 2022, and as of the date of this legal opinion, he has failed to provide any further documentation. The other 6 individuals did not respond or provide any documents to support their claims. Additional contacts were initiated with them as provided in **Exhibit IV**.

413 Environmental LLC is aware of this potential claim from the owners of the property so-called "Não Esmorece", is in progress to have a conditional agreement in place with the landowners, and if the landowners´ claim is substantiated the parcel will be included in the overall project.

Considering the aforementioned overlapping and public comments, the Property owner contacted the Secretary of State for Cities and Territories of Amazonas (SECT) and requested a search in the public files. SECT answered by requesting additional documents to update the information regarding the property in its files, as they could not find it in the searches carried out. The requested documents are being collected by Mr. Luiz Ernesto Pereira Taranto, as owner of the Property, to be provided to that public body.

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In the absence of further official documentation by SECT, it is our opinion that the property has a valid registry with the proper Real Estate Registry Office showing Luiz Ernesto Pereira Taranto as the lawful owner. If any other regularization or the filing of a lawsuit becomes necessary for this purpose, the owner has already provided a POA to his lawyers so that they can adopt the measures that may be necessary as provided for in **Exhibit V**.

We hope we have clarified your doubts and remain available for other clarifications.

Best Regards,

DocuSigned by:
Lúcia Veloso Aragão | Vieira Rezende
Lúcia Veloso Aragão

DocuSigned by:
Ewerton Oliveira
Ewerton Oliveira

VIEIRA REZENDE ADVOGADOS

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Appendix 1a: Ownership Due Diligence Support Evidence (folder – available for consultation)

Appendix 2: 413 Environmental Management System (pdf file - available for consultation)

Appendix 3: Local Stakeholder Consultation Reports and Support Files (folder - available for consultation)

Appendix 4: Request to deforest (pdf file - available for consultation).

Appendix 5: Forest inventory (pdf file - available for consultation).

Appendix 6: Risk Tool Assessment (available for consultation)

Appendix 7. Testing significance of GHG emissions in project activities

We used the T-Sig tool Version 01 to determine which GHG emissions by sources, possible decreases in carbon pools, and leakage emissions are insignificant for this project.

We used the T-Sig tool Version 01 to determine which GHG emissions by sources, possible decreases in carbon pools, and leakage emissions are insignificant for this project. The Tool T-SIG was used to determine which emissions were included in the calculations as a minimum. Emissions were then calculated through applying Modules E-BPB, E-FCC and E-NA.

Source	Relative Contribution	Rank	Significant?	Description
Non-tree aboveground biomass	0.02	5	No	The contribution of understory shrubs, vines and herbaceous plants to aboveground mass can be variable but generally very small fraction of the total biomass (**about 3% or less** [Hegarty 1989, Jordan and Ubl 1978, Tanner J 980 as cited in Brown and Lugo, 1992][69])
Aboveground biomass	0.71	1	Yes	
Belowground biomass	0.16	2	Yes	
Dead wood	0.06	3	Yes	i. Dead wood stocks are greater in the baseline 3,784,784 t(CO2e) than in the project 61,065 t(CO2e) scenario (in conformance with REDD-MF), and ii. Dead wood was determined to be significant using the T-SIG module.
Timber harvest products	0	7	No	i. Timber harvest occurs in the process of deforestation, and timber is destined for commercial markets (sawnwood).
Direct CH_4 emissions due to biomass burning as part of deforestation	0.04	4	No	

[69] Brown, S., & Lugo, A.(1992). Aboveground biomass estimates for tropical moist forests of the Brazilian Amazon. *Interciencia. Caracas*, *17*(1), 8-18.

Source	Relative Contribution	Rank	Significant?	Description
Direct N_2O emissions due to biomass burning as part of deforestation	0.01	6	No	