YACUMAMA FOREST CARBON PROJECT

Document Prepared by ClimeCo LLC

Project title	Yacumama Forest Carbon Project
Project ID	1133
Monitoring period	01-Jan-2014 to 31-Dec-2022
Original date of issue	13-May-2024
Most recent date of issue	12-March -2026
Version	1.0
VCS Standard Version	4.7
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The Yacumama Forest Carbon Project ("Project") is a payment for ecosystem services forest conservation Project, otherwise known as a Reducing Emission from Deforestation and forest Degradation (REDD) Project, on 3,202 ha of privately-owned forestland located in the Amazon Basin of Peru. The Yacumama property encompasses tropical rainforest in three parcels: Yacumama (202 ha), Yacurana (1,425 ha), and Santuario Privado (1,575 ha), of which the latter two parcels would be made available for conversion to agricultural uses in the absence of carbon financing with the total forest area of 2,863 ha subject to conversion. During this monitoring period, the Project resulted in a total of 295,730 t CO_2e emission reductions and average of 32,859 t CO_2e per year [1].

The overall goal for the Project is to protect and conserve the tropical lowland floodplain forest on Yacumama for long-term carbon sequestration, avoidance of GHG emissions from deforestation and degradation, and conservation of biodiversity. Yacumama is a privately held, former eco-tourist lodge and forestland located in the Amazon Basin of Peru whose current ownership ("Project proponent") chose to alter its mission from tourism, supplemented by forest resource exploitation and agriculture, to ecological research, education, and conservation.

A majority of Yacumama would, by economic necessity, be harvested and converted to agricultural use by the Project proponent in the absence of funding from carbon financing to support the costs of maintaining the property. The Project proponent began harvesting activities based upon an approved 12-month harvest Plan. However, before pursuing a more aggressive approach to harvest the timber, Yacumama management became aware of and investigated the development of a carbon Project as an alternative income stream. The Yacumama management team ceased timber harvesting operations by 2011 and began to investigate carbon financing as a sustainable long-term solution to their financial situation.

Yacumama began contacting various technical experts in late 2011 and sent the Virginia Tech Conservation Management Institute maps, a forest harvest plan, ownership documents, tax receipts, export licenses, etc. to review the purpose of implementing a forest carbon Project. The Project uses carbon financing to protect the forest and avoid harvesting of the forest for the valuable timber and conversion into agriculture. The primary methods employed to achieve the desired result is maintaining and increasing a robust presence both at the main facility and implementing regular patrols of the property to prevent incursions and illegal logging.

The main Project Proponent and property owner is now Aaron Bishop (Yacumama LTD S.A.), who took ownership following the passing former owner, Lawrence Bishop, in 2024. In the Project, Mr. Bishop is responsible for hiring contractors for monitoring activities, carbon sales, and finances. The other entity directly involved in the Project is Mr. Norman Walters, the resident site manager. Mr. Walters is

[1] Further information available at Yacumama ERR calcs.xlsx

responsible for management of the infrastructure, forest protection at Yacumama, and general business matters. In addition, Mr. Walters is the diplomatic liaison between Yacumama and the local communities because of his fluency in the local Spanish dialect. ClimeCo LLC updated the Project design document, revised the baseline and associated data collection, and the Project monitoring plan. Project activities are to undertake a forest carbon inventory, model regional deforestation and land-use patterns, and mitigate deforestation pressures by utilizing payment for the Project's ecosystem services. In addition to voluntarily foregoing land clearing and conversion to agriculture, current ownership chose to alter its mission from tourism, supplemented by forest resource exploitation and agriculture, to ecological research, education, and conservation. The primary methods employed to achieve the desired result are maintaining and increasing a robust presence and implementing regular patrols of the property to prevent incursions and illegal logging.

The Project was first developed and registered under the Verified Carbon Standard (VSC v.4.2) as Agriculture, Forestry, or Land Use (AFOLU). It is not covered by a jurisdictional REDD program.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Validation/ verification	01-January-2012 to 31-December-2013	VCS	Environmental Services, Inc., (ESI)	Two years
Verification	01-January-2014 to 31-December-2022	VCS	TÜV SÜD America, Inc	Nine years

1.3 Sectoral Scope and Project Type

Sectoral scope	14
AFOLU Project category [2]	Reduced Emissions from Deforestation and Degradation (REDD+)
Project activity type	Avoiding Planned Deforestation (APD) Non-grouped Project

1.4 Project Proponent

Organization name	Yacumama
Contact person	Aaron Bishop
Title	Owner
Address	657 Cajon Street, Redlands, CA 92373
Telephone	(+1) 909-792-1028
Email	yfcpProject@gmail.com

1.5 Other Entities Involved in the Project

Organization name	Yacumama

[2] See Appendix 1 of the VCS Standard

Role in the Project	Site Manager
Contact person	Norman Walters
Title	Director Yacumama S.R. Ltda Peru SA
Address	644 NW 18th St. Homestead, FL 33030
Telephone	(+1) 786-376-1072
Email	newaltersdesigns@gmail.com

Organization name	Virginia Tech Conservation Management Institute
Role in the Project	Technical Lead for validation and first verification (2012-2013)
Contact person	Verl Emrick
Title	Research Scientist-Ecologist
Address	1900 Kraft Drive, Suite 250, Blacksburg Va
Telephone	(+1) 540-231-8851
Email	vemrick@vt.edu

Organization name	ClimeCo
Role in the Project	Project Developer for baseline reassessment and second verification (2014-2022
Contact person	Brad Seely
Title	Vice President, Nature-Based Solutions
Address	1 East Philadelphia Ave Boyertown, PA 19512
Telephone	(+1) 587.801.8446
Email	bseely@climeco.com

1.6 Project Start Date

Project start date	01-January-2012
Justification	Project start date is based upon a series of decisions made by the Yacumama management team during 2010 and 2011 (personal communication Lawrence Bishop December 2011) to cease pursuing timber harvesting operations and pursue carbon financing as a sustainable long-term solution to their financial situation. Since the previous Project developer received documents from Mr. Bishop in January 2012 specifically for the purpose of

	pursuing a Forest Carbon Project, the Project is using January 1, 2012, as the Project start date.

1.7 Project Crediting Period

Crediting period	☐ *Seven years, twice renewable* ☐ *Ten years, fixed* X Other: 30 years, fixed
Start and end date of first or fixed crediting period	01-January-2012 to 31-December-2041

1.8 Project Location

The Yacumama Forest Carbon Project is in the Peruvian Amazon Basin approximately 15 km straight line upstream from the confluence of the Rio Marañon and Rio Ucayali which join to form the Amazon River. The entire Yacumama property encompasses (3,202 ha) of tropical rainforest in three parcels: Yacumama (202 ha), Yacurana (1,425 ha), and Santuario Privado (1,575 ha). The Project area is located at latitude -4° 34' 03.26'' South, and at longitude -73° 27' 04.64'' West in the Loreto District, Peru roughly 90 km south of the city of Iquitos Figures 1.8-1, 1.8-2 and 1.8-3.

Figure 1.8-1. Yacumama Forest Carbon Project location at a continental scale.

Figure 1.8-2. Yacumama Forest Carbon Project location at a regional scale, located at latitude -4° 34' 03.26'' South, and at longitude -73° 27' 04.64'' West in the Loreto District, Peru roughly 90 km south of the city of Iquitos.

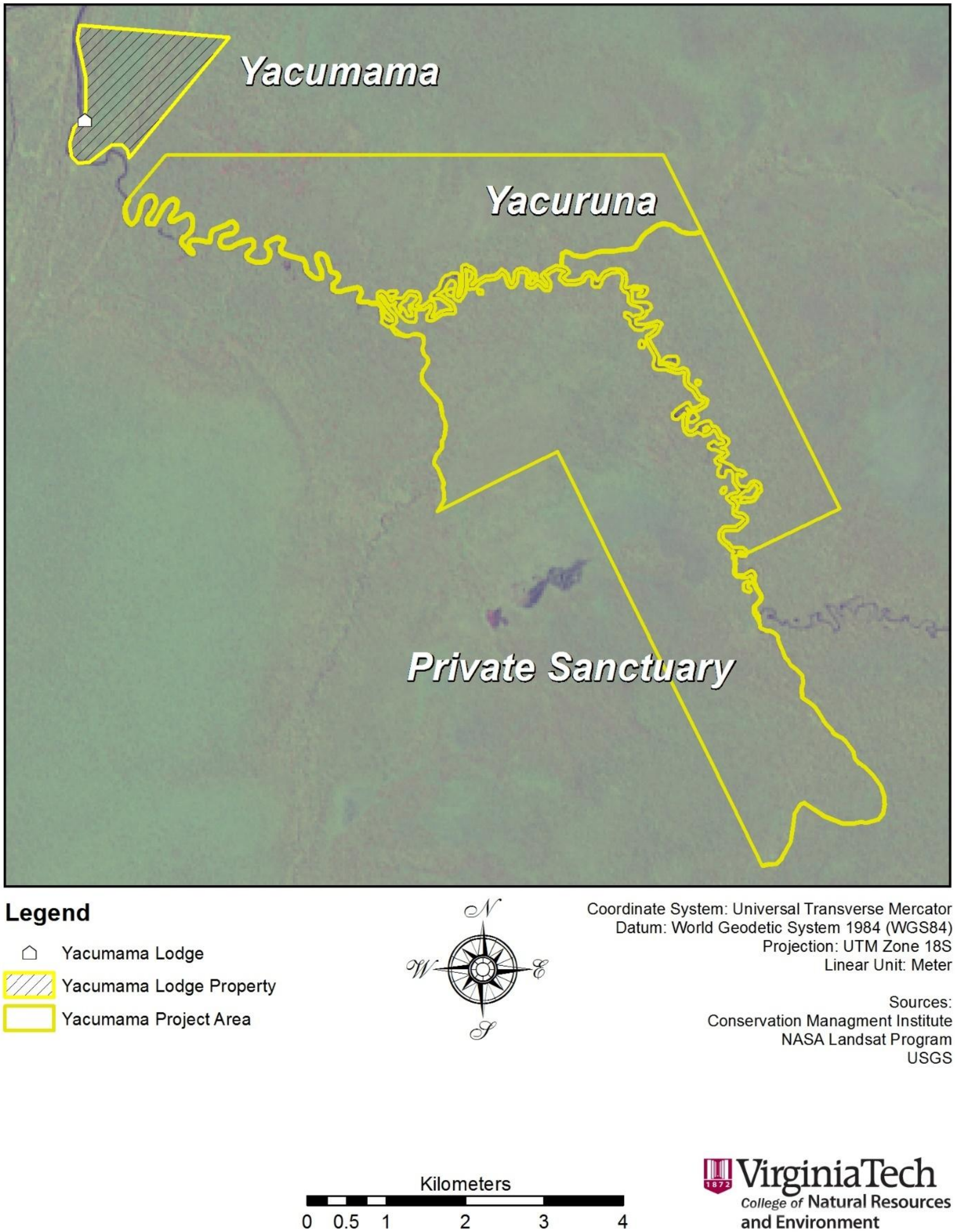

Figure 1.8-3. Yacumama Forest Carbon Project boundary at a local scale.

1.9 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
Methodology	VM0007	VM0007 REDD+ Methodology Framework (REDD+MF),	V1.7
Module	VMD0001	VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB)	V1.2
Module	VMD0005	VMD0005 Estimation of carbon stocks in the long-term wood products pool (CP-W)	V1.2
Module	VMD0006	VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL)	V1.4
Module	VMD0009	VMD0009 Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP)	V1.3
Module	VMD0011	VMD0011 Estimation of emissions from market-effects (LK-ME)	V1.2
Module	VMD0013	VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning	V1.3
Module	VMD0015	VMD0015 Methods for monitoring of greenhouse gas emissions and removals (M-REDD)	V2.3
Module	VMD0016	VMD0016 Methods for stratification of the Project area (X-STR)	V1.3
Module	VMD0017	VMD0017 Estimation of uncertainty for REDD Project activities (X-UNC)	V2.2
Tool	VT0001	VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities	V3.0
Tool	Not applicable	Tool for testing significance of GHG emissions in A/R CDM Projects activities	V1.0

1.10 Double Counting and Participation under Other GHG Programs

1.10.1 No Double Issuance

Is the Project receiving or seeking credit for reductions and removals from a Project activity under another GHG program?

☐ Yes ☒ No

1.10.2 Registration in Other GHG Programs

Is the Project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are Project reductions and removals or Project activities also included in an emissions trading program or binding emission limit?

☐ Yes ☒ No

1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the Project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

☐ Yes ☒ No

1.11.3 Supply Chain (Scope 3) Emissions

Do the Project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

If yes:

Is the Project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

If yes:

Has the Project proponent(s) or authorized representative posted a public statement on their website saying, "Carbon credits may be issued through the Verified Carbon Standard Project [Project ID] for the greenhouse gas emission reductions or removals associated with [Project proponent or authorized representative organization name(s)] [name of product(s) whose emissions footprint is changed by the Project activities]."

☒ Yes ☐ No

1.12 Sustainable Development Contributions

The Project activity of protecting native tropical rainforest from planned deforestation contributes to the UN SDGs and Peru's specific goals in numerous ways.

Peru has highlighted national goals[3] concerning eradication of poverty, conservation, restoration, and sustainable management of ecosystems, and protection of biodiversity. Peru has also stated that to assure a basic standard of living condition for every citizen, environmental health must be a priority. For Peru, the conservation and sustainable management of forest resources is key for climate change mitigation and adaptation, and for the provision of ecosystem services, ecotourism opportunities, and the preservation of Peru's cultural diversity.

Peru, a country containing 13% of the Amazonian rainforest, has specifically named rainforest protection as a national priority[4] as indicated by their Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change[5] (UNFCC) and their National Climate Change Adaptation Plan (2021). The goals of this plan are to limit Peru's GHG emissions by 30-40% by 2030, for Peru to become net carbon neutral by 2050, and to implement 90 adaptation measures in key sectors to improve resilience to climate change, including water, health, aquaculture, agriculture, and forestry. Peru also signed a Joint Declaration of Intent in 2021 with Norway, under which Norway made a $10M payment to Peru as part of the climate and forest partnership to support the implementation of Peru's climate emergency goals. The US Agency for International Development (USAID) is active in Peru, with numerous Projects aimed at increasing climate resilience, empowering marginalized populations, improving natural resource management, reducing deforestation, limiting GHG emissions, and protecting biodiversity.

[3] https://sustainabledevelopment.un.org/index.php?page=view&type=6200&nr=25&menu=172

[4] https://www.usaid.gov/peru/press-releases/peru-reaching-key-milestones-rainforest-protection

[5] https://www.usaid.gov/climate/country-profiles/peru#:~:text=Government%20of%20Peru%20Climate%20Priorities&text=Key%20mitigation%20and%20adaptation%20goals,Aquaculture%2C%20Agriculture%2C%20and%20Forests

Table 1.12-1. Sustainable Development Contributions.

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current Project contributions	Contributions over Project lifetime
1)	1.1 No Poverty	1.1.1 Proportion of population below the international poverty line	Employment of stakeholder members	No further changes this monitoring period	The Project employed two permanent staff and hired six temporary staff and has therefore contributed positively to the financial security of these individuals (and will continue to do so).
2)	15.1 Ensure the conservation of terrestrial ecosystems, in particular forests.	15.1.1 Forest area as a proportion of total land area	Prevention of planned deforestation for timber harvest and conversion to agricultural land	The current implementation and border patrols of the Project protect the Project area from previously planned or illegal deforestation	The Project has already protected (and will continue to protect) 2,863ha of tropical rainforest from planned or illegal deforestation
3)	15.2 Promote the implementati on of sustainable management of all types	15.2.1 Progress towards sustainable forest management	Prevention of planned deforestation for timber harvest and conversion to agricultural land	The current implementation and border patrols of the Project protect the Project area from previously planned or illegal deforestation	The Project has already protected (and will continue to protect) 2,863ha of tropical rainforest from planned or illegal deforestation

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current Project contributions	Contributions over Project lifetime
	of forests [and] halt deforestation				
4)	15.5 Take significant action to reduce the degradation of natural habitats, halt the loss of biodiversity, and protect and prevent the extinction of threatened species	15.5.1 Red List Index	Habitat conservation for native species that could be found within the Project area, according to the IUCN Red List (Appendix 6.3)	The current implementation and border patrols of the Project protect habitat for Red List species from the habitat loss and fragmentation that occur as a result of deforestation	The Project has already protected (and will continue to protect) 2,863ha of tropical rainforest from habitat loss and fragmentation that occurs as a result of deforestation

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current Project contributions	Contributions over Project lifetime
6)	13.1 Strengthen resilience and adaptive capacity to climate related disasters	13.2.2 Total GHG emissions per year (tonnes of greenhouse gas emissions avoided or removed)	Implemented activities to increase avoided emissions of carbon dioxide and mitigate global climate change	By conserving 2,863 ha of tropical rainforest, Project Yacumama has prevented the release of 295,730 thousand tonnes of carbon into the atmosphere during the monitoring period (2014-2022)	Prevented the release of 295,730 thousand tonnes of carbon into the atmosphere

1.13 Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the Project description.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

Stakeholder Identification	Not applicable as there has been no change in the identified stakeholders since the Project start date.
Legal or customary tenure/access rights	Not applicable as there has been no change in the identified stakeholders since the Project start date.
Stakeholder diversity and changes over time	Not applicable as there has been no change in the identified stakeholders since the Project start date.
Expected changes in well-being	Not applicable as there has been no change in the identified stakeholders since the Project start date.
Location of stakeholders	Not applicable as there has been no change in the identified stakeholders since the Project start date.
Location of resources	Not applicable as there has been no change in the identified stakeholders since the Project start date.

2.1.2 Stakeholder Consultation and Ongoing Communication

During the monitoring period (2014–2022) and in the period leading up to this verification, the Project Proponent maintained communication with the identified stakeholder groups. The primary stakeholders are the lodge employees and local staff, several of whom were actively involved in the collection of forest biomass data and will continue to play a key role in patrolling the property. An update on the status of the Project has been provided to the lodge employees. One of the Project guardians is the commissioner of the Puerto Miguel community and has been closely involved with the Yacumama property for approximately 30 years; this long-standing relationship has facilitated trust and transparency in sharing information about Project objectives, progress, and challenges.

The Yacumama management team, Project guardians, and temporary staff are in frequent contact, primarily via WhatsApp, following an informal but consistent communication protocol that includes weekly messages providing verbal assessments of Project activities, notifications of any observed intrusions, and discussion of logistical needs (e.g., boat maintenance, repairs and renovations to the main facility). As the Project guardians and most temporary staff reside in the village of Puerto Miguel, this ongoing dialogue naturally extends into the community, allowing information on Project status and activities to circulate more broadly among residents and providing an accessible channel for concerns or feedback to be relayed back to the Project Proponent.

Other identified stakeholders include neighboring tourism operators (Dolphin Corners Ecolodge, Renaco Lodge, and Jungle Walk Lodge), Amazon Promise (which uses the lodge facilities to support healthcare operations along the Yarapa River), and the Peruvian Forestry Department. No material grievances were reported by those stakeholders during the monitoring period (2014 – 2022); rather, ongoing communication has primarily supported operational coordination (e.g., patrolling, logistics, and use of facilities), reinforced community awareness of Project objectives, and helped ensure that local stakeholders remain informed and engaged prior to and throughout the verification process.

2.1.3 Free, Prior, and Informed Consent

Consent	The Project proponent, Aaron Bishop, has sole ownership of the property rights over the Yacumama Project area. Under the VCS Standard v4.7, Free, Prior, and Informed Consent (FPIC) is understood as a safeguard to protect the rights of indigenous peoples and local communities, particularly with respect to decision-making processes that may affect their lands, territories, and resources. In the case of the Yacumama Project, the Project area is private land, and the Puerto Miguel had solidified their boundaries, which is now considered as a county that surrounds the Yacumama lodge property area. In fact, Puerto Miguel community does not rely on resources from within the Project boundaries for its livelihood or customary use, and there are no overlapping claims or demonstrated dependence on the Project area. Prior to the Project's registration, the Puerto Miguel community was informed of the objectives and importance of conserving the forested area of the Yacumama property, consistent with the description in Section 5.3 of the registered Project description and was given the opportunity to raise questions or concerns regarding the proposed activities; no objections or grievances were recorded. As described in Section 2.1.2 of this Monitoring Report, communication between the Project Proponent, Project guardians, lodge staff, and the Puerto Miguel community has continued during the monitoring period through regular interactions and information sharing,

	thereby maintaining transparency and an accessible channel for any concerns that might arise. In light of the private ownership of the Project area, the absence of community dependence on its resources, the prior disclosure and opportunity for input provided to the Puerto Miguel community, and the absence of any ongoing or unresolved conflicts or grievances during the monitoring period, the Project Proponent is considered to have met the FPIC safeguard requirements applicable to this Project.
Outcome of FPIC	See above. There are no ongoing or unresolved conflicts. The Project has not and will not encroach on land, relocate people without consent, and force physical or economic displacement.

2.1.4 Grievance Redress Procedure

Grievances received	Resolution and outcome
No grievance was raised during the monitoring period.	Not applicable

2.1.5 Public Comments

Summary of comments received	Actions taken
Not applicable because no additional public comments were received outside of the Public Comment Period.	Not applicable.

2.2 Risks to Stakeholders and the Environment

2.2.1 Management Experience

The Project management team at ClimeCo possesses the necessary experience related to all Project activities, including the development and management of VCS forest and non-forest carbon Projects. ClimeCo is a leading carbon Project company, with experience globally across major carbon standards and multiple Project types. The former 3GreenTree team (now ClimeCo) is a leading forest carbon Project developer with experience that includes creating the IFM VM0012 methodology, developing multiple VCS forest carbon Projects worldwide, and extensive forest management and ecosystem modeling expertise. The ClimeCo team holds significant experience developing and managing VCS AFOLU and non-AFOLU Projects under various carbon standards (further details at:

https://climeco.com). Key staff include Brad Seely, PhD. (https://climeco.com/brad-seely/) and Clive Welham, PhD., RPBio, (https://climeco.com/clive-welham/).

Mr. Aaron Bishop is responsible for hiring qualified contractors for future monitoring assessments, carbon sales, and finances in the United States. Mr. Norman Walters is responsible for management of the infrastructure of the lodge facilities [6], forest protection at Yacumama, and business matters within the country of Peru. In addition, Mr. Walters is the diplomatic liaison between Yacumama and the locals. Mr. Walters has extensive experience working in the Peruvian Amazon and was the manager for Yacumama Lodge, and managed all aspects of construction, employee relations, banking, liaison for all Peruvian Government actions and interactions, and defended Yacumama SRLtda in the Peruvian Judicial System. Mr. Walters is responsible for daily operations at Yacumama during the Project.

Dr. Verl Emrick was responsible for managing and implementing all the initial scientific/technical aspects of the Project. Dr. Emrick is a Research Ecologist and Senior Project Manager with the Virginia Tech- Conservation Management Institute within the College of Natural Resources and Environment.

2.2.2 Risk Assessment

	Risk identified	Mitigation or preventative measure taken
Natural and human-induced risks to stakeholders' wellbeing	The natural risks identified relate to mean precipitation and river flood	The Project area is situated in a region characterized by high precipitation and frequent flooding, which can pose risks to the lodge infrastructure used as a base for Project guardians. To mitigate and prevent these risks, the lodge infrastructure undergoes regular renovations, including raising the floor to reduce vulnerability to flooding. Additionally, river levels are closely monitored throughout the rainy season to ensure timely response to any potential threats, safeguarding the wellbeing of the Project stakeholders.
Risks to stakeholder participation	The only risk identified in the stakeholder participation is related to ensuring equitable	To mitigate and prevent this risk from occurring, all engagement occurred in-person with direct

[6] The former Yacumama lodge is adjacent to the project area but is not part of the project. The remaining lodge buildings now house the permanent staff (who are the only permanent residents near the project area) that, support researchers, patrol project area and monitor boat traffic on the Yarapa River within the project area.

	access to information and accessibility of consultations across identified stakeholder groups	representatives of stakeholder groups and both Spanish and English language flyers describing the Project and meetings were posted and circulated both among lodge employees and in the village of Puerto Miguel. Furthermore, a Spanish translation of the original English PD was placed at the lodge and the village. Community meetings were held in community spaces.
Working conditions	Given that work takes place in the tropical lowland floodplain forest forests of Peru, several potential risks have been identified related to field accidents that may require first aid (including accidents related to animals, plants, personal injury etc.)	In order to mitigate and prevent these risks, the following measures are in place: • Field crews are trained in forestry field risks, including inclement weather conditions and proper best management practices in the industry • Field crews are requested to carry basic first aid kits while in the field to treat minor cuts and ailments • Field crews bring appropriate field supplies, including equipment, water, and food • Transportation will be provided to the nearest hospital for employees, field crews, and visitors as needed for more serious medical care. There have been no Project injuries related to these risks to date. • Employees and field crews are trained in the use of equipment and/or have been using the field

		equipment as a part of their daily life. • Sharp equipment must be transported in their cases. • Field crews, visitors, and employees are advised to wear snake boots, long pants, long shirts, hats, sunscreen, and other protective clothing measures to protect against natural elements and animals. Chest or hip waders are advised to be worn in the field during times of heavy rains and high waters. • Weather is closely monitored in the region, including periods of predicted heavy rains and droughts. Field visits are planned accordingly and have been rescheduled in the past for safety reasons associated with risks of flash flooding. • Boats are used to navigate the Project areas in times of rainy seasons and high waters. Only experienced and/or licensed drivers may drive boats within the Project activities.
Safety of women and girls	No risk identified	No mitigation or preventative measure necessary to be taken as equal opportunities have been provided in the context of gender equity and pay for labor and work. No child labor occurs within the Project. No discrimination or sexual harassment has occurred. Reference Section 2.3 for further

		information on respect for human rights and equity.
Safety of minority and marginalized groups, including children	No risk identified	No mitigation or preventative measure necessary to be taken as equal opportunities have been provided in the context of gender equity and pay for labor and work. No child labor occurs within the Project. No discrimination or sexual harassment has occurred. Reference Section 2.3 for further information on respect for human rights and equity.
Pollutants (air, noise, discharges to water, generation of waste, release of hazardous materials)	No risk identified	No mitigation or preventative measure necessary to be taken as the Project activities do not generate any pollutants or waste materials, including but not limited to air, noise, discharges to water, generation of waste, or release of hazardous materials.

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

	Risks identified [7]	Mitigation or preventative measure(s) taken
Discrimination	No risk identified	The Project is committed to providing an environment free of discrimination, where all individuals are treated with respect and dignity. This is confirmed by conversations with Project staff and employee records.
Sexual harassment	No risk identified	The Project is committed to providing an environment free of sexual harassment, where all individuals are treated with

[7] The identified risks and commensurate mitigation or preventative measure(s) for forced labor, child labor, and human trafficking, must be inclusive of staff and contracted workers employed by third parties.

		respect and dignity. This is confirmed by conversations with Project staff and employee records.
Equal pay for equal work	No risk identified	The Project is committed to offer women and men equal remuneration for work of equal value. Women and men working in identical or similar jobs receive the same pay. This is confirmed by conversations with Project staff and employee records.
Gender equity in labor and work	No risk identified	The Project is committed to gender equity in all aspects of labor and work. Equal opportunities have been provided in the context of gender equity and pay for labor and work.
Forced labor	No risk identified	Project staff and contracted workers employed by third parties are not forced labor. This is confirmed by conversations with Project staff and employee records.
Child labor	No risk identified	Project staff and contracted workers employed by third parties do not use child labor. Only residents of Puerto Miguel are hired as Project staff. This is confirmed by conversations with Project staff and employee records.
Human trafficking	No risk identified	Project staff and contracted workers employed by third parties does not use human trafficking. Only residents of Puerto Miguel are hired as Project staff. This is confirmed by conversations with Project staff and employee records.

2.3.2 Human Rights

Risks identified	Mitigation or preventative measure(s) taken
No risk identified	The Project respects human rights as set out in the International Labour Organization's Declaration on Fundamental Principals and Rights at Work as part of Project design and implementation and is committed to upholding the rights of indigenous peoples, local communities, and customary rights holders in its area of intervention as applicable. The Project follows the principles and standards of international human rights law, the United Nations Declaration on the Rights of Indigenous Peoples, and the ILO Convention 169 on Indigenous and Tribal Peoples. Yacumama LTD. is committed to ensuring employee health and safety, offering fair compensation and employment benefits, expanding employment opportunities, and offering job training. The Project recognizes, respects, and promotes the protection of the rights of employees in line with international human rights laws. Reference Sections 2.3.1. and 1.15 for further information on a safe, equitable working environment. While there are no Indigenous People (IPs), local communities (LCs), nor customary rights holders in the Project area, the Project ensured that the identified stakeholder groups, including local community members, were fully informed, consulted, and involved in the design, implementation, and monitoring of the Project activities.

2.3.3 Indigenous Peoples and Cultural Heritage

Risks identified	Mitigation or preventative measure(s) taken
No risk identified	The Yacumama forest carbon Project is conserving the biodiversity and cultural

	heritage of the Amazon rainforest by reducing deforestation and promoting sustainable livelihoods for the local communities. The Project monitors and reports on the impacts of its activities on the cultural values and practices of the indigenous peoples and other forest dwellers, such as their sacred sites, traditional knowledge, languages, and customs. The Project also engages with the stakeholders through participatory processes, consultations, and capacity building to ensure their rights and interests are respected and protected.

2.3.4 Property Rights

Risks identified	Mitigation or preventative measure(s) taken
Disputes over rights to territories and resources	There are no ongoing or unresolved conflicts or disputes over rights to lands, territories, and resources in the Project area. There were no disputes that were resolved within the last ten years. Accordingly, there are no activities undertaken by the Project that could prejudice the outcome of any unresolved dispute. Land tenure documentation, including land titles and proof of purchase, has been provided to the audit team to confirm these statements.
Respect for property rights	There are no legal or customary tenure/access rights to territories and resources, including collective and conflicting rights, held by indigenous people (IPs), local communities (LCs), nor customary rights holders in the Project area. The Project area is completely under private property ownership. The Project activities do not lead to involuntary removal or relocation of property rights holders from their lands or territories and does not force rights holders to relocate activities important to their culture or livelihood.

2.3.5 Benefit Sharing

Summary of the benefit sharing plan	Not applicable as the Project did not impact on property rights. The Project does not impact on property rights as

	described in Section 2.3.4 above, and as such there is not a benefit sharing agreement in place.
Benefit sharing during the monitoring period	Not applicable as the Project area is privately owned by the Project proponent.

2.4 Ecosystem Health

	Risk identified	Mitigation or preventative measure taken during the monitoring period
Impacts on biodiversity and ecosystems	No risk identified	No mitigation or preventative measure is necessary to be taken as the Project activities help protect biodiversity and ecosystem health in comparison to the without-Project scenario. If the forest were to be converted to agriculture, the impact on biodiversity could be significant. The conversion process would involve deforestation, which directly leads to habitat loss. This loss of habitat can result in the extinction of species that are endemic to these forests and rely on them for survival. Additionally, agricultural practices often involve the use of pesticides and fertilizers, which can contaminate local water sources and harm aquatic life. The simplification of the ecosystem to a single crop also reduces the variety of food sources and shelter available for wildlife.
Soil degradation and soil erosion	No risk identified	No mitigation or preventative measure necessary to be taken as the Project activities help protect soil health. Protecting the forest from deforestation enhances soil health, reduces soil erosion and compaction, reduces nutrient

		depletion, and improves water retention in comparison to the without-Project scenario.
Water consumption and stress	No risk identified	No mitigation or preventative measure is necessary to be taken as the Project area is subject to natural rainfall to sustain tree health. The Project activities do not contribute to water consumption or stress.
Usage of fertilizers	No risk identified	No mitigation or preventative measure is necessary to be taken as the Project activities do not include any usage of fertilizers or chemicals.

2.4.1 Rare, Threatened, and Endangered species

Species or habitat	Reference Appendix 6.3 for additional information on the species that may be present in the habitats within the Project area, as the Yacumama property encompasses 3,202 ha of tropical rainforest in the Amazon Basin of Peru. The Project will not adversely impact these areas, nor will it adversely impact the habitats for rare, threatened, or endangered species. The Project activities actively promote the protection of critical habitats for these species, as it is well known that deforestation in the Amazon tropical rainforests has led to habitat loss, ecosystem fragmentation, biodiversity reduction, increased vulnerability to fires, and susceptibility to climate change, all of which can negatively impact the habitats of rare, threatened, or endangered species. The conservation of forests, including their biodiversity and ecosystem health, is the primary activity of the Project. The previous verification report [8] confirmed that "no negative impacts are expected because activities related to the Project goals do not involve a change to the management of the forest resources on the property."

[8] VERIF_REP_1133_01JAN2012_31DEC2013.pdf

Areas needed for habitat connectivity	The Project will not adversely impact habitat connectivity as the main Project activity is forest conservation.

	Risks identified	Mitigation or preventative measure(s) taken
Habitats for rare, threatened, and endangered species	No risk identified	The Project will not adversely impact the habitats for rare, threatened, or endangered species as the main Project activity is forest conservation.
Areas for habitat connectivity	No risk identified	The Project will not adversely impact habitat connectivity as the main Project activity is forest conservation.

2.4.2 Introduction of species

This section is not applicable to this Project as no species were introduced.

2.4.3 Ecosystem conversion

This section is not applicable to this Project since it is a REDD+ rather than ARR, ALM, WRC or ACoGS Project types.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The primary Project activity is the prevention of planned deforestation within the Yacumama property. In the absence of carbon financing, a majority of the Project area would, by economic necessity, have been harvested by the Project proponent and converted to agricultural land. Prior to the adoption of carbon finance, the Project proponent began harvesting forest resources under an approved 12-month harvest plan, the *Operativo Anual Para Permiso Forestal De Propiedad Privada* (Annual Operating Plan Forest Permit on Private Property). However, before continuing with a more aggressive harvesting regime, the Yacumama management team became aware of carbon offsets as an alternative income stream and decided to halt timber extraction.

Timber harvesting operations ceased in 2011. From that date onward, maintaining ownership of the property and foregoing the planned conversion to agriculture became the central Project activity. Since 2011, carbon financing has been used to manage and maintain ownership of the property as a sustainable long-term source of finance. The Yacumama Project was officially registered under Verra in 2020, but the core activity of preventing planned deforestation has been continuously implemented since 2011, including throughout the current monitoring period (2014–2022).

Initially, Lawrence Bishop, Aaron's father, was responsible for hiring contractors to manage monitoring, carbon sales, and finances. Mr. Bishop has served as the primary United States fiscal manager for Yacumama lodge since its inception in the 1990's. Mr. Bishop initially contracted the Virginia Tech Conservation Management Institute to (i) support the development of the Project design document, (ii) collect data supporting the Project, (iii) design the Project monitoring plan and (iv) implement the initial rounds of monitoring. For the 2023 baseline review, Mr. Bishop contracted ClimeCo to support development of the updated Project design document and monitoring report, and to collect additional data supporting the Project. Implementation decisions regarding Project activities are now the sole responsibility of Aaron Bishop.

3.1.1 Monitoring of implemented activities

Maintaining ownership by the Project proponent and preventing planned deforestation (i.e., stopping the planned harvest and conversion of forest to agricultural land) are the central Project activities. Implementation of these activities has been monitored through a combination of:

- **Forest cover change analysis:** Deforestation and forest degradation are monitored using forest cover change analyses over the Project area and leakage belt. These analyses are used to detect any unplanned forest loss and to confirm that the planned conversion to agriculture has not occurred during the monitoring period.
- **On-the-ground protection and patrols:** A robust, continuous presence is maintained at the main facility (Yacumama Lodge), and regular patrols of the property and adjacent river corridors are conducted to prevent incursions and illegal logging that could compromise GHG benefits. Two Project guardians are employed to monitor the forested area for signs of intrusion (e.g., boats,

campsites), including beyond the 50 m buffer from the stream center. Bi-weekly boat patrols along the Yarapa River and its tributaries, Sabalillo and Yanayacu, focus on easily accessible riverbanks. On average, approximately 104 patrols occur per year since the Project start date. Patrol activities are recorded and reviewed as part of the monitoring process.

- **Signage and community engagement:** To reinforce Project rules and deter unauthorized logging, 24 signs have been placed strategically along the riverbank (see Figure 3.1-1). The Project guardians also engage directly with members of the local community, informing them of ongoing conservation efforts and the prohibition of logging within the Project area. The involvement of one Project guardian, who also serves as a commissioner and respected member of the Puerto Miguel community, is critical for effective communication and enforcement.
- **Staffing and operational records:** The need to patrol the forest and rivers and to monitor forest biomass requires hiring and training staff, usually from the local community of Puerto Miguel. Currently, two Project guardians are employed on an ongoing basis, and typically four additional community members are hired as temporary staff to support the forest carbon monitoring program. These staffing arrangements and rotations form part of the implementation monitoring record.

3.1.2 Forest carbon monitoring program

To ensure permanence of climate benefits and quantify removals, a forest carbon monitoring program was implemented prior to the monitoring period and has continued throughout. A total of 25 permanent nested circular plots were randomly allocated within the Project area as a source of forest biomass data (Appendix A of validated PD[21], see Figure 3.1-2 and Table 3.1-1). Diameter at breast height (1.3m above ground) of included trees is measured following Standard Operating Procedures based on Pearson et al. (2005) [9]. Virginia Tech conducted field measurements in 2013, and ClimeCo conducted the subsequent monitoring measurements in 2023.

Results from the monitoring program indicate that aboveground carbon stocks (t CO_2e) within the Yacumama Project area increased by approximately 3% over the first 10 years (Table 3.1-2). These measurements, combined with forest cover change analyses, demonstrate that the Project is maintaining and enhancing forest carbon stocks over time.

3.1.3 Impact of Project activities on GHG emission reductions or removals during the monitoring period

During the monitoring period (2014–2022), the principal Project activities—preventing planned deforestation, maintaining ownership, and conducting regular patrols and monitoring—have had a positive impact on GHG emission reductions and removals:

- **Prevention of planned deforestation:** The most important activity is the continued decision by the Project proponent not to implement the baseline scenario of harvesting and converting the

[9] See PDF file SOP for field data collection (Moist Tropical Forests) Dec 20

forest to agricultural land. By maintaining forest cover and avoiding the planned conversion, the Project has prevented emissions that would have occurred under the baseline.

- **Patrols and enforcement:** Continuous staffing at the lodge, regular land and river patrols, and visible signage have deterred illegal logging and other incursions that could result in unplanned forest loss. These activities help secure the avoided emissions associated with the planned deforestation and protect the standing carbon stock.

- **Forest carbon monitoring:** The forest carbon monitoring program (permanent sample plots) provides empirical evidence that the forest is being maintained and that aboveground biomass has increased modestly over time, thereby contributing to net removals.

Over the current verification period, preventing the planned harvest by the Project proponent and effectively patrolling the Yarapa River and its tributaries have resulted in an estimated 295,730 tCO2e of avoided emissions. The forest cover change analysis (see Section 5.3.1.1) demonstrates that the Project has been effective in reducing deforestation for the current verification period, and the plot-based biomass measurements confirm that carbon stocks have been maintained or increased.

During this monitoring period (2014–2022), there were no events that negatively impacted the GHG emission reductions or removals, or the monitoring of those benefits. No new Project activities leading to the intended GHG benefit commenced during the monitoring period; instead, the activities initiated prior to the monitoring period (cessation of timber harvest, maintenance of property ownership, staffing of guardians, patrolling, and forest carbon monitoring) continued to be implemented consistently. Leakage was monitored by the Project proponent, and internal non-permanence risk factors related to Project management have been reduced.

3.1.4 Start date and continuation of Project activities

The primary Project activity of stopping harvest by the Project proponent and preventing forest conversion to agricultural land began in 2011, when timber harvesting operations were ceased. From that point forward, the Project proponent chose to maintain the forest for carbon benefits rather than proceed with the planned baseline scenario of commercial harvest and agricultural conversion.

All key Project activities that commenced prior to the monitoring period—cessation of logging, maintaining ownership to avoid planned deforestation, maintaining a robust presence at Yacumama Lodge, implementing regular patrols, engaging with the local community, installing and maintaining signage, and operating the forest carbon monitoring program—continued throughout the monitoring period (2014–2022). The forest cover change analysis and monitoring plot results for this period confirm that:

- No conversion of forest to agricultural land has occurred within the Project area since 2011;

- The Project has been effective in reducing deforestation during the current verification period; and

- Preventing the planned harvest and maintaining active patrolling and enforcement have together avoided an estimated 295,730 tCO2e of emissions to the atmosphere.

Finally, the Yacumama Project is located within a jurisdiction not currently covered by an operational jurisdictional REDD+ program. Peru's Ministry of Environment is working to consolidate the country's carbon Projects under a national jurisdictional REDD+ (J-REDD+) program; however, at the time of writing this document, no official national J-REDD+ system covering the Project area has been published or implemented.

Figure 3.1-1 Sign posted along the riverbank to inform about the Yacumama Forest Carbon Project. All communication is in Spanish (Private property. Yacumama Project. Trespassing of unauthorized people is prohibited. Do not cut trees in this zone).

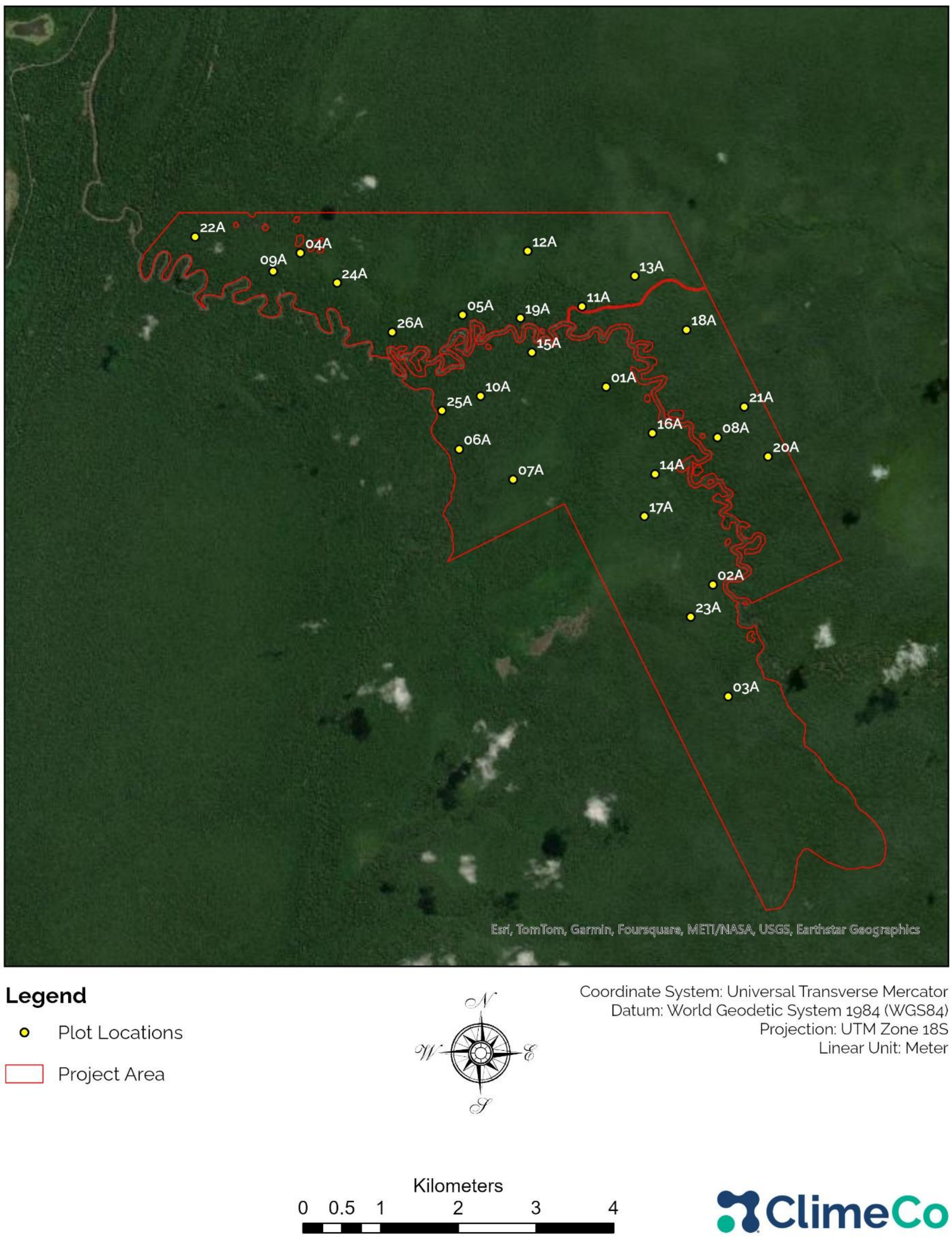

Figure 3.1-2 Yacumama Project area and forest plot allocation.

Table 3.1-1 Coordinates to Forest biomass assessment and monitoring plot locations.

Forest Plot ID	WGS84 UTM Zone 18S UTM X-Coordinate	UTM Y-Coordinate
01A	678296	9492323
02A	679668	9489778
03A	679865	9488339
04A	674361	9494048
05A	676446	9493250
06A	676402	9491522
07A	677100	9491132
08A	679729	9491673
09A	674011	9493810
10A	676679	9492205
11A	677986	9493358
12A	677285	9494071
13A	678663	9493754
14A*	678924	9491201
15A	677341	9492767
16A	678894	9491726
17A	678788	9490656
18A	679331	9493059
19A	677191	9493208
20A	680381	9491426
21A	680075	9492068
22A	673004	9494255
23A	679384	9489362
24A	674830	9493661
25A	676182	9492019
26A	675544	9493026

Table 3.1-2 Aboveground carbon in the Yacumama forest plots in 2013 and 2023.

Plot ID	AGB (t CO_2e) 2013	2023
01A	308.92	248.51
02A	270.53	178.26
03A	205.55	239.07
04A	238.83	247.89
05A	369.57	381.36
06A	300.56	392.43
07A	292.28	380.16

08A	300.56	392.43
09A	292.28	380.16
10A	276.52	181.24
11A	316.35	249.91
12A	216.93	262.99
13A	290.89	142.04
14A*	250.36	-
15A	289.51	280.61
16A	204.83	171.92
17A	261.63	299.63
18A	279.02	388.02
19A	184.88	280.84
20A	469.03	322.55
21A	401.73	489.83
22A	256.81	361.35
23A	199.36	218.74
24A	220.36	159.86
25A	223.85	219.88
26A	-	374.60
Number of plots	25	25
Average	276.95	285.25
Total Project	792,907	816,685

*Plot was inaccessible in 2023, so a new plot 26A was allocated from a random direction and distance.

3.2 Deviations

3.2.1 Methodology Deviations

3.2.1.1 Procedure to Derive $A_{planned,i}$ (Area of Planned Deforestation)

During baseline reassessment, a methodology deviation was applied in relation to the procedure used to derive the total area planned for deforestation ($A_{planned,i}$) under VMD0006.

Due to the absence of publicly available parcel-level land tenure data in the project region it was necessary to employ a structured remote sensing analysis of seven proxy areas to determine the total area eligible for deforestation during the baseline period (see Section 5.1.3). Two distinct deforestation dynamics were identified: (i) large-scale, spatially coherent, and rapid deforestation (Proxies 4–7), and (ii) dispersed, incremental deforestation across broader landscapes (Proxies 1–3).

While Proxies 1–3 were retained for the estimation of the deforestation rate to ensure conservativeness, they were not considered appropriate for determining $A_{planned,i}$, as their fragmented and multi-actor clearing dynamics do not reflect the coordinated, parcel-scale conversion behavior anticipated under the baseline scenario. Proxies 4–7, by contrast, exhibited spatially contiguous clearing patterns, rapid temporal progression, and homogeneous post-conversion land use consistent with single-management large-scale agricultural expansion.

To derive $A_{planned,i}$ conservatively, the lowest cumulative proportion of deforested area observed within this behaviorally similar group (80%) was applied as the cap to the Project Area.

The deviation consisted solely of limiting the derivation of $A_{planned,i}$ to the subset of proxies exhibiting behaviorally similar large-scale conversion dynamics (Proxies 4–7), rather than averaging across all identified proxies. This deviation was restricted to the procedure for establishing the cap for $A_{planned,i}$ and did not affect any other component of the methodology. The approach did not result in an overestimation of baseline emissions and maintained the conservativeness of GHG emission reduction quantification during the monitoring period.

3.2.1.2 Inclusion of Proxy Areas 1–3 in the Estimation of the Planned Deforestation Rate

During the baseline reassessment, a methodology deviation was applied in relation to the interpretation of the VMD0006 proxy area selection criteria for determining the planned deforestation rate (D%Planned). This deviation happened during the monitoring period, and this it affects the baseline deforestation rate used for credit calculations.

In the absence of a valid, verifiable deforestation plan, VMD0006 requires the use of at least six proxy areas that meet specified similarity criteria. Seven proxy areas were selected and assessed through remote sensing analysis. Two distinct deforestation behavior patterns were identified: (i) slower deforestation with smaller, more fragmented patches (Proxies 1–3, and (ii) faster deforestation with larger clearing patches (Proxies 4–7).

Due to limited availability of parcel-level tenure and deforestation agent data in Peru, the Project was unable to conclusively demonstrate that Proxies 1–3 fully met all similarity criteria related to land tenure type and deforestation agents. However, these proxies were retained in the analysis because:

- They are actively undergoing deforestation and have not reached a deforestation endpoint;
- Independent contextual information (Verra's open-access deforestation risk map for Peru) indicates continued high deforestation risk in these areas; and
- Their inclusion results in a lower average annual proportion of land cleared, thereby increasing the conservativeness of the estimated planned deforestation rate.

The deviation was limited exclusively to the interpretation of proxy selection criteria under VMD0006 and did not affect any other methodological requirements. Importantly, the inclusion of Proxies 1–3 did not result in an overestimation of baseline emissions or emission reductions; rather, it strengthened the conservativeness of the baseline deforestation rate applied during the monitoring period.

3.2.2 Project Description Deviations

3.2.2.1 First Monitoring Period (2012 – 2013)

There is no Project description deviation applied in the first monitoring period.

3.2.2.2 Second Monitoring Period (2014 – 2022)

3.2.2.2.1 Deforestation Rate Update

In the original validated PD[21], the it was assumed that the entire Project area would be cleared within 10 years. This assumption was justified on the basis that the area was suitable for agricultural conversion and that the Project proponent possessed full legal authority to carry out deforestation. The approved harvest plan served as the basis for the annual deforestation rate (area cleared per year) used to establish the initial baseline scenario. Considering the validity of the harvest plan and the common practice analysis conducted during Project validation, it was determined that 10% of the Project area would have been converted to agriculture each year over a 10-year period, as specified in the validated PD[21].

During the current monitoring period (2014–2022), this originally assumed 10% annual deforestation rate was re-evaluated and updated to comply with all requirements in Section 5.1.3 of VMD0006. The revised rate was derived from a VMD0006-compliant proxy area analysis rather than relying solely on the two historical examples of common practice referenced in the validated PD[21]. Seven proxy areas were selected, and historical tree-cover loss was quantified for each proxy over defined reference periods (see Section 5.1.3). Forest cover loss was analyzed from 2002 to 2013, and then from 2002 to 2021. For each proxy area, annual forest-loss rates were calculated as the average annual area of forest cover lost over the relevant reference period, and the Project-level deforestation rate was established as the seven proxy-area rates.

Based on this analysis, it was determined that approximately 80% of the forested portion of the Project area (2,863 ha) could be converted to agriculture, corresponding to a potential total deforested area of 2,290.4 ha. This total was used as the cap on cumulative allowable loss during the crediting period. For the period 2014–2021, the updated analysis estimated an annual deforestation rate of 121 ha/year. Following the baseline reassessment in 2022, the annual rate was adjusted to 90 ha/year. These values correspond to two updated deforestation rates applied during the crediting period: (1) 4.22% from 2014 to 2021 (First Baseline Period) and (2) 3.15% from 2022 to 2031 (Second Baseline Period). The original 10% annual deforestation rate was preserved for the initial two years of the Project (2012 and 2013), during which 286.3 ha/year (totaling 572.6 ha) were accounted toward the cumulative loss cap (estimated to be reached in 2023, year 9 of the Project). A detailed description of the deforestation-rate revision process is provided in Appendix 6.5.

3.3 Grouped Projects

This is not a grouped Project.

3.4 Baseline Reassessment

Did the Project undergo baseline reassessment during the monitoring period?

☒ Yes ☐ No

Reassessment of the baseline scenario followed requirements established in Section 6.2 of the methodology VM0007 v1.7, the latest approved version of the VCS REDD methodology. Section 3.4 of the updated PD (2026) was revised to reflect that reassessment. It distinguishes the two baseline periods (Jan 1, 2012- Dec 31, 2021) and (Jan 1, 2022- Dec 31, 2031) and clarifies the adjustment made to the first period related to the update on the rate of deforestation. Specifically, the baseline rate of deforestation for relevant years of the current monitoring period (2014-2021) was reduced from 10%/yr to 4.22%/yr.

The baseline for the last year of the current monitoring period (2022) was set according to the baseline reassessment for the Jan 1, 2022- Dec 31, 2031 period. The reassessed baseline scenario, starting in 2022, is to continue with Project activities of avoiding deforestation, maintaining and increasing a robust presence both at the main facility (lodge area not part of the Project area) and implementing regular patrols of the property to prevent incursions and illegal logging. The deforestation rate determined from the proxy analysis during this period (See Section 5.1.3) was 3.15%/yr. In addition, the limit for deforestation within the Project area ($A_{planned}$) was determined to be 80% of the Project area or 2,290.4 ha. The upper limit of $A_{planned}$ is expected to be reached at Project year 19 (2030) (See Yacumama ERR calcs v2.1_2026-01-09).

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	Project Forest Cover Benchmark Map
Data unit	ha
Description	Map showing the location of forest land within the Project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event.
Source of data	The 2012 land use/land cover (LULC) map (figure 6) was derived from a cloud free Landsat 5, 2011 (Julian Day 219) image as downloaded from the United States Geographic Survey's (USGS) Global Visualization Viewer (GloVis) (http://glovis.usgs.gov).
Value applied	Used in equation 3,8 in VCS module M-REDD
Justification of choice of data or description of measurement methods and procedures applied	Required by methodology. The minimum map accuracy should be 90% for the classification of forest/non-forest in the remote sensing imagery.
Purpose of Data	Calculation of baseline emissions
Comments	No additional comments

Data / Parameter	R
Data unit	t root d.m. t^{-1} shoot d.m.
Description	Root to shoot ratio appropriate to biome applied as belowground biomass per unit area.
Source of data	$C_{AB\_tree,l}$ multiplied by a root to shoot ratio available in the IPCC GL AFLOU. Global ecoregion specifically from IPCC GPG-LULCF [10].
Value applied	0.20 for ABG < 125 t. ha^{-1}, 0.24 for ABG > 125 t. ha^{-1}
Justification of choice of data or description of measurement methods and procedures applied	Tropical ratio provided in IPCC GPG-LULUCF.

[10] Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., ... & Wagner, F. (2003). Good practice guidance fo r land use, land-use change and forestry. Good practice guidance for land use, land-use change and forestry. Available at https://www.ipcc.ch/site/assets/uploads/2018/03/GPG_LULUCF_FULLEN.pdf

Domain	Ecological Zone	Aboveground biomass	Root-to-shoot ratio	Range
Tropical	Tropical rainforest	<125 t.ha-1	0.20	0.09-0.25
		>125 t.ha-1	0.24	0.22-0.33
	Tropical rainforest	<20 t.ha-1	0.56	0.28-0.68
		>20 t.ha-1	0.28	0.27-0.28
Subtropical	Subtropical humid forest	<125 t.ha-1	0.20	0.09-0.25
		>125 t.ha-1	0.24	0.22-0.33
	Subtropical dry forest	<20 t.ha-1	0.56	0.28-0.68
		>20 t.ha-1	0.28	0.27-0.28

Purpose of Data	Calculation of baseline emissions Calculation of Project emissions
Comments	Used in the calculation in Below-ground biomass.

Data / Parameter	fj(X,Y)
Data unit	Kg tree^{-1}
Description	Allometric equation for species *j* linking measured tree variable(s) to aboveground biomass of living trees, expressed as Kg tree^{-1}
Source of data	Pearson, T., Walker, S. and Brown, S. 2005. Sourcebook for Land Use, Land-Use Change and Forestry Projects. Winrock International and the World Bank Biocarbon Fund. 57pp
Value applied	Used in to estimate above ground biomass of individual trees. Tree (AGB) Tropical Wet Forest >4000 (Pearson et al., 2005) AGB= 21.297 – 6.953 * (D) + 0.740 * (D2)
Justification of choice of data or description of measurement methods and procedures applied	The equation was selected based upon the total inputs of moisture received via rainfall and yearly flood events.
Purpose of Data	Calculation of baseline emissions Calculation of Project emissions
Comments	Allometric equation was validated using the limited measurements approach.

Data / Parameter	$\Delta C_{BSL,i}$
Data unit	t CO_2-eha^{-1}
Description	Net carbon stock changes in all pools in the baseline stratum *i*

Source of data	VCS BL-PL module (VMD0006 v1.3)
Value applied	295.18
Justification of choice of data or description of measurement methods and procedures applied	See VCS BL-PL module (VMD0006 v1.3)
Purpose of Data	Calculation of leakage emissions
Comments	No additional comments

Data / Parameter	$A_{planned,i}$
Data unit	ha
Description	The total area under the baseline scenario planned for deforestation.
Source of data	Value represents the 80% deforestation cap under the baseline established through an empirical analysis of 20 years of deforestation trends (2002–2021) in proxy areas, focusing on landscapes that have nearly completed their deforestation cycle. Four of seven proxies exhibited advanced agricultural expansion with cumulative forest loss between 80% and nearly 100%, providing evidence for a realistic upper bound on forest conversion under comparable conditions.
Value applied	2,290.4ha
Justification of choice of data or description of measurement methods and procedures applied	Updated proxy areas selection and analysis outlined in Section 3.2.1.1
Purpose of Data	Calculation of baseline emissions
Comments	No additional comments

Data / Parameter	$D\%_{planned,i,t}$
Data unit	% $year^{-1}$
Description	Projected annual proportion of Project area deforested.

Source of data	Updated proxy area selection and analysis outlined in Section 5.1.
Value applied	From 2012 to 2013: 10% From 2014 to 2021: 4.22% From 2022 to 2031: 3.15%
Justification of choice of data or description of measurement methods and procedures applied	Identified through common practice analysis and the most conservative figure that will result in the Project being deforested within 19 years of the start date.
Purpose of Data	Calculation of baseline emissions
Comments	No additional comments

Data / Parameter	$AA_{planned,i,t}$
Data unit	ha year^{-1}
Description	Annual area of baseline planned deforestation for stratum *i* at time *t*;
Source of data	Updated proxy area selection and analysis outlined in Section 5.1.
Value applied	From 2012 to 2013: 286.3 ha year^{-1} From 2014 to 2021: 121 ha year^{-1} From 2022 to 2029: 90 ha year^{-1} 2030: 30 ha year^{-1} From 2031 to 2041: 0 ha year^{-1}
Justification of choice of data or description of measurement methods and procedures applied	This figure represents the most conservative figure that will result in the Project being deforested within 19 years of the start date. Based upon a common practice analysis.
Purpose of Data	Calculation of baseline emissions Calculation of Project emissions
Comments	No additional comments

Data / Parameter	$L\text{-}D_{,i}$

Data unit	%
Description	% Likelihood of deforestation in stratum *i*.
Source of data	Operativo Anual Para Permiso Forestal De Propiedad Privada (Annual operating plan for forest permit on private property)
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	From BL-PL "For all other planned deforestation areas (i.e., areas not under both government control and zoned for deforestation), $L\text{-}D_{,i}$ shall be equal to 100%"
Purpose of Data	Calculation of baseline emissions Calculation of Project emissions
Comments	No additional comments

Data / Parameter	D_{mn}
Data unit	t d.m.m^{-3}
Description	Mean wood density of commercially harvested species.
Source of data	Species specific values from the literature Brown (1997) and Zane et al. (2009). Appendix A of validated PD[21] summarizes values from local publications in Peru.
Value applied	0.55 t dry mass m^{-3} green volume
Justification of choice of data or description of measurement methods and procedures applied	The 7 commercial tree species listed in the approved Yacumama harvest plan (Appendix B of validated PD[21]) were used to determine the "mean wood density of commercially harvested species" in the Project area (Table 16). Densities were obtained from Brown (1997) and Zane et al. (2009) and are available Appendix A of validated PD[21]. The mean of the 7 species densities resulted in a tree density of 0.55.
Purpose of Data	Calculation of baseline emissions Calculation of Project emissions
Comments	No additional comments

Data / Parameter	Project Area

Data unit	ha
Description	Area in which the Project occurs
Source of data	Remote sensing data, COFOPRI maps, and original survey maps.
Value applied	2,863 ha
Justification of choice of data or description of measurement methods and procedures applied	Use remote sensing data to eliminate water bodies from the Project area. Original survey maps and remote sensing were used to confirm Project area boundaries
Purpose of Data	Calculation of baseline emissions Calculation of Project emissions
Comments	No additional comments

Data / Parameter	PML_{FT}
Data unit	%
Description	Mean merchantable biomass as a proportion of total above ground tree biomass for each forest type.
Source of data	Field data from Yacumama harvest plan.
Value applied	+/- 15
Justification of choice of data or description of measurement methods and procedures applied	Use field data collected in support of Yacumama harvest plan.
Purpose of Data	Calculation of leakage emissions
Comments	No additional comments

Data / Parameter	PMP_i
Data unit	%
Description	Proportion of total biomass in commercial species that is merchantable.
Source of data	Field data from Yacumama harvest plan.

Value applied	+/- 15
Justification of choice of data or description of measurement methods and procedures applied	Use field data collected in support of Yacumama harvest plan.
Purpose of Data	Calculation of leakage emissions
Comments	No additional comments

Data / Parameter	CF
Data unit	t C t d.m.-1
Description	Carbon fraction of dry matter
Source of data	IPCC
Value applied	0.47
Justification of choice of data or description of measurement methods and procedures applied	Species specific values from the literature (eg, IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.3)
Purpose of Data	Calculation of leakage emissions
Comments	No additional comments

Data / Parameter	LDF
Data unit	t C m^{-3}
Description	Factor for calculating the biomass of dead wood created during logging operations m^{-3} extracted.
Source of data	Default value provided in VCS LK-ME (VMD0011 v1.2)
Value applied	0.53
Justification of choice of data or description of measurement methods and procedures applied	Used default value reported in VCS LK-ME (VMD0011 v1.2)
Purpose of Data	Calculation of leakage emissions

Comments	No additional comments

Data / Parameter	LIF
Data unit	t C m^{-3}
Description	Factor for calculating emissions arising from the creation of logging infrastructure during logging operations m^{-3} extracted
Source of data	Default value provided in VCS LK-ME (VMD0011 v1.2)
Value applied	0.29
Justification of choice of data or description of measurement methods and procedures applied	Used conservative default value
Purpose of Data	Calculation of leakage emissions
Comments	No additional 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 baseline in stratum i at time t
Source of data	Estimates derived from field measurements
Value applied	From 2012 to 2013: 1,105 From 2014 to 2021: 466 From 2022 to 2029: 348 2030: 115 From 2031 to 2041: 0
Justification of choice of data or description of measurement methods and procedures applied	Used estimates derived from field measurements conducted in support of the development of the Yacumama forest harvest plan.
Purpose of Data	Calculation of leakage emissions
Comments	No additional comments

Data / Parameter	$E_{REDD\_BSLSS,\ i,\ pool\ \#}$
Data unit	t CO2e
Description	Carbon stock or GHG sources (e.g. trees, dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the baseline case (EBSL SS,i, pool#)
Source of data	The terms denoting significant carbon stocks, GHG sources or leakage emissions from baseline modules used to calculate net emission reductions.
Value applied	$C_{AB\ tree}$ 81,668 $C_{BB\ tree}$ 19,219 C_{DW} 0 C_{WP} 10 GHG 0
Justification of choice of data or description of measurement methods and procedures applied	The terms denoting significant carbon stocks, GHG sources, or leakage emissions from models used to calculate net emission reductions.
Purpose of Data	Calculation of uncertainty
Comments	No additional comments

Data / Parameter	$U_{REDD\ BSLSS,\ i,\ pool\ \#}$
Data unit	%
Description	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case (1,2…n represent different carbon pools and/or GHG sources) (UBSL,SS,i,pool#)
Source of data	Calculations from Field Measurements
Value applied	$C_{AB\ tree}$ 7.90 $C_{BB\ tree}$ 7.11 C_{DW} 0 C_{WP} 1.71 GHG 0

Justification of choice of data or description of measurement methods and procedures applied	Uncertainty in pools derived from field measurements.
Purpose of Data	Calculation of uncertainty
Comments	No additional comments

Data / Parameter	WW_{ty}
Dta unit	Dimensionless
Description	Fraction of extracted biomass effectively emitted to the atmosphere during production by class of wood product ty.
Source of data	Winjum et al. 1998 [11]
Value applied	0.24
Justification of choice of data or description of measurement methods and procedures applied	Default value for developing countries from the CP-W v1.2 module (VMD0005)
Purpose of Data	Calculation of baseline emissions
Comments	Parameter values to be updated if new empirically based peer-reviewed findings become available.

Data / Parameter	SLF_{ty}
Data unit	Dimensionless
Description	Fraction of wood products that will be emitted to the atmosphere within 5 years by class of wood product.
Source of data	Winjum et al. 1998[10]
Value applied	0.2
Justification of choice of data or description of measurement methods and procedures applied	Default value for sawnwood from the CP-W v1.2 module (VMD0005)

[11] Winjum,J.K., Brown,S. and Schlamadinger,B. 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. Forest Science 44: 272-284.

Purpose of Data	Calculation of carbon stock entering the wood products pool at the time of deforestation
Comments	No additional comments

4.2 Data and Parameters Monitored

Data / Parameter	Project Forest Cover Monitoring Map
Data unit	ha
Description	Map showing the location of forest land within the Project area at the beginning of each monitoring period, and after every five-year. If within the Project Area some forest land is cleared, the benchmark map (from 2012) must show the deforested areas at each monitoring event
Source of data	Remote sensing in combination with GPS data collected during ground truthing
Description of measurement methods and procedures to be applied	The minimum map accuracy should be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less or more than every 5 years examination must occur prior to any verification event
Value monitored	100% of Project area
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image.
QA/QC procedures to be applied	Document outlining the Standard Operating Procedures (SOP) for measuring monitoring plots is shared with the inventory crew. The QA/QC section of the SOP describes crew training, data records, data verification, non-conformance, and data archiving. See Section 5.3.2
Purpose of the data	Calculation of baseline and Project emissions
Calculation method	See Section 5.3.
Comments	If stratification is required in the future due to ex-post monitoring, then new strata will be identified using module X-STR.

Data / Parameter	Degradation Participatory Rural Appraisal results
Data unit	ha and m
Description	Semi structured interviews to obtain information on the area that is potentially subject to degradation ($ADeg,i$) and the distance of degradation penetration from access buffer.
Source of data	Participatory rural appraisal
Description of measurement methods and procedures to be applied	Consists of semi structured interviews that assess whether the following activities are occurring in the Project area: -Harvesting of fuel wood -Harvesting of wood for charcoal production -Timber harvest If 10% of those interviewed/ surveyed believe that degradation or any of the above may be occurring, then a limited field sampling must be undertaken.
Frequency of monitoring/recording	Every 2 years
Value monitored	0
Monitoring equipment	Surveying several transects of known length and width across the access-buffer area
QA/QC procedures to be applied	See Section 5.2.3 of M-REDD (VMD0015 v2.3)
Purpose of the data	Calculation of baseline and Project emissions
Calculation method	See Sections 5.1, 5.2 and 5.3.
Comments	An estimation was made in the Project case. In the current Project the parameter is set to “0” since there is an infrastructure, hiring, and policies in place to prevent deforestation.

Data / Parameter	$A_{DefPA,i,u,t}$
Data unit	ha

Description	Area of recorded deforestation in the Project area in stratum i converted to land use u at time t (if any occurs)
Source of data	Remote sensing imagery
Description of measurement methods and procedures to be applied	Supervised landcover classification was performed to differentiate between three landcover classes in the Project area: water, non-forest and forest areas.
Frequency of monitoring/recording	Must be monitored at least every 5 years or, if verification occurs at a frequency of less than every 5 years, examination must occur prior to any verification event.
Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image
QA/QC procedures to be applied	See Section 4.3
Purpose of data	Calculation of baseline and Project emissions
Calculation method	See Section 4.3
Comments	This was presumed to be zero ex ante. The Project has in place a clear management strategy, infrastructure, and personnel in place to restrict access to the Project area for the purposes of harvesting trees.

Data / Parameter	PMP_i
Data unit	%
Description	Merchantable biomass as a proportion of total above ground tree biomass for stratum *i*
Source of the data	Onsite measurements
Description of measurement methods and procedures to be applied	Merchantable biomass is equal to merchantable volume multiplied by wood density determined from Yacumama forest harvest plan.
Frequency of monitoring/recording	Monitored every 5 years prior to verification event.
Value monitored	0

Monitoring equipment	Direct measurement. See Section 5.3.1
QA/QC procedures to be applied	See Section 5.1 of LK-ME (VMD0011 v1.2)
Purpose of data	Calculation of leakage emissions
Calculation method	See Section 5.1 of LK-ME (VMD0011 v1.2)
Comments	Ex-ante a time zero measurement shall be made of this factor.

Data / Parameter	A_i
Data unit	ha
Description	Total Area of Project stratum *i*
Source of data	Own assessment (direct forest inventory of the Project area)
Description of measurement methods and procedures to be applied	This parameter is updated at baseline renewal when aboveground biomass is re-inventoried as per module CP-AB (at least every 10 years)
Frequency of monitoring/recording	At a minimum every time the baseline is updated (at least every 10 years)
Value monitored	2,863
Monitoring equipment	GPS
QA/QC procedures to be applied	See CP-W (VMD0005 v1.2)
Purpose of the data	Calculation of baseline and Project emissions
Calculation method	Equation 3 of CP-W (VMD0005 v1.2)
Comments	Ex-ante it shall be assumed that strata area will remain constant

Data / Parameter	A_{sp}
Data unit	ha
Description	Area of forest carbon monitoring plots
Source of data	Nested plot design published in Pearson et al (2005).

Description of measurement methods and procedures to be applied	See Section 4.3.1.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event.
Value monitored	Tree Class / Plot Radius / Plot Area / Proportion of Hectare: ≥5.0cm / 4.0m / $50m^2$ / 0.005 ≥20.0cm / 14.0m / $616m^2$ / 0.062 ≥50.0cm / 20.0m / $1256m^2$ / 0.125
Monitoring equipment	30m fiberglass tape, DBH tape
QA/QC procedures to be applied	See Section 4.3.1
Purpose of the data	Calculation of baseline and Project emissions
Calculation method	See Section 5.1 and 5.2
Comments	Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante. Where part of Project monitoring, ex-ante the number and area of sample plots shall be estimated based on Projected sample effort relative to Projections of growth and emissions.

Data / Parameter	DBH
Data unit	cm
Description	Diameter at breast height (1.3m) of a tree in cm
Source of data	Field measurements in forest carbon monitoring plots
Description of measurement methods and procedures to be applied	Measured at 1.3m above-ground unless tree has buttresses or irregular growth. Minimum diameter is 5cm. See field methods section for detailed procedures. Must be monitored at least every 5 years or if verification < 5 years, or a major event occurs monitoring must take place more frequently.
Frequency of monitoring/recording	Monitoring will occur at minimum every 10 years or more frequently if events dictate a reset of the baseline.
Value monitored	See database for tree measurements.

Monitoring equipment	Diameter tape increment in centimeters, 1.3m staff, 30m fiberglass tape, GPS to navigate to permanent plots
QA/QC procedures to be applied	See Section 4.3.1
Purpose of the data	Calculation of baseline and Project emissions
Calculation method	Direct observation
Comments	Key variable used to calculate with Project carbon stocks and year by year growth rate.

Data / Parameter	N
Data unit	Dimensionless
Description	Number of sample points
Source of data	Published forest biomass and standard deviation from Nebel et al (2001) [12].
Description of measurement methods and procedures to be applied	Information from Nebel et al (2001) was entered into Winrock Sampling Calculator to determine total number of plots needed. Must be monitored at least every 5 years or if verification < 5 years, or a major event occurs monitoring must take place more frequently.
Frequency of monitoring/recording	Minimum of every 10 years for baseline renewal.
Value applied	25 forest plots
Monitoring equipment	See Section 4.3.1
QA/QC procedures to be applied	See Section 4.3.1
Purpose of the data	Calculation of baseline and Project emissions
Calculation method	Winrock Sampling Calculator
Comments	Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante. Where part of Project monitoring, ex-ante the number of sample plots shall

[12] Nebel, G., J. Dragsted, and A.S. Vega. 2001a. Litter fall, biomass and net primary production in flood plain forests in the Peruvian Amazon. Forest Ecology and Management 150: 93-102.

	be estimated based on Projected sample effort relative to Projections of growth and emissions.

Data / Parameter	$\Delta A_{P,DistPA,q,i,t}$
Data unit	ha
Description	Area impacted by natural disturbance in Project stratum I, converted to natural disturbance stratum q at time t; ha
Source of data	Remote sensing imagery combined with ground verification points and/or GPS coordinates.
Description of measurement methods and procedures to be applied	Required by M-REDD module (VMD0015 v2.3)
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.
Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image
QA/QC procedures to be applied	See Section 4.3.3
Purpose of the data	Calculation of Project emissions
Calculation method	See Section 5.2
Comments	No major ecological disturbance is predicted within the Project area under the Project scenario.

Data / Parameter	$\Delta C_{P,Def,i,t}$
Data unit	t CO2e
Description	Net carbon stock change as a result of deforestation in the Project area in the Project case in stratum i at time t; t CO2e
Source of data	Calculated
Description of measurement methods	Required by M-REDD module (VMD0015 v2.3)

and procedures to be applied	
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.
Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image
QA/QC procedures to be applied	See Section 4.3.2. Quality control and quality assurance (QA/QC) will follow standard professional practices related to data processing, handling, and reporting. Generally, the entity responsible for data collection will review the data collection methods, check the data to ensure that they are collected correctly, assure that data are summarized and analyzed using accepted scientific principles, and cross-check the data with other data sources and with previous years to ensure that the data are realistic, complete and consistent over time (Penman et al., 2003) [13].
Purpose of the data	Calculation of Project emissions
Calculation method	See Section 4.3.2.
Comments	No deforestation is planned or allowed within the Project area under the Project scenario.

Data / Parameter	$\Delta C_{P,DistPA,i,t}$
Data unit	t CO2e
Description	Net carbon stock change as a result of disturbance in the Project area in the Project case in stratum i at time t; t CO2e
Source of data	Calculated
Description of measurement methods and procedures to be applied	Required by methodology.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.

[13] Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., ... & Wagner, F. (2003). Good practice guidance fo r land use, land-use change and forestry. Good practice guidance for land use, land-use change and forestry. Available at https://www.ipcc.ch/site/assets/uploads/2018/03/GPG_LULUCF_FULLEN.pdf

Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image
QA/QC procedures to be applied	See Section 4.3. Quality control and quality assurance (QA/QC) will follow standard professional practices related to data processing, handling, and reporting. Generally, the entity responsible for data collection will review the data collection methods, check the data to ensure that they are collected correctly, assure that data are summarized and analyzed using accepted scientific principles, and cross-check the data with other data sources and with previous years to ensure that the data are realistic, complete and consistent over time (Penman et al. 2003) [14].
Purpose of the data	Calculation of Project emissions
Calculation method	See Section 4.3
Comments	No additional comments

Data / Parameter	$\Delta C_{P,Deg,I,t}$
Data unit	t CO2-e
Description	Net carbon stock change as a result of degradation in the Project area in the Project case in stratum i at time t; t CO2-e
Source of data	Calculated
Description of measurement methods and procedures to be applied	Required by M-REDD module (VMD0015 v2.3)
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.
Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image

[14] Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., ... & Wagner, F. (2003). Good practice guidance fo r land use, land-use change and forestry. Good practice guidance for land use, land-use change and forestry. Available at https://www.ipcc.ch/site/assets/uploads/2018/03/GPG_LULUCF_FULLEN.pdf

QA/QC procedures to be applied	See Section 4.3. Quality control and quality assurance (QA/QC) will follow standard professional practices related to data processing, handling, and reporting. Generally, the entity responsible for data collection will review the data collection methods, check the data to ensure that they are collected correctly, assure that data are summarized and analyzed using accepted scientific principles, and cross-check the data with other data sources and with previous years to ensure that the data are realistic, complete and consistent over time (Penman et al. 2003).
Purpose of the data	Calculation of Project emissions
Calculation method	See Section 4.3.
Comments	No major ecological disturbance is predicted within the Project area under the Project scenario.

Data / Parameter	$GHG_{P-E,i,t}$
Data unit	t CO2-e
Description	Greenhouse gas emissions as a result of deforestation and degradation activities within the Project area in the Project case in stratum i in year t; t CO2-e
Source of data	Calculated
Description of measurement methods and procedures to be applied	Required by methodology M-REDD (VMD0015 v2.3).
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.
Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image
QA/QC procedures to be applied	See Section 4.3. Quality control and quality assurance (QA/QC) will follow standard professional practices related to data processing, handling, and reporting. Generally, the entity responsible for data collection will review the data collection methods, check the data to ensure that they are collected correctly, assure that data are summarized and analyzed using accepted scientific principles, and cross-check the data with other data sources and with previous years to ensure that the

	data are realistic, complete and consistent over time (Penman et al. 2003).
Purpose of the data	Calculation of Project emissions
Calculation method	See Section 4.3
Comments	No major ecological disturbance is predicted within the Project area under the Project scenario.

Data / Parameter	$C_{AB\_tree,i}$
Data unit	t CO2-e ha^{-1}
Description	Carbon stock in above-ground biomass in trees in the baseline stratum, *i*
Source of data	Field measurements monitored with allometric equation published in Pearson et. al. (2005) [15]
Description of measurement methods and procedures to be applied	See Section 4.3.1.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.
Value monitored	In 2013, 276.95 t CO2-e ha^{-1}. In 2023, 285.25 t CO2-e ha^{-1}.
Monitoring equipment	Computer and spreadsheet software.
QA/QC procedures to be applied	Independent 3rd party audit of field measurements utilizing re-measurement of a sample of plots.
Purpose of the data	Calculation of baseline emissions
Calculation method	Calculation method follows Pearson et. al. 2005.
Comments	Key variable used to calculate with Project carbon stocks and year by year growth rate.

Data / Parameter	$C_{BB\_tree,i}$

[15] Pearson, T., S. Walker and S. Brown. 2005. Sourcebook for land use, land-use change and forestry projects. Winrock International and the BioCarbon Fund of the World Bank.

Data unit	t CO2-e ha^{-1}
Description	Carbon stock in below-ground biomass in trees in the baseline stratum, i
Source of data	$C_{AB\_tree,I}$ multiplied by a SA ratio available in the IPCC GL AFLOU
Description of measurement methods and procedures to be applied	See Section 4.3.1section.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.
Value monitored	In 2013, 56.14 t CO2-e ha^{-1}. In 2023, 67.13 t CO2-e ha^{-1}
Monitoring equipment	Computer and spreadsheet software.
QA/QC procedures to be applied	Independent 3rd party audit of field measurements utilizing re-measurement of a sample of plots.
Purpose of the data	Calculation of baseline emissions
Calculation method	Calculation method follows CP-AB
Comments	Key variable used to calculate with Project carbon stocks and year by year growth rate.

Data / Parameter	Leakage (Activity Shifting) $\Delta C_{LK\text{-}AS,planned}$
Data unit	t CO2-e ha^{-1}
Description	Activity shifting leakage resulting from Project implementation and will include an assessment of acreage harvested and greenhouse gas emissions (Biomass burning and N_2O)
Source of data	Remote sensing and ground surveys
Description of measurement methods and procedures to be applied	Remote sensing will be used to monitor property controlled by Project proponent to ensure no harvest of forest resources occurs or emissions of greenhouse gases (biomass burning and N_2O).
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event.

Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image
QA/QC procedures to be applied	See Section 4.3.3
Purpose of the data	Calculation of leakage emissions
Calculation method	See Section 5.3
Comments	The likelihood of activity shifting leakage is considered very low since the Project proponent plans to maintain Yacumama as a base for Project related operations and thus undisturbed from its' current state.

Data / Parameter	$A_{defLK,i,t}$
Data unit	ha
Description	The total area of deforestation by the baseline agent or class of agent of the planned deforestation in stratum *i* in year *t*
Source of data	Remote sensing
Description of measurement methods and procedures to be applied	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation.
Frequency of monitoring/recording	Will be reexamined at least every 5 years or if verification occurs at a frequency of less than every 5 years examination must occur prior to any verification event
Value monitored	0
Monitoring equipment	Landsat imagery (or higher resolution) using multiple images to get a cloud free image
QA/QC procedures to be applied	See Section 4.3.3
Purpose of the data	Calculation of leakage emissions
Calculation method	See Section 5.3
Comments	No additional comments

4.3 Monitoring Plan

The Yacumama Monitoring Plan follows requirements established by the VCS Standard v4.7, Section 9.3 of VM0007, Part 1 of LK-ASP (VMD0009 v1.3) and LK-ME (VMD0011 v1.2). For this monitoring period (Jan 1, 2014 to Dec 31, 2022), it ensures the avoidance of 295,730 t CO_2e emissions from land clearing and conversion to agriculture during this monitoring period (2014 to 2022). The following tasks are implemented:

4.3.1 Monitoring Project implementation

a. *Technical description of the monitoring task*

- Bi-weekly boat patrols along the Yarapa River and its tributaries, Sabalillo and Yanayacu.
- 5-year interval measurement of the forest carbon monitoring plots, in total 25 plots.

b. *Data to be collected*

- Signs of intrusion along the riverbanks, considering the 50-meter from the stream's center buffer zone. Placement of signs for identification of private property.
- Live tree's distance to plot center, tree species common, and diameter at breast height/DBH (1.3 m above the ground). Trees are included in three sub-plots according to the inclusion criteria:

Tree DBH Class (cm)	Plot Radius (m)	Plot Area (m^2)	Proportion of hectare
≥ 5	4	50	0.005
≥ 20	14	616	0.062
≥ 50	20	1256	0.125

c. *Overview of data collection procedures*

Further information on the steps for including and measuring trees is available on Standard Operating Procedure for carbon plot measurement available in separate document [16].

d. *Quality control and quality assurance procedure*

Further information on crew training, data recording, data verification and non-conformances is available on Standard Operating Procedure for carbon plot measurement available in separate document[83].

e. *Data archiving*

Further information on data archiving is available on Standard Operating Procedure for carbon plot measurement available in separate document[20].

f. *Organization and responsibilities of the parties involved in all the above*

Monitoring tasks happen at least every 5 years, or if verification occurs on a frequency of less/more than every 5 years examination must occur prior to any verification event over the crediting period. The

[16] See PDF file Yacumama_SOP for field data collection (Moist Tropical Forests)

Project proponent (Yacumama Management/Aaron Bishop) is responsible for contracting qualified organization to perform the monitoring tasks [17]. In concert with Yacumama management, the selected organization collects, summarizes, analyzes, and archives all of data required to perform the monitoring tasks. Yacumama management secures a third-party auditor to verify that the monitoring follows all VCS requirements.

4.3.2 Monitoring actual carbon stock changes and GHG emissions

a. Technical description of the monitoring task

This monitoring task was designed to assess changes in forest cover (if any) in the Project area. These changes are measured prior to each verification as part of the overall monitoring program. Methods follow and are consistent with VCS M-REDD (VMD0015 v2.3).

b. Data collected

Forest cover data (water, non-forest, forest land) for the entire Project area is available for the beginning of the monitoring period, five years after, and the year of baseline renewal. If within the Project area some forest land is cleared, the Project Forest Cover Monitoring Map must show the changes in forested area (if any) areas at each verification event.

c. Overview of data collection procedures

Supervised landcover classification is performed to differentiate between three landcover classes in the Project area: water, non-forest and forest areas. These landcover classes represent major components of the landscape and are feasible to differentiate in terms of spectral properties. Supervised landcover classification has historically been performed for many environmental management and forestry purposes [18] [19]). Supervised classification involves four general steps: 1) collecting training samples representative of the different landcover classes; 2) training a classifier algorithm to develop relationships between spectral signatures and landcover classes; 3) implementing the classification algorithm on the target imagery; 4) performing an accuracy assessment of the classification (Stehman & Foody, 2019). The classifier algorithm applied is Random Forest using Google Earth Engine (GEE). Further information on the supervised landcover classification with the Random Forest algorithm is available in a separate document [20].

d. Quality control and quality assurance procedure

In landcover classification, accuracy assessment involves the creation of a confusion matrix, which summarizes whether each pixel in the validation data was classified correctly or incorrectly by the

[17] ClimeCo was selected to perform the monitoring task for the period of 2014 to 2022.

[18] Ahmed, O. S., Franklin, S. E., & Wulder, M. A. (2014). Integration of lidar and landsat data to estimate forest canopy cover in coastal British Columbia. Photogrammetric Engineering & Remote Sensing, 80(10), 953–961.

[19] Matasci, G., Hermosilla, T., Wulder, M. A., White, J. C., Coops, N. C., Hobart, G. W., & Zald, H. S. J. (2018). Large-area mapping of Canadian boreal forest cover, height, biomass and other structural attributes using Landsat composites and lidar plots. Remote Sensing of Environment, 209, 90–106. https://doi.org/https://doi.org/10.1016/j.rse.2017.12.020

[20] See accompanying PDF file Yacumama_Monitoring GHG_ RF Classification_Report

classifier algorithm. Further information on the supervised landcover classification with the Random Forest algorithm is available in a separate document[24].

e. Data archiving

All data collected and documents created as part of the monitoring program are archived electronically on secure servers. Final tabular data is compiled in MS-excel compatible spreadsheets, and final documents are maintained in MS-word. Geo-spatial data is compiled in ESRI or ARC compatible geodatabases with appropriate meta-data that meets Federal Geographic Data Committee standards. All data and documents are kept for at least two years after the end of the Project. A mirror copies of the databases on secure portable hard drives are also housed with Yacumama management.

f. Organization and responsibilities of parties involved in the above

Monitoring tasks happen at least every 5 years, or if verification occurs on a frequency of less/more than every 5 years examination must occur prior to any verification event over the crediting period. The Project proponent (Yacumama Management/Aaron Bishop) is responsible for contracting qualified organization to perform the monitoring tasks. In concert with Yacumama management, the selected organization collects, summarizes, analyzes, and archives all of data required to perform the monitoring tasks. Yacumama management secures a third-party auditor to verify that the monitoring follows all VCS requirements.

4.3.3 Monitoring leakage carbon stock changes and GHG emissions

a. Technical description of the monitoring task

In the validated PD [21], ex-ante "Activity Shifting Leakage" and "Market Effects Leakage" relative contribution as a carbon source were considered insignificant. However, where the lodge property is located, that parcel could be considered a source of activity leakage as it is also controlled by the Project proponent, the identified baseline deforestation agent. This monitoring task was designed to assess changes in forest cover (if any) in the Yacumama parcel. These changes are measured prior to each verification as part of the overall monitoring program. Methods follow and are consistent with VCS modules M-REDD (VMD0015 v2.3), Section 5.1 Part 1 of LK-ASP (VMD009 v1.3) and LK-ME (VMD0011 v1.2).

b. Data collected

Forest cover data (water, non-forest, forest land) for the entire Project area should be available at the beginning of the monitoring period, every five years after, and the year of baseline renewal. If within the Project area some forest land is cleared, the Project Forest Cover Monitoring Map must show the changes in forested area (if any) areas at each verification event.

c. Overview of data collection procedures

Supervised landcover classification is performed to differentiate between three landcover classes in the Project area: water, non-forest and forest areas. These landcover classes represent major

[21] See PDF Yacumama_PROJ_DESC_1133_29DEC2016 at https://registry.verra.org/app/projectDetail/VCS/1133

components of the landscape and are feasible to differentiate in terms of spectral properties. Supervised landcover classification has historically been performed for many environmental management and forestry purposes[22,23]. Supervised classification involves four general steps: 1) collecting training samples representative of the different landcover classes; 2) training a classifier algorithm to develop relationships between spectral signatures and landcover classes; 3) implementing the classification algorithm on the target imagery; 4) performing an accuracy assessment of the classification (Stehman & Foody, 2019). The classifier algorithm applied is Random Forest using Google Earth Engine (GEE). Further information on the supervised landcover classification with the Random Forest algorithm is available in separate document[24].

d. Quality control and quality assurance procedure

In landcover classification, accuracy assessment involves the creation of a confusion matrix, which summarizes whether each pixel in the validation data was classified correctly or incorrectly by the classifier algorithm. Further information on the supervised landcover classification with the Random Forest algorithm is available in separate document[24].

e. Data archiving

All data collected and documents created as part of the monitoring program are archived electronically on secure servers. Final tabular data is compiled in MS-excel compatible spreadsheets, and final documents are maintained in MS-word. Geo-spatial data is compiled in ESRI or ARC compatible geodatabases with appropriate meta-data that meets Federal Geographic Data Committee standards. All data and documents are kept for at least two years after the end of the Project. A mirror copies of the databases on secure portable hard drives are also housed with Yacumama management.

f. Organization and responsibilities of parties involved in the above

Monitoring tasks happen at least every 5 years, or if verification occurs on a frequency of less/more than every 5 years examination must occur prior to any verification event over the crediting period. The Project proponent (Yacumama Management/Aaron Bishop) is responsible for contracting qualified organization to perform the monitoring tasks[21]. In concert with Yacumama management, the selected organization collects, summarizes, analyzes, and archives all of data required to perform the monitoring tasks. Yacumama management secures a third-party auditor to verify that the monitoring follows all VCS requirements.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Baseline from Jan 1, 2012 to Dec 31, 2021

For the first baseline scenario (Period of Jan 1, 2012 to Dec 31, 2021), the Project proposed that 10% of the Project area per year would have been converted to agriculture, culminating with the entire Project area been deforested within 10 years. The basis for that assumption lied in the Project area been suitable for conversion, since the annual inundation of floodwaters results in deposition of rich nutrient sediments carried by rivers, making some of the most fertile soils of the Amazon Basin (Kvist and Nebel 2001, McClain and Cossio 2003). These areas were widely acknowledged for their agricultural productivity, and in 1997, the Peruvian Amazon Research Institute (IIAP) called for intensified agricultural development in the floodplains of the Loreto Department due to the more favorable edaphic conditions when compared to dry land (terra firme) (Kvist and Nebel 2001). Furthermore, the suitability of floodplains in the Amazon basin for agriculture, in both a historical and prehistorical context, was widely recognized (Fraser et al. 2012).

Furthermore, during the validation, the two parcels that comprise the Project area, Fundo Yacurana I and Satuario-Privado, were both considered as suitable for agriculture. The entire area Fundo Yacurana I was assessed to be suitable for "agricultural exploitation" by the Operativo Anual Para Permiso Forestal De Propiedad Privada 2009 (Annual operating plan for permission to timber private property 2009). Specifically, it was identified that 61% of the property was considered as suitable for cultivo permanente (permanent cultivation) and 39% as pastoreo (Pasture) (Pages 5 & 6 of the validated PD[Error! Bookmark not defined.]). Since Santuario-Privado was immediately adjacent to Fundo Yacurana I (see Figure 1.13-3), having the same soils, climate, and hydrologic regime; that parcel was, then, also considered as suitable for "agricultural exploitation". In addition, the ownership and tax documents on page 23 of the 2009 harvest plan classified the property 'type' as S. Productiva (productive), the same as Yacurana I.

Section 3.1 of the validated PD[Error! Bookmark not defined.] stated that the approved Yacumama harvest plan was 63.76 ha/yr. But, during the initial validation, it was requested a methodology deviation related to the calculation of the Area of Deforestation (1.2 BL-PL) and Rate of Deforestation (1.3 BL-PL). It was developed a common practice analysis based on two plantations (Tamshiyacu and Nueva Requena) that estimated an alternative baseline deforestation rate (i.e., 2,387.5 ha/year). The analysis (using the BL-PL module VMD006 v1.4) of potential alternative land use scenarios identified conversion to agriculture as the most likely baseline scenario. There were a variety of crops that could be grown in the region both on a commercial and individual scale. Commonly grown crops of the region included rice, corn, beans, and peanuts particularly in riparian areas, and manioc, plantains and bananas on upland soils (McClain and Cossio 2003). All these crops were grown within the Project zone and regionally. In addition, oil palm plantations were increasing at a relatively rapid rate in the Peruvian Amazon Basin

(Gutierrez-Velez et al. 2011). Finally, large new cacao plantations near the project area were clearing vast areas of forests at relatively rapid rates[22].

However, in 2025, during the second verification and baseline reassessment, the Project adjusted the baseline established for Jan, 2012 to Dec, 2021. The originally assumed 10% annual deforestation rate was re-evaluated and updated to comply with all requirements in Section 5.1.3 of VMD0006. The revised rate is now derived from a VMD0006-compliant proxy area analysis rather than relying solely on the two historical examples of common practice referenced in the registered PD[21]. Seven proxy areas were selected, and historical tree-cover loss was quantified for each proxy over defined reference periods.

Forest cover loss was analyzed for a reference period from 2002 to 2013 (to adjust the baseline established for Jan, 2012 to Dec, 2021) For each proxy area, annual forest-loss rates were calculated as the average annual area of forest cover lost over the relevant reference period, and the project-level deforestation rate was established as the seven proxy-area rates. Due to the absence of reliable, publicly available tenure datasets for Peru, it was not possible to directly identify landholdings with the same formal tenure status as the project area. To address this limitation, the proxy areas were conservatively delineated using multiple reference layers[23,24,25] to ensure they reasonably represent locations where the same agent of deforestation would operate in the baseline scenario.

Based on this analysis, it was determined that approximately 80% of the forested portion of the Project area (2,863 ha) could be converted to agriculture, corresponding to a potential total deforested area of 2,290.4 ha. The 80% limit was derived from an empirical review of long-term deforestation dynamics observed in the proxy areas. Specifically, deforestation was analyzed across a 20-year period (2002-2021) for all proxy areas, with particular attention to those proxies that exhibit advanced or near-complete deforestation trajectories and can therefore be considered to have largely completed their deforestation cycle. This assessment allows for an evidence-based estimation of the maximum extent of forest conversion that is realistically achieved under comparable land-use and deforestation agent conditions.

Among the seven proxy areas analyzed, four proxies (Proxies 4, 5, 6, and 7) exhibit high cumulative deforestation levels over the 20-year period, with total forest loss ranging from 80% to nearly 100% of the 2002 forest area. These proxies showed agricultural expansion progressing to an advanced stage and to minimal or fragmented remaining forest cover. This total of 2,290.4 ha was used as the cap on cumulative allowable forest cover loss during the crediting period.

The updated analysis estimated an annual deforestation rate of 4.22% (121 ha/year), which was applied for the period of 2014 to 2021. The original 10% annual deforestation rate was preserved for

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[22] http://earthobservatory.nasa.gov/IOTD/view.php?id=82076

[23] https://developers.google.com/earth-engine/datasets/catalog/projects_landandcarbon_assets_wri_gdm_drivers_forest_loss_1km_v1_2_2001_2024

[24] https://plataforma.mapbiomas.org/coverage/coverage_lclu?t[regionKey]=peru&t[ids][]=16-1-1&t[divisionCategoryId]=4&tl[id]=1&tl[themeKey]=coverage&tl[subthemeKey]=coverage_lclu&tl[legendKey]=default&tl[year]=2024&tl[pixelValues][]=27

[25] https://doi.org/10.5281/zenodo.4473715

the initial two years of the Project (2012 and 2013), during which 286.3 ha/year (totaling 572.6 ha) were accounted toward that cumulative loss cap, which is estimated to be reached in 2023, year 9 of the Project. A detailed description of the deforestation-rate revision process is provided in Section 5.1.3.

Baseline from Jan 1, 2022 to Dec 31, 2031

Reassessment of the baseline scenario followed requirements established on Section 6.2 of the methodology VM0007 v1.7, which states that baseline reassessment must include the evaluation of the validity of proxies for GHG emissions. For the period from 2022 to 2031, the updated proxy area analysis estimated an annual deforestation rate of 3.15% (90 ha/year). The starting point for this baseline reassessment is the forest cover at the end of baseline period (Dec 31, 2021). This reassessment analyzed changes in the drivers and/or behavior of the baseline agent of deforestation that can cause the change in land use and/or land management practices and changes in carbon stocks. Deforestation was monitored within all areas owned by Project proponent, the Project area and the parcel where lodge is located, using remote sensing following the rules established in the monitoring plan available in Section 5.3. Results indicate that agent of deforestation, still the Project proponent, has not materially changed the project area because of the project activities. Within the project boundary, no intact forest was cleared for agriculture production. Furthermore, evaluation of Laws, Statutes and Other Regulatory Frameworks in Peru since project start date identified that the new National Strategy on Forests and Climate Change (2016)[26] would forbid deforestation of the whole Project area, considering its REDD purpose. Peru's Strategy outlines a policy framework aimed at preventing deforestation to reduce GHG emissions across the country.

Nevertheless, In the absence of the carbon project, the most plausible baseline land-use change scenario within the project area is conversion of forest to agriculture using slash-and-burn practices, consistent with documented common practice in the Peruvian Amazon Basin. National technical assessments and peer-reviewed literature describe agricultural expansion in lowland Amazonian Peru, particularly along river corridors, as being implemented through a sequential process of vegetation cutting, tree felling, drying of biomass, and subsequent burning (tumba, rozo y quema)[27,28]. This land-conversion system is characteristic of both smallholder and emerging commercial agriculture in the region and has been widely identified as a principal driver of deforestation associated with subsistence and market-oriented crop production[28,29]. Government technical documentation further indicates that, under this system, a substantial fraction of cleared aboveground biomass is intentionally burned to facilitate land preparation, with estimates suggesting that approximately half of the biomass is combusted in situ and an additional fraction is burned ex situ, while the remaining biomass is left to

[26] https://www.un-redd.org/sites/default/files/2021-10/Peru_ENBCC_2016_FINAL.pdf

[27] Ministry of the Environment (MINAM). (2016). National Strategy on Forests and Climate Change - ENBCC (Supreme Decree No. 007-2016-MINAM). Government of Peru. Available at https://www.minam.gob.pe/wp-content/uploads/2016/07/ESTRATEGIA-NACIONAL-SOBRE-BOSQUES-Y-CAMBIO-CLIM%C3%81TICO-DECRETO-SUPREMO-007-2016-MINAM1.pdf?utm_source=chatgpt.com

[28] Che Piu, H., & Menton, M. (2014). The context of REDD+ in Peru: Drivers, agents and institutions (Occasional Paper 106). Center for International Forestry Research (CIFOR). Available at: https://www.cifor-icraf.org/publications/pdf_files/OccPapers/OP-106.pdf

[29] La Barreda Noa, D. (2021). Deforestation and land-use change in the Peruvian Amazon: Drivers and policy challenges. Revista de Investigaciones Altoandinas, 23(3), 245–258. Available at https://www.ucm.es/iuca/file/articulo_2_m-a_2021_resumen?ver=

decompose on site[30]. Slash-and-burn mechanism is the dominant operational method by which forest land is converted to crops commonly grown in the region, including rice, maize, manioc, plantains, oil palm, and cacao[28]. Accordingly, inclusion of post-deforestation burning as part of the reassessed baseline scenario, while explicitly accounting for incomplete combustion and residual biomass decomposition, is consistent with documented common practice and represents a conservative and methodologically sound baseline assumption under VM0007.

The date of the next scheduled baseline revision must be January 2032.

5.1.1 Biomass Baseline Carbon Stocks [31]

Baseline biomass carbon stocks were the above ground tree > 5 cm DBH and below-ground biomass. Above-ground non-tree biomass (lianas and palms), down or standing dead wood, and leaf litter were not measured, which resulted in a conservative estimation of carbon stocks in the Project area. The mean total carbon pool in 2023 was based on field data collected in 2023 and independently verified [32]. Above-ground biomass (kg) was calculated using the tropical wet forest equation from Brown (1997) [33]. Above-ground biomass for each tree was converted from kilograms to tons (divided by 1,000) and from the plot area to hectare (10,000 divided by plot area). Below-ground biomass for each tree was estimated using the appropriate root to shoot ratio from CP-AB (VMD0001 v1.2). Above and Below-ground biomass (t d.m./ha) were converted to above and below-ground carbon stock (t CO_2-e/ha) by multiplying the mass by the carbon fraction of biomass (0.47) and by the total atomic weight of CO_2 (44/12). Above-ground and below-ground biomass attributed to non-tree biomass (palms and lianas) and soil carbon was conservatively excluded. Table 5.1-1 summarizes the above-ground, below-ground and total tree biomass within the Project area at Yacumama. Using the total area subject to deforestation (2,290.4 ha) the total above ground tree biomass is 379,119 (t d.m.) and total below ground biomass 89,216 (t d.m.).

Table 5.1-1 Summary of above-ground, below ground and total tree biomass with the Project area at Yacumama.

	AGB Tree Biomass	BGB Tree Biomass	Total Tree Biomass
Average (t d.m./ha)	165.53	38.95	204.48
Average (t CO_2-e/ha)	285.25	67.13	352.38
Standard Deviation	87.49	22.87	110.29
Confidence (95%)	36.11	9.44	45.53
Confidence % of mean	7.90	7.11	7.74

[30] Ministry of the Environment (MINAM). (2000) National Environmental Information System (SINIA). CHAPTER 4 - Causes of Deforestation (Document 173) (In Spanish). General Directorate of Territorial Planning, Lima, Peru. Available at https://sinia.minam.gob.pe/sites/default/files/sinia/archivos/public/docs/173.pdf

[31] See Appendix A of the validated PD for detailed field methods, QA/QC, and allometric equation validation

[32] See accompanying MS-excel Yacumama ERR calcs.

[33] Brown, S. (1997). Estimating biomass and biomass change of tropical forests: a primer (Vol. 134). Food & Agriculture Org..

5.1.2 Uncertainty Analysis

Uncertainty was calculated using the equation and approach in the module X-UNC (VMD0017 v2.2).

5.1.2.1 Part 1 - Uncertainty in Baseline Estimates

Step 1: Assess uncertainty in Projection of baseline rate of deforestation or degradation. Because the deforestation rate was determined through a common practice analysis and in concert with the Yacumama harvest plan there is no uncertainty in deforestation rate, thus

$$U_{REDD_{BSL,RATTE,t*}} = 0$$

Step 2: Assess uncertainty of emissions and removals in Project area in Baseline Scenario using equation 5 from X-UNC (VMD0017 v2.2).

$$Uncertainty_{REDD\_BSL,SS} = \frac{\sqrt{\sum_1^n (U_{REDD\_BSL,i,pool\ \#} * E_{REDD\_BSL,i,pool\ \#})^2}}{\sum_1^n E_{REDD\_BSL,i,pool\ \#}}$$

$$U_{REDD_{BSL},SS,i} = \frac{659{,}406}{100{,}895}$$

$$U_{REDD_{BSL},SS,i} = 6.54\%$$

Where:

$Uncertainty_{REDD\_BSL,SS}$	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline case (%)
$U_{REDD\_BSL,SS,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in stratum *i* in the REDD baseline case (%)
$E_{REDD\_BSL,SS,t,i}$	Sum of combined carbon stocks and GHG sources in the REDD baseline case (t CO2-e)
i	1, 2, 3 …M strata (unitless)

Step 3: Estimate Total Uncertainty in REDD Baseline Scenario using equation 6 from X-UNC (VMD0017 v2.2).

$$Uncertainty_{REDD_{BSL},t*} = \sqrt{U_{REDD_{BSL,RATTE,t*}}^{\ 2} + U_{REDD\_BSL,SS,i}^{\ 2}}$$

$$Uncertainty_{REDD_{BSL},t*} = 6.54\%$$

5.1.2.2 Part 2 - Uncertainty in WRC baseline estimates

Not Applicable

5.1.2.3 Part 3 - Uncertainty in the Ex-Post REDD Project scenario

No deforestation occurs during the first 10 years of the Project. Deforestation was monitored and tracked directly using remote sensing techniques described below in section Monitoring of leakage, Carbon Stock changes and Greenhouse gas emissions. Since no ex-post (re-) measurements of carbon pools or GHG sources have been made, uncertainty in Project scenario is already included in $Uncertainty_{REDD_{BSL},t*}$, so $U_{REDD_{WPS}}$ is set equal to zero.

$$U_{REDD-WPS} = 0$$

Where:

$U_{REDD-WPS}$	Total uncertainty in the REDD Project scenario (%)
$U_{REDD-WPS,SS,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in stratum *i* in the REDD Project scenario (%)
$E_{REDD-WPS,SS,t,i}$	Sum of combined carbon stock and GHG sources multiplied by the area of stratum *i* (A_i) in the REDD Project scenario (t CO2e)
i	1, 2, 3 ...*M* strata (unitless)

5.1.2.4 Part 4 - Uncertainty in WRC Project scenario estimates

Not Applicable

5.1.2.5 Part 5 - Total Error in REDD Project Activity

Total Project uncertainty is equal to the combined uncertainty in the baseline and Project estimates for the REDD using equation 21 in X-UNC (VMD0017 v2.2).

$$NER_{REDD+\_ERROR,} = \sqrt{(Uncertainty_{REDD_{BSL},t*} \times \Delta C_{BSL-REDD,t*})^2 + (Uncertainty_{REDD_{WPS}} \times \Delta C_{WPS-REDD,t*})^2}$$

$$NER_{REDD+\_ERROR,} = 6.54\%$$

Where:

$NER_{REDD+ERROR,}$	Cumulative uncertainty for the REDD+ (REDD and WRC) Project activities up to year $t*$ (%)
$Uncertainty_{REDD_{BSL},t*}$	Cumulative uncertainty in REDD baseline scenario up to year *t* (%)
$Uncertainty_{REDD_{WPS}}$	Total uncertainty in the REDD Project scenario (%)
$\Delta C_{BSL-REDD,t*}$	Net GHG emissions in the REDD baseline scenario up to year $t*$ (t CO2e)
$\Delta C_{WPS-REDD,t*}$	Net GHG emissions in the REDD Project scenario up to year $t*$ (t CO2e)
t	1, 2, 3, ...$t*$ time elapsed since the Project start (year)

Because total error is within the threshold of +/- 15% so no deduction is made in Project accounting.

5.1.3 Updated Deforestation Rate: proxy area selection and analysis

To comply with the requirements of VMD0006, Section 5.1.3, a conservative and transparent approach was used to delineate proxy areas for estimating the baseline deforestation rate for the Yacumama Project.

5.1.3.1 Context and data constraints

A key limitation for attending all the VMD0006 requirements is the absence of accessible tenure or ownership boundary data in Peru. As such, it was not possible to directly identify polygons representing landholdings with the same management and land use rights type as the Project area.

Despite this, we attempted to locate proxy sites with comparable tenure characteristics by reviewing available national and regional datasets, cadastral portals, and land-use information. However, no publicly available data with sufficient spatial coverage or reliability were found. A summary matrix of the data sources consulted and their relevance to the tenure assessment is provided in the supporting file: Peru Spatial Dataset Bibliographic Review.xlsx.

To address this, proxies were delineated using spatial indicators of the same agent of deforestation: permanent agricultural expansion, following a reproducible geospatial procedure grounded in publicly available datasets and conservativeness.

5.1.3.2 Data sources

1. **World Resource Institute (WRI) Global Forest Watch – Tree Cover Loss by Dominant Driver**[34]
   Accessed via Google Earth Engine. Agriculture-related driver classes were used as contextual reference layers to characterize agriculture-driven forest loss consistent with the project's baseline deforestation agent.

2. **MapBiomas Peru – Palm Oil and Agriculture Land Use Classes**[35]
   Used as a contextual reference layer to assess agricultural land-use patterns and broader deforestation trends.

3. **Existing Proxy Areas** The three proxy areas delineated in the registered Project Description were maintained and used as spatial reference points to help locate additional suitable proxies within the same landscape context.

4. **Global Palm Oil Map 2019**[36]
   This dataset is a high-resolution global map of industrial and smallholder oil palm plantations for 2019, accessed through ArcGIS Living Atlas, and was used as a reference layer to support the delineation of proxy areas.

5.1.3.3 Spatial analysis and delineation process

Identification of deforestation corridors and general proxy region
Analysis of reference layers revealed that agricultural deforestation is concentrated along linear

[34] https://developers.google.com/earth-engine/datasets/catalog/projects_landandcarbon_assets_wri_gdm_drivers_forest_loss_1km_v1_2_2001_2024

[35] https://plataforma.mapbiomas.org/coverage/coverage_lclu?t[regionKey]=peru&t[ids][]=16-1-1&t[divisionCategoryId]=4&tl[id]=1&tl[themeKey]=coverage&tl[subthemeKey]=coverage_lclu&tl[legendKey]=default&tl[year]=2024&tl[pixelValues][]=27

[36] https://doi.org/10.5281/zenodo.4473715

corridors such as roads and rivers. These features exhibit a consistent clearing pattern extending approximately 2 km on either side, corresponding to observed parcel widths in high-resolution satellite imagery (Figure 5.1-1). Priority was given to regions, where original proxies are located, and the vicinity of the Yacumama Project area. Two broad regions were therefore defined for proxy delineation: the Iquitos region and the Pucallpa region.

Figure 5.1-1 Linear pattern along road corridor (~2 km width) near Pucallpa.

1. Digitization of linear features
   Roads intersecting areas classified as "agriculture-driven loss" from the WRI dataset and other reference layers were manually digitized.

   Two primary roads were selected- one near Pucallpa and another near Iquitos.

2. Buffering to represent management strips
   Each digitized road was buffered by 2 km on either side, producing elongated polygons that capture the typical width of agricultural encroachment zones visible in satellite data.

   Settlement areas were excluded to avoid bias from mixed-use or residential zones, maintaining consistency with the intended post-deforestation land-use type.

3. Subdivision of buffered polygons

   - In the Pucallpa region, the buffered corridor was retained as a single proxy area. The area encompasses numerous smallholder palm-oil plantations, verified using the 2019 Global Palm Oil Map. Including both deforested and remaining forest patches ensured a conservative representation of ongoing agricultural expansion. Proxy 3 was created in this area.
   - In the Iquitos region, the buffered corridor was subdivided by the central road to create two proxy polygons. This subdivision reflects smaller settlement patterns and localized management zones, further reducing the risk of overestimating deforestation rates. Further, the Iquitos region exhibits a more fragmented and heterogeneous land-use pattern, with smaller-scale clearings interspersed with settlements and secondary vegetation. In this context, using the road as the primary divider provided a logical and transparent spatial boundary. Proxies 1 and 2 were digitized in this area.

4. **Delineation of remaining proxies**
   The three polygons referenced in the original PD were digitized from basemap imagery and maintained as Proxies 4,5 and 7. Finally, Proxy 6 was also digitized from the basemap imagery using the reference layers as another large-scale palm oil area in the Pucallpa area.

See Table 5.1-2 for a summary of all seven proxy areas and Figure 5.1-2 for a map of the proxy areas.

Table 5.1-2 Summary of Proxy Areas.

Proxy ID	Area (ha)	Location
1	14,205	Iquitos-along Road
2	13,888	Iquitos-along Road
3	13,524	Pucallpa- along Road
4	6,248	Pucallpa- original proxy
5	5,059	Pucallpa- original proxy
6	3,250	Pucallpa- large scale palm oil
7	2,565	Tamchiyacu- original proxy

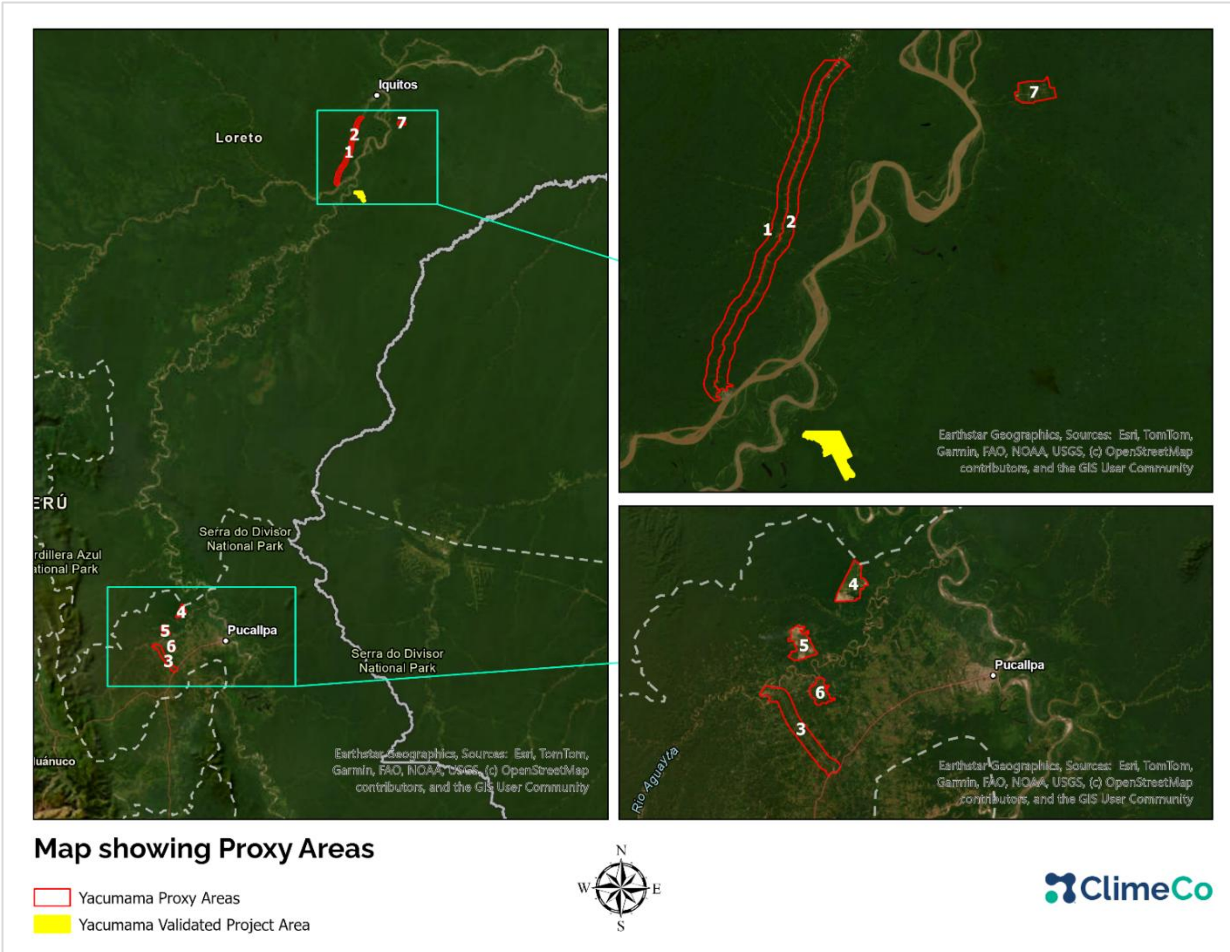

Figure 5.1-2 Map depicting proxy areas.

5.1.3.4 Conservativeness

Given the land tenure data limitations in Peru, this approach was intentionally designed to minimize bias and avoid overestimation of baseline deforestation rates. By relying on publicly available, verifiable datasets and applying consistent spatial rules, such as fixed 2 km buffers along agricultural deforestation corridors, the delineation process eliminates subjective judgment in defining proxy boundaries.

Proxy areas were selected only where deforestation could be confidently linked to agricultural expansion, and locations with uncertain or mixed drivers (e.g., settlement/infrastructure) were excluded. The inclusion of both active agricultural clearings and remaining forest patches further ensures that the derived rates represent a conservative lower-bound estimate of expected baseline deforestation.

This approach prioritizes representativeness over magnitude, ensuring that the proxies conservatively capture real, observable agricultural expansion patterns while remaining defensible under the intent of VMD0006 Section 5.1.3. It reflects the best available and most transparent methodology possible given the inherent spatial and data constraints in the Peruvian context.

5.1.3.5 Suitability Assessment

To comply with Section 5.1.3 of VMD0006, seven proxy areas were selected to determine the rate of planned deforestation. Criterion 7 of Section 5.1.3 requires that the forest type, soil type, slope/elevation characteristics of each proxy be within ± 20 % of those in the Project area.

A spatial analysis was performed to verify this requirement. The following biophysical datasets were used:

- **Soil:** FAO Harmonized World Soil Database accessed via ArcGIS Online, used to identify eligible soil classes and their proportional distribution across the Project area and proxies.
  1) Research shows which soil classes are eligible for conversion to agriculture inclusive of Gleysols[37], Acrisols[38] and Cambisols[39]).
- **Forest Type/Vegetation**: The national-level ecoregion shapefile from Ministerio del Ambiente (MINAM) of Peru (available from GEO GPS Perú)[40] was used to classify the Project and proxy areas into ecoregion/forest-type categories, enabling comparison of forest/ecological zone composition.
- **Slope and Elevation**: Derived from SRTM Digital Elevation Model (30 m) downloaded from Google Earth Engine and processed in ArcGIS Pro to generate slope (%), elevation classes (500 m intervals), and ratio of gentle (< 15 %) to steep (≥ 15 %) terrain.

Spatial overlay and zonal analysis were conducted in GIS to verify the biophysical similarity of the seven selected proxy areas to the Project area, as required under Section 5.1.3 of VMD0006. Using the FAO Harmonized World Soil Database (ArcGIS Online), the MINAM Peru ecoregion shapefile (GEO GPS Perú), and slope and elevation layers derived from the SRTM DEM, proportional distributions of soil type, forest/ecoregion, slope, and elevation classes were calculated for the Project and each proxy. The results confirm that all proxies fall within ± 20 % of the Project area across these parameters, demonstrating that the selected sites are biophysically comparable and suitable for use in estimating baseline deforestation rates.

Table 5.1-3 summarizes the results, and the supporting materials, including the spatial layers and an Excel file containing the eligibility calculations are provided separately.

Table 5.1-3 Results of Proxy Areas Suitability Evaluation.

Category	Project Area	P_1	P_2	P_3	P_4	P_5	P_6	P_7
Vegetation (%)								
Tropical Amazon Forest	100%	100%	100%	100%	100%	100%	100%	100%
Other	0%	0%	0%	0%	0%	0%	0%	0%
Elevation (%)								
0-500m	100%	100%	100%	100%	100%	100%	100%	100%
Slope Class (%)								
Gentle (<15%)	99.7%	88.2%	86.2%	92.6%	94.3%	94.4%	98.8%	97.3%

[37] A) Feintrenie, L., Vázquez Navarrete, C. J., & Lagunes Espinoza, L. del C. (2025). *Oil palm in Mexico and in the Americas / Le palmier à huile au Mexique et en Amérique latine*. Cahiers Agricultures, 34, Article 11. https://doi.org/10.1051/cagri/2025009

B) Feintrenie, L., Vázquez Navarrete, C. J., & Lagunes Espinoza, L. del C. (2021). *Oil palm in Mexico and in the Americas / Le palmier à huile au Mexique et en Amérique latine*. Cahiers Agricultures, 30, Article 41. https://doi.org/10.1051/cagri/2021026

C) Kahn, F. (1988). *Ecology of economically important palms in Peruvian Amazonia*. Advances in Economic Botany, 6.

[38] Thompson-Morrison, H.; Ariantiningsih, F.; Arief, S.M.; Gaw, S.; Robinson, B. Nutrients and Contaminants in Soils of Current and Former Oil Palm Production Systems from Indonesia. *Land* 2023, *12*, 2144. https://doi.org/10.3390/land12122144

[39] FAO. (2015). *World Reference Base for Soil Resources 2014: International soil classification system for naming soils and creating legends for soil maps (Update 2015).*

[40] https://www.geogpsperu.com/2018/03/mapa-de-ecorregiones-minam-shapefile-pdf.html#google_vignette

Steep (=>15%)	0.3%	11.8%	13.8%	7.4%	5.7%	5.6%	1.2%	2.7%
Soil Type (%)								
Cambisols, Gleysols and Acrisols	100%	100%	100%	100%	100%	100%	100%	100%
Other	0%	0%	0%	0%	0%	0%	0%	0%

5.1.3.6 Deforestation Rate

Methods and Data Sources

Tree Cover Data

- Data Source: The 2001 tree cover data was derived from the Global Forest Change (GFC) dataset by Hansen et al. (2013), accessible through Google Earth Engine (GEE). This dataset provides comprehensive tree cover and annual forest loss data starting from 2000.
- Methodology:
    - Baseline Tree Cover: The GFC dataset's 2000 tree cover data served as the initial reference. A minimum canopy cover threshold of 10% was applied, ensuring that only areas meeting this forest density were considered forested. To maintain ecological comparability, a minimum contiguous forest area of 0.5 hectares was set. Forest cover and contiguity align with FAO's definition of forest utilized in the Project.
    - Tree Loss Calculation in 2001: Data from 2001 was analyzed within the defined forested areas followed by subtracting these losses from the 2000 tree cover.
    - Overlay with Ecoregion Map: To refine accuracy, the 2001 forest cover layer was overlaid with ecoregion layer from Ministerio del Ambiente (MINAM) of Peru in ArcGIS. This overlay ensured that only areas classified as forest within the ecosystem map were retained in the analysis, helping to exclude other land cover types (e.g. plantations) that might have been misclassified in the GFC dataset.

The combined GFC and Peru Ecoregion data provided a verified forest cover dataset for 2001, which served as a reliable baseline for subsequent deforestation analysis. This data was extracted using a customized GEE script and refined in ArcGIS (see link - GEE Global Forest Change Script).

Tree Loss Data Analysis from 2002 to 2022

- Data Source: Tree loss from 2002 to 2022 was again derived from the GFC dataset, accessed through GEE.
- Methodology:
    - Data Collection: Using GEE, tree loss data was collected for each year on an Area of Interest (AOI)[41] scale, capturing all recorded deforestation events around Project location. The same 10% canopy cover and 0.5-hectare forest area thresholds applied in previous steps were maintained.
    - ArcGIS: These annual tree loss datasets were then clipped to the verified 2001 forest cover in the proxy areas, ensuring that tree loss calculations focused only on areas meeting the 2001 forest cover criteria.

This approach created an annual tree loss dataset specifically for the proxy areas, providing a time series of deforestation trends from 2002 to 2022 (see link - GEE Tree Loss Script). The final tree cover and tree

[41] AOI can be identified in GEE Global Forest Change Script.

loss dataset which was extracted using ArcGIS. The extracted data was then used to calculate the annual deforestation rate for the Project area.

Results

5.1.3.6.1 Deforestation Rate 1

Based on the analysis conducted, the deforestation rate 1 was **4.22%** and it was applied from 2014 until 2021.

5.1.3.6.2 Deforestation Rate 2

Based on the analysis conducted, the deforestation rate 2 was **3.15%** and it was applied from 2022 until 2031 (the reassessed baseline).

Table 5.1-4 summarizes the results of the deforestation rate analysis for the two periods. The complete calculation file is provided as supporting documentation.

Table 5.1-4 Results of Deforestation Rate Analysis.

ProxyID	Total Size (ha)	2002 Forest Area (ha)	Def 1 (ha)	Def 2 (ha)	% Def 1	% Def 2	% Def 1 /yr	% Def 2 /yr
1	14,204.92	13,301.32	1,569.88	2,323.93	11.8%	17.5%	1.0%	0.9%
2	13,887.70	13,006.76	1,640.46	2,758.26	12.6%	21.2%	1.1%	1.1%
3	13,524.32	12,006.92	3,033.06	4,885.52	25.3%	40.7%	2.1%	2.0%
4	6,247.86	6,232.38	5,097.12	6,131.96	81.8%	98.4%	6.8%	4.9%
5	5,058.67	5,040.78	4,704.22	4,942.20	93.3%	98.0%	7.8%	4.9%
6	3,249.89	3,204.92	2,108.54	2,565.29	65.8%	80.0%	5.5%	4.0%
7	2,564.76	2,564.41	1,629.28	2,172.33	63.5%	84.7%	5.3%	4.2%
						Average	4.22%	3.15%

Carbon stocks in agro-ecosystems

Conversion to agriculture after harvest of forest products is the most probable land use under the baseline scenario. While it is likely that large areas of the Project would be subject to conversion to monocultures of rice or other intensive cropping system, under the baseline scenario we identified a 'multi-crop / short-term fallow' as our baseline agriculture system. The 'multi-crop / short-term fallow' agriculture system is the most widespread in the Loreto province followed by intensive cropping systems (Henman et al. 2008). In addition, the 'Land Use Capacity Description' (Yacumama Harvest Plan) classifies the entire area of Yacurana I as suitable for either 'Pasture' or 'Standing Crop' agriculture. For the "Private sanctuary" parcel, ownership, and tax documents on page 23 of the 2009 harvest plan classify the property 'type' as S. Productiva (productive) the same as Yacurana I and thus can be reasonably assumed to be suitable for the same type of agriculture.

Therefore, to establish post-deforestation tree stocks (above and below ground) the Project determined that a "silvo-pasture" agro-ecosystem would be represent the most accurate and conservative post deforestation agro-ecosystem C stocks. It was used values from Markewitz et al. (2004) [42], who calculated an above ground biomass of 7.8 +/- 5.2 [43] Mg ha^{-1} for ‘degraded pasture with tree islands’ (i.e. silvo-pasture system formed 19 years after deforestation in the Brazilian Amazon. This silvo-pasture system closely resembles the agro-ecosystem described above under the baseline scenario and has likely reached equilibrium with respect to C fluxes due to the time elapsed since deforestation. Below ground biomass was not directly measured by Markewitz et al. (2004) thus the Project calculated $C_{BB\ tree\ post,i}$ in the same manner as in the Project scenario using the above ground biomass estimates.

5.1.3.6.3 Fate of Forest Resources Lost to Agricultural Conversion (Long-lived Wood Products) [44]

The standard practice in Peru for conversion of forest to agricultural lands is to remove valuable timber species and then bulldoze and burn the remaining trees. Long Lived wood products were accounted for using Option 1 of the CP-W (VMD0005 v1.2).

Option 1: Direct Volume Extraction Estimation

Step 1: Identify the wood product class(es) that are the anticipated end use of the extracted carbon calculated in Step 2. Sawnwood

The definition of sawnwood according to the UNFCC (2003) “Sawnwood is roundwood that is sawed lengthways or by profile chipping, to produce planks, beams, joists, sleepers and lumber….” On page 30 of the Yacumama annual harvest plan under the heading: Activities: Primary Processing …“The primary processing at the site…will be made using a portable sawmill…by which pieces of wood are obtained….” Thus, it is anticipated that the wood product class for the trees cut on the property would be sawnwood.

Step 2: Calculate the biomass carbon of the volume extracted by wood product type ty from within the Project boundary:

$$C_{XB,ty,l} = \frac{1}{A_i} * \sum_{j=1}^{S} (V_{ex,ty,j,I} * D_j * CF_j * 44/12)$$

$$C_{XB,ty,l} = \frac{1}{2{,}290} * (245.99 * 0.55 * 0.47 * 44/12)$$

$$C_{XB,ty,l} = \frac{1}{2{,}290} * 233.15$$

$$C_{XB,ty,l} = 0.102\ tCO2 - e\ ha^{-1}$$

Where:

[42] Markewitz, D., Davidson, E., Moutinho, P., & Nepstad, D. (2004). Nutrient loss and redistribution after forest clearing on a highly weathered soil in Amazonia. Ecological Applications, 14(sp4), 177-199. Available at https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/01-6016

[43] The mean C value plus standard deviation (7.8+5.2 = 13Mg ha^{-1}) was used as $C_{AB\ tree\ post,i}$ in the calculations below and in the accompanying MS-excel Yacumama ERR calcs.

[44] Long-lived wood products were calculated and then assessed for significance using T-SIG.

$C_{XB,ty,l}$	Mean stock of extracted biomass carbon by class of wood product ty from stratum *i*; t CO2-e ha-1
A_i	Total area of stratum *i*; ha.
$V_{ex,ty,j,I}$	Volume [45] of timber extracted from within stratum *i* (does not include slash left onsite) by species *j* and wood product class *ty*; m^3
D_j	Mean wood density of species *j*; t d.m.m^{-3}
CF_j	Carbon fraction of biomass for tree species *j*; t C t-1 d.m.
j	1, 2, 3, … S tree species
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)

Note: Because not all of the 7 commercial "species" listed in the harvest plan (Appendix B of the validated PD[21]) were actually identified to species, the Project choose to use the total overall volume for Vex,ty,j . Furthermore, since these 7 commercial "species" were not identified to species, we calculated a mean Dj. Densities were obtained from Brown (1997) [46] and Zane et al. (2009) [47]. If multiple values were provided among studies, a mean value was calculated. The mean of the 7 species densities resulted in a tree density of 0.55.

Step 3: Calculate the biomass carbon extracted that enters the wood products pool at the time of deforestation.

$$C_{WP,i} = \sum_{ty=s,w,oir,p,o} C_{XB,ty,i} * (1 - WW_{ty})$$

$$C_{WP,i} = 0.102 * (1 - 0.24)$$

$$C_{WP,i} = 0.08 \ \ tCO2e\ ha^{-1}$$

Where:

$C_{WP,i}$	Carbon stock entering the wood products pool from stratum *i*; t CO2-e ha^{-1}
$C_{XB,ty,i}$	Mean stock of extracted biomass carbon by class of wood product ty from stratum *i*; t CO2-e ha-1

[45] The value of 245.985m^3 is listed on pg 29 of the Yacumama Harvest Plan.

[46] Brown, S. (1997). Estimating biomass and biomass change of tropical forests: a primer (Vol. 134). Food & Agriculture Org..

[47] Zanne, A.E., Lopez-Gonzalez, G., Coomes, D.A., Ilic, J., Jansen, S., Lewis, S.L., Miller, R.B., Swenson, N.G., Wiemann, M.C., and Chave, J. 2009. Global wood density database. Dryad. Identifier: http://hdl.handle.net/10255/dryad.235.

WW_{ty}	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product *ty*; dimensionless
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
i	1, 2, 3, … M strata

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 [48]

$$C_{WP100,i} = C_{WP,i} - C_{WP,i} * \left(1 - SLF_p\right) * \left(1 - OF_p\right)$$

$$C_{WP100,i} = 0.08 - 0.08 * (1 - 0.20) * (1 - 0.84)$$

$$C_{WP100,i} = 0.08 - (0.08 * 0.8 * 0.16)$$

$$C_{WP100,i} = 0.067\ tCO2 - e\ ha^{-1}$$

Where:

$C_{WP100,i}$	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 CO2-e ha-1
$C_{WP,i}$	Carbon stock entering wood products pool at time of deforestation from stratum *i*; t CO2-e ha-1
SLF_{ty}	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product *ty*; dimensionless
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
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
i	1, 2, 3, … M strata

5.1.3.6.4 Loss of biomass attributable to fuel-wood collection

Since the property is privately owned, no harvest of standing tree biomass for fuelwood has occurred, has historically been allowed or will be allowed in the Project area under the Project scenario.

[48] Source data: Winjum, J.K., Brown, S. and Schlamadinger, B. 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. Forest Science 44: 272-284.

5.1.3.6.5 Avoided emissions from fertilizer use

Emissions from fertilizer use were conservatively excluded from the baseline scenario.

5.1.3.6.6 Avoided emissions from biomass burning

In the baseline scenario, land clearing would include piling and burning of all remaining above-ground woody biomass on the site after the valuable timber species are removed. Module E-BPB (VMD0013 v1.3) was used to calculate emissions due to biomass burning. A_{burn} was considered as half of $A_{planned}$ (See Section 3.2.1.1).

$$E_{biomassburn,i,t} = \sum_{g=1}^{G} \left(\left(\left(A_{burn,i,t} \times B_{i,t} \times COMF_i \times G_{g,i} \right) \times 10^{-3} \right) \times GWP_g \right)$$

$$E_{biomassburn,i,t} = 0 \ (for\ t = 2012\ and\ 2013)$$

$$E_{biomassburn,i,t} = 60 \ (for\ t = 2014\ to\ 2021)$$

$$E_{biomassburn,i,t} = 45 \ (for\ t = 2022\ and\ 2029)$$

$$E_{biomassburn,i,t} = 15 \ (for\ t = 2030)$$

$$E_{biomassburn,i,t} = 0 \ (for\ t = 2031\ to\ 2041)$$

Where:

$E_{biomassburn,i,t}$	Greenhouse gas emissions due to biomass burning in stratum *i* in year *t* of each GHG (CO_2, CH_4, N_2O) (t CO_2e)
$A_{burn,i,t}$	Area burnt for stratum *i* in year *t* (ha)
$B_{i,t}$	Average aboveground biomass stock before burning stratum *i*, year (t d.m. ha^{-1})
$COMF_i$	Combustion factor for stratum *i* (unitless)
$G_{g,i}$	Emission factor for stratum *i* for gas *g* (kg t^{-1} d.m. burnt)
GWP_g	Global warming potential for gas *g* (t CO_2/t gas g)
g	1, 2, 3 … G greenhouse gases including carbon dioxide [49], methane and nitrous oxide (unitless)
i	1, 2, 3, …M strata (unitless)
t	1, 2, 3, … t* time elapsed since the start of the Project activity (years)

[49] Carbon dioxide may be omitted where carbon dioxide emissions are calculated in an alternate module through stock change

5.1.3.6.7 Avoided emissions from transportation fuel use

Emissions from transportation fuel use are conservatively omitted in both the baseline and Project scenarios.

5.1.3.6.8 Total Carbon Stock Change in Baseline Scenario

Module BL-PL (VMD0006 v1.4) was used to calculate baseline carbon stock changes. The values of aboveground carbon (t CO_2e) before deforestation (forest values) were obtained from the plot network. Belowground carbon (t CO_2e) is a proportion of aboveground based on root to shoot ratios listed on VMD0001 v1.2. Above and belowground after deforestation (pasture values) were retrieved from literature as explained in Section 4.1.5. Total carbon stock changes in above ground tree biomass were calculated using equation 6 from BL-PL (VMD0006 v1.4).

$$\Delta C_{AB\ tree,i} = C_{AB\ tree\ bsl,i} - C_{AB\ tree\ post,i}$$

$$\Delta C_{AB\ tree,i} = 285.25\ t\ CO_2 - e\ ha^{-1} - 47.67\ t\ CO_2 - e\ ha^{-1}$$

$$\Delta C_{AB\ tree,i} = 237.59\ t\ CO_2 - e\ ha^{-1}$$

Total carbon stock changes in below ground tree biomass were calculated using equation 8 from BL-PL (VMD0006 v1.4).

$$\Delta C_{BB\ tree,i} = C_{BB\ tree\ bsl,i} - C_{BB\ tree\ post,i}$$

$$\Delta C_{BB\ tree,i} = 67.13\ t\ CO_2 - e\ ha^{-1} - 9.53\ t\ CO_2 - e\ ha^{-1}$$

$$\Delta C_{BB\ tree,i} = 57.59\ t\ CO_2 - e\ ha^{-1}$$

Where:

$\Delta C_{AB\ tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum *i*; t CO_2e ha^{-1}
$C_{AB\ tree\ bsl,i}$	Forest carbon stock in aboveground tree biomass in stratum *i*; t CO_2e ha^{-1}
$C_{AB\ tree\ post,i}$	Post-deforestation carbon stock in aboveground tree biomass in stratum *i*; t CO_2e ha^{-1}
$\Delta C_{BB\ tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum *i*; t CO_2e ha^{-1}
$C_{BB\ tree\ bsl,i}$	Forest carbon stock in belowground tree biomass in stratum *i*; t CO_2e ha^{-1}
$C_{BB\ tree\ post,i}$	Post-deforestation carbon stock in belowground tree biomass in stratum *i*; t CO_2e ha^{-1}

The sum of the baseline carbon stock changes in all pools at time t was calculated using equation 13 from BL-PL (VMD0006 v1.4).

$$\Delta C_{BSL,i,t} = AA_{planned,i,t} * \left(\Delta C_{AB\ tree,i} - \Delta C_{WP,i} + \Delta C_{ABnon-tree,i} + \Delta C_{LI,i}\right) +$$

$$\left(\sum_{t-10}^{t} AA_{planned,i,t}\right) * \left(\Delta C_{BB\ tree,i} + \Delta C_{BB\ non-tree,i} + \Delta C_{DW,i}\right) * \left(\frac{1}{10}\right) +$$

$$\left(\sum_{t-20}^{t} AA_{planned,i,t}\right) * \left(C_{WP100,i} + \Delta C_{SOC,i}\right) * \left(\frac{1}{20}\right)$$

Where:

$\Delta C_{BSL,i,t}$	Sum of the baseline carbon stock change in all terrestrial pools in stratum *I* in year *t*; t CO_2e ha^{-1}
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum *i* in year *t*; ha
$C_{WP100,i}$	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^{-1}
$\Delta C_{AB,tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum *i*; t CO_2e ha^{-1}
$\Delta C_{BB,tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum *i*; t CO_2e ha^{-1}
$C_{AB,non-tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum *i*; t CO_2e ha^{-1}
$\Delta C_{BB,non-tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum *i*; t CO_2e ha^{-1}
$\Delta C_{WP,i}$	Baseline carbon stock change in wood products in stratum *i*; t CO_2e ha^{-1}
$\Delta C_{DW,i}$	Baseline carbon stock change in dead wood in stratum *i*; t CO_2e ha^{-1}
$\Delta C_{LI,i}$	Baseline carbon stock change in litter in stratum *i*; t CO_2e ha^{-1}
$\Delta C_{SOC,i}$	Baseline carbon stock change in soil organic carbon in stratum *i*; t CO_2e ha^{-1}
i	1, 2, 3, … M strata (dimensionless)
t	1, 2, 3, … $t*$ years elapsed since the Project start of the Project activity

The baseline net GHG emissions was determined using equation 1 from BL-PL (VMD0006 v1.4) for APWD-REDD Project activities (terrestrial carbon pools):

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

Where:

$\Delta C_{BSL,planned}$	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 change in all pools in the baseline stratum *i* in year *t*; c
$GHG_{BSL-E,i,t}$	Greenhouse gas emissions as a result of 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

5.2 Project Emissions

The net greenhouse gas emissions under the Project scenario will be calculated using the following equation 1 from VCS module M-REDD (VMD0015 v2.3).

$$\Delta C_{WPS-REDD} = \sum_{t-1}^{t} \sum_{i=1}^{m} (\Delta C_{P,DefPA,i,t} + \Delta C_{P,Deg,I,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t})$$

$$\Delta C_{WPS-REDD} = 0$$

Where:

$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD Project scenario up to year $t*$; t CO2-e
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the Project area in the Project case in stratum *i* at time *t*; t CO_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* at time *t*; t CO_2e
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the Project area in the Project case in stratum *i* at time *t*; t CO_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* at time *t*; t CO_2e

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

Under the Project scenario there were no planned/predicted activities that caused or changed carbon stocks and/or greenhouse gas emissions.

Specifically:

1. No deforestation or harvest of any type was allowed or will be conducted under Project scenario. Thus $\Delta C_{P,DefPA,i,t}$ = 0

2. No collection of fuel wood for direct biomass burning and/or charcoal production was allowed under the Project scenario. In addition, the Project was specifically designed to prevent timber poaching and any degradation from timber poaching. Thus $\Delta C_{P,Deg,I,t}$ = 0

3. No major disturbances (e.g. wildfire, geologic events, pest and disease outbreaks, extreme weather) occurred during the first 10 years of the Project. Yacumama is in the upper Peruvian Amazon Basin, defined as the region above the confluence of the Rio Ucayali and Rio Marañon (Figure 1.8-2), and is affected by yearly flooding events that temporarily inundate large tracts of tropical forest. Annual flooding is a natural part of the system and a key component of local ecosystem processes (Kvist and Nebel 2001) [50]. Flood waters originating in the Andes Mountains carry large sediment loads that deposit essential plant nutrients as the flood waters recede. Thus $\Delta C_{P,DistPA,i,t}$ = 0

4. Because harvest plan was not implemented, and Project activities included restricting those fuel wood and timber poaching, GHG emissions involved in these activities are not anticipated. Thus $GHG_{P-E,i,t}$ = 0.

5.2.1 2014 to 2022 Forest Cover Change

Besides avoiding the implementation of the harvest plan, deforestation has been monitored following VCS module M-REDD (VMD0015 v2.3) and the results of such monitoring are documented below. Remotely sensed data covered the entire Project area for the beginning of the monitoring period and thereafter every 5 years (2014 and 2019). Data is also available for 2023, the year in which monitoring and verification occurred. Source of satellite imagery was Landsat 8, Sentinel-2 and PlanetScope.

The method selected to detect and map deforestation was supervised landcover classification with Random Forest (RF) algorithm. The same method was used for the entire monitoring period (2014 to 2022) as effectiveness has been demonstrated by previous research [51]. Supervised classification involves four general steps: 1) collecting training samples representative of the different landcover classes; 2) training a classifier algorithm to develop relationships between spectral signatures and landcover classes; 3) implementing the classification algorithm on the target imagery; 4) performing an

[50] Kvist, L.P., and G. Nebel. 2001. A review of Peruvian flood plain forests: ecosystems, inhabitants and resource use. Forest Ecology and Management 150: 3-26.

[51] Abdi, A. M. (2020). Land cover and land use classification performance of machine learning algorithms in a boreal landscape using Sentinel-2 data. *GIScience & Remote Sensing*, *57*(1), 1–20.

accuracy assessment of the classification [52]. Excluding sample polygon collection, the classification process was performed using Google Earth Engine (GEE).

The RF algorithm was able to effectively distinguish between water, non-forest and forest classes as confirmed by the classification accuracy assessment. Map accuracy for the classification of forest/non-forest was beyond the minimum of 90% established by the M-REDD module. Project Forest Cover Map was updated for the monitoring period. Project area has only one forest class, so no stratification is necessary. The 2012 Benchmark Map, created to support the validated PD[21], was updated to show the location of forest land within the Project area for the years 2014, 2019 and 2023 (Appendix 6.2). The area of each landcover class was calculated and a summary of changes is available in Table 5.2-1. Further information on methodological procedures is available in separate document[24].

Table 5.2-1 Summary of changes in forested area between 2014, 2019 and 2023 within the Project area.

Landcover class	Area in hectares			
	2014	2019	2023	Change in Landcover
Forest	2805.60	2912.25	2920.22	115
Non-Forest	96.34	9.94	24.63	-72
Water	97.73	77.48	53.94	-44
TOTAL	**3,000**	**3,000**	**3,000**	

Therefore, area of recorded deforestation in the Project area is

$$\Delta C_{P,DefPA,i,t} = 0$$

Forest degradation through extraction of trees for illegal timber or fuelwood and charcoal was also monitored following the VCS module M-REDD (VMD0015 v2.3). The first step in addressing forest degradation through wood extraction was to complete a participatory rural appraisal (PRA) of the communities inside and surrounding the Project area to determine if there was the potential for illegal extraction of trees to occur. The first assessment demonstrated no potential pressure for these activities then degradation ($\Delta C_{P,Deg,i,t}$) was assumed to be zero and no monitoring was needed. The PRA was repeated during the remeasurement of the monitoring plots. There were two separate time where PRA was conducted, one with the primary stakeholders at the Yacumama lodge, and another with members of the Puerto Miguel village. It was asked the following questions:

1. Is there illegal harvesting of trees in the Project area?

2. Are trees harvested for charcoal production?

3. Are trees harvested for fuel?

[52] Stehman, S. V, & Foody, G. M. (2019). Key issues in rigorous accuracy assessment of land cover products. *Remote Sensing of Environment*, *231*, 111199. https://doi.org/https://doi.org/10.1016/j.rse.2019.05.018

All in attendance agreed that no illegal harvest was occurring for either fuel and/or charcoal production. It was pointed out again that any illegal harvesting would happen at the riverbanks during summer, which would be easily noticed. Based upon the results of the two different PRA interviews, illegal harvesting for building, charcoal and/or fuel wood was not detected in the Project area. Where the PRA or the limited sampling indicates no degradation occurring:

$$\Delta C_{P,Deg,i,t} = 0$$

5.3 Leakage Emissions

5.3.1 Activity Shifting Leakage (LK-ASP)

Activity shifting leakage was assessed using module VMD0009 v1.3 "Estimation of emissions from activity shifting for avoided planned deforestation (LK-ASP)". The deforestation agent was determined to be the current landowner based upon the approved Operativo Anual Para Permiso Forestal De Propiedad Privada 2009 (Annual operating plan for permission to timber private property 2009) (Appendix B of the validated PD[21]). The Project proponent controls 1 additional property within Peru (Figure 3 and Table 4.2) [53] where the lodge structures are located. There was no history of deforestation or greenhouse gas emissions within the previous 5 years of the Project start date and no verifiable plans for deforestation for controlled and future controlled lands existed since the Project start date.

Using equation 1 from LK-ASP (VMD0009 v1.3) GHG emissions from activity shifting leakage are calculated as:

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

$$\Delta C_{LK-AS,planned} = (0 * 295.18) + 0$$

$$\Delta C_{LK-AS,planned} = 0$$

Where:

$\Delta C_{LK-AS,planned}$	Net greenhouse gas emissions due to activity shifting leakage for Projects preventing planned deforestation; t CO_2e
$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum *i* at time *t*; ha
$\Delta C_{BSL,i}$	Net carbon stock changes in all pools in baseline stratum *i*;
$GHG_{LK,E,i,t}$	Greenhouse gas emissions as a result of leakage of avoided deforestation activities in stratum *i* in year *t*; t CO_2e

[53] The parcel identified as "Yacumama" is not part of the project area and is the parcel that the remaining lodge facilities occupy.

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

Step1: Determination of the Baseline Rate of Forest Clearance by the Deforestation Agent

Option 1.3b: Estimations of forest clearance are calculated using equation 4 from LK-ASP (VMD0009 v1.3) as:

$$NewR_{i,t} = (\%D_{planned,i,t,OP} * A_{planned,i,OP})$$

Where:

$NewR_{i,t}$	New calculated forest clearance in stratum *i* in year *t* by the baseline agent of the planned deforestation where no leakage is occurring (ha)
$\%D_{planned,i,t,OP}$	Projected annual proportion of land that will be deforested outside the Project boundary in stratum *i* in year *t* (percent)
$A_{planned,i,OP}$	Total area of planned deforestation outside the Project boundary over the baseline period for stratum *i* (ha)
i	1, 2, 3, … M strata
t	1, 2, 3, … t* years elapsed since the start of the REDD Project activity

Step 2: Estimate new Projection of forest clearance by the baseline agent of deforestation (using equation 5 in LK-ASP/VMD0009 v1.3) with Project implementation if no leakage is occurring.

$$NewR_{i,t} = WoPR_{i,t} - (\%D_{planned,i,t} * A_{planned,i})$$

Where:

$NewR_{i,t}$	New calculated forest clearance in stratum *i* in year *t* by the baseline agent of the planned deforestation where no leakage is occurring (ha)
$WoPR_{i,t}$	Deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t* in the absence of the Project (ha)
$\%D_{planned,i,t,OP}$	Projected annual proportion of land that will be deforested outside the Project boundary in stratum *i* in year *t* (%)
$A_{planned,i,OP}$	Total area of planned deforestation outside the Project boundary over the baseline period for stratum *i* (ha)
i	1, 2, 3, … M strata
t	1, 2, 3, … t* years elapsed since the start of the REDD Project activity

Step 3: Monitor all areas deforested by baseline agent of deforestation through the years in which planned deforestation was forecast to occur. Area of activity shifting is calculated using equation 6 in LK-ASP (VMD0009 v1.3):

All areas owned by the landowner in Peru were monitored for deforestation using remote sensing data. As illustrated on the Random Forest classified imageries from 2013 and 2023 [54], the landowner has not materially changed the Project area as a result of the Project. Within the Project boundary, no intact forest was cleared for agriculture production.

$$LKA_{planned,i,t} = A_{defLK,i,t} - NewR_{i,t}$$

Where:

$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum *i* at time *t*; ha
$A_{defLK,i,t}$	The total area of monitored deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t*
$NewR_{i,t}$	New calculated forest clearance in stratum *i* in year *t* by the baseline agent of the planned deforestation where no leakage is occurring (ha)
i	1, 2, 3, … M strata
t	1, 2, 3, … t* years elapsed since the start of the REDD Project activity

Step 4: Monitor greenhouse gas emissions (e.g. biomass burning and nitrous oxide emissions) outside the Project area boundary by baseline agent of deforestation using equation 7 in LK-ASP

$$GHG_{LK,E,i,t} = E_{biomassburn,i,t} + N_2 0_{direct-N,i,t}$$

Where:

$GHG_{LK,E,i,t}$	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum *i* in year *t* (t CO2e).
$E_{biomassburn,i,t}$	Non-CO2 emissions due to biomass burning in stratum *i* in year *t* (t CO2e)
$N_2 0_{direct-N,i,t}$	Direct N2O emission as a result of nitrogen application on the alternative land use in stratum *i* in year *t* (t CO2e)
i	1, 2, 3, … M strata
t	1, 2, 3, … t* years elapsed since the start of the REDD Project activity

[54] See the accompanying PDF Yacumama_RF_Modeling_Report

5.3.1.1 2014 to 2022 Forest Cover

The method selected to detect and map deforestation was already described in the Monitoring Plan and Project emissions sections. A map showing the location of forest land within the lodge parcel was created for the years 2014, 2019 and 2023 (Appendix 6.3). The area of each landcover class was calculated and a summary of changes is available in Table 5.3-1.

Table 5.3-1 Summary of changes in forested area between 2014 and 2022 within the lodge parcel.

Landcover class	Area in hectares			
	2014	2019	2023	Change in Landcover
Forest	182.01	198.39	199.01	17
Non-Forest	15.29	0.78	0.94	-14.35
Water	4.60	2.73	1.88	-2.72
TOTAL	**202**	**202**	**202**	

No biomass burning, deforestation or degradation were detected during this monitoring period. Thus,

$$A_{defLK,i,t} = 0$$

5.3.2 Market-Effects Leakage through Decreased Timber Harvest

Market Effects leakage (ΔC_{LK-ME}) was assessed using module VMD0011 v1.2 "Estimation of Emissions from Market Effects (LK-ME). The volume of timber Projected to be extracted for commercial markets yearly for each stratum ($V_{BSL,EX,i,t}$) under the baseline scenario was calculated by multiplying the volume (3.858 m^3) of merchantable trees per hectare (3.858 m^3 obtained from the approved Yacumama harvest plan Appendix B of the validated PD[21], page 29, Volume Table summarization) by the area planned of forest loss per year..

The 7 commercial tree species listed in the approved Yacumama harvest plan were used to determine the "mean wood density of commercially harvested species" in the Project area (Table 5.3-1). Densities were obtained from Brown (1997) [55] and Zane et al. (2009) [56]. If multiple values were provided among studies, a mean value was calculated. The mean of the 7 species densities resulted in a tree density of 0.55 (i.e. D_{MN}).

[55] Brown, S. 1997. Estimating biomass and biomass change of tropical forests: a primer (Vol. 134). Food & Agriculture Org..

[56] Zanne, A.E., Lopez-Gonzalez, G., Coomes, D.A., Ilic, J., Jansen, S., Lewis, S.L., Miller, R.B., Swenson, N.G., Wiemann, M.C., and Chave, J. 2009. Global wood density database. Dryad. Identifier: http://hdl.handle.net/10255/dryad.235.

Table 5.3-2 Seven commercial species listed in the approved Yacumama deforestation plan and their wood densities. Wood densities were obtained from Brown (1997) [57] and Zane et al. (2009) [58].

Common Name	Scientific Name	Density (t dry mass m^{-3} green volume)	Notes
Moena	*Aniba sp.*	0.54	Used figures for *Aniba amazonica*
Lagarto caspi	*Calophyllum brasiliense*	0.53	
Andiroba	*Carapa guianensis*	0.52	
Almendro	*Caryocar macrocarpon*	0.65	*C. glabrum* is synonymous
Shiringa	*Hevea guianensis*	0.53	Used figure for *Hevea indet* a closely related species. Some authorities do not recognize as a separate species.
Mari-mari	*Hymenolobium sp.*	0.58	Fabaceae level mean
Quillosisa	*Vochysia sp.*	0.49	Quillosisa is recognized *Vochysia lanceoloata* by ITTO (http://www.tropicaltimber.info/)
	Mean Density	**0.55**	

Yearly carbon emission due to displaced timber harvests in the baseline scenario was calculated using the equation 5 from LK-ME (VMD0011 v1.1) in the following manner:

$$C_{BSL,XBT,I,t} = \left(\left(V_{BSL,XE,it} * D_{MN} * CF\right) + \left(V_{BSL,XE,it} * LDF\right) + \left(V_{BSL,XE,it} * LIF\right)\right) * 44/12$$

Where:

$C_{BSL,XBT,I,t}$	Carbon emission due to timber harvests in the baseline scenario in stratum *i* at time *t*; t CO_2e
$V_{BSL,XE,it}$	Volume of timber Projected to be extracted from within the Project boundary during the baseline in stratum *i* at time *t*; m^3

[57] Brown, S. 1997. Estimating biomass and biomass change of tropical forests: a primer (Vol. 134). Food & Agriculture Org..

[58] Zanne, A.E., Lopez-Gonzalez, G., Coomes, D.A., Ilic, J., Jansen, S., Lewis, S.L., Miller, R.B., Swenson, N.G., Wiemann, M.C., and Chave, J. 2009. Global wood density database. Dryad. Identifier: http://hdl.handle.net/10255/dryad.235.

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 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)
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 start of the REDD Project activity

PMP_i is defined as the merchantable biomass as a proportion of the total aboveground tree biomass in stratum *i* at time t in the Project area. PMLFT is defined as the proportion of total biomass that is merchantable for each forest type in the Project area. Because there is a single strata and forest type in the Project area (i.e. they are exactly the same) $PMP_i = PML_{FT}$. Thus, PML_{FT} is equal (± 15%) to PMP_i; therefore LF_{ME} = 0.4.

Since there was only one strata, the summed carbon emission due to yearly timber harvests in the baseline case potentially displaced through implementation is $AL_{T,i}$ =4,370. LK_{MAF} was not applied since no leakage management activities were established within areas under the control of the Project proponent in order to minimize the displacement of land use activities to areas outside the Project area. Thus, annual market effects leakage through decreased timber harvest was calculated using equation 2, 3 and 4 of LK-ME (VMD0011 v1.2):

$$LK_{MarketEffects,timber} = \sum (LF_{ME} * LK_{MAF} * AL_{T,i})$$

Where:

$LK_{MarketEffects,timber}$	Total GHG emission due to market-effects leakage through decreased timber harvest; t CO_2e
LF_{ME}	Leakage factor to market-effects calculations (dimensionless)
LK_{MAF}	Leakage management adjustment factor (dimensionless)
$AL_{T,i}$	Summed emissions from timber harvest in stratum *i* in the baseline case potentially displaced through implementation of the Project; t CO_2e
i	1, 2, 3, … M strata (dimensionless)

$$LK_{MAF} = 1 - \left({}^{PRODMB_{LMA,t}} \middle/ {}_{PRODMB_{BL,t}} \right)$$

Where:

LK_{MAF}	Leakage management adjustment factor (dimensionless)
$PRODMB_{LMA,t}$	Production biomass in commercial species that is merchantable in year *t* in leakage management areas (t per year)
$PRODMB_{BL,t}$	Production biomass in commercial species that is merchantable in year *t* in the baseline case (t per year)
t	1, 2, 3, … $t*$ time elapsed since the start of the Project activity (years)

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

Where:

$AL_{T,i}$	Summed emissions from timber harvest in stratum *i* in the baseline case potentially displaced through implementation of the Project; t CO_2e
$C_{BSL,XBT,i,t}$	Carbon emission due to displaced timber harvests in the baseline scenario in stratum *i* in year *t*; t CO_2e
i	1, 2, 3, … M strata (dimensionless)
t	*1, 2, 3, … t* time elapsed since the Project start of the REDD Project activity (years)*

5.4 GHG Emission Reductions and Carbon Dioxide Removals

Prior to final summary, each of the GHG emissions and carbon pools were tested for significance using the T-SIG module [59]. Table 5.4-1 summarizes the carbon pools measured and/or calculated in the baseline and Project scenarios for this monitoring period (2014 - 2022). These pools are above ground tree biomass, below ground tree biomass, long lived wood products, market leakage and activity shifting leakage. Based upon T-SIG, long lived wood products can be treated as de-minimis and thus are excluded from further analyses.

[59] See the accompanying MS-excell document Yacumama ERR calcs.

Table 5.4-1 Summary of the relative contribution of carbon pools and GHG emission sources calculated using T-SIG.

Carbon Pool/GHG Emission Source	Average GHG Emissions (t CO2e/ha)	Total GHG Emissions (t CO2e)	Relative Contribution (%)
Above-ground Tree Biomass (ΔC_{AB})	26,921	242,291	82
Below-ground Tree Biomass (ΔC_{BB})	5,331	47,980	16
Long Lived Wood Products (HWP_{Stored})	0	-1	0
Long Lived Wood Products ($HWP_{Decomposed}$)	0	0	0
Activity Shifting Leakage (ASP)	0	0	0
Market-effects Leakage (ME)	717	6,452	2
Total	**5,495**	**296,722**	**100**

The total net GHG emissions reductions of the REDD Project activity were calculated following Section 8.4.2 of the VM0007 v1.7.

$$NER_{REDD} = \Delta C_{BSL-REDD} - \Delta C_{WPS-REDD} - \Delta C_{LK-REDD}$$

$$\Delta C_{BSL-REDD} = \Delta C_{BSL,planned}$$

$$\Delta C_{LK-REDD} = \Delta C_{LK-AS,planned+} \Delta C_{LK-ME}$$

Where:

NER_{REDD}	Total net GHG emission reductions of the REDD Project activity up to year $t*$ (t CO_2e)
$\Delta C_{BSL-REDD}$	Net GHG emissions in the REDD baseline scenario up to year $t*$ (t CO_2e)
$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD Project scenario up to year $t*$ - from Module *M-REDD* (t CO_2e)
$\Delta C_{LK-REDD}$	Net GHG emissions due to leakage from the REDD Project activity up to year $t*$ (t CO_2e)
$\Delta C_{BSL,planned}$	Net GHG emissions in the baseline scenario from planned deforestation up to year $t*$- from Module *BL-PL* (t CO_2e)

$\Delta C_{LK-AS,planned}$	Net GHG emissions due to activity shifting leakage for Projects preventing planned deforestation to year $t*$ - from Module LK-*ASP* (t CO_2e)
ΔC_{LK-ME}	Net GHG emissions due to markets-effects leakage up to year $t*$ - from Module *LK-ME* (t CO_2e)

Table 5.4-2 Requested information for Projects required to assess permanence risk.

State the non-permanence risk rating (%)	24
Has the non-permanence risk report been attached as either an appendix or a separate document?	☒ Yes ☒ No
For ARR and IFM Projects with harvesting, state, in tCO_2e, the Long-term Average (LTA).	Not applicable
Has the LTA been updated based on monitored data, if applicable?	Not applicable
State, in tCO_2e, the expected total GHG benefit to date.	295,730[60]
If a loss occurred (including a loss event or reversal), state the amount of tCO_2e lost:	No loss event occurred since Project start date

The net GHG emissions for planned deforestation in the Project scenario, before reductions for a risk buffer, are conservatively estimated at 295,730 t CO_2e for this monitoring period (2014-2022) (Table 5.4-3). The overall Project risk buffer from planned deforestation was obtained from the analysis performed using AFOLU Non-Permanence Risk Tool v4.2[61].

The number of Verified Carbon Units (VCUs) for the crediting period was estimated using equation 18 of VM0007 v1.7.

$$\mathrm{VCU_t} = \left(\mathrm{Adjusted\_NER_{REDD+,t_2}} - \mathrm{Adjusted\_NER_{REDD+,t_1}}\right) - \mathrm{Buffer_{Total}}$$

Where:

VCU_t	Number of Verified Carbon Units for the monitoring period $t = t_2 - t_1$
$Adjusted\_NER_{REDD+,t_2}$	Total net GHG emission reductions in the REDD+ Project activity up to year t_2 and adjusted to account for uncertainty (t CO_2e)
$Adjusted\_NER_{REDD+,t_1}$	Total net GHG emission reductions in the REDD+ Project activity up to year t_1 and adjusted to account for uncertainty (t CO_2e)
$Buffer_{Total}$	Total permanence risk buffer withholding (t CO_2e)

[60] Value refers to the 2014-2022 monitoring period before buffer deduction (GHG benefit to date = Baseline – Project – Leakage)

[61] See accompanying MS-word document VCS Non-Permanence Risk Report Project1133

The precision of uncertainty met the allowable level set by the VM0007 v1.7 of +/- 15% of NER_{REDD} at 90% confidence level, as indicated on Section 4.1.3. Therefore, no deduction was necessary.

$$\mathrm{Adjusted\_NER}_{\mathrm{REDD+}} = NER_{REDD}$$

Table 5.4-3 Ex-post GHG Emissions for the baseline, Project, and total VCU issuance after deductions for the risk buffer.

Vintage period	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Buffer pool allocation (tCO_2e)	Reductions VCUs (tCO_2e)	Removals VCUs (tCO_2e)	Total VCU issuance (tCO_2e)
01-Jan-2014 to 31-Dec-2014	32,295	0	738	7,751	23,807	0	23,807
01-Jan-2015 to 31-Dec-2015	32,858	0	738	7,886	24,235	0	24,235
01-Jan-2016 to 31-Dec-2016	33,421	0	738	8,021	24,663	0	24,663
01-Jan-2017 to 31-Dec-2017	33,985	0	738	8,156	25,091	0	25,091
01-Jan-2018 to 31-Dec-2018	34,548	0	738	8,291	25,519	0	25,519
01-Jan-2019 to 31-Dec-2019	35,111	0	738	8,427	25,946	0	25,946
01-Jan-2020 to 31-Dec-2020	35,674	0	738	8,562	26,374	0	26,374
01-Jan-2021 to 31-Dec-2021	36,237	0	738	8,697	26,802	0	26,802
01-Jan-2022 to 31-Dec-2022	28,053	0	551	6,733	20,770	0	20,770
Total	**302,182**	**0**	**6,452**	**72,524**	**223,206**	**0**	**223,206**

Table 5.4-4 Percent difference between the estimated ex-ante GHG emission reductions and carbon dioxide removals and the achieved reductions and removals for the monitoring period.

Vintage period	Ex-ante estimated reductions/ removals (tCO2e)	Achieved reductions/ removals (tCO2e)	Percent difference (%)	Explanation for the difference
01-Jan-2014 to 31-Dec-2014	31,558	31,558	0	
01-Jan-2015 to 31-Dec-2015	32,121	32,121	0	
01-Jan-2016 to 31-Dec-2016	32,684	32,684	0	
01-Jan-2017 to 31-Dec-2017	33,247	33,247	0	
01-Jan-2018 to 31-Dec-2018	33,810	33,810	0	
01-Jan-2019 to 31-Dec-2019	34,373	34,373	0	
01-Jan-2020 to 31-Dec-2020	34,936	34,936	0	
01-Jan-2021 to 31-Dec-2021	35,499	35,499	0	
01-Jan-2022 to 31-Dec-2022	27,502	27,502	0	
Total	295,730	295,730		

6 APPENDIX

6.1 Benchmark Landcover Map

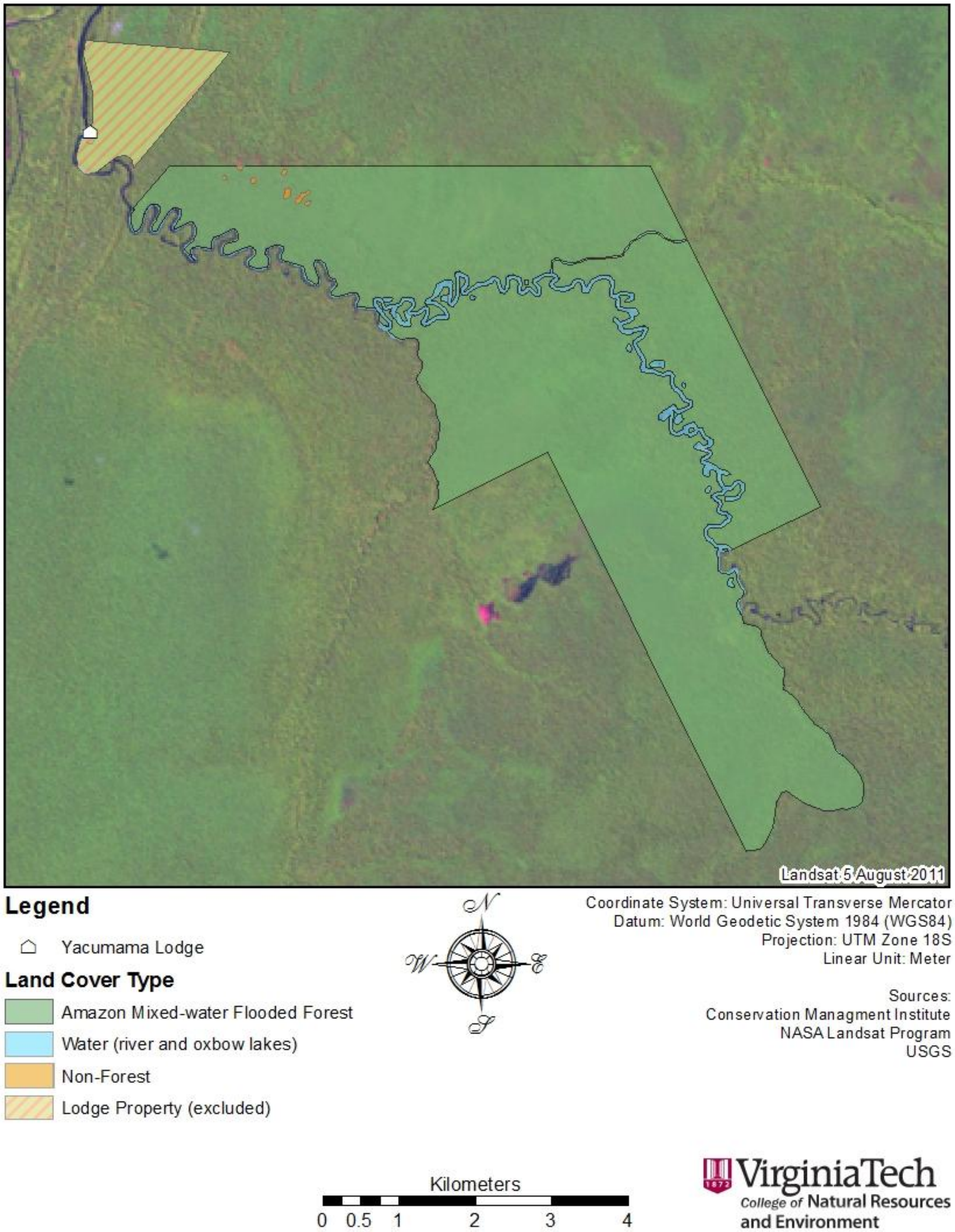

Figure 6.1-1 Landcover classification for the Project area in 2011.

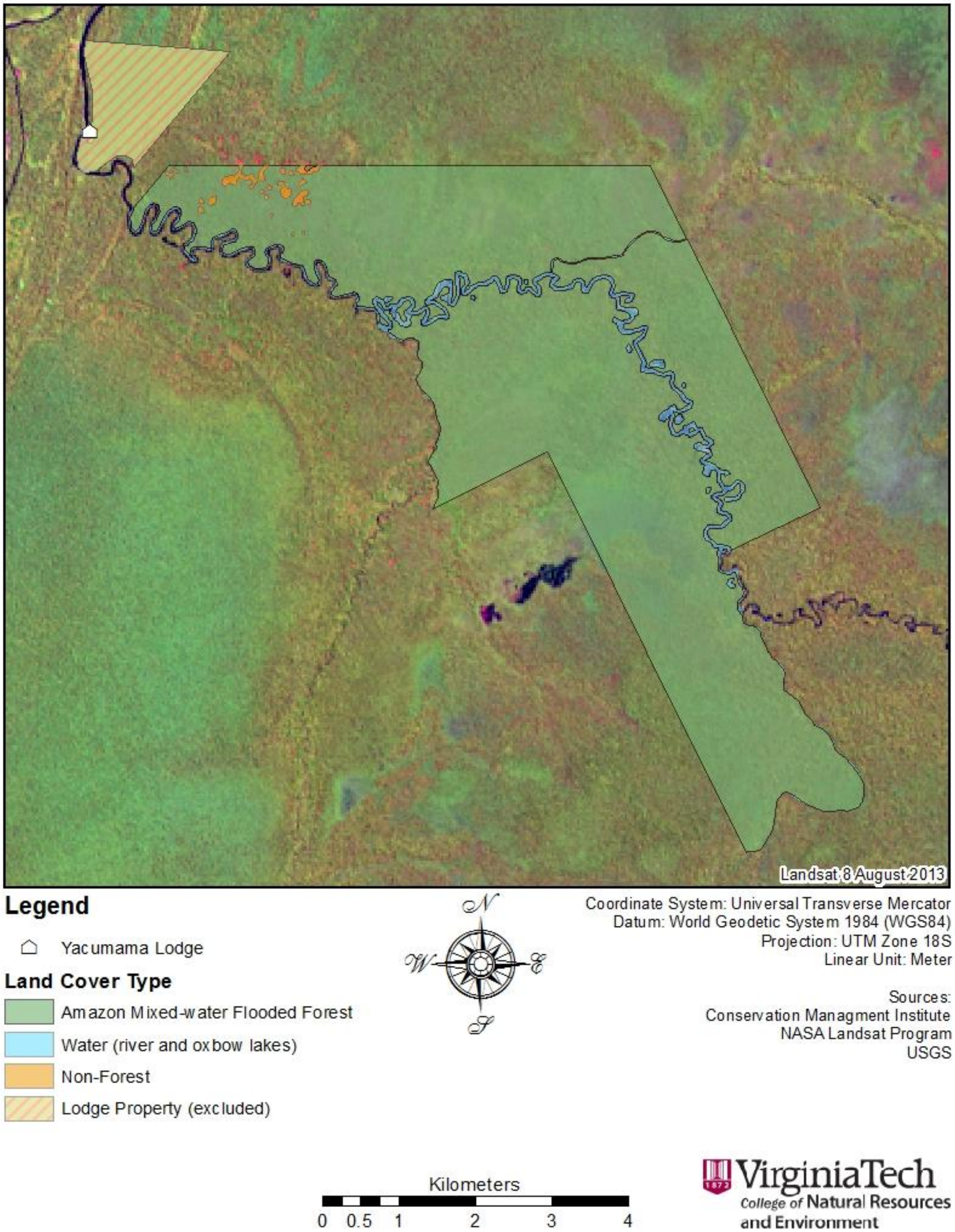

Figure 6.1-2 Landcover classification for the Project area in 2013.

6.2 2014 to 2022 Landcover Change

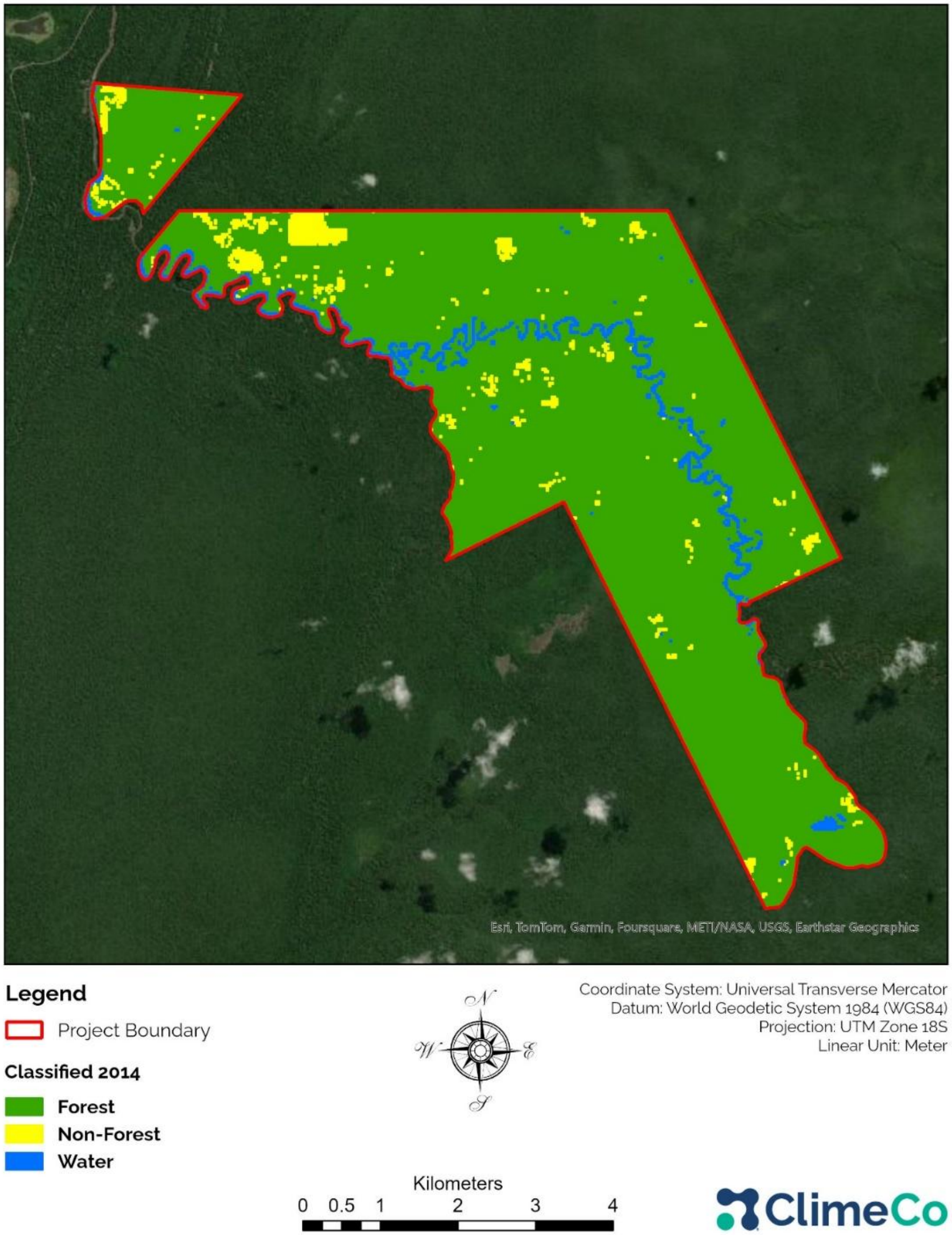

Figure 6.2-1 Random Forest (RF) classified Landsat-8 imagery showing the distribution of the predicted landcover classes for Yacumama Project area in 2014.

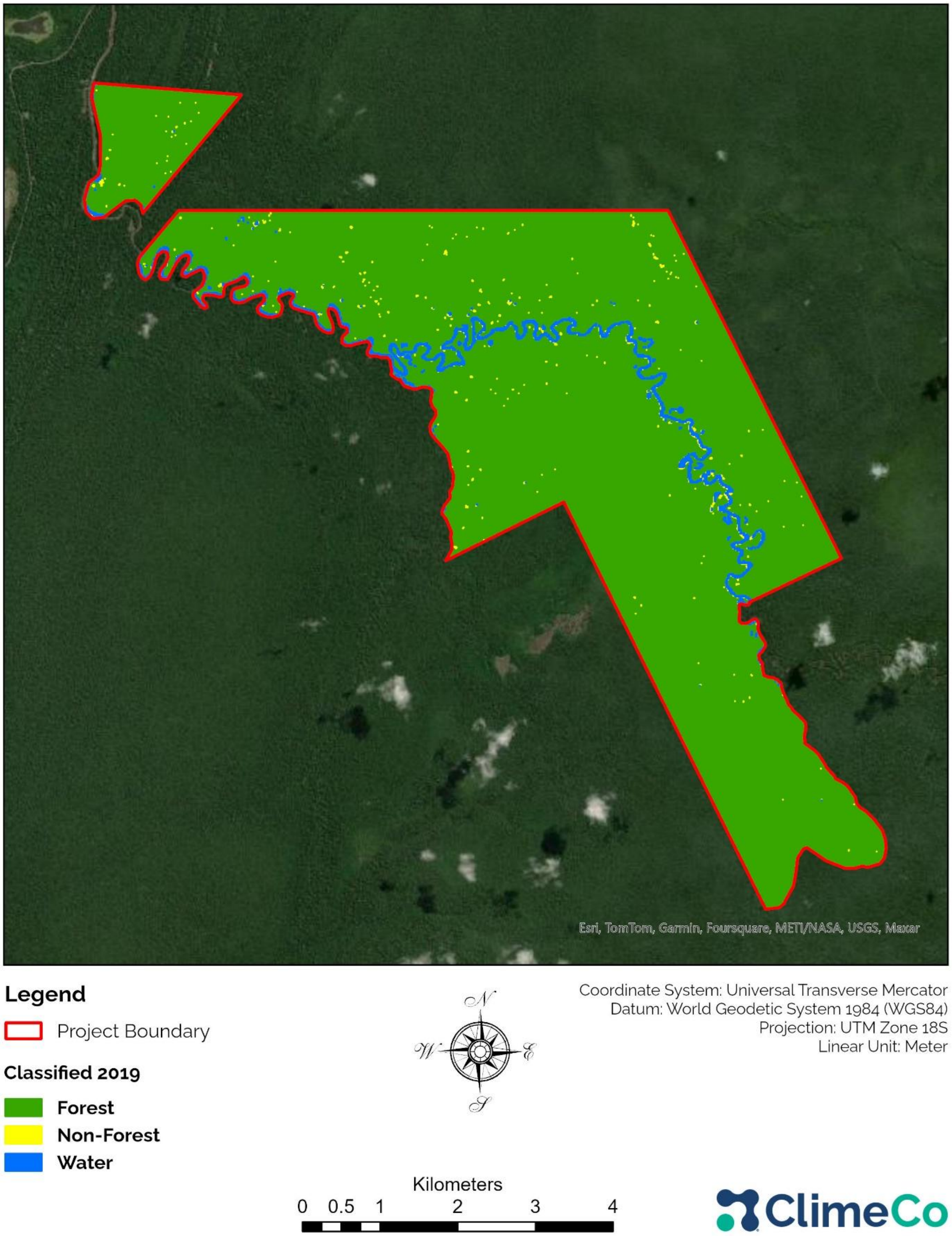

Figure 6.2-2 Random Forest (RF) classified Landsat-8 imagery showing the distribution of the predicted landcover classes for Yacumama Project area in 2019.

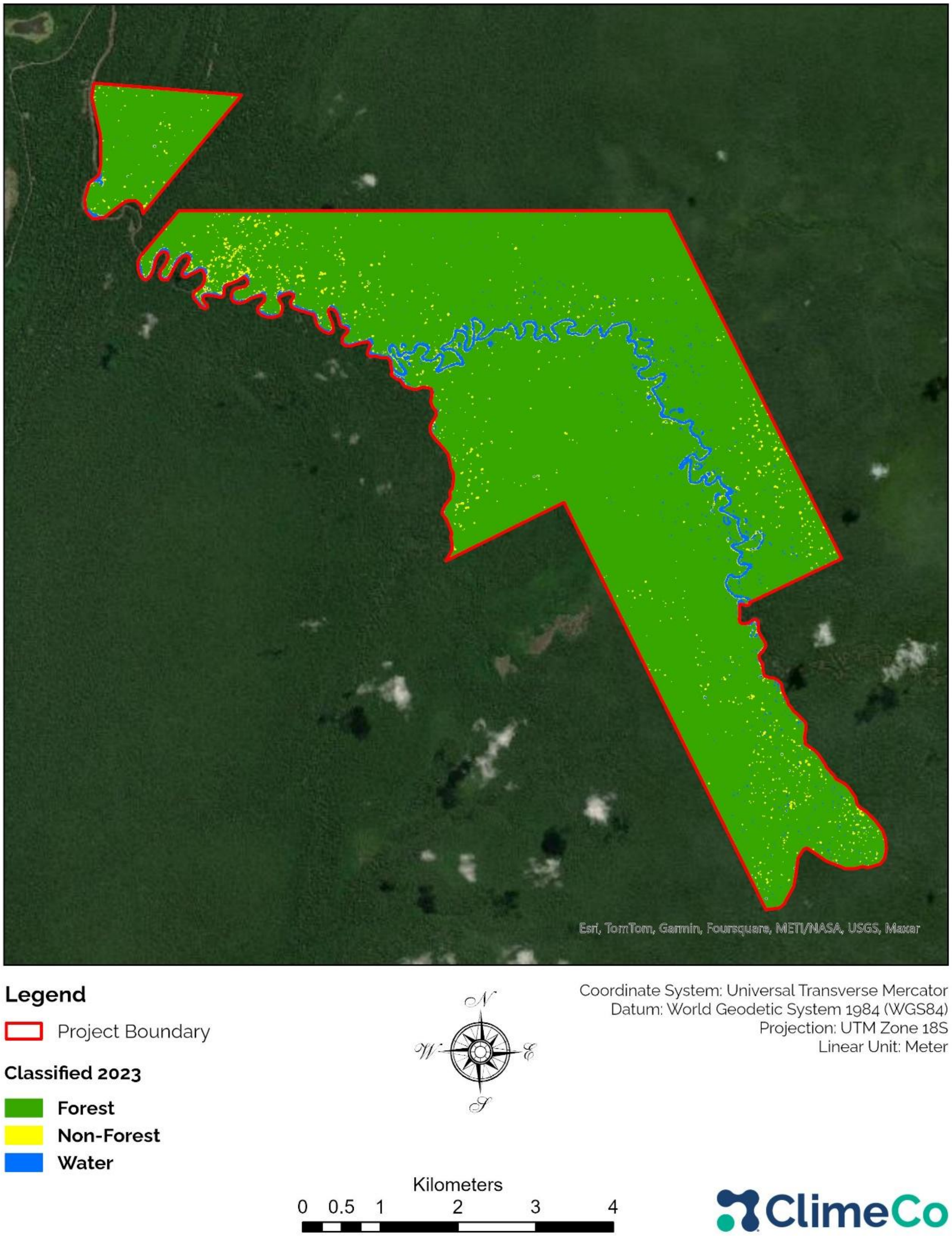

Figure 6.2-3 Random Forest (RF) classified PlanetScope imagery showing the distribution of the predicted landcover classes for Yacumama Project area. This classification had an overall accuracy of 0.97, with a Kappa coefficient of 0.95.

6.3 Rare, Threatened, and Endangered species

The following table provides information on the potential species that could be found in the Yacumama Project area and adjacent habitats to the property utilizing the IUCN Red List of Threatened Species mapping [62].

Scientific Name	Common Name	Species Classification	IUCN Redlist Category	Habitat
Diospyros dolmen	Dolmen Wood	Tree	Endangered	Primary forests on sandy laterite, white clay, and/or well-drained soils, at 130-200 m elevation
Orthemis faaseni	Odonata species	Insect	Endangered	Streams within primary forest subcanopy
Inia geoffrensis	Amazon river dolphin	Mammal	Endangered	Rivers and flooded forests in the high-water seasons
Sotalia fluviatilis	Tucuxi (river dolphin)	Mammal	Endangered	All three types of water in the Amazon basin: white water, clear water, and black water
Otocinclus cocama	Zebra oto	Fish	Endangered	Medium size creek, with clear water and lots of marginal vegetation, or small ponds (cochas)
Guatteria revoluta	Guatteria revoluta	Tree	Endangered	Non-inundated forest, on sandy to clayey soil at elevations of 100-150 m
Duguetia nitida	Duguetia nitida	Tree	Endangered	Non-inundated forests at elevations from 120-150 m
Ateles belzebuth	White-bellied spider monkey	Mammal	Endangered	High primary forest, generally associated with clay soil forests; visit flooded forests when fruit productivity is high
Ocotea minutiflora	Ocotea minutiflora	Tree	Endangered	Lowland forests between 100-110 m altitude
Crax globulosa	Wattled curassow	Bird	Endangered	Lowland, riverine, humid forest and várzea
Bolitoglossa altamazonica	Nauta salamander	Amphibians	Near Threatened	Primary terra firme forest and white-sand forest
Speothos venaticus	Bush dog	Mammal	Near Threatened	Habitat generalist, occurring generally near water sources

[62] IUCN Red List of Threatened Species

Scientific Name	Common Name	Species Classification	IUCN Redlist Category	Habitat
Atelocynus microtis	Short-eared dog	Mammal	Near Threatened	Undisturbed rainforest in the Amazonian lowlands
Leontocebus illigeri	Illiger's saddle-back tamarin	Mammal	Near Threatened	Amazonian lowland forest, both in tierra firme forest and in seasonally flooded forest
Vampyrum spectrum	Spectral bat	Mammal	Near Threatened	Lowland, evergreen forest, and occasionally in cloud or deciduous forest or swampy areas
Leopardus wiedii	Margay	Mammal	Near Threatened	Continuous forest habitat and tree cover, ranging from continuous forest to small forest fragments in savanna ecosystems, both evergreen and deciduous
Neochen jubata	Orinoco geese	Bird	Near Threatened	Forest-covered banks of tropical rivers and damp clearings, wet savannas and muddy and sandy margins of large freshwater wetlands
Deconychura pallida	Southern long-tailed woodcreeper	Bird	Near Threatened	Primary terra firme forest (with no flooding), but also in permanently flooded forest
Contopus cooperi	Olive-sided flycatcher	Bird	Near Threatened	Forest edges and openings, semi-open forest, water edges and harvested forest where some structure has been retained
Dendroplex kienerii	Zimmer's woodcreeper	Bird	Near Threatened	This species occurs below 200 m in the "várzea" (seasonally flooded forest) and "igapó" (permanently flooded forest)
Calidris subruficollis	Buff-breasted sandpiper	Bird	Near Threatened	Wintering grounds in northern South America in a variety of habitats, including lowland forest, cloudforest, secondary growth, forest edges and plantations

Scientific Name	Common Name	Species Classification	IUCN Redlist Category	Habitat
Morphnus guianensis	Crested eagle	Bird	Near Threatened	Lowland tropical and subtropical forest
Setophaga striata	Blackpoll warbler	Bird	Near Threatened	Wintering grounds in northern South America in a variety of habitats, including lowland forest, cloudforest, secondary growth, forest edges and plantations
Tinamus guttatus	White-throated tinamou	Bird	Near Threatened	Primary tropical rainforest, generally 'terra firme' (without flooding), up to altitudes of 500 m, but may also tolerate secondary forest
Agamia agami	Agami Heron	Bird	Near Threatened	Swampy stream and lake margins within tropical forest, and also in seasonal marshes and coastal mangroves, under 300 m in elevation
Mitu tuberosum	Razor-billed curassow	Bird	Near Threatened	Lowland forest, including terra firme forest, gallery forest, seasonally flooded forest and lake margins
Spizaetus ornatus	Ornate hawk-eagle	Bird	Near Threatened	Humid forest, tall gallery forest, rainforest, cloudforest and deciduous forest
Pourouma herrerensis	Pourouma herrerensis	Tree	Near Threatened	Non-inundated rainforests
Myrmoborus melanurus	Black-tailed antbird	Bird	Near Threatened	Understory of flooded lowland (várzea) forest along rivers, streams, oxbow lakes and on river islands
Plesiotrygon iwamae	Long-tailed river stingray	Fish	Vulnerable	Freshwater systems
Trichechus inunguis	Amazonian manatee	Mammal	Vulnerable	Lowland tropical areas below 300 m asl, restricted to freshwater systems, can be found in the three types of water in Amazonian rivers (white, black and clear)

Scientific Name	Common Name	Species Classification	IUCN Redlist Category	Habitat
Tayassu pecari	White-lipped peccary	Mammal	Vulnerable	Primarily humid tropical forests, but can be found across diversity of habitats including wet and dry grasslands and woodlands, Gran Chaco, tropical dry forests, and coastal mangroves
Tapirus terrestris	South American tapir	Mammal	Vulnerable	Lowland South American moist swamp forests, dry and moist shrublands and grasslands and a wide variety of wetlands
Myrmecophaga tridactyla	Giant anteater	Mammal	Vulnerable	Tropical moist forest, dry forest, savanna habitats and open grasslands
Priodontes maximus	Giant armadillo	Mammal	Vulnerable	Close to water within undisturbed primary rain forest habitats
Leopardus tigrinus	Oncilla	Mammal	Vulnerable	Broad range of forested habitats
Brachyplatystoma rousseauxii	Gilded catfish	Fish	Vulnerable	Demersal species (living at or near the bottom of the water body)
Apistogramma cinilabra	Cichlid species	Fish	Vulnerable	Small ponds situated in dense, primary rainforest
Heliotrygon rosai	Rosa's round ray	Fish	Vulnerable	Demersal species (living at or near the bottom of the water body) in freshwater systems
Cedrela odorata	Spanish cedar	Tree	Vulnerable	Humid or dry lowland forest, preferring well-drained soil
Aotus nancymaae	Nancy Ma's night monkey	Mammal	Vulnerable	Flooded and un-flooded tropical forest
Percnostola arenarum	Allpahuayo antbird	Bird	Vulnerable	Dense terra firme forest on white sandy soil
Conirostrum margaritae	Pearly-breasted conebill	Bird	Vulnerable	Broad range of forested habitats
Pseudoxandra cauliflora	Pseudoxandra cauliflora	Tree	Vulnerable	Non-inundated forests at low elevations up to 150 m
Doliocarpus verruculosus	Doliocarpus verruculosus	Tree	Vulnerable	Riparian forests and flooded areas, between 100 and 200 m elevation

Scientific Name	Common Name	Species Classification	IUCN Redlist Category	Habitat
Callimico goeldii	Goeldi's monkey	Mammal	Vulnerable	Habitat specialist concentrating on bamboo forests and disturbed forests (secondary growth) but can also be found in more open, mature forest
Cebuella niveiventris	Eastern pygmy marmoset	Mammal	Vulnerable	Restricted to river-edge forest
Primolius couloni	Blue-headed macaw	Bird	Vulnerable	Edge of humid lowland evergreen forest, along rivers and by clearings and other breaks in continuous canopy, from lowlands to 1,550 m
Endlicheria arachnocome	Endlicheria arachnocome	Tree	Vulnerable	Seasonally flooded (tahuampa) lowland forests, between 90-140 m altitude
Cebuella pygmaea	Western pygmy marmoset	Mammal	Vulnerable	Restricted to river-edge forest
Cacajao ucayalii	Uakari	Mammal	Vulnerable	Occurs in flooded forests, low to medium hill and high terrace forests, and palm swamps.
Adelobotrys macranthus	Adelobotrys macranthus	Tree	Vulnerable	Primary forests between 0-500 m
Lagothrix lagothricha	Common woolly monkey	Mammal	Vulnerable	Lowland primary forest, and occasionally also in secondary and disturbed/fragmented habitats. They enter flooded forests at certain times of the year to feed on fruits

6.4 Main Risks Identified by the AFOLU Non-Permanence Risk Tool

6.4.1 Payback Period

A potential internal risk assessed is that the payback period is directly related to the sale of credits. To mitigate this risk, we have established a robust financial monitoring plan. It is imperative to have readily available financial resources. Specifically, a percentage of the total cash required to cover Project expenses until revenue from credits sale.

It is important to note that the credits generated from the first monitoring period (2012-2013), and verified in 2017, were not sold completely. This highlights the necessity for diligent financial management and strategic planning for the next baseline period.

To ensure a steady income for the Project, the management team has decided to include two more verifications, allowing credits to be issued at four-year intervals (2027 and 2031). This adaptation will help stabilize the Project's financial inflow.

The Project Proponent will be responsible for the following:

I. Monitoring Project Expenses/Cash Flow Annually: Annual reviews of Project expenses and cash flow will be conducted to ensure financial stability and to anticipate any shortfalls that may arise before reaching breakeven.
II. Ensuring Credible Sellers: The Project Proponent will identify and engage credible sellers, such as aggregators, brokers, or traders, who can facilitate the marketing and sale of carbon credits. This includes seeking advisors to guide the relationship with buyers.
III. Monitoring Carbon Credit Price: Continuous monitoring of carbon credit prices will be carried out to optimize the timing and strategy for credit sales, ensuring maximum financial returns.

6.4.2 Project Longevity

Another significant risk concerns Project longevity. The Project proponent has committed to a minimum 30-year Project period. While Verra has since updated the VCS standard, requiring a minimum longevity of 40 years for any Projects registered after January 1, 2024, the Project, by virtue of being registered prior to Jan 1, 2024, is allowed to keep the 30-year length. There is a binding agreement in place with a Project development partner (made available to the audit team), committing the proponent to maintain activities and Project permanence for a minimum of 30 years.

Additional Risks:

6.4.2.1 Illegal Logging

Illegal logging poses a serious threat to the Project's objectives. To combat unauthorized timber harvesting, bi-weekly boat patrols are conducted along the Yarapa River and its tributaries, Sabalillo and Yanayacu, focusing on easily accessible riverbanks. Furthermore, 24 strategically placed signs along the riverbank reinforce the conservation message. Engaging local community members as Project guardians is also vital for monitoring and reporting any illegal activities.

6.4.2.2 Community Engagement

Engaging positively with the community is another critical area of focus. The Project has learned from Participatory Rural Appraisal (PRA) findings that meaningful engagement with local communities is essential to prevent illegal logging. By involving respected community members in Project activities, the initiative fosters local support for conservation efforts.

6.4.3 Monitoring Progress and Documenting Lessons

To ensure effective monitoring, a lesson learned was that a better **patrol reporting system** needed to be established. The implemented system enables systematic reporting of patrol results through a dedicated WhatsApp channel, allowing the manager to make prompt judgment calls regarding any incidents of trespassing or illegal logging. An **annual review meeting** will also be conducted each year with staff, the manager, and the Project proponent. This meeting will serve as a platform to discuss the effectiveness of current strategies, share lessons learned, and explore potential improvements.

The **forest carbon monitoring** program will continue to include periodic measurements of the 25 permanent plots every ten years. These measurements will document changes in aboveground carbon stocks and provide valuable data for future decision-making.

Tracking **community engagement** will involve recording interactions with local community members and documenting their feedback and suggestions. This information will be crucial for adapting strategies to better meet community needs. Additionally, the performance of credit sales will be monitored closely in collaboration with the specialized marketing company. By analyzing market trends and buyer preferences, the Project can adjust its approach to maximize revenue.

6.4.4 Adaptation Plan

The adaptation plan includes a flexible patrolling strategy, which will allow adjustments in patrol frequency and routes based on identified hotspots of illegal activities. The guardians are responsible for identifying those hotspots. This responsiveness is crucial for maintaining effective oversight of the Project area. Moreover, dynamic community engagement strategies will be implemented to regularly reassess community needs and adapt engagement efforts accordingly. This ensures that local voices are heard and considered in Project decisions. Finally, to remain competitive in credit sales, the Project will adopt a market-responsive approach. Working closely with the specialized company, strategies for pricing and selling credits will be adjusted based on market demand to optimize revenue generation.

6.5 Deforestation Rate Update: proxy area selection and analysis

6.5.1 Supporting Files

The following supporting files accompany this report:

1. **Yacumama Proxy Suitability Summary.xlsx**- Contains tabulated eligibility calculations and summary statistics comparing the Project and proxy areas across soil, slope, elevation, and ecoregion parameters.
2. **Suitability Reference Layers.gdb** - Geodatabase with all spatial reference layers used for the suitability analysis, including soil, slope, elevation, and ecoregion datasets.
3. **2002_Treecover.zip** - Layer representing baseline tree cover in 2002, used to establish pre-deforestation forest extent for proxy areas.
4. **TreeLoss_2002-2021.zip**- Hansen et al. global forest loss dataset clipped to the proxy areas, used to quantify observed deforestation rates over the 2002–2021 period.
5. **Yacumama_ProxyArea_Final.zip**- Shapefile delineating the seven selected proxy areas used in the analysis.
6. **Yacumama_Rate of Deforestation.xlsx**- Calculation file summarizing annual deforestation rates derived from remote sensing analysis for each proxy, consistent with Section 5.1.3 of VMD0006.
7. **Peru Spatial Dataset Bibliographic Review.xlsx**- A summary matrix of the spatial data sources consulted and their relevance to the tenure assessment.
8. **WRIDataset_PermanentAgri.tif**- Raster layer representing permanent agriculture from the *WRI Tree Cover Loss by Dominant Driver* dataset.
9. **Yacumama ERR calcs v2.1_2026-01-09.xlsx**- Spreadsheet where the final emission and reductions are calculated.