RESTORING DEGRADED LANDS FOR BIODIVERSITY CONSERVATION AND LIVELIHOOD DEVELOPMENT IN BRAZIL

Document Prepared by Natural Capital Partners and Saving Nature

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The Project "Restoring Degraded Lands for Biodiversity Conservation and Livelihood Development in Brazil" is a grouped project that falls under the VCS category afforestation, reforestation, and revegetation (hereafter referred to as ARR). Long term conservation of the forests in the Project area is achieved through a broad range of activities focusing on reversing the impact from various deforestation and degradation agents. An extensive monitoring system will be set up to track effectiveness of project activities.

The objective of the proposed grouped project is to restore degraded lands and improve the connectivity of forest cover to restore genetic diversity and achieve viable wildlife populations of endemic, threatened, and endangered species. The Project focuses on biodiversity conservation and wildlife habitat restoration with the active participation of the local communities. These activities provide economic benefits by creating employment opportunities and social welfare related to protecting a vital watershed.

The grouped project will be managed by Natural Capital Partners with the support of Saving Nature and other local partners. Natural Capital Partners is a UK/ US company of private nature and have experience in developing and managing natural climate solution projects focused on the voluntary carbon market.

Saving Nature was founded by Dr. Stuart Pimm with a vision of restoring nature for sustainable gains and achieving a broader impact. Saving Nature adopts a unique approach for leveraging local conservation actions to solve global environmental challenges by connecting critical habitats for biodiversity. They restore and recover tropical forests to connect forest fragments that are too small for the long-term survival of threatened, endangered, and endemic species. They have experience in restoring tropical forests in Brazil, Indonesia, India, Columbia, and Ecuador.

The first group of instances of the Project covers 626.29 ha of degraded land in Brazil's Atlantic Forest. The Project is centered in the Guapiaçu watershed, which has followed a pattern of destructive land-use changes that reflects the broader trajectory of deforestation and anthropogenic changes in the Atlantic Forest. Upland areas, unsuitable for sugar cane, were cleared for coffee. Several decades of coffee exhausted the soils, and the plantations were abandoned. Production then went to cattle. These pastures are now extremely depleted. Even with the introduction of non-native grasses, the production levels are low across many upland areas. Worse, the grazing leads to erosion and degradation of water quality downstream.

The Project is working to change this, by reforesting these heavily degraded areas to stem further degradation and improve watershed quality. The Project implementer for the first group of instances is the Brazilian NGO, Reserva Ecológica de Guapiaçu (REGUA). REGUA manage a 18,760 acre (7,559 ha) private reserve, including 864 acres (350 ha) of forests restored with 550,000 native trees since 2005. Given that this is a grouped project, the total is an estimate of future project activities. The first group of instances of the Project will sequestrate approximately 383,724 tCO_2e over a period of 40 years. Estimated annual average GHG emission removals is 9,593 tCO_2e. Beyond the global environmental objectives (carbon sequestration), the Project focuses on achieving local sustainable development and environmental objectives which are described in the following section:

Project's contribution towards sustainable development

Environmental Criteria:

The Project goal is to create viable habitat for endemic, threatened, and endangered species. By reforesting critical areas and connecting forest fragments, the Project will rescue species marooned in habitat fragments too small for their long-term survival. A series of strategic wildlife corridors that connect isolated forests by restoring native vegetation and canopy cover will enable threatened and endangered species to move freely, restoring genetic diversity, and supporting population rebound.

Social Criteria:

Environmental services provided by forests are essential to the social welfare of populations in rural areas (Alarcon, 2016). Restoring forests can ensure cleaner water, by reducing soil erosion and avoiding sediment pollution in water reservoirs (World Resources Institute, 2019). The reserve is situated in important watershed for over 2.5 million people on the East side of Guanabara Bay. This watershed provides clean drinking water to communities living and working throughout the region. The forests here are vital to protecting the headwaters of this important source of fresh water. Without them, landslides, silting, and flooding threaten the health and safety of thousands of residents.

According to the Millennium Ecosystem Assessment (MEA) (AEM, 2005), incorporating the values and social perception of local communities into environmental planning promotes the empowerment of the communities and increases political support for defining investment priorities for maintaining ecosystem services and biodiversity conservation. The Project involves low-income families in the area who will get more opportunities to increase their income and thus be less prone to pursue unsustainable practices that might increase CO_2 emissions, harm the environment, and further reduce the rainforests.

Terrestrial forests are part of a larger ecosystem that typically includes various types of land-uses and that sequester carbon dioxide through the process of photosynthesis. Therefore, establishing forests on degraded, underutilized lands will sequestrate a significant amount of GHGs compared to baseline. Trees

are planted in cooperation with local partners who are committed to environmental sustainability and social responsibility and are confident that the extraordinary costs involved in pioneering this project will eventually be covered by the supplementary cash flow from sale of VCUs.

Economic Criteria:

Labor requirements for the Project are fulfilled with local employment. Therefore, the major portion of the budget for labor will be retained within the country and the local community.

The Project creates direct employment at agreed wages by employing local community members in a continuous seed to tree process, in which the community benefits economically from conservation efforts. The Project hires individuals from the local communities, creating direct financial benefits, including employment opportunities and the Project promoter is committed to provide all the training necessary. The Project proponent (PP) will promote a working family model where both men and women can actively participate in the Project. Emphasis to be made on activities that promote the involvement of women in the area. Types of employment opportunities include:

- Soil preparation: Selection of site for collecting soil for nursery pots. Crumbling the soil into smaller particulates. Mixing the soil with lime and fertilizer. Sifting the soil to get smaller particulates.
- Soil bagging: Taking the sifted soil and filling bags.
- Seed and seedling collecting: Locating trees which are producing desired seeds. Collecting seeds and seedlings for the nursery.
- Seed and seedling planting: Planting seeds or seedlings in the soil-filled bags.
- Drilling and digging holes: Use of augers or digging equipment to prepare areas for planting.
- Project Monitoring: Collecting data to validate restoration work.
- Data Processing: Entering project data into the central archive.

Beyond employment related to the restoration project, there are job opportunities in reserve management, security, community outreach, and scientific research. The ecotourism operation offers additional employment opportunities for local labor in the hospitality industry, including field guides, housekeeping, guest relations, and transportation.

1.2 Sectoral Scope and Project Type

Sectoral Scope 14: Agriculture, Forestry, Land use.

Afforestation, Reforestation, and Revegetation (ARR)

The Project is a grouped project.

The Project has been developed under VCS sectoral scope 14 (Agriculture, Forestry and Other Land Use) and is categorized as the VCS AFOLU category ARR: Afforestation, Reforestation and Revegetation. As abovementioned, the Project is a grouped project.

1.3 Project Eligibility

The proposed project is eligible under the scope of the VCS Program due to the following points:

- The Project is a reforestation/ restoration project hence falls under the ARR category
- The baseline scenario is lands with vegetation below the national forest definition
- The lifetime of the Project is minimum of 40 years with the option to renew
- The period between the start date and the date of validation is less than 5 years
- The calculation of GHG emissions was based on approved methodologies

1.4 Project Design

The proposed project has been designed as a grouped project.

Eligibility Criteria

The proposed project has developed a set of eligibility criteria for inclusion of new restoration areas as instances willing to join the grouped project at different stages.

As this is a grouped project, all instances shall meet the elements mentioned in Sections 3.5.8 to 3.5.19 of the VCS Standard (Version 4.0). In addition, new areas willing to become instances of the Project shall conform to the applicability conditions of the selected methodology, including conditions applicable to each activity.

Every plot being part of an instance shall consider the definition of forest established by the Government of Brazil under the UNFCCC[1]:

- Minimum tree crown cover = 30 percent
- Minimum land area = 1 hectare
- Minimum tree height = 5 meters

[1] https://cdm.unfccc.int/DNA/index.html

General Eligibility Criteria

- All lands belonging to the Project should be degraded and should not contain forests 10 years prior to the planting.
- All the parcels must be located within Brazil.
- The start date of plantations in each instance shall be after the start date of the Project set in Section 1.8.
- None of the areas belonging to the Project (fully or in part) shall be classified as wetland.
- Soil disturbance attributable to the Project activity will not cover more than 10 percent of the area in each of the following types of land, when these lands are included within the Project boundary:
    - Land containing organic soils.
    - Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in Appendices 1 and 2 of the selected methodology.
- Forestation of the land within the proposed project boundary performed with or without being registered as the ARR VCS project activity shall not lead to violation of any applicable law even if the law is not enforced.

  In the case of parcels / instances displacing agricultural activities, these displacements shall not cause, directly or indirectly, any drainage of wetlands or peat lands.

1.5 Project Proponent

Organization name	Natural Capital Partners Europe Limited
Contact person	Oliver Crouch
Title	Chief Product Officer
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1.6 Other Entities Involved in the Project

Organization name	Saving Nature
Role in the project	Project developer/financer
Contact person	Dr. Stuart Pimm
Title	Founder
Address	Bland Spring Place, Durham, NC, 27713, USA Web: www.savingnature.com
Telephone	646-489-5481
Email	stuartpimm@me.com

Organization name	Reserva Ecológica de Guapiaçu (REGUA)
Role in the Project	Implementing Partner
Contact person	Nicholas Locke
Title	Founder
Address	Caixa Postal 98112, CEP 28680-000 Cachoeiras de Macacu-RJ, Brazil Web: www.regua.org
Telephone	+55 (21) 2745-3947
Email	info@regua.org

1.7 Ownership

Any landowner willing to participate in the Project should provide a legal title of the land that is issued/ certified by a competent authority. All the participants need to sign an agreement with Natural Capital Partners. This agreement describes the roles and responsibilities of all parties related to the Project implementation, monitoring and revenue distribution mechanism.

Landownership: All lands to be restored in the first phase are private lands belonging to REGUA. There are two ways to demonstrate the ownership of the planted parcels: (1) Land registry document and (2) Municipal certification (these documents are available and shall be produced during validation).

Project ownership (in respect of a GHG emission reduction or removal): Natural Capital Partners have signed an agreement with Saving Nature to act as the Project Proponent for the proposed grouped project. REGUA has agreed that the property rights on the carbon credits generated by this project instance are exclusively allocated to Saving Nature. Under this agreement, REGUA committed not to assert any property rights over the carbon credits generated and/or to be generated by the Project.

1.8 Project Start Date

The start data of the Project activity is 01 September 2017, which is the date of the land preparation occurred.

1.9 Project Crediting Period

The Project crediting period for this grouped project shall be 40 years renewable, beginning on October 01, 2017, and ending on October 01, 2057.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2017	34
2018	485
2019	1,692
2020	2,935
2021	5,091
2022	7,299
2023	10,912
2024	14,991

2025	17,188
2026	20,010
2027	19,923
2028	19,655
2029	19,438
2030	18,981
2031	18,590
2032	17,850
2033	17,002
2034	16,694
2035	16,058
2036	16,192
2037	15,941
2038	15,124
2039	14,351
2040	12,894
2041	11,500
2042	9,114
2043	6,235
2044	4,818
2045	2,727
2046	2,727
2047	2,727
2048	2,727
2049	2,727
2050	2,727

2051	2,727
2052	2,727
2053	2,727
2054	2,727
2055	2,727
2056	2,727
Total estimated ERs	383,724
Total number of crediting years	40
Average annual ERs	9,593

1.11 Description of the Project Activity

This proposed ARR project is a grouped project aiming to promote restoration and conservation of degraded lands in Brazil. All lands belonging to the Project are not located within a jurisdiction covered by a jurisdictional REDD+ program. The activities planned shall seek to promote ecological connectivity, habitat management, biodiversity conservation, and poverty alleviation in the area. These goals will be achieved by establishing forest corridors using native tree species. The Project will reduce the pressure on the remaining natural forests and support passive forest protection in the region.

The main goals of the Project are: a) improve connectivity and / or continuity of forest cover to achieve positive outcomes for biodiversity at the community and landscape levels; b) improve rural incomes; c) improve the conditions of conservation and protected area management at the regional level, including better community resilience to climate change; d) mitigate climate change; e) recover watersheds; and f) reduce erosion.

To achieve the above goals, the following activities are allowed under the proposed grouped project:

a. Restoring degraded lands for conservation
b. Restoring degraded lands using agroforestry practices

Restoring degraded lands for conservation – activities that involve planting native tree species on non-forest lands for the purpose of forest conservation falls under this category. Areas under the Project will protect the selected area for the duration of the Project and beyond, retaining the carbon contained in the existing biomass and sequester additional carbon in the recovered forests.

This project seeks to establish, in the first activity instances, 626.29 hectares of forest plantations. The Project uses site preparation and tree planting to establish native trees on degraded lands. The practice

is to plant 675 native trees per acre (1,667 per ha). No harvesting is allowed within the Project area. The process starts with identifying which species to plant from adjacent forests, which are exceptionally rich in plant biodiversity. REGUA works with an international consortium (Treedivnet), local universities, botanic gardens, and specialized nurseries (including the Luisa Sartori Institute) to select species from the natural seed bank. Instances may use different measures / technologies to convert the non-forest land into forest land and/or to revegetate the Project area. Nevertheless, the main steps to implement activities will be organizing the logistics, training, site selection, species selection, seedling preparation, planting (site preparation, planting, etc.), maintenance and monitoring.

The intended intervention will be carried out in the Guapiaçu River sub-basin, a tributary to the Macacu River, located in the Baixadas Litorânea region, in the municipality of Macacu Waterfall - Rio de Janeiro, in the eastern portion of the Baía Hydrographic Basin from Guanabara. This sub-basin is limited to the north and west by the mountain range known as Serra dos Órgãos, an area with important forest fragments and water resources.

The Guapiaçu River sub-basin provides a supply of clean drinking water to approximately 2.5 million inhabitants from the metropolitan Rio de Janeiro state. Because of its water quality, the area has attracted investments by the water mining industry, including Schincariol, Cascataí, and Persona.

The Guapiaçu River sub-basin is also a strategic area for conservation within the Atlantic Forest. It offers great potential for biodiversity recovery, carbon dioxide sequestration, and community empowerment, in addition to serving as a model for other areas with similar characteristics.

The area offers nature-based tourism potential, due to its cascading rivers, fauna and flora, mountain ranges and standing forests. The area attracts eco-tourists and adventure tourists interested in nature-based experiences, providing additional economic opportunities in hospitality management for the local community.

Despite its wealth of biodiversity and importance for conservation of water resources, the region has suffered from destructive land-use changes associated with human activities, such as unsustainable livestock grazing, hunting, lack of basic sanitation, urban development, and irresponsible mass tourism. The Project is providing an alternative future for the region that is viable and sustainable.

The Project's ARR activities use native tree species commonly present in the surrounding area and harvested from the nearby natural seed bank. Species that were used for restoration during 2017-2019 are presented in the following table:

		Year of planting/ Number of trees planted			
Family	**Scientific name**	**2017**	**2018**	**2019**	**Total**
Fabaceae	*Abarema cochliacarpos*	-	25	-	25
Fabaceae	*Aegiphila integrifolia*	100	350	413	863
Lamiaceae	*Aegiphila verticillata*	-	-	20	20
Fabaceae	*Albizia pedicellaris*	-	-	50	50
Fabaceae	*Albizia polycephala*	-	-	144	144
Euphorbiaceae	*Alchornea sidifolia*	10	23	-	33

Fabaceae	*Amburana cearensis*	-	-	230	230
Fabaceae	*Anadenanthera peregrina*	-	1461	1142	2603
Annonaceae	*Anaxagorea dolichocarpa*	40	-	-	40
Fabaceae	*Andira anthelmia*	-	-	140	140
Fabaceae	*Andira legalis*	200	268	107	575
Annonaceae	*Annona cacans*	-	60	203	263
Annonaceae	*Annona dolabripetala*	150	-	84	234
Annonaceae	*Annona mucosa*	730	310	337	1377
Fabaceae	*Apuleia leiocarpa*	-	159	1131	1290
Apocynaceae	*Aspidosperma parvifolium*	2	-	-	2
Apocynaceae	*Aspidosperma ramiflorum*	150	501	898	1549
Apocynaceae	*Aspidosperma spruceanum*	80	12	-	92
Fabaceae	*Ateleia glazioveana*	-	550	540	1090
Moraceae	*Brosimum* sp	10	85	2	97
Combretaceae	*Buchenavia tetraphylla*	16	7	-	23
Malpighiaceae	*Bunchosia maritima*	-	72	-	72
Malpighiaceae	*Byrsonima laxiflora*	55	150	4	209
Meliaceae	*Cabralea canjerana*	-	-	273	273
Calophyllaceae	*Calophyllum brasiliense*	-	-	200	200
Myrtaceae	*Campomanesia guazumifolia*	360	503	349	1212
Lecythidaceae	*Cariniana ianeirensis*	-	-	530	530
Lecythidaceae	*Cariniana legalis*	-	-	25	25
Achariaceae	*Carpotroche brasiliensis*	250	310	1199	1759
Caryocaraceae	*Caryocar edule*	-	21	32	53
Salicaceae	*Casearia sylvestris*	10	54	186	250
Fabaceae	*Cassia ferruginea*	-	-	36	36
Urticaceae	*Cecropia hololeuca*	-	80	150	230
Urticaceae	*Cecropia pachystachya*	1	5	5	11
Meliaceae	*Cedrela fissilis*	86	318	441	845
Meliaceae	*Cedrela odorata*	-	-	50	50
Malvaceae	*Ceiba crispiflora*	-	160	-	160
Malvaceae	*Ceiba speciosa*	-	1694	915	2609
Fabaceae	*Centrolobium tomentosum*	160	213	661	1034
Fabaceae	*Chamaecrista ensiformis*	290	664	-	954
Fabaceae	*Chloroleucon tortum*	-	157	304	461
Sapotaceae	*Chrysophyllum flexuosum*	-	-	433	433
Sapotaceae	*Chrysophyllum imperiale*	-	-	17	17
Verbenaceae	*Citharexylum myrianthum*	840	1207	2600	4647
Rhamnaceae	*Colubrina glandulosa*	-	-	208	208
Fabaceae	*Copaifera trapezifolia*	-	-	1618	1618
Boraginaceae	*Cordia ecalyculata*	-	-	165	165

Boraginaceae	*Cordia silvestris*	255	160	-	415
Boraginaceae	*Cordia* sp	-	56	-	56
Boraginaceae	*Cordia superba*	-	307	-	307
Boraginaceae	*Cordia trichotoma*	15	503	40	558
Lecythidaceae	*Couratari pyramidata*	30	-	589	619
Euphorbiaceae	*Croton floribundus*	-	-	50	50
Euphorbiaceae	*Croton urucurana*	-	476	-	476
Fabaceae	*Cryptocarya aschersoniana*	1	565	657	1223
Sapindaceae	*Cupania oblongifolia*	-	268	439	707
Sapindaceae	*Cupania vernalis*	-	50	403	453
Bignoniaceae	*Cybistax antisyphilitica*	200	50	656	906
Fabaceae	*Dahlstedtia floribunda*	-	-	86	86
Fabaceae	*Dalbergia nigra*	240	164	3505	3909
Araliaceae	*Dendropanax* sp	-	363	332	695
Fabaceae	*Dialium guianense*	-	95	-	95
Ebenaceae	*Diospyros brasiliensis*	128	-	-	128
Sapotaceae	*Diploon cuspidatum*	155	28	528	711
Fabaceae	*Enterolobium contortisiliquum*	-	529	607	1136
Fabaceae	*Enterolobium glaziovii*	670	247	200	1117
Malvaceae	*Eriotheca* sp	25	2	-	27
Fabaceae	*Erythrina speciosa*	4	61	553	618
Fabaceae	*Erythrina velutina*	-	-	100	100
Erythroxylaceae	*Erythroxylum pulchrum*	140	-	50	190
Myrtaceae	*Eugenia brasiliensis*	1	55	-	56
Myrtaceae	*Eugenia florida*	120	-	-	120
Myrtaceae	*Eugenia pyriformis*	-	-	84	84
Myrtaceae	*Eugenia* sp2	-	432	250	682
Myrtaceae	*Eugenia* sp5	-	50	-	50
Myrtaceae	*Eugenia uniflora*	6	591	465	1062
Arecaceae	*Euterpe edulis*	100	-	584	684
Moraceae	*Ficus clusiifolia*	-	-	44	44
Moraceae	*Ficus gomelleira*	1	5	-	6
Moraceae	*Ficus guaranitica*	-	200	-	200
Phytolaccaceae	*Gallesia integrifolia*	3	963	530	1496
Clusiaceae	*Garcinia gardneriana*	40	38	-	78
Clusiaceae	*Garcinia* sp	74	47	-	121
Rubiaceae	*Genipa americana*	390	1466	1013	2869
Meliaceae	*Guarea guidonia*	895	2797	294	3986
Meliaceae	*Guarea kunthiana*	-	50	-	50
Meliaceae	*Guarea macrophylla*	-	733	-	733
Malvaceae	*Guazuma ulmifolia*	20	1716	486	2222

Bignoniaceae	*Handroanthus chrysotrichus*	470	1353	855	2678
Bignoniaceae	*Handroanthus heptaphyllus*	-	1001	538	1539
Bignoniaceae	*Handroanthus impetiginosus*	-	250	200	450
Bignoniaceae	*Handroanthus* sp1	406	9	1360	1775
Bignoniaceae	*Handroanthus* sp2	-	13	-	13
Bignoniaceae	*Handroanthus vellosoi*	-	940	300	1240
Fabaceae	*Hymenaea courbaril*	66	523	477	1066
Humiriaceae	Indeterminada	-	-	3	3
Indeterminada	Indeterminada	-	-	10	10
Sapotaceae	Indeterminada	-	-	34	34
Myrtaceae	Indeterminada	35	6	-	41
Myrtaceae	Indeterminada	-	60	-	60
Myrtaceae	Indeterminada	106	-	-	106
Indeterminada	Indeterminada	-	110	-	110
Myrtaceae	Indeterminada	-	240	-	240
Indeterminada	Indeterminada	-	278	-	278
Annonaceae	Indeterminada	290	12	-	302
Indeterminada	Indeterminada	-	-	333	333
Lauraceae	Indeterminada	-	83	288	371
Fabaceae	*Inga edulis*	730	3426	1225	5381
Fabaceae	*Inga laurina*	-	521	240	761
Fabaceae	*Inga* sp1	-	333	420	753
Fabaceae	*Inga* sp2	13	1	-	14
Fabaceae	*Inga vera*	67	1060	1610	2737
Bignoniaceae	*Jacaranda micrantha*	-	-	20	20
Caricaceae	*Jacaratia spinosa*	250	1019	531	1800
Euphorbiaceae	*Joannesia princeps*	53	155	383	591
Calophyllaceae	*Kielmeyera* sp	-	-	190	190
Lythraceae	*Lafoensia glyptocarpa*	-	64	57	121
Lythraceae	*Lafoensia pacari*	-	-	50	50
Lecythidaceae	*Lecythis pisonis*	-	112	283	395
Fabaceae	*Libidibia ferrea*	-	641	310	951
Chrysobalanaceae	*Licania tomentosa*	3	468	994	1465
Chrysobalanaceae	*Lonchocarpus cultratus*	5	48	1255	1308
Malvaceae	*Luehea divaricata*	2	-	233	235
Euphorbiaceae	*Mabea fistulifera*	-	758	34	792
Fabaceae	*Machaerium nyctitans*	-	22	780	802
Sapotaceae	*Manilkara subsericea*	105	-	-	105
Euphorbiaceae	*Margaritaria nobilis*	1	-	-	1
Sapindaceae	*Matayba guianensis*	262	-	170	432
Celastraceae	*Maytenus* sp	-	-	44	44

Fabaceae	*Melanoxylon brauna*	6	-	15	21
Lauraceae	*Mezilaurus* sp	370	1059	636	2065
Fabaceae	*Mimosa bimucronata*	-	150	-	150
Fabaceae	*Moldenhawera polysperma*	-	-	5	5
Asteraceae	*Moquiniastrum polymorphum*	1060	9230	1489	11779
Fabaceae	*Myrocarpus frondosus*	-	14	-	14
Fabaceae	*Myroxylon peruiferum*	-	54	1050	1104
Primulaceae	*Myrsine coriacea*	970	1657	754	3381
Moraceae	*Naucleopsis oblongifolia*	7	-	-	7
Fabaceae	*Nectandra membranacea*	720	210	678	1608
Lauraceae	*Ocotea acutifolia*	-	60	-	60
Fabaceae	*Ocotea diospyrifolia*	15	214	-	229
Lauraceae	*Ocotea* sp	9	-	477	486
Fabaceae	*Ormosia arborea*	200	74	336	610
Malvaceae	*Pachira glabra*	-	24	-	24
Fabaceae	*Parapiptadenia rigida*	-	234	400	634
Fabaceae	*Paubrasilia echinata*	20	95	103	218
Fabaceae	*Peltophorum dubium*	-	235	790	1025
Fabaceae	*Piptadenia gonoacantha*	1070	2879	2382	6331
Fabaceae	*Piptadenia paniculata*	870	1976	1653	4499
Fabaceae	*Plathymenia reticulata*	204	750	845	1799
Fabaceae	*Platycyamus regnellii*	6	22	-	28
Melastomataceae	*Pleroma granulosum*	120	400	576	1096
Myrtaceae	*Plinia cauliflora*	-	-	35	35
Myrtaceae	*Plinia edulis*	-	60	69	129
Fabaceae	*Poincianella pluviosa*	11	525	957	1493
Rubiaceae	*Posoqueria latifolia*	2	-	-	2
Urticaceae	*Pourouma guianensis*	-	-	10	10
Sapotaceae	*Pouteria butyrocarpa*	-	130	448	578
Sapotaceae	*Pouteria caimito*	162	392	43	597
Sapotaceae	*Pouteria psammophila*	150	-	-	150
Sapotaceae	*Pouteria* sp1	34	-	-	34
Sapotaceae	*Pouteria* sp2	1	-	-	1
Sapotaceae	*Pradosia lactescens*	370	12	928	1310
Burseraceae	*Protium heptaphyllum*	-	300	540	840
Malvaceae	*Pseudobombax grandiflorum*	-	850	260	1110
Malvaceae	*Pseudobombax longiflorum*	-	-	326	326
Fabaceae	*Pseudopiptadenia contorta*	6	-	956	962
Fabaceae	*Pseudopiptadenia inaequalis*	330	22	316	668
Myrtaceae	*Psidium cattleianum*	21	50	182	253
Myrtaceae	*Psidium guajava*	-	-	300	300

Myrtaceae	*Psidium guineense*	-	-	301	301
Myrtaceae	*Psidium* sp	-	-	200	200
Fabaceae	*Pterocarpus rohrii*	380	445	66	891
Fabaceae	*Pterogyne nitens*	-	655	-	655
Malvaceae	*Pterygota brasiliensis*	110	595	861	1566
Sapindaceae	*Sapindus saponaria*	-	200	97	297
Anacardiaceae	*Schinus molle*	-	-	50	50
Anacardiaceae	*Schinus* sp	-	200	-	200
Anacardiaceae	*Schinus terebinthifolia*	180	1133	1195	2508
Fabaceae	*Schizolobium parahyba*	90	189	684	963
Fabaceae	*Senegalia* sp	-	3047	3740	6787
Fabaceae	*Senna macranthera*	23	70	298	391
Fabaceae	*Senna multijuga*	-	335	200	535
Elaeocarpaceae	*Sloanea* sp	-	-	83	83
Solanaceae	*Solanum pseudoquina*	3	108	554	665
Bignoniaceae	*Sparattosperma leucanthum*	-	-	120	120
Anacardiaceae	*Spondias mombin*	115	781	1192	2088
Anacardiaceae	*Spondias venulosa*	-	124	43	167
Malvaceae	*Sterculia apetala*	-	20	50	70
Fabaceae	*Swartzia langsdorffii*	15	34	748	797
Fabaceae	*Swartzia oblata*	88	657	945	1690
Fabaceae	*Swartzia simplex* var. *grandiflora*	-	7	-	7
Arecaceae	*Syagrus romanzoffiana*	-	-	200	200
Bignoniaceae	*Tabebuia cassinoides*	-	-	1100	1100
Bignoniaceae	*Tabebuia rosea*	-	200	-	200
Apocynaceae	*Tabernaemontana laeta*	793	1469	2484	4746
Apocynaceae	*Tabernaemontana salzmannii*	755	-	-	755
Fabaceae	*Tachigali paratyensis*	-	-	140	140
Anacardiaceae	*Tapirira guianensis*	-	296	20	316
Olacaceae	*Tetrastylidium grandifolium*	-	-	578	578
Cannabaceae	*Trema micrantha*	-	350	-	350
Meliaceae	*Trichilia hirta*	-	220	-	220
Sapindaceae	*Tripterodendron filicifolium*	3	62	87	152
Myristicaceae	*Virola bicuhyba*	150	1166	1395	2711
Myristicaceae	*Virola gardneri*	1	-	-	1
Lamiaceae	*Vitex megapotamica*	-	10	153	163
Lamiaceae	*Vitex polygama*	-	102	313	415
Annonaceae	*Xylopia sericea*	-	-	2	2
Rutaceae	*Zanthoxylum rhoifolium*	10	17	-	27
Bignoniaceae	*Zeyheria tuberculosa*	-	88	45	133
Total planted		19,367	70,250	77,117	166,734

Nursery and plantation activities –REGUA has been operating a nursery on the reserve since 2004 (23K 729430.03 m E and 7515201.91 m S). The nursery has a capacity of 80,000 seedling per annum but continues to expand as the Project scale increases. REGUA also sources seedlings from local nurseries within an 80 km radius to supplement species diversity.

Plant production –The Project uses 180 species of native plants cultivated from the seed bank in the surrounding area. Seeds are collected from forest stands in the Project vicinity and germinated in local nurseries, owned by REGUA, partner organizations, and the surrounding community. Forest stands are evaluated and monitored to assure their physical, physiological, and genetic quality.

Site preparation – areas identified for the proposed grouped projects have species that are below the national forest definition. These are mostly herbaceous vegetation that in some instances needs to clear for planting.

Preparation for Planting

Land is prepared in September, prior to the rainy season and 30 to 60 days prior to planting. Any existing germinating or growing trees are left standing and included in the tree planting program. Holes on slopes are marked with a hoe but placed randomly to avoid any straight lines.

Restoration Methods

For forest restoration, REGUA uses the planting methodology developed by the Laboratory of Ecology and Forest Restoration of ESALQ - Superior School of Agriculture Luiz de Queiroz from the University of São Paulo. According to this methodology, all regenerating individuals located in the selected area, identified as native to the Atlantic Forest, are protected and fertilized. It is worth mentioning that in riparian forests, chemical products will not be used in reforestation. Other planting methodologies will be investigated, which replace chemical inputs with alternatives, such as mowing and mechanized weeding or manual.

The Project adapts plantings according to the species and location of the site. All planting information is recorded and archived in a database, including details on site preparation, fertilization, machinery and equipment used, species planted, management practices, and conservation measures.

Planting Methods: Planting is carried out in the rainy months from October through February, using four sets of operations prescribed for restoration, according to the regeneration stages of the areas defined by the study eligibility criteria for this project.

Planting uses seedlings of native species in spacings of 3 x 2 meters. An average of 1,667 seedlings are planted per hectare, totalling about 1,043,542 seedlings in the 626.29hectares of the Project, accounting for a replacement rate of up to 20%. Planting is done in cribs, distributed according to the marking made during the crowning operation. The seedling is placed in the center of the cradle, keeping the lap just below the soil and slightly compacting the filler soil. Seedling distribution in the field intersperse lines with species developed for “filling” and “diversity”, with approximately 50% of the seedlings per hectare belonging to each group.

- “Filling species” have the physiological aptitude to grow in full sun. They include pioneer and secondary growth species with fast growth and high shading capacity, such as A*egyphilla sellowiana; Antisiphillitic cybystax; Croton floribundus; Enterolobium contortisiliquum; Erytrina speciosa; Guarea trichilioides; Joannesia princeps; Luehea grandiflora; Artemisian mimosa;*

Mimosa bimucronate; Schinus therebinthifolius; Senna macranthera; Senna multijuga; Sparattosperma leucanthum; Spondias dulcis; Shake micrantha; Miconia cinnamomifolia; American genipa.

- "Diversity species" have the lowest growth rates and / or poor canopy coverage but are fundamental to the succession of the planted area. These species gradually replace those in filling lines when they enter senescence, occupying the restored area and ensuring its sustainable management. They include seedlings of climax species, as well as pioneer and secondary species with low shading, such as *Alchornea glandulosa; Anadenanthera colubrina; Bombacopsis glabrous; Iron Caesalpinea; Caesalpinia peltophoroides; Cedrela fissilis; Centrolobium tomentosum; Chorisia speciosa; Glandular colubrin; Cordia sellowiana; Cordia superba; Cordia trichotoma; Cytharexyllum mirianthum; Eugenia uniflora; Gallesia gorazema; Gochnatia polymorpha; Hymenaea courbaril; Inga edulis; Inga uruguensis; Jacaranda puberula; Jacaratia spinosa; Peltophorum dubium; Piptadenia gonoacantha; Pseudobombax grandiflorum; Psidium guajava; Schizolobium parahyba; Lutea spondias; Tabebuia crysotrycha; Tabebuia heptaphylla; Tabebuia SP; Granular Tibouchina; Lecythis pisonis; Lafoensia glyptocarpa; Pterocarpus violaceus; Myrciaria trunciflora; Marlierea edulis; Cupania vernalis; Eugenia brasiliensis.*

Natural Regeneration: Natural regeneration includes identifying, crowning, and fertilizing regenerating individuals of native species present in the area. This operation considerably reduces the number of new seedlings required for restoration and improves operational efficiencies and outcomes.

Density Planting: Void remnants with little presence of regenerants are planted with native species in consecutive lines of "filling species" and "diversity species". Plantings are spaced with 2 m between lines and 3 m between seedlings in the same line. Planting methods include full chemical application, manual crowning of cribs, opening cradles, fertilizing, and cleaning of the remaining areas (chemical clearing) to reduce competition with grasses.

Enrichment Planting: Plantings are enriched with secondary and climax native species to increase diversity, following the same methodology as density planting (except for total chemical application) at 6 m spacing among the seedlings.

Weeding: All areas are weeded manually in the first 6 months to clear grasses using hoes and tillage to avoid drift from chemical spraying that could damage the seedlings. Plots are inspected monthly for the first 90 days, and grasses are cleared as necessary, either manually or with Glyphosate when competition from grasses is excessive. In later months and through the second year, grasses and weeds are cleared manually every 3 or 4 months to reduce competition.

Watering: The Project does not require watering or water retainers, being located in an area with high rainfall.

Mowing: The planted areas are mowed to eliminate grasses, especially brachiaria (*Brachiara humidicola*), reducing competition with the seedlings planted and regeneration individuals for light, water, and nutrients.

Control of leaf-cutting ants: Leaf-cutting ants are controlled with ant killers distributed throughout the restoration area under the supervision of the technical staff responsible for the Project. Application conforms with current regulations and follows the manufacturer's indication.

Manual crowning: Crowning methods consist of manual removal (weeding with hoe) of all vegetation within a radius of 50 cm around regenerating individuals and locations marked for planting seedlings, thus avoiding competition for water, light, and nutrients. Whenever possible and applicable, crowning will be carried out in bands, following the slope level.

Opening of cradles: The cradles for planting seedlings are opened obeying the spacing of 3 m. x 2 m, still respecting a quincount distribution. Cribs are a minimum size of 30 cm. x 30 cm. x 30 cm. Additionally, a small stool at the top of the slope, above the crib, which will have the function to help retain rainwater.

Fertilization: Fertilizer is mixed with the soil used to fill the cradle during planting, using chemical fertilizers (NPK, in formulation 6-30-6, 100 g per cot; superphosphate, 300 g per cradle) and organic fertilizers (Fertilurb, organic compound produced from solid waste generated in the city, 3 kg per cradle).

Replanting: Plantings are inspected 30 to 60 days after planting. If seedling mortality exceeds 10%, trees are replaced and fertilized. Trees are not replaced if mortality is under 10% and there is evidence of spontaneous natural regeneration. Trees are also not replaced if mortality is under 5% as the remaining trees are sufficient for reforestation.

1.12 Project Location

The potential project area for the Project is the degraded lands in Brazil and all areas that will have similar baseline scenario. Over the Project crediting period, instances will be defined including their exact location.

Geographic Location of the First Group of Instances:

The Project is centered in the Guapiaçu watershed in Brazil. Closest largest city is Rio de Janeiro. Each eligible area of this instance has been identified and polygons are defined using GIS software. The coordinates shall be submitted as KML files.

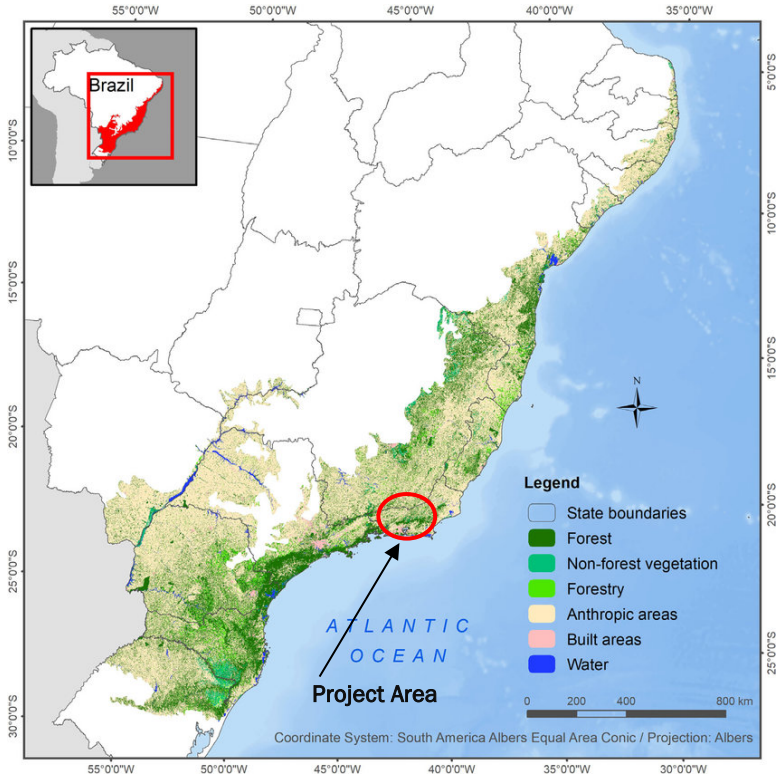

Figure: Project location in the Guapiaçu watershed

1.13 Conditions Prior to Project Initiation

The baseline is the same as the conditions existing prior to the Project initiation. The description of the scenario is explained in Section 3.4. Therefore, the prior conditions are not repeated in this.

General Climate

The following is description about the climate, hydrology, topography, relevant historic conditions, soils, vegetation, and ecosystems applicable to the first instance of the proposed grouped project:

1. Climate
   The climate in the Guapiaçu River sub-basin is tropical. It rains much less in winter than in summer. According to Köppen and Geiger, the climate classification is A_w.

   a. Precipitation
      The average annual precipitation varies around 2,000 - 2,600 mm, with the rainiest months in December and January and the driest months presenting in June and July. Rainfall during the driest month (July) is approximately 32 mm and the rainfall in December is reported to be 208 mm. The difference between the driest month precipitation and the wettest month is 176 mm.

   b. Temperature
      The region's climate is characterized as a tropical type Af (Köppen, 1948), with an average annual temperature of 22.4°C. The warmest month of the year is February with an average temperature 26.1 ° C. July is the coldest month, with temperatures averaging 20 ° C. During the year is the lowest average temperature.

2. Hydrology
   The study area is located in Hydrographic Region V, Guanabara Bay, which comprises all the basins located in its eastern part and which covers the municipalities of Cachoeira de Macacu, Bonito river, Tanguá, Itaboraí, São Gonçalo, Guapimirim and Magé, also belonging to the metropolitan region of Rio de Janeiro (Junior et al ., 2009). The municipality of Cachoeiras de Macacu, due to its location privileged, presents a great variety of water resources. The region is inserted in two large hydrographic basins, the São João and Guapi-Macacu rivers.

3. Geology

   The Guapiaçu River sub-basin area covers a segment along the central portion Serra do Mar in the state of Rio de Janeiro. This humid mountainous region shows a relief sculpted on several rocks formed by geological events since remote times, being characterized by steep escarpments, embedded valleys, peaks rocky cliffs. In this way, the elements of the geological substrate control the forms of this exuberant landscape, which welcomes a remnant Atlantic Forest. Therefore, it can be emphasized that some geomorphological features, such as steep slopes and high altitudes, condition the difficult accessibility and low occupation of the region, constituting a positive factor for the preservation of its forest cover, but the flatter areas were used intensive way. The steep feature of the relief is directly associated with erosive phenomena on the slopes (eg landslides) and floods in the valley bottoms due to the abundant rainfall and discharge of its drains.

Such characteristics of mountainous relief, combined with humid climatic conditions, guarantee the peculiarity of this region, making the management of the land use and occupation merits adequate planning and monitoring, with a view to the maintenance and restoration of the precious Atlantic Forest.

The main geological formation is formed by diabase dikes and the most extensive dike of all, with about 30 km, which passes through the lowlands of Guapiaçu, climbs the escarpment Serra do Mar along the thalweg of the Manoel Alexandre river, passes through Alto de Centenary and crosses the granitic body of Salinas by the head of the stream namesake. Pinto et al. (1980) report a thickness of 120 meters and edges of cooling for this dike, registered in station at the head of the Manoel stream Alexandre. Another parallel dike passes through Alto de São Lourenço and can reach an extension of 25 km, it is accepted its continuity towards NE (along the passage between the granitic bodies of Salinas and Caledonia) and for SW, connecting with the body that passes at the headwaters of São Miguel stream.

Such characteristics are relevant in the Guapiaçu River sub-basin, downstream, the escarpments and reverses of the Serra do Mar followed by hills and massifs coastal areas, a small area of coastal plateaus and, finally, large areas of coastal plains and fluvial accumulation models.

4. Soil

One of the main characteristics of the soil near the intervention area is that it is an extensive floodplain, with a tendency to frequent flooding in the lower areas, during rainy periods. The soils that occur in the area are alluvial, formed depositions of sediments from the Guapiaçu River and its tributaries. Alluvial soils are included in the Brazilian soil classification system, under the name of Fluvic Neossols. Also present in these lowland areas are soils of the type Gleissolo.

Another characteristic of this area is the presence of hills and hills, in which it is identified soils of the Red-yellow Latosol and Red yellow Argisol classes. The Oxisols are deeper and more resistant to the action of erosive processes, since Argisols are more susceptible to erosion. Much of these hills and hills are if covered by vegetation, but part of these areas is found as pasture, case of the Project intervention area, making it more susceptible to processes erosive.

5. Ecosystem

The topography of the area varies from the flat relief to the escarpments of the Serra do Mar Mountain ranges, making up the important Central Corridor of the Atlantic Forest. The vegetation cover is characterized as Dense Ombrophylous Forest (FOD), varying in the different phyto-physiognomies: Alluvial FOD, Lowland FOD, Submontana FOD, Montana FOD and Alto-Montana FOD, according to the classification of Veloso et al. (1991) and IBGE (2012)

According to PROBIO's vegetation coverage data, the Guapiaçu River sub-basin has an area of 442.38 km^2, of which 54% have medium stage vegetation advanced regeneration stage (Table 1). This important portion of forest remnants is responsible for providing numerous services in

the region. The water potential of the sub-basin stands out with the presence of several mineral water mining and beverage companies benefiting from if of this potential.

Table 1. Land use and cover in the Guapiaçú River Sub-Basin

Classes	Area (ha)	Percentage (%)
Outcrop	16.58	0.09%
Agricultural area	1,009.70	5.64%
Field altitude	129.82	0.73%
Floodable field	128.15	0.72%
Pasture	6,923.55	38.67%
Exposed soil	37.74	0.21%
Advanced stage vegetation regeneration	9,269.03	51.78%
Vegetation early-stage regeneration	24.74	0.14%
Vegetation medium stage regeneration	363.15	2.03%
Total - Guapiaçu River Sub-Basin	**17,902.44**	**100%**

Flora

The basin has formations of the highly diversified Dense Rainforest (RIZZINI, 1979; VELOSO et al., 1991; AMADOR, 1997), forming three strata: (1) emerging trees with a canopy reaching about 45 m in height, (2) the main canopy of 5 to 10 m, and (3) smaller understory trees shaded below (MELLO et al., 2003). According to Freitas et al. (2005), most forest fragments in this area are found at an altitude of 100 to 200 m, and vary in size between 19 and 200 ha. These fragments occur inland of rural properties and are surrounded by agricultural plantation and pasture. In analyzing forest fragmentation of this basin, Freitas (2004) also affirms that it is located in one of the regions with the highest coverage of Dense Rainforest in the State of Rio de Janeiro and is a priority area for biodiversity conservation. In study carried out for the APA management plan for the Macacu River basin (of which the Guapiaçu river basin is a sub-basin), Rodrigues et al. (2009) concluded that the forest remnants located on private properties are extraordinarily rich and species diversity and include important populations of individuals representative of the characteristic flora of the phytoecological formations of the Dense Ombrophilous Forest of Baixas and Submontana.

Fauna

The Atlantic Forest is one of the top five biodiversity hotspots on Earth. Bio-inventories at REGUA confirm it is an important area of the Atlantic Forest for biodiversity and an area of high conservation priority. Its expansive forest cover, from humid forest in the lowlands up to montane elfin forest at 2,000 meters above sea level, wetlands, rivers, grassland, and farmland, fosters a high diversity of species.

- *Mammals:* 264 mammal species have been recorded in the Atlantic Forest, of which 72 (27%) are endemic. Among primates, 80% are endemic. 73 species (27%) have been recorded at REGUA, including primates, felines, canids, sloths, anteaters, armadillos, possums, and rodents. Among the endemic species sighted are brown howler monkeys (Allouata fusca), black-eared possums (Didelphis

aurita), and russet rice rats (Oryzomys russatus). These species play an important ecological role in seed dispersal, contributing to the vitality and recovery of fragmented areas.

Five endangered felines have also been sighted at REGUA – the margay (Leopardus wiedii), the tiger cat (Leopardus tigrinus), the ocelot (Leopardus pardalis), the Moorish cat (Herpailurus yaguarondi), and the jaguar (Puma concolor). Primates spotted in the Reserve include the southern muriqui (Brachyteles arachnoides), the largest and most threatened primate in the Americas.

Furthermore, success with reforestation has enable the reintroduction of tapirs to the reserve, with the first tapir born in the wild here in 100 years.

- *Amphibians*: 456 species of amphibian are found in the Atlantic Forest, of which 282 (62%) are endemic. Of these, 73 species (16%), of which 15 are endemic, have been recorded at REGUA.
- *Birds:* 682 species of birds occur in the Atlantic Forest, of which 199 (29%) are endemics. Within REGUA, 485 species (71%) have been recorded.

Orchids: A total of 97 orchid species from 51 genera have been identified at REGUA. 44 of these species are new citations for the municipality of Cachoeiras de Macacu.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project complies with all laws and regulations of respective countries, regions. All the selected lands have clearly defined ownership titles. In the case of the first group of instances, both instances and all its parcels are in Brazil hence the following is a description about laws and regulations applicable to the first instance.

Regulatory framework - Brazil is one of the signatories of the Kyoto Protocol (ratified in 2005) and a member of the UNFCCC (United Nations Framework Convention on Climate Change – ratified in 1995) and an active member of the ITTO (International Tropical Timber Organization). The country has established a Designated National Authority (DNA) under the CDM. Brazil also has recently signed the Paris Agreement (Paris 2015, COP2167). The Project complies with this regulatory framework, because in the AFOLU scope, Afforestation/Reforestation is one of several mechanisms by which GHG emissions are expected to be reduced.

National Legislation (Federal laws) – Nationally, the most significant effort to date was the submission of Bill No. 195/2011, which "establishes the national system to reduce emissions from deforestation and degradation, conservation, sustainable forest management, maintenance and increase of carbon stocks (REDD+), and other provisions", which are still in progress. Following is a description about main national laws that govern the forest sector. None of these laws and regulations are barriers for the Project implementation.

- **Law n° 12.727 - October 17, 2012.** This establishes general norms on the protection of the vegetation, areas of Permanent Preservation and the areas of Legal Reserve; Logging, supply of forest raw materials, control of the origin of forest products and control and prevention of forest fires,

and provides economic and financial instruments to achieve its objectives. http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12727.htm

- **Law n° 12.651 - May 25, 2012.** It provides for the protection of native vegetation; amending Laws No. 6938, of August 31, 1981, Law No. 9393, of December 19, 1996, and Law No.11428 of December 22, 2006; revoking Laws No. 4771, of September 15, 1965, and No. 7754 of April 14 1989, and Provisional Measure No. 2166-67, of August 24, 2001; and other measures. Establishes the New Brazilian Forest Code.

  http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm

- **Law n° 7.804 - July 18, 1989**. Amended Law 6.938, dated August 31, 1981, which provides for the National Policy on the Environment, its purposes and mechanisms for formulation and application, Law 7,735 of February 22, 1989, Law 6803, of July 2, 1980, and makes other provisions. http://www.planalto.gov.br/ccivil_03/leis/L7804.htm

Local Legislation –

- Law No. 12187 of 12/29/2009: It established the National Policy on Climate Change (PNMC) and provides other measures.

- Provisional Measure No. 571, of 05/25/2012: It amends Law 12651 of May 25, 2012, which provides for protection of native vegetation; amending Laws No. 6938, of August 31, 1981, Law No. 9393, of December 19, 1996, and Law No.11428 of December 22, 2006; revoking Laws No. 4771, of September 15, 1965, and No. 7754 of April 14, 1989, and Provisional Measure No. 2166- 67, of August 24, 2001.

- Law No. 58,054 of 3/23/1966: It promulgates the Convention for the protection of flora, fauna and scenic beauties of the American countries.

- Decree No. 96944 of 10/12/1988: It created the Program in Defence of the Ecosystem Complex of the Legal Amazon, and other measures.

- Decree No. 2661 of 7/8/1998: It regulates the sole paragraph of art. 27 of Law 4.771 of September 15, 1965 (Forest Code), by establishing precautionary standards for activities involving fire in agropastoral and forestry practices, and other measures.

- Decree No. 2959 of 2/10/1999: It provides for measures to be implemented in the Legal Amazon, for monitoring, prevention, environmental education, and forest fire fighting.

- Decree No. 5975 of 11/30/2006: It regulates art. 12, final part, 15, 16, 19, 20 and 21 of Law 4771 of September 15, 1965, art. 4, item III, of Law 6938 of August 31, 1981, art. 2 of Law No. 10650, of April 16, 2003, amends and adds provisions to Decrees 6514/08 and 3420/00, and other provisions.

- Decree No. 7390 of 12/9/2010: Regulates articles 6, 11 and 12 of Law 12187 of December 29, 2009, establishing the National Policy on Climate Change (PNMC), and other measures.

- Decree-Law No. 5452 of 05/01/1943: Approves Labor Laws Consolidation. CONAMA Resolution No. 16 of 12/07/1989: It establishes the Integrated Program for Assessment and Environmental Control of the Legal Amazon.
- CONAMA Resolution No. 378 of 10/19/2006: It defines undertakings potentially responsible for national or regional environmental impact for purposes of item III, paragraph 1, art. 19 of Law 4771 of September 15, 1965, and other measures.
- CONAMA Resolution No. 379 of 10/19/2006: It creates and regulates the data system and on forest management under the National Environmental System - SISNAMA.
- CONAMA Administrative Rule No. 218 of 5/4/1989: It provides for felling and exploration of native forests and successors forest formations of the Atlantic Forest, and other measures.
- IBAMA Administrative Rule No. 37 of 4/3/1992: Recognizes as Official List of Brazilian Endangered Flora Species the list found in the Administrative Rule.
- Ministry of Environment Administrative Rule No. 103 of 4/5/2006: It provides for the implementation of the Document of Forest Origin - DOF, and other measures.
- Ministry of Environment Administrative Rule No. 253 of 8/18/2006: It establishes, from 1 September 2006 on, under the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), the Document of Forest Origin (DOF), replacing the Authorization for Transportation of Forest Products (ATPFs).
- Administrative Rule 1896 of 09/12/2013: It amends Regulatory Norm No. 31. Ministry of Environment Administrative Rule No. 1 of 9/5/1996: It provides for Obligatory Reforestation and Forest Integrated Plan.
- Ministry of Environment Administrative Rule No. 07 of 4/27/1999: It provides for the authorization for deforestation in the Legal Amazon States.
- Ministry of Environment Administrative Rule No. 02 of 5/10/2001: It provides for the economic exploration of forests in rural properties located in the Legal Amazon, including Legal Reserve areas and with exception of permanent preservation established in current legislation, which will be carried out through multiple use sustainable forest management practices.
- IBAMA Normative Instruction No. 30 of 12/31/2002: It informs the geometric volume calculation of standing trees, applying the volume equation that specifies it, and other measures.
- IBAMA Normative Instruction No. 112 of 08/21/2006: It regulates the Document of Forest Origin - DOF, established by Ordinance Ministry of Environment Administrative Rule .253 of August 18, 2006. (Amended by IBAMA Normative Instruction No. 134 of November 22, 2006)
- Ministry of Environment Administrative Rule No. 06 of 12/15/2006: It provides for the reforestation and consumption of forest raw materials, and other measures.

- IBAMA Normative Instruction No. 178 of 6/23/2008: It defines guidelines and procedures, provided by IBAMA, for consideration and approval on the issue of forest suppression authorizations and other forms of native vegetation in an area greater than two thousand hectares in rural properties located in the Legal Amazon, and a thousand hectares in rural properties located in the remaining regions of the country.

Regulatory Norm No. 31 of 03/03/2005: Approves the Regulatory Norm for Safety and Health at Work in Agriculture, Cattle Raising, Forestry, Forest Exploration, and Aquafarming.

1.15 Participation under Other GHG Programs

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

The Project has not been registered nor seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

Project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The Project is not included in any other emission trading program or any other mechanism, therefore, reductions and removals generated by this Project will not be used for compliance under any other program or mechanism.

1.16.2 Other Forms of Environmental Credit

The Project has not sought or not received any other form of GHG-related environmental credits.

1.17 Additional Information Relevant to the Project

Leakage Management

The Project will use the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" for this purpose. The applied methodology considers only one source of leakage: increase in GHG emissions attributable to displacement of pre-project agricultural activities. Leakages are not expected in this grouped project and in the initial phase.

There is no anticipated net leakage related to the Project. In fact, without the Project intervention, the land, likely will be transformed by residential development, permanently altering the landscape and the local community. Saving Nature and our local partner are working to acquire

the available to land to restore native forests, save biodiversity, protect the watershed and fight climate change.

The applied methodology for leakage identifies only one source of leakage relevant to the Project: increase in GHG emissions attributable to displacement of pre-project agricultural activities. Burning of any biomass within the Project area is not a common practice under the pre-project scenario. Therefore, under the Project there will be no displacement of burning to any other location outside the boundary.

Displacement of productive activities - in this case relocation of cattle - is unlikely. Land typically becomes available when an owner dies or is no longer able to manage the property. Their children are often not interested in continuing to live in a rural area and are abandoning the land to move to urban areas for more career opportunities. More recently, developers are creating homes in the area for the wealthy residents of Rio de Janeiro. This demand has driven up real estate prices and provided additional financial incentives to sell the properties.

First Group of Instances – The first group of instances will be implemented in lands owned by REGUA; Pre-project condition is degraded status. In the case of areas with agriculture potential, agroforestry activities will be implemented, including best practices for soil conservation and culture rotation. No additional agriculture areas will be installed in areas under REGUA control, outside the first group of instances. Therefore, no leakage activities will occur.

Commercially Sensitive Information

There is no commercially sensitive information.

Sustainable Development

This project actively promotes restoration of lands within the Atlantic Forest area and thus promotes several aspects of sustainable development and provide a wide range of co-benefits (non-carbon benefits).

- Social co-benefits: Project activities have stimulated an increase in the local workforce employed. It has also allowed the specialization and qualification of this workforce and produced a wage increase of these workers, with consequent benefits to their families.
- Climate co-benefits: The Project has a positive impact on the microclimate of the region: in fact, it contributes to less water evaporation, less soil reflectivity, and a reduction in temperatures. This could, if thought on a large scale, also have significant effects on the climate of the region.
- Environmental co-benefits: Soil: The Project has a positive impact on the soil; before the starting of the Project, the land was characterized by erosions and degraded pasture. Before the plantation the erosions have been recovered, contour lines have been made on all the parcels, to reduce the speed of rainwater on the ground and to increase ground water retention. After the

planting the soil improves the characteristics: macro and micro minerals improved due mainly by fertilization.

Further Information

All information is provided in each section with supporting evidence.

2 SAFEGUARDS

2.1 No Net Harm

This project uses soil enrichment methods to restore degraded bare lands and uses native species to improve the forest cover. Tree planting on degraded lands provides multiple non-carbon benefits (explained in this VCS PD) and unlikely to have any negative environmental and socio-economic impacts. REGUA pays above local salary levels, at least 20% and observes all the correct legislation, with gender and racial equality. The Project partners are continuously monitoring the impacts and if such negative impact arises, proper mitigatory action will be taken.

2.2 Local Stakeholder Consultation

Will be filled during the final submission for validation.

2.3 Environmental Impact

This grouped project targets three issue facing our planet – climate change, mass species extinctions, and environmental degradation. As a result, it has a triple bottom line, helping to rebuild a planet pushed to extremes.

Increased forest cover - Brazil's Atlantic Forest is one of the world's 25 Biodiversity Hotspots. Over time, wide-scale deforestation has reduced it to five percent of the original forest cover. Consequently, this tropical forest, its rich biodiversity, and its ecosystem services are among the most imperilled on the planet.

Increased biodiversity – Sixty percent of Brazil's endangered species are found in the Atlantic Forest. In total, there are 24,000 species of plants, mammals, birds, and amphibians, and reptiles, of which 9,500 species exist nowhere else on earth. Importantly, there are also countless more unknown to science. What remains of The Atlantic Forest is a patchwork of remnants that are the last refuge for some of the greatest wealth of biodiversity on the planet. As the forest continues to dwindle, the increasingly stranded species have been called "the living dead" by Brazilian conservationist Antonio Rossano Mendes Ponte.

The Project will increase the forest cover with multiple species thus creating a natural habitat for a variety of fauna and flora species.

Improvement of soil conditions – The Project will improve soil conditions by reducing erosion, drying, soil compaction and nutrient depletion caused by decades of destructive land-use patterns.

Climate change mitigation and adaptation - Restoring tropical forests is the best way to offset carbon dioxide emissions while rebuilding habitats for endangered species. On average, tropical forests soak up about 26 tons of CO_2 per hectare per year as they grow back. If done strategically with the right trees in the right places, reforestation can sequester carbon dioxide while helping save endangered species survive.

2.4 Public Comments

This section shall be filled once the VCS PD is listed in the Verra site and receive comments from the Global Stakeholder consultation process.

2.5 AFOLU-Specific Safeguards

This section comprises of the local stakeholder identification process and a description of results. The local stakeholder mainly includes the local households lives near by the Project and the local government. During the Project design phase and subsequent verifications, local stakeholders were involved in every stage of the Project.

Aside from generating local employment and sourcing local products, REGUA participates in local associations and council meetings offering advice and experience in the activities it develops. This platform offers opportunities to discuss topics such as planning, water sources, and waste and litter disposal. Some of these topics are still very new issues facing the local community and open forums are an opportunity to collectively address community concerns. In addition, the staff meets annually during the holiday season with the local community to discuss goals, programs, and progress. These meetings provide an opportunity for the local community to ask questions, raise concerns, and offers suggestions and feedback.

REGUA focuses on empowering local communities through awareness and education. To do so, they have developed a variety of outreach and social programs that foster community engagement and create a true education partnership. Most of the local community have not travelled and perceive that the world is covered in rainforest and habitat loss is acceptable in the name of progress. To provide context, understanding and appreciation for Brazil's unique natural heritage, REGUA's environmental educators have developed, organized, and manage a variety of education programs. The education programs provide an opportunity to influence future thinkers and enlist them the conservation in action.

More information will be provided in this section at the final submission for validation.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

This is an ARR project that aims to reforest degraded lands, which are expected to remain degraded or to continue degraded in the absence of the Project.

Title of the methodology: Afforestation and reforestation of lands except wetlands (AR-ACM0003) Version 02.0

The methodology also refers to the latest approved versions of the following tools:

- A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01)
- A/R Methodological Tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)
- A/R Methodological Tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.0) - Change in carbon stocks in deadwood and litter has been excluded from calculation under the conservative approach under applicability condition. Hence this tool wasn't used.
- Methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.1)
- A/R Methodological Tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02.0)
- A/R Methodological Tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" (Version 01.1.0)

3.2 Applicability of Methodology

The selected methodology AR-ACM0003 Version 02.0 is applicable since the Project meets the following conditions:

Condition 01

The land subject to the Project activity does not fall in wetland category

Applicability

The lands belonging to the Project activity are terrestrial degraded or bare lands and the land does not fall in wetland category. All the new instances will be assessed to ensure that wetlands are not included in the Project. Each instance will be reported properly.

Condition 02

Soil disturbance attributable to the Project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the Project boundary:

(i) Land containing organic soils.

(ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to referred methodology.

Applicability

The land subjected to the Project activity does not contain organic soil and there were no land management practices carried out before the Project. Therefore, this condition is not applicable. A project activity applying this methodology shall also comply with the applicability conditions of the tools contained within the methodology and applied by the Project activity.

The Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01) is applicable under the following conditions:

Condition 01

Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.

Applicability

All the laws and regulations and compliancy are described under section 1.14 of the VCS PD. The VCS ARR grouped project activity described in the document is not lead to violation of any applicable law within the countries.

Condition 02

This tool is not applicable to small - scale afforestation and reforestation project activities.

Applicability

The Project is a large-scale grouped VCS ARR project activity. Therefore, this eligibility condition is not applicable.

A/R Methodological Tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)

Condition 01

The tool is applicable to all occurrence of fire within the Project boundary.

Applicability

Proper fire preventive measures have been applied by PP however in case there is an outbreak of fire, such fire will be reported, and non-CO_2 GHG emissions shall be reported. Hence this tool is applicable.

Condition 02

Non-CO_2 GHG emissions resulting from any occurrence of fire within the Project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥ 5% of the Project area.

Applicability

Non-CO_2 GHG emissions resulting due to site preparation shall be accounted under the above condition, hence applicability criteria have been met. Fire hazard will be monitored continuously.
A/R Methodological Tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02.0)

Condition 01

This tool is not applicable if the displacement of agricultural activities attributable to the Project activity is expected to cause any drainage of wetlands or peatlands.

Applicability

The lands belonging to the Project activity are terrestrial degraded or bare lands and the land does not fall in wetland category. All the new instances will be assessed to ensure that wetlands are not included in the Project. Each instance will be reported properly.

A/R Methodological Tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" (Version 01.1.0)

Condition 01

This tool is applicable when the areas of land, the baseline scenario, and the Project activity meet the following conditions:

(a) The areas of land to which this tool is applied:

i. Do not fall into wetland category; or

ii. Do not contain organic soils as defined in "Annex A: glossary" of the IPCC GPG LULUCF 2003;

iii. Are not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2;

(b) The A/R CDM project activity meets the following conditions:

(i) Litter remains on site and is not removed in the A/R CDM project activity; and

(ii) Soil disturbance attributable to the A/R CDM project activity, if any, is:

- In accordance with appropriate soil conservation practices, e.g. follows the land contours;
- Limited to soil disturbance for site preparation before planting and such disturbance is not repeated in less than twenty years.

Applicability

The Project is implemented on degraded or degrading lands and has satisfied the following applicability conditions.

1. The baseline studies revealed that the areas do not include any organic soils or wetlands.

2. Rate of loss of carbon stocks in mineral soils due to erosion within the Project area will not increase above the baseline rate since;

i. Soil disturbance from site preparation will not exceed 10% of the total project area

ii. Ploughing, if any, will follow the land contours.

3. Litter (including woody twigs, barks and leaves) shall remain on site. Hence the soil organic carbon pool has been conservatively neglected.

3.3 Project Boundary

Table: Carbon pools and sources selected for accounting GHG changes on the ARR activities

Source		Gas	Included?	Justification/Explanation
Baseline	Above and below ground biomass	CO_2	Yes	Above and below ground carbon stock in the baseline is presented in the isolated trees and grasses. The trees present in the Project Area before the Project was neither harvested, nor cleared, nor removed. These didn't suffer mortality because of competition from trees planted in the Project, or damage because of implementation of the Project activity and they are not inventoried along with the Project trees in monitoring of carbon stocks throughout the crediting period of the Project activity. Therefore, carbon stock in the baseline can be accounted as zero.
		CH_4	No	This is not a requirement of the methodology.
		N_2O	No	This is not a requirement of the methodology.
	Dead wood, litter and soil organic carbon	CO_2	Yes	It is expected that carbon stock in these pools will not decrease due to the implementation of the Project activity.
		CH_4	No	This is not a requirement of the methodology.
		N_2O	No	This is not a requirement of the methodology.
Project	Above and below ground biomass	CO_2	Yes	Carbon stock in above ground biomass is the major carbon pool subjected to Project activity and it is expected to increase due to the implementation of the Project activity. Carbon stock in below ground biomass is expected to increase due to the implementation of the Project activity.
		CH_4	No	This is not a requirement of the methodology.
		N_2O	No	This is not a requirement of the methodology.
	Dead wood, litter and soil organic carbon	CO_2	Yes	Carbon stock in these pools may increase due to implementation of the Project activity.
		CH_4	No	This is not a requirement of the methodology.
		N_2O	No	This is not a requirement of the methodology.

Figure: Project boundaries in the Guapiaçu watershed

3.4 Baseline Scenario

The baseline scenario of the lands is degraded and does not contain any forests 10-years prior to the planting start date. For the assessment the forest definition established by the Government of Brazil (minimum tree crown cover = 30 percent, minimum land area = 1 hectare, and minimum tree height = 5 meters) is used. These lands have followed a pattern of destructive land-use changes that reflects the broader trajectory of deforestation and anthropogenic changes in the Atlantic Forest. Upland areas, unsuitable for sugar cane, were cleared for coffee. Several decades of coffee exhausted the soils, and the plantations were abandoned. Production then went to cattle. These pastures are now extremely depleted. Even with the introduction of non-native grasses, the production levels are low across many upland areas. Worse, the grazing leads to erosion and degradation of water quality downstream.

3.5 Additionality

The proposed project is implemented with the active participation of local communities. The main objective is to conserve the lands. No commercial plantations are established. Therefore, carbon financing is an integral part for the long-term sustainability of the forests. A complete assessment of the additionality shall be provided at the final submission for validation using the A/R CDM

Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01).

3.6 Methodology Deviations

There are no deviations from the methodology.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline Emissions have been estimated in accordance with the selected methodology, Section 8.2 "Baseline Emissions". Baseline net GHG removals by sinks are calculated with the following equation:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} \quad \text{Equation (1)}$$

Where:

$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks in year *t*; t CO_2-e
$\Delta C_{TREE\_BSL,t}$	=	Change in carbon stock in baseline tree biomass within the Project boundary in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_BSL,t}$	=	Change in carbon stock in baseline shrub biomass within the Project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_BSL,t}$	=	Change in carbon stock in baseline dead wood biomass within the Project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta C_{LI\_BSL,t}$	=	Change in carbon stock in baseline litter biomass within the Project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

According to the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", carbon stock in trees ($C_{TREE,BSL}$) and shrubs ($C_{SHRUB,BSL}$) in the baseline can be accounted as zero if all of the following conditions are met:

(a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the Project activity;

(b) The pre-project trees do not suffer mortality because of competition from trees planted in the Project, or damage because of implementation of the Project activity, at any time during the crediting period of the Project activity;

(c) The pre-project trees are not inventoried along with the Project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the Project activity.

In the first instance and subsequent instances, all pre-project trees will be accounted under the monitoring system and the abovementioned conditions will be fulfilled. Therefore, the baseline emissions for the Project will be accounted as zero.

4.2 Project Emissions

As per the Section 5.5 of the methodology, GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the Project boundary, and transportation attributable to the Project activity shall be considered insignificant and therefore accounted as zero.

The actual net GHG removals by sinks shall be calculated using the following equation:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \quad \text{Equation (2)}$$

Where:

$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$GHG_{E,t}$	=	Increase in non-CO_2 GHG emissions within the Project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

As the Project does not considers emission of non-CO_2 GHG related to biomass burning, $GHG_{E,t}$ will be consider zero.

Considering that the Project will only consider above-ground biomass, below ground biomass and soil organic carbon as the carbon pools, the change in the carbon stocks in project, occurring in the selected carbon pools in year *t* shall be calculated as follows

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta SOC_{AL,t} \quad \text{Equation (3)}$$

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e

$\Delta C_{TREE\_PROJ,t}$ = Change in carbon stock in tree biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$\Delta SOC_{AL,t}$ = Change in carbon stock in SOC in project, in year *t*, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO_2-e

Change in carbon stock in trees between two points of time ($\Delta C_{TREE\_PROJ,t}$) will be estimated by direct estimation of change by re-measurement of sample plots, using the following equation

$$\Delta C_{TREE} = \frac{44}{12} \times CF_{TREE} \times \Delta B_{TREE}$$

.

Where;

ΔC_{TREE} = Change in carbon stock in trees between two successive measurements; t CO_2-e

CF_{TREE} = Carbon fraction of tree biomass; t CO_2-e

ΔB_{TREE} = Change in tree biomass within the biomass estimation strata; t d.m.

Changes in tree biomass within a defined stratum will be obtained using the following equation

$$\Delta B_{TREE} = A \times \Delta b_{TREE}$$

Where

ΔB_{TREE} = Change in tree biomass within the biomass estimation strata; t d.m.

A = Sum of areas of the biomass estimation strata; ha

Δb_{TREE}	=	Mean change in tree biomass per hectare within the biomass estimation strata; t d.m. ha^{-1}

Mean change in tree biomass per hectare within the biomass estimation strata will be obtained using the following equation

$$\Delta b_{TREE} = \sum_{i=1}^{M} w_i \times \Delta b_{TREE,i}$$

Where

Δb_{TREE}	=	Mean change in tree biomass per hectare within the biomass estimation strata; t d.m. ha^{-1}
w_i	=	Ratio of the area of stratum I to the sum of areas of biomass estimation strata (i.e. $w_i = A_i / A$); dimensionless
$\Delta b_{TREE,i}$	=	Mean change in carbon stock per hectare in tree biomass in stratum i; t d.m.ha^{-1}

Mean change in tree biomass per hectare in a stratum and the associated variance are estimated as follows:

$$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} \Delta b_{TREE,p,i}}{n_i}$$

Where;

$\Delta b_{TREE,i}$	=	Mean change in carbon stock per hectare in tree biomass in stratum i; t d.m.ha^{-1}
$\Delta b_{TREE,p,i}$	=	Change in tree biomass per hectare in plot *p* in stratum i; t d.m.ha^{-1}
n_i	=	Number of sample plots, in stratum I, in which biomass was re-measured

Carbon stock estimation uncertainty

Following the selected methodology, carbon stock estimation uncertainty needs to be calculated using the following equation

$$u_{\Delta C} = \frac{t_{VAL} \times \sqrt{\sum_{i=1}^{M} w_i^2 \times \frac{s_{\Delta,i}^2}{n_i}}}{|\Delta b_{TREE}|}$$

$u_{\Delta C}$	=	Uncertainty in ΔC_{TREE}
t_{VAL}	=	Two-sided Student's t-value for a confidence level of 90% and degrees of freedom equal to n – M, where n is total number of sample plots within the tree biomass estimation strata, and M is the total number of tree biomass estimation strata
$S^2{}_{\Delta,i}$	=	Variance of mean change in tree biomass per hectare in stratum *i*; (t d.m. ha^{-1})^2
n_i	=	Number of sample plots, in stratum *i*, in which tree biomass was re-measured

Estimation of variance will be calculated using the following equation:

$$s_{\Delta,i}^2 = \frac{n_i * \sum_{p=1}^{n_i} \Delta b_{TREE,p,i}^2 - \left(\sum_{p=1}^{n_1} \Delta b_{TREE,p,i}\right)^2}{n_i * (n_i - 1)}$$

Where;

$S^2{}_i$	=	Variance of mean tree biomass per hectare in stratum *i*; (t d.m. ha^{-1})^2
$\Delta b_{TREE,p,i}$	=	Change in tree biomass per hectare in plot *p* in stratum i; t d.m.ha^{-1}
n_i	=	Number of sample plots, in stratum *i*

If estimated uncertainty for the change in carbon stocks is over 10%, an uncertainty discount should be applied according to the provisions of Annex 2 of the methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" V4.2.

4.3 Leakage

Leakage is not accounted for this project as it is considered insignificant

4.4 Net GHG Emission Reductions and Removals

The ex-ante estimation of tree biomass and shrubs in the first group of instances and the Project was performed considering the best available public information and conservative values proposed by the selected methodology.

Root-shoot ratio, carbon fraction, CO_2/C ratio, increase of above-ground biomass and soil organic carbon values used are presented in the table below.

Parameter	Value	Source
Root-shoot ratio for trees	0.25 for Above-ground biomass <125 t/ha 0.33 for Above-ground biomass >125 t/ha	Table 4.4 of Chapter 4: Forest Lands of the report 'Guidelines for National Greenhouse Gas Inventories (IPCC, 2006)'
Carbon Fraction	0.47	Default value from CDM AR Tool 14
CO_2/C	44/12	Universal constant
Increase of above-ground biomass (ton of dry matter/ha/year)	1 < 10 years – 13.47 10 < 20 years – 10.0 > 20 years – 1.9	AZEVEDO, Aline Damasceno (2012). Composição florística e estoque de carbono em áreas de recuperação da Mata Atlântica na bacia do rio Guapiaçu, Cachoeiras de Macacu, RJ. 2012. Dissertação (Mestrado em Ciências Ambientais e Florestais – Conservação da Natureza). TABLE 3A.1.5 of the Good Practice Guidance for Land Use, Land-Use Change and Forestry – GPG-LULUCF (IPCC, 2003)
The rate of change in SOC stock in stratum i of the areas of land, in year t; t C ha-1 yr-1	< 20 years - 0.8 > 20 years - zero	A/R Methodological Tool 'Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' (Version 01.1.0)

Projection of areas to be implemented during the first 10 years in the first instance -

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Area (ha)	11.68	37.99	35.97	67.74	64.88	110.98	133.91	65.89	97.25	626.29

GHG Emission Reductions and Removals from first group of instances

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2017	34	0	0	34

2018	485	0	0	485
2019	1,692	0	0	1,692
2020	2,935	0	0	2,935
2021	5,091	0	0	5,091
2022	7,299	0	0	7,299
2023	10,912	0	0	10,912
2024	14,991	0	0	14,991
2025	17,188	0	0	17,188
2026	20,010	0	0	20,010
2027	19,923	0	0	19,923
2028	19,655	0	0	19,655
2029	19,438	0	0	19,438
2030	18,981	0	0	18,981
2031	18,590	0	0	18,590
2032	17,850	0	0	17,850
2033	17,002	0	0	17,002
2034	16,694	0	0	16,694
2035	16,058	0	0	16,058
2036	16,192	0	0	16,192
2037	15,941	0	0	15,941
2038	15,124	0	0	15,124
2039	14,351	0	0	14,351
2040	12,894	0	0	12,894
2041	11,500	0	0	11,500
2042	9,114	0	0	9,114
2043	6,235	0	0	6,235
2044	4,818	0	0	4,818
2045	2,727	0	0	2,727

2046	2,727	0	0	2,727
2047	2,727	0	0	2,727
2048	2,727	0	0	2,727
2049	2,727	0	0	2,727
2050	2,727	0	0	2,727
2051	2,727	0	0	2,727
2052	2,727	0	0	2,727
2053	2,727	0	0	2,727
2054	2,727	0	0	2,727
2055	2,727	0	0	2,727
2056	2,727	0	0	2,727
Total	**383,724**	0	0	**383,724**

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,t}$
Data unit	t CO_2e
Description	Baseline net GHG removals by sink in year t
Source of data	N/A
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Assumed to be zero as per the AR tool
Purpose of Data	Used for calculation of baseline emission removals
Comments	N/A

Data / Parameter	CF
Data unit	t C (t d.m.)$^{-1}$
Description	Carbon fraction of tree biomass
Source of data	IPCC LULUCF GPG (2006) default value of 0.47 t C / t d.m.
Value applied	*0.47*
Justification of choice of data or description of measurement methods and procedures applied	The default value of 0.47 is used as there is no available transparent and verifiable information to justify a different value for the Project area and species
Purpose of Data	• *Determination of baseline scenario (AFOLU projects only)* • *Calculation of project emissions*
Comments	*N/A*

Data / Parameter	R_j
Data unit	Dimensionless
Description	Root-shoot ratio for tree species
Source of data	Table 4.4 of Chapter 4: Forest Lands of the report 'Guidelines for National Greenhouse Gas Inventories (IPCC, 2006)'
Value applied	0.25 for Above-ground biomass <125 t/ha 0.33 for Above-ground biomass >125 t/ha
Justification of choice of data or description of measurement methods and procedures applied	Requested by the methodology and the abovementioned tool
Purpose of Data	• *Determination of baseline scenario (AFOLU projects only)* • *Calculation of project emissions*
Comments	*N/A*

Data / Parameter	$b_{TREE,i}$
Data unit	ton of dry matter/ha/year
Description	Mean tree Above ground biomass per hectare in stratum i
Source of data	AZEVEDO, Aline Damasceno (2012). Composição florística e estoque de carbono em áreas de recuperação da Mata Atlântica na bacia do rio Guapiaçu, Cachoeiras de Macacu, RJ. 2012. Dissertação (Mestrado em Ciências Ambientais e Florestais – Conservação da Natureza). Table 3A.1.5 of the Good Practice Guidance for Land Use, Land-Use Change and Forestry – GPG-LULUCF (IPCC, 2003)
Value applied	1 < 10 years – 13.47 10 < 20 years – 10.0 > 20 years – 1.9
Justification of choice of data or description of measurement methods and procedures applied	The value of 13.47 used as the average annual increase up to 10 years is taken from inventories carried out in the Project areas (reference provided) The Good Practice Guidance for Land Use, Land-Use Change and Forestry – GPG-LULUCF (IPCC, 2003) provides values for estimating accumulations annual biomass above ground in Table 3A.1.5. According to forest types presented in this Table, the Project is located in areas with a precipitation above 2000 mm per year. As mentioned in the general section in the item climate the region presents average annual precipitation above 2000 mm, in the item flora in the same general section, project intervention area is characterized by the formation of forest. Therefore, the values of 10 t d.m./ha/year were used for years 11-20 and 1.9 t d.m./ha/year was used for year 21 onwards. To be conservative, the carbon accumulation of above-ground biomass in the first year that following planting will be considered zero.
Purpose of Data	• *Determination of baseline scenario (AFOLU projects only)* • *Calculation of ex-ante project emission removals*
Comments	*N/A*

Data / Parameter	dSOCt
Data unit	tC/ha/year
Description	The rate of change of SOC within the Project boundary, in year *t*
Source of data	Default value based on A/R Methodological Tool 'Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' (Version 01.1.0)

Value applied	< 20 years - 0.8 > 20 years - zero
Justification of choice of data or description of measurement methods and procedures applied	Default value is used
Purpose of Data	• *Calculation of ex-ante project emission removals*
Comments	*N/A*

5.2 Data and Parameters Monitored

Data / Parameter	A_i
Data unit	*ha*
Description	Area of tree biomass stratum *i*
Source of data	Field measurement
Description of measurement methods and procedures to be applied	All areas planted will be tracked in the field using GPS, which is a standard procedure to be followed for both baseline and monitoring inventory. Standard operating procedures (SOPs) for project monitoring coherent with the best practices for forest inventories are applied.
Frequency of monitoring/recording	Initial measurement is done before planting starts, then the areas will be monitored annually *or at each verification*
Value applied	Areas considered given in Section 1.12
Monitoring equipment	GPS (Garmin), GPS in smartphone, ArcGIS or QGIS software
QA/QC procedures to be applied	Team members involved in the monitoring have been made aware of accurate measurements, and have been provided with training on GPS/GIS application
Purpose of data	Calculation of project emission removals
Calculation method	Measure the boundary of planting using the GPS
Comments	N/A

Data / Parameter	$A_{PLOT,i}$
Data unit	ha
Description	Area of a sample plot in stratum *i*
Source of data	Field measurement
Description of measurement methods and procedures to be applied	All areas planted will be tracked in the field using GPS, which is a standard procedure to be followed for both baseline and monitoring inventory. Sample plots of 10 m x 10 m (each at 0.01 ha) will be fixed using random sampling within the Project boundary after calculating the number of sample plots needed for each stratum.
Frequency of monitoring/recording	Monitoring is done at the end of every monitoring period, at least every 5 years
Value applied	0.01
Monitoring equipment	Measuring tape, GPS
QA/QC procedures to be applied	Field teams are trained in all inventory procedures including layout of plots as well as GPS and GIS applications. Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible.
Purpose of data	Calculation of project emission removals
Calculation method	When plots are established, the location is identified using GPS and recording. At the end of every monitoring period, growth measurements will be taken, and the staff will visit each plot using the pre-recorded GPS coordinates and remeasure the plot size to determine the area
Comments	N/A

Data / Parameter	$Instance_{ID}$
Data unit	*Dimensionless*
Description	Identification code for each instance
Source of data	Project database
Description of measurement methods and procedures to be applied	The Project database will assign an ID code for each new instance register on the system. This ID will be used in all documents and tools related to that instance during the whole project implementation process

Frequency of monitoring/recording	Once at the beginning of the eligibility process of each potential instance.
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross check with the Project database on the number of instances entered the grouped project
Purpose of data	• Calculation of project carbon sequestration • To assign the Project benefits to the relevant instance
Calculation method	*N/A*
Comments	N/A

Data / Parameter	n_i
Data unit	Dimensionless
Description	Number of sample plots in stratum *i*
Source of data	Calculated
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Monitoring is done at the end of every monitoring period, at least every 5 years
Value applied	The first monitoring has not yet been concluded
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emission removals
Calculation method	Calculated as specified in the methodological tool AR-AM Tool 03 Version 2.1.0 [“Calculation of the number of sample plots for measurements within A/R CDM project activities”]
Comments	N/A

Data / Parameter	DBH
Data unit	cm
Description	Diameter at breast height of the tree
Source of data	Field measurement
Description of measurement methods and procedures to be applied	DBH is measured at 1.3 m height along stem using a DBH tape. During the initial stages of plant growth, it is not possible to measure the diameter at 1.3 m height using the DBH tape as their height would be much less than that. Therefore, the basal diameter (D_{10}) or D_{30} will be measured using a calliper.
Frequency of monitoring/recording	Monitoring is done at the end of every monitoring period, at least every 5 years
Value applied	N/A
Monitoring equipment	DBH tape / Diameter tape
QA/QC procedures to be applied	Field teams are trained in all inventory procedures as well as taking accurate measurements. Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible. Measurements will be taken by 2 people, where one person measures and reads the value out loud to the recorder and the recorder will read the recorded value out loud to the person measuring for confirmation. This help reduce errors. A pole with 1.3 m height mark will be used to determine the 1.3 m level of the tree from the bottom for taking DBH readings when the plants are tall enough. The Project shall select 25% of the data sheets and cross check with actual field measurements during his visit to the site, after which he will sign off on the data sheets as true sheets.
Purpose of data	Calculation of project emission removals
Calculation method	N/A
Comments	N/A

Data / Parameter	H
Data unit	m
Description	Height of the tree
Source of data	Field measurement

Description of measurement methods and procedures to be applied	First the trunk is determined by selecting the start of the second strongest/thickest branch from top. In case there are two equally thick branches the second one is determined as the start of the trunk. The height of the tree is then measured using a PVC or bamboo pole.
Frequency of monitoring/recording	Monitoring is done at the end of every monitoring period, at least every 5 years
Value applied	N/A
Monitoring equipment	PVC / bamboo pole, measuring tape / sunto altimeter
QA/QC procedures to be applied	Field teams are trained in all inventory procedures as well as taking accurate measurements. Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible. Measurements will be taken by 2 people, where one person measures and reads the value out loud to the recorder and the recorder will read the recorded value out loud to the person measuring for confirmation. This help reduce errors. To measure the height of each mangrove tree: • The height pole will be held up vertically directly below the highest point of the tree • Measure the height of the tree to the nearest 10 cm, based on the known length of the pole • Record the result The pole will be divided into 1-meter intervals and each point will be marked with red tape. Yellow tape will be used to mark every 0.5 m. When the pole is held up as mentioned above, the marks on the pole will be used to determine the point on the pole that indicates the height of the tree. Then, the pole will be laid down on the ground and the length from the bottom of the pole to the determined point will be measured using a measuring tape to identify the height of the tree. In situations where the tree canopy is higher than 3 m, a clinometer will be used to increase the accuracy. The Project director shall select 25% of the data sheets and cross check with actual field measurements during his visit to the site, after which he will sign off on the data sheets as true sheets.
Purpose of data	Calculation of project emission removals
Calculation method	N/A
Comments	N/A

Data / Parameter	T
Data unit	Years
Description	Time period elapsed between two successive estimations of carbon stock in a carbon pool
Source of data	N/A
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	N/A
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emission removals
Calculation method	If the two successive estimations of carbon stock in a carbon pool are carried out at different points of time in year t_2 and t_1, (e.g. in the month of September in year t_1 and in the month of July in year t_2), then a fractional value will be assigned to T
Comments	N/A

5.3 Monitoring Plan

Monitoring will be organized according to the AR-ACM0003 tool. All the data that are mentioned in this section will be collected and archived electronically and kept for 3 years after the end of last crediting period. The Monitoring Plan shall be developed by Erin Willigan from Saving Nature and Suraj A. Vanniarachchy from Natural Capital Partners who are also responsible in the preparation of the VCS PD.

The following monitoring plan has been designed for the proposed grouped project aiming to ensure a viable and robust tracking of the Project implementation and performance and to increase the carbon stocks in all instances. The plan considers all applicability conditions set by the methodology and allows the verification of the change in carbon stocks in the selected pools and the monitoring of project emissions.

The monitoring is divided in the following:

1) Monitoring the integration of new plots (new instances) of the Project,

2) Monitoring the implementation and project activities
3) Monitoring of GHG Emission and during the lifetime of the Project (including emissions at the Project implementation and leakage if the threshold is reached).

1. **Monitoring the integration of new plots (new instances) of the Project.**

The monitoring of the integration of new instances will start with a field visit, photo-georeferencing each potential parcel to be part of an instance, assessing vegetation cover, land use and the presence of trees. The georeferenced tool format will be applied for data collection in the field as well as the status tool for new producers including questions on land use in the instance area and economic activities and information necessary to assess the potential of pre-project activities displacement.

Information collected in the field will be transferred to REGUA, recorded in physical formats and all entries recorded in the Project database, supported by a GIS software.

Within the database, potential areas are identified as being accepted, rejected or waiting for approval. If data of a particular parcel includes unresolved anomalies, the area will not be accepted until new data is available. Only instances accepted may obtain approval to start the implementation of project activities under the Project.

2. **Monitoring the implementation and project activities**

Monitoring of the implementation of the Project will ensure the proper development of the Project according to the design document and verify the implementation of the management plan established. This step will be carried out REGUA with the local communities. All activities performed in each parcel / instance and stratum will be recorded and relevant parameters quantified, using a predefined format, including the following:

- Site preparation: Date of operation, tools used.
- Planting: Date of planting, project activity stratum (confirmation of planning scheme) - the number of trees planted will be calculated from the data obtained.
- Geographic boundary of the Project: After plantations are established the Project boundary (instances boundary), and strata boundaries, will be re measured and adjusted. Areas of each stratum will be recalculated and adjusted accordingly.
- Tree survival rate and replacement of sapling in the first year
- Disturbances: date, location, kind of disturbance, affected area (using GPS), significance, whether anthropogenic or natural (disease, insects, fire, unplanned cuts, etc.). All substantial disturbances

(any event that results in a loss of more than 5% of carbon stocks in pools) from human or natural causes will be documented on an annual basis and the biomass lost will be measured by the Project crew.

On every site visit to the instance, the monitoring team will mark a GPS point and link it to a georeferenced photo. The sampling will be carried out in such a way that it ensures established principles of forest inventory and management best practice are put into practice.

Processes for collection of data and parameters

As per the methodology, all data collected during each monitoring period will be stored in hardcopy and softcopy formats for a period of two years after the end of each crediting period. Field measurements will be recorded on standardized formats to ensure accurate data collection. Data will be collected according to the methods stated in Section 5.2, following all stated QA/QC procedures via trained personnel, where the verification system is interlocked with the QA/QC procedures. All parameter data collection frequency, i.e. the monitoring period will be set to at minimum once a year and at maximum every five years. Calibration of equipment will be done under the directive of the Project director as deemed necessary. This is mainly necessary for the GPS/GIS devices.

Project boundary

Project boundary is initially mapped and stratified using GPS, field surveys, satellite maps and land use maps. The maps created ex-ante are not expected to change, however, they will be updated if necessary, as the Project planting progresses. Project boundary shall be examined using GPS every year as a control mechanism for encroachment and to ensure that the correct boundary is maintained for every monitoring period.

Existing plants

Any existing plants have not been accounted for as part of the carbon stock and will be allowed to grow naturally. They will be monitored continuously throughout the monitoring period to ensure they are not affected by any of the Project activities. The existing plants will be recorded during planting by the survey team. If there are any existing plants within the sample plots, these will also be recorded. Similarly, these plants will not be removed and will be monitored throughout the crediting period.

3. Monitoring the greenhouse gas emission and removal

Information will be monitored periodically to maintain accuracy data of carbon removal. Monitoring comprises collecting information, recording, compilation, and analysis to make estimations and report GHG emissions and removals. Monitoring activities will ensure that commonly established principles of forest inventory and management are put into practice. All the monitoring will be done according to the selected methodology and related tools and with the respect of the confidence interval at 90% with a margin of error of ± 10%.

Sampling plan and size

AR-AM Tool 03 Version 2.1.0 will be used to determine the number of samples required for this project (the overall project as well as per stratum. For the expected precision, the default value required by the methodology of 90% will be applied, i.e. the margin of error is expected to be 10% or less.

The sampling design will also be stratified according to the year of planting and once established, it will be permanent throughout the lifetime of the Project. The sample plots will be used to monitor changes carbon stock at the required precision level.

Plots will be selected based on AR-AM Tool 03 Version 2.1.0 to ensure that sample plots are evenly distributed by weighting the sample plots according to stratum, as well as the random placement of sample plots.

Internal auditing and QA/QC procedures

Procedures to be followed for QA/QC are as follows:

- Collecting reliable field measurements

  The team involved so far has been trained in data collection and GIS application as applicable. In addition, some members already have past experience. The team is aware of future data collection requirements from sample plots that are yet to be set up. Any new staff will also be trained adequately, and the PP has experience in training personnel for similar projects. The Project uses the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003) as the main reference document for all monitoring activities.

- Verifying the methods used to collect field data

  The data collected by the team will be verified by taking random checks from stands, including their re-measurement by a senior member of the monitoring team. Any errors, if present, will be corrected and recorded for each stratum. In case of more than 25% error in the sample plots checked, the entire stratum will be remeasured and recorded again.

- Verifying data entry and analysis techniques

  Reliable carbon estimates require proper entry of data into the data analysis spreadsheets. Possible errors in this process will be minimised by cross checking these entries. In order to ensure more precise output, internal tests will be incorporated into the spreadsheets to ensure that the data are realistic. Communication between all

personnel involved in measuring and analysing data will be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis.

- Data maintenance and archiving

  Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) is an important component of the work. Data archiving takes several forms and copies (electronic and paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports are stored in PP's office. These monitored data will be archived for 2 years following the end of the crediting period as well (note that this project has a renewable crediting period).

APPENDIX