

SUMATRA MERANG PEATLAND PROJECT (SMPP)

MONITORING REPORT



**FOREST
CARBON**



Document Written by Forest Carbon

Project Title	Sumatra Merang Peatland Project (SMPP)
Project ID	1899
Version	Version 1.4
Report ID	20211221
Date of Issue	21-Dec-2021
Project Location	South Sumatra, Indonesia
Project Proponent(s)	Primary Contact Forest Carbon Pte Ltd Contact Name: Jeffrey Chatellier, CEO Email: j.chatellier@forestcarbon.com Phone: +62 21 5740817 PT Global Alam Lestari Contact Name: Reagen Pangestu, President Director Email: reagen.pangestu@globalalamlestari.com Phone: +62 878 83632218
Prepared By	Forest Carbon
Validation/Verification Body	AENOR Internacional, S.A.U. Contact Name: Jose Luis Fuentes Address: Génova 6. 28004 Madrid- Spain. Email: jfuentes@aenor.com Phone: +34 914326000 Website: aenor.com
GHG Accounting/ Crediting Period	January 1 st , 2016 – December 31 st , 2062; 47-year lifetime
Monitoring Period of this Report	January 1 st , 2020 – December 31 st , 2020; 1-year third monitoring
History of CCB Status	Date of Validation: 26 November 2019 Date of 1st Verification: 26 November 2019 Date of 2nd Verification: 30 October 2020

Gold Level Criteria

The SMPP aims to generate exceptional benefits for climate and biodiversity, under both the Verified Carbon Standard (VCS) and Climate, Community, and Biodiversity (CCB) standards (Third Edition).

Climate:

The SMPP will prevent the emission of an average of 1,338,569 tones CO₂-e annually through the protection and restoration of a degraded peatland area. This will be achieved through the restoration of the project area's hydrology through the construction of dams to block canals that are currently draining the project area. Detailed information about the SMPP's climate benefits generated through project activities can be found throughout Section 3.3.1 (with project activities described in Project Description (PD) Section 2.1.1).

Biodiversity: The SMPP is protecting a critical habitat for 3 critically endangered species, 10 endangered species, and 22 vulnerable species. The species protected within the SMPP project area include the endemic Sumatran tiger (*Panthera tigris* ssp. *Sumatrae*), the Sumatran Surili (*Presbytis melalophos*), and the Sambar deer (*Rusa unicolor*), as well as other important species such as the sun bear (*Helarctos malayanus*), the agile gibbon (*Hylobates agilis*), and the rhinoceros hornbill (*Buceros rhinoceros*). The SMPP protects the area from further degradation and facilitates natural regeneration, which resulted in an increase of forest cover by ~10% during this monitoring period. This regeneration strengthens wildlife corridors to neighboring national parks to ensure a more ecologically intact habitat that these species can depend on. Detailed information about the SMPP's biodiversity benefits can be found throughout Section 1 (with project activities related to biodiversity described in PD Section 2.1.11.6).

A summary of these biodiversity and climate benefits is available in Section 1.

Table of Contents

1	Summary of Project Benefits	13
1.1	Unique Project Benefits.....	13
1.2	Standardized Benefit Metrics	14
2	General	24
2.1	Project Description	24
2.2	Project Implementation Status	34
2.3	Stakeholder Engagement.....	38
2.4	Management Capacity	44
2.5	Legal Status and Property Rights	47
3	Climate	52
3.1	Monitoring.....	52
3.2	Quantification of GHG Emission Reductions and Removals	65
3.3	Optional Criterion: Climate Change Adaptation Benefits	104
4	Community.....	109
4.1	Net Positive Community Impacts	109
4.2	Other Stakeholder Impacts	112
4.3	Community Impact Monitoring	113
4.4	Optional Criterion: Exceptional Community Benefits	123
5	Biodiversity.....	124
5.1	Net Positive Biodiversity Impacts	124
5.2	Offsite Biodiversity Impacts.....	132
5.3	Biodiversity Impact Monitoring	133
5.4	Optional Criterion: Exceptional Biodiversity Benefits	147
6	Additional Project Implementation Information	153
7	Additional Project Impact Information	153
8	References	154
9	List of Annexes	157

List of Figures

Figure 1. Schematic workflow of the GHG data collection, data management, and annual reporting	59
Figure 2. Data collection, QA/QC, and processing workflow.	60
Figure 3. SMPP Causal model for SMPP biodiversity program.....	129

List of Maps

Map 1. Location of the SMPP area in Sumatra, Indonesia.	26
--	----

Map 2. Location of the SMPP Project Area and Project Zone.	27
Map 3. Forest cover benchmark in 2020.	63
Map 4. Location of the dip wells in the project area.	64
Map 5. Location of the project area and the six reference regions selected for proxy areas.	70
Map 6. Baseline scenario map of the project area.	73
Map 7. Baseline stratification of the project area based on emission characteristics.	75
Map 8. Fire occurrence suitability that predicted risk probability.	83
Map 9. Planned and completed canal blocks in late 2019 through early 2020.	87
Map 10. Land cover classification in the project area for 2020.	90
Map 11. Stratification based on emission characteristics for WRC in 2020.	92
Map 12. Map of SMPP area showing the location of point count transects during this monitoring period.	136
Map 13. Map of SMPP area showing the location of transects with nested vegetation plots during this monitoring period.	139
Map 14. Map of SMPP area showing camera traps surveyed during this monitoring period.	144

List of Tables

Table 1. Summary of applicability conditions.	28
Table 2. Key milestones in the SMPP's development and implementation.	34
Table 3. Summary of non-permanence risk analysis for the SMPP.	37
Table 4. Summary of stakeholder consultations	40
Table 5. Actions to mitigate potential occupational risks	43
Table 6. Key skills required to implement the project activities.	44
Table 7. Laws and regulations specific to the PAN/RAP license and the compliance activities.	50
Table 8. Roles and responsibilities of the monitoring team members.	61
Table 9. Reference region selection criteria.	67
Table 10. Summary of suitable reference regions.	69
Table 11. Baseline stratification of peatlands and water bodies based on emission characteristics.	74
Table 12. Land use strata change in the baseline scenario for ARR	75
Table 13. Variables used for quantifying baseline GHG emissions from microbial decomposition of peat, peat burnings and dissolved organic carbon from water bodies.	76
Table 14. A summary of the annual GHG emissions from peat microbial decomposition, uncontrolled peat burning and water bodies in the project area under the baseline scenario in 2020.	78
Table 15. The stratification used for the calculation of GHG emissions per stratum, the area per each stratum and the CO ₂ and CH ₄ default factors used for the specific land-use.	79
Table 16. GHG emissions from microbial decomposition of peat in the baseline.	80
Table 17. Total GHG emissions from uncontrolled peat burning in the baseline scenario per stratum.	84
Table 18. Annual GHG emissions from peat burning in the baseline scenario.	84
Table 19. GHG emissions from Dissolved Organic Carbon in water bodies in the baseline scenario.	85

Table 20. The assumed annual planting and harvesting under ARR activities within the monitoring period in the baseline scenario.	85
Table 21. Baseline net GHG removal from ARR activities in project area within monitoring period in the baseline scenario.	86
Table 22. Summary of accuracy in the error matrix	89
Table 23. MODIS and VIIRS hotspots (high confidence, i.e. $\geq 80\%$) with records detection in the project area showing no detected hotspots in 2020.	90
Table 24. Stratification of project area based on emission characteristics from peat and water bodies in 2020.	91
Table 25. A summary of the annual GHG emissions from peat and water bodies under the project scenario in 2020.....	93
Table 26. The stratification used for the calculation of GHG emissions per stratum, the area per each stratum and the CO ₂ and CH ₄ default factors used for the specific land-use.....	94
Table 27. GHG emissions from microbial decomposition of peat in the project scenario in 2020.	95
Table 28. GHG emissions from Dissolved Organic Carbon in water bodies in the project scenario in 2020.	96
Table 29. Project scenario net GHG removals by ARR activity within the project period in 2020.....	98
Table 30. Applicability of leakage modules.....	99
Table 31. Comparison between the estimated and the actual parameters in 2016-2020.	100
Table 32. Deforested areas and leakage calculations as occurred in HTI concessions (ha), based on the MoEF land use land cover dataset. Values in parentheses = deforestation detected in HTI-wood fiber concessions.	101
Table 33. Deforested areas and leakage calculations as occurred in HTI concessions (ha), based on the global tree cover loss dataset. Values in parentheses = deforestation detected in HTI-wood fiber concessions.	101
Table 34. Total net GHG emission reductions of the WRC project activities.	103
Table 35. Total net GHG removals of the ARR project activities.....	103
Table 36. Total net GHG emissions from WRC and ARR project activities.	103
Table 37. Annual non-permanence risk buffer withholding.....	104
Table 38. Calculation of estimated verified carbon units.	104
Table 39. Climate change adaptation benefits from project activities.	105
Table 40. Impacts for specific community groups in the SMPP during the monitoring period	109
Table 41. Details of the SMPP's community monitoring plan with results from the 2020 monitoring period.	114
Table 42. Direct changes to biodiversity during the 2020 monitoring period.....	124
Table 43. Indirect changes to biodiversity during the 2020 monitoring period.	126
Table 44. Negative offsite biodiversity impacts and mitigation measures.	132
Table 45. Summary of biodiversity monitoring in 2020.....	134
Table 46. Summary of biodiversity metrics assessed for bird species surveyed in point transect surveys in year 2020.	137
Table 47. Density of the 17 bird trigger species in individuals per ha for in year 2020.	138

Table 48. Summary of biodiversity metrics assessed for tree and non-tree plant species surveyed in nested vegetation plot surveys in year 2020.	139
Table 49. Density of individuals per ha of each tree maturity category, and average fern cover (%) and average shrub cover (%) in year 2020.	141
Table 50. Tree trigger species abundance and density per hectare (ha) for each tree maturity category for all trigger species observed during vegetation plots in year 2020.	141
Table 51. Summary of biodiversity metrics assessed for mammal species surveyed in camera trap surveys in year 2020.	145
Table 52. Relative Abundance Index (RAI) and Naïve Occupancy by year for each of the 18 mammal trigger species recorded in the project area, 12 of which were recorded during this monitoring period.	146
Table 53. Trigger species in the SMPP.	148

List of Acronyms

Abbreviation	Meaning
A/R	Afforestation/Reforestation
AFOLU	Agriculture, Forestry, and Other Land-Use
AGB	Aboveground biomass
ANR	Assisted Natural Regeneration
ARR	Afforestation, Reforestation, and Revegetation
BD	Bulk Density
BRG	<i>Badan Restorasi Gambut</i> / Peat Restoration Agency
C	Carbon
CCB(A)	Climate, Community, and Biodiversity (Alliance)
CDM	Clean Development Mechanism
CE	Total Community Engagement
CH ₄	Methane
CIFOR	Center for International Forestry Research
CIRAD	<i>Centre de cooperation Internationale en recherche agronomique pour le developpement</i> / French Agricultural Research Centre for International Development
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO ₂	Carbon dioxide
CO ₂ -e	Carbon dioxide equivalents
CPUE	catch per unit effort
CR	Critically Endangered
CUPP	Conservation of Undrained and Partially Drained Peatland
DBH	Diameter at Breast Height
DEL	Drainability Elevation Limit
DM	Dry Matter
dNDVI	Differencing Normalized Difference Vegetation Index

Abbreviation	Meaning
DOC	Dissolved Organic Carbon
DRM	Disaster Risk Management
DTM	Digital Terrain Model
EN	Endangered
ENSO	El Niño/Southern Oscillation
ER	Emission Reduction
ESA	European Space Agency
EVI	Enhanced Vegetation Index
EWS	Early Warning System
F	Fire
FAO	Food and Agriculture Organization of the United Nations
FCPA	US Foreign Corruption Practice Act
FGD	Focus Group Discussion
FPIC	Free, Prior, and Informed Consent
FSC	Forest Stewardship Council
FV	Total Financial Viability
G	Geological Events
GFOI	Global Forest Observations Initiative
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GMO	Genetically Modified Organism
GOFC-GOLD	Global Observation for Forest Cover and Land Dynamics
HCV	High Conservation Value
HP	<i>Hutan Produksi</i> / Production Forest
HR	Human Resources

Abbreviation	Meaning
HTI	<i>Hutan Tanaman Industri</i> / Industrial Plantation Forest
INCAS	Indonesian National Carbon Accounting System
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IUP PAN/RAP	<i>Izin Usaha Pemanfaatan Penyerapan Karbon dan/atau Penyimpanan Karbon</i> / Carbon storage and sequestration license
LiDAR	Light Detection and Ranging
LT	Total Land Tenure
MNDWI	Modified Normalized Difference Water Index
MODIS	Moderate-Resolution Imaging Spectroradiometer
MoEF	Indonesian Ministry of the Environment and Forestry
MRPP	Merang REDD Pilot Project
MRV	Monitoring, Reporting, and Verification
MSAVI	Modified Soil Adjusted Vegetation Index
MTVI	Modified Triangular Vegetation Index
N ₂ O	Nitrous oxide
NBR	Normalized Burn Ratio
NBR2	Normalized Burn Ratio 2
NDC	Nationally Determined Contribution
NDMI	Normalized Difference Moisture Index
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
NTFP	Non-Timber Forest Products
NER	Net GHG Emission Reductions
NGR	Net GHG Emission Removals
OC	Total Opportunity Cost

Abbreviation	Meaning
OLI	Landsat 8 Operational Land Imager
ON	Other Natural Risk
PC	Total Political
PCA	Principal Component Analysis
PD	Project Description
PD	Pest and Disease Outbreak
PDT	Peat Depletion Time
PERADI	<i>Perhimpunan Advokat Indonesia</i> / Indonesian Bar Association
PKBM	<i>Pusat Kegiatan Belajar Masyarakat</i> / Learning Centers
PL	Total Project Longevity
PM	Total Project Management
PRA	Participatory Rural Appraisal
PT GAL	PT Global Alam Lestari
PT RHM	PT Rimba Hutani Mas
PT WLMS	PT Wahana Lestari Makmur Sukses
QA/QC	Quality Assurance/Quality Control
RDP	Rewetting of Drained Peatland
REDD	Reduced Emissions from Deforestation and forest Degradation
REDD+	Reducing Emissions from Deforestation and Degradation plus carbon stock enhancement
RTE	Rare, threatened, or endangered (species or ecosystems)
SAVI	Soil Adjusted Vegetation Index
SD	<i>Sekolah Dasar</i> / Elementary School
SMA	<i>Sekolah Menengah Atas</i> / High School
SMART	Spatial Monitoring and Reporting Tool
SMP	<i>Sekolah Menengah Pertama</i> / Junior High School

Abbreviation	Meaning
SMPP	Sumatra Merang Peatland Project
SOP	Standard Operation Procedure
SRTM	Shuttle Radar Topography Mission
TIRS	Landsat 8 Thermal Infrared Sensor
tPDT	time (years) until PDT is reached, i.e. all peat soil is depleted
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USGS	U.S. Geological Survey
VCS	Verified Carbon Standard
VCU	Verified Carbon Unit
VIIRS	Visible Infrared Imaging Radiometer Suite
VU	Vulnerable
W	Extreme Weather
WRC	Wetlands Restoration and Conservation

1 SUMMARY OF PROJECT BENEFITS

This section highlights some of this project's important benefits. Section 1.1 (Unique Project Benefits) should be considered in conjunction with the project's conceptual model. Section 1.2 provides estimates on quantifiable benefits that will be generated over the lifetime of the project.

1.1 Unique Project Benefits

The Sumatra Merang Peatland Project (SMPP) aims to generate a variety of project benefits throughout the lifetime of the project. This section outlines unique project benefits that are not captured in Section 1.2 below.

Outcome or Impact	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
Hydrological function restoration	- The project successfully completed the construction of an additional 91 dams, bringing the total to 188 peat compaction dams across the concession. Consequently, the installation created a positive impact by raising the water table levels throughout 2020. - In October 2020 the project installed 66 dip well sensors to measure water table level in near real-time. The measurement data from the field is then fed to an online dashboard monitoring system.		188 peat compaction dams were installed across the project area. 87 temporary boxed dams installed - Continuous monitoring of the water table level using dip well and smart sensors.
Fire prevention and fire threat reduction	In 2020, the project detected zero fire hotspots in the SMPP area (using a Satellite-based early warning system). SMPP forest patrol teams responded to two hotspot instances outside of the project area during 2020. The occurrence of hotspots in the project zone has reduced significantly compared to the previous monitoring period.	PD Section 2.1.11 and 4.3.1 in this document	- Reduction in human activity within the SMPP area which has led to reduced fire risk. - Satellite-based early warning system (EWS) to detect and mitigate fires as early as possible - Forest patrols focused on detecting and identifying hotspot fire threats, and continuously monitoring

Outcome or Impact	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	- No illegal activity was detected during the monitoring period. - The project facilitated fire safety trainings for each SMPP field staff member upon their induction into the project. - Continued engagement with neighboring concessions for fire safety coordination and joint training. A new MoU with the neighboring concession PT RHM establishes a mandate to collaborate on fire prevention and control, which was formally signed in early October 2020. This agreement strengthens the northern boundary of the project for fire prevention. This MOU now compliments the previously signed MoU with PT WLMS to protect the southern boundary. - Reduction in human activity within the SMPP area which has led to reduced fire risk		for fire in the SMPP and wider area. - Fire training for SMPP staff working inside the project area; and - Fire response training for nearby concessions and SMPP stakeholders. - Continued engagement with neighboring concessions on fire safety coordination and joint training. Through our project efforts, we aim to continue minimize the impact of fires within the project area and maximize fire resilience in the SMPP and surrounding landscape. These efforts will allow natural forest ecosystems to recover, provide extended habitats that support key species, and limit the negative impacts to health and livelihoods from smoke haze and air pollution.

1.2 Standardized Benefit Metrics

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
GHG emission reductions or removals	Net estimated emission removals in the project area, measured against the without-project scenario	(25,430)	3.2.4.3	(321,524)

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	Net estimated emission reductions in the project area, measured against the without-project scenario	1,051,401	3.2.4.2	3,459,475
Forest ¹ cover	For REDD ² projects: Number of hectares of reduced forest loss in the project area measured against the without-project scenario	N/A	N/A	N/A
	For ARR ³ projects: Number of hectares of forest cover increased in the project area measured against the without-project scenario	0 Hectares (Ha) Was not measured in the monitoring period.	3.1.3.1.7	0 Hectares (Ha) Has not been measured yet during the project.
Improved land management	Number of hectares of existing production forest land in which IFM ⁴ practices are expected to occur as a result of the project's activities, measured against the without-project scenario	N/A	N/A	N/A
	Number of hectares of non-forest land in which improved land	N/A	N/A	N/A

¹ Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*)

² Reduced emissions from deforestation and forest degradation (REDD) - Activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*)

³ Afforestation, reforestation and revegetation (ARR) - Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*)

⁴ Improved forest management (IFM) - Activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood and fuelwood (*VCS Program Definitions*)

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	management practices are expected to occur as a result of the project's activities, measured against the without-project scenario			
Training	Total number of community members who have improved skills and/or knowledge resulting from training provided as part of project activities	132 households which with either expectant women or mothers with babies received training on identifying the dangers of stunting and how to avoid them. - Five people from the two villages, Muara Merang and Kepayang, were trained to assemble and install rainwater catchment systems as a livelihoods opportunity. 50 households received training on the usage and maintenance of rainwater catchment systems, as well as one elementary school and one health center operator.	2.1.11; 4.3.1	132 households which of either pregnant women or mothers with babies received training on identifying the dangers of stunting and how to avoid them. - Five people from the two villages, Muara Merang and Kepayang, were trained to assemble and install rainwater catchment systems. 50 households received trainings on the usage and maintenance of rainwater catchment systems, as well as one elementary school and one health center operator.
	Number of female community members who have improved skills and/or knowledge	132 households which consisted of either pregnant women or mothers	2.1.11.5	132 households which consisted of either pregnant women

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	resulting from training provided as part of project activities of project activities	with babies received training on identifying the dangers of stunting and how to avoid them. An estimated 50% of the 50 households that received rainwater catchment systems also received training on the usage and maintenance of the rainwater catchment system.		or mothers with babies received training on identifying the dangers of stunting and how to avoid them. An estimated 50% of the 50 households that received rainwater catchment systems also received training on the usage and maintenance of the rainwater catchment system.
Employment	Total number of people employed in project activities, ⁵ expressed as number of full-time employees. ⁶	62 employees as of December 2020, of which 42 were assigned full time at the field.	2.1.11.5; 4.2.1; 4.4.1	62 employees as of December 2020, of which 42 were assigned full time at the field.
	Number of women employed as a result of project activities, expressed as number of full-time employees	21% of employees = 13 women	2.1.11.5; 4.2.1; 4.4.1	13 women as of December 2020
Livelihoods	Total number of people with improved	16 community fishermen and two farmer families maintained livelihoods through	2.1.11.5; 4.2.1; 4.3.1	22 recorded community fishermen and two farmer families maintained

⁵ Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers and community members that are paid to carry out project-related work.

⁶ Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region or economic territory (adapted from the UN System of National Accounts (1993) paragraphs 17.14[15.102];[17.28])

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	livelihoods ⁷ or income generated as a result of project activities	protection of, and access to fishing grounds and access to farming land. Ten fish farmers are supported through the establishment of a fish farmer group, pond construction equipment, fish seedlings and fish food. 10 elementary school teachers and 7 afterschool teachers are also supported by the project. During this monitoring period, 13 women were directly employed by SMPP.		livelihoods through protection of and access to fishing grounds and access to farming land. Ten fish farmers are supported through the establishment of a fish farmer group, pond construction equipment, fish seedlings and fish food. Ten elementary school teachers and 7 afterschool teachers are also supported by the project. Up to this monitoring period, 13 women were directly employed by SMPP.
	Number of women with improved livelihoods or income generated as a result of project activities	Eight women are currently supported with scholarship to continue their higher education at Open University. Six women as afterschool program teachers are also supported by the project.	2.1.11.5; 4.2.1; 4.3.1	Eight women are supported with scholarship to continue their higher education at Open University. Six women as afterschool program teachers are also supported by the project.
Health	Total number of people for whom health	The project has expanded its support	2.1.11.5; 4.3.1	The project has so far supported three

⁷ Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	services were improved as a result of project activities, measured against the without-project scenario	to three health facilities in the two villages, Muara Merang and Kepayang, with renovation as required. The project has also provided medical equipment and regularly delivers medicines that will benefit approximately 8,000 residents of both villages.		health facilities in the two villages, Muara Merang and Kepayang, with renovation as required. The project has also provided medical equipment and regularly delivers medicines that will benefit approximately 8,000 residents of both villages.
	Number of women for whom health services were improved as a result of project activities, measured against the without-project scenario	Approximately 50% or ~4,000 female residents in both Muara Merang and Kepayang villages.	2.1.11.5; 4.2.1; 4.3.1	Approximately 50% or ~4,000 female residents in both Muara Merang and Kepayang villages.
Education	Total number of people for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	224 total students including 12 students who received scholarships to <i>Universitas Terbuka</i> who will likely become future teachers in both villages. 135 <i>Sekolah Dasar</i> (SD) students attending afterschool programs. 77 students received scholarships to attend adult continuing education programs. The adult education programs were funded by the	2.1.11.5; 4.2.1; 4.3.1; 4.4.1; 4.3.1	224 total students, including 12 students who received scholarships to <i>Universitas Terbuka</i> and who will likely become future teachers in both villages. 135 <i>Sekolah Dasar</i> (SD) students attending afterschool programs. 77 students received scholarships to attend adult continuing

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
		project to be conducted in the villages to allow higher attendance and reduce cost of attendance for community members.		education programs.
	Number of women and girls for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	97 total students, including eight students who received scholarships to <i>Universitas Terbuka</i> and who will become future teachers in both villages. More than 50% of 135 <i>Sekolah Dasar</i> (SD) students attending afterschool programs = 72. 17 students received scholarships to attend adult continuing education programs. The adult education programs were funded by the project to be conducted in the villages to allow higher attendance and reduce cost of attendance for community members.	2.1.11.5; 4.2.1; 4.3.1; 4.4.1	97 total students, including, eight students who received scholarships to <i>Universitas Terbuka</i> and who will become future teachers in both villages; more than 50% of 135 <i>Sekolah Dasar</i> (SD) students attending afterschool programs = 72. 17 students received scholarships to attend adult continuing education programs.
Water	Total number of people who experienced increased water quality and/or improved access to drinking water as a	50 rainwater catchment systems have been installed in houses in both Muara Merang and	2.1.11.5; 4.3.1	50 rainwater catchment systems have been installed in houses in both Muara

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	result of project activities, measured against the without-project scenario	Kepayang village. One system was also installed in the Kepayang elementary school and one in the Muara Merang health facility. Residents with improved household water resources = ~200-300 people.		Merang and Kepayang village. One system was also installed in Kepayang elementary school. Two systems were installed in one of each of the village health facilities which both see an average 30-50 patients per month. Residents with improved household water resources = ~200-300 people. The project plans to expand the beneficiaries to more households and other public facilities in 2021.
	Number of women who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	Around 50% of the household members that have been positively impacted through the installation of rainwater catchment systems are women= ~100-150	2.1.11.5; 4.3.1	Around 50% of the household members that have been positively impacted through the installation of rainwater catchment systems are women= ~100-150
Well-being	Total number of community members whose well-being ⁸ was	Livelihoods of 16 community fishermen, 10 fish	4.2.1; 4.3.1; 4.4.1	Livelihoods 16 community fishermen, 10 fish

⁸ Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g. Training, Employment, Livelihoods, Health, Education and Water), and may also include

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	improved as a result of project activities	farmers and two farmer families and the education reaching 224 students (see Education section above)		farmers and two farmer families and the education reaching 224 students (see Education section above)
	Number of women whose well-being was improved as a result of project activities	Well-being of the women in the 16 community fishermen and 10 fish farmers, as well as two farmer families and women in education program reaching 224 students (see Education section above). Eight women are currently supported with scholarship to continue higher education level at Open University. Six women as afterschool program teachers are also supported by the project. During the monitoring period, 13 women are directly employed by SMPP.	4.2.1; 4.3.1; 4.4.1	Well-being of the women in the 16 community fishermen and 10 fish farmers, as well as two farmer families and women in education program reaching 224 students (see Education section above). Eight women are currently supported with scholarship to continue higher education level at Open University. Six women as afterschool program teachers are also supported by the project.
Biodiversity conservation	Change in the number of hectares significantly better managed by the project for biodiversity	22,922 ha	2.1.7; 5.4.1	22,922 ha

other benefits such as strengthened legal rights to resources, increased food security, conservation of access to areas of cultural significance, etc.

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	conservation, ⁹ measured against the without-project scenario			
	Number of globally Critically Endangered or Endangered species ¹⁰ benefiting from reduced threats as a result of project activities, ¹¹ measured against the without-project scenario	13 Critically Endangered or Endangered species and 22 Vulnerable species occurring in the project area.	5.5.1	13 Critically Endangered or Endangered species and 22 Vulnerable species occurring in the project area.

⁹ Managed for biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation, e.g. enhancing the status of endangered species

¹⁰ Per IUCN's Red List of Threatened Species

¹¹ In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

2 GENERAL

2.1 Project Description

2.1.1 Implementation Description

The Sumatra Merang Peatland Project (SMPP) aims to protect and restore 22,922 ha of a peatland ecosystem located in the Musi Banyuasin district in South Sumatra province. This large peatland ecosystem is currently in a predominantly degraded state due to the historical impact of logging, canal construction, and fires. Activities have been designed to maximize the ability of the project to restore the ecological functions of the project area, and the wider peat dome in which it exists, while building strong and supportive relationships with the broad range of stakeholders within the landscape. The project focus on ecosystem restoration involves activities such as forest patrolling, fire prevention and monitoring, canal blocking and hydrology management, reforestation and assisted natural regeneration (ANR), community development, biodiversity management and monitoring, as well as cross-cutting activities (more details can be found in the SMPP PD section 2.1.11 and Section 2.2.1). Most of these activities are ongoing and multiple community development sub-activities have seen positive growth in terms of participation and expansion of activities.

This report covers the monitoring period from January 1st, 2020 to December 31st, 2020. Throughout this monitoring period, the project has supported a daily forest patrol system on the ground in the project area, along with daily weather monitoring. The project continued to implement community development activities and other programs to positively impact stakeholders. During the monitoring period an additional 91 dams were successfully constructed, bringing the total to 188 permanent canal blocking dams. Ecological leakage was monitored at 22 transects outside the project boundary at the main outflows and included in the hydrological modeling that extended 1 km outside the project area. Project teams also installed an additional 66 internet-connected dip well sensors to measure water table level in near real-time, bringing the total to 74. The project also installed 12 new camera traps on top of the five purchased in 2019 which has allowed for increased scope in monitoring positive biodiversity impacts.

For calculations or analysis in this monitoring report that were done using a tool or a module, we will adjust our analysis in the upcoming monitoring plan with updated tools or modules, as appropriate. For example, we calculated our non-permanence analysis using the most recent Non-Permanence Risk Tool (v4.0). If there is any update made to the tool, we will use that updated version to re-analyze our non-permanence analysis.

Overall, from the beginning of this third monitoring period in January 2020 through the end of the monitoring period in December 2020, the SMPP estimates that 1,025,971 metric tons (t) CO₂-e in emission reductions or removals (i.e. estimated carbon units) were achieved.

2.1.2 Project Category and Activity Type

The SMPP is an Agriculture, Forestry, and Other Land-Use (AFOLU) project. More specifically, the project activities are categorized as a combination of Afforestation, Reforestation and Revegetation (ARR) and Wetlands Restoration and Conservation (WRC). Under the WRC component, the project activities relate to both the Conservation of Undrained and Partially Drained Peatland (CUPP) and Rewetting of Drained Peatland (RDP). The SMPP is not a grouped project.

2.1.3 Project Proponent(s)

The SMPP has two project proponents, as listed below.

Organization name	Forest Carbon Pte Ltd
Contact person	Jeffrey Chatellier
Title	CEO

Address	152 Beach Road #28-00 Gateway East, Singapore (189721)
Telephone	+62 21 5740817
Email	j.chatellier@forestcarbon.com

Organization name	PT Global Alam Lestari
Contact person	Reagen Pangestu
Title	President Director
Address	Grand Ville Bayung Indah Blok A no. 9, Bayung Lencir, Musi Banyuasin, South Sumatra 30756
Telephone	+62 878 83632218
Email	reagen.pangestu@globalalamlestari.com

2.1.4 Other Entities Involved in the Project

Key implementing and technical partners are listed below.

Organization name	Mirova Natural Capital (previously Althelia Climate Fund/ACF)
Role in the project	Impact Investment Partner
Contact Person	Vincent Gradt
Title	Managing Director
Address	LABS House, 15-19 Bloomsbury Way, London WC1A 2TH, UK
Telephone	+44 20 8126 7765
Email	vincent.gradt@mirova.com

Organization name	Ecosphere+ Ltd
Role in the project	Marketing Partner
Contact Person	Lisa Walker
Title	CEO
Address	LABS House, 15-19 Bloomsbury Way, London WC1A 2TH, UK
Telephone	+44 203876 5228
Email	lisa@ecosphere.plus

2.1.5 Project Start Date (G1.9)

The project start date is January 1st, 2016, as according to the Verified Carbon Standard (VCS) definition, this was the date activities contributing toward greenhouse gas (GHG) emission reductions and removals were initiated. In January of 2016, the project started to establish a permanent presence within the project area through the construction of the project's main camp and by starting to conduct formal patrol activities leading to effective prevention of fire and forest degradation.

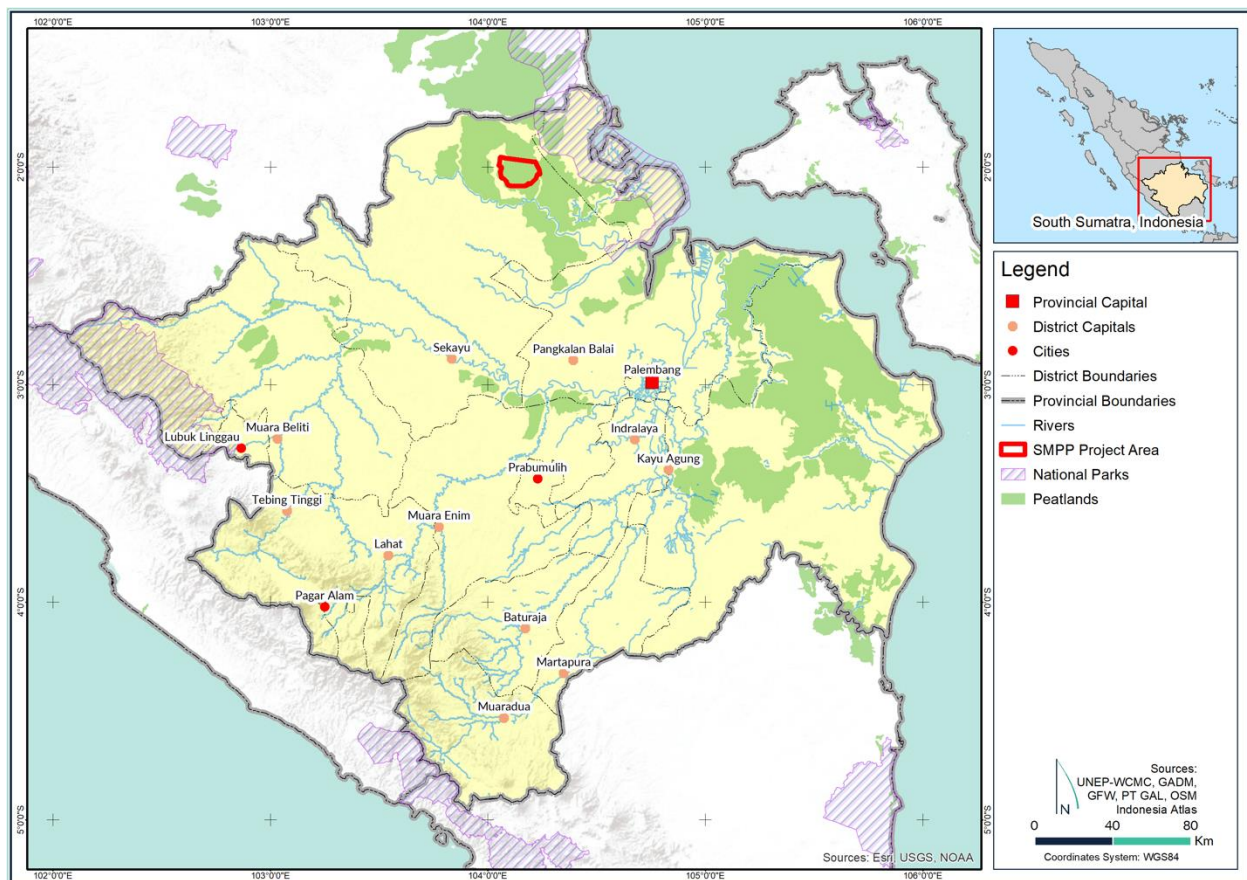
2.1.6 Project Crediting Period (G1.9)

The duration of the VCS project crediting period is 47 years, with the project beginning on January 1st, 2016 and ending on December 31st, 2062. The PAN/RAP carbon storage and sequestration license held by PT Global Alam Lestari is extendable for up to 50 years.

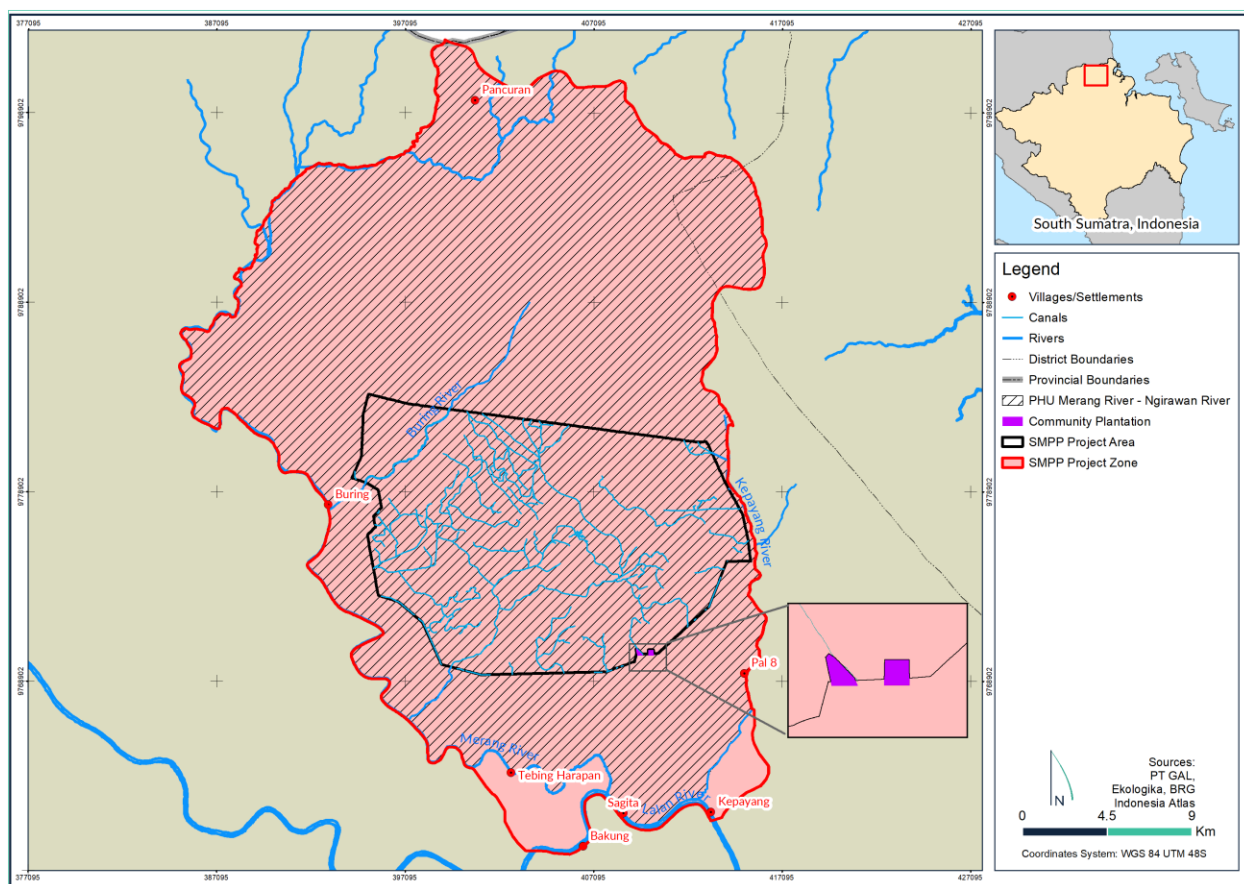
Per the VCS guidelines, a mandatory baseline re-evaluation is to be executed at a minimum of every 10 years after the project start. Therefore, there will be a mandatory baseline re-evaluation on or before January 1st, 2026 and every ten years afterwards.

2.1.7 Project Location

The SMPP is located within Bayung Lencir sub-district, Musi Banyuasin district, South Sumatra province, Sumatra, Republic of Indonesia (see Map 1). The Musi Banyuasin regency is located in the northern part of South Sumatra province and is between 103-104° 45' East (E) and 1.3° - 4° South (S), 14,266 square kilometers (km²). The SMPP area lies between the following geographic coordinates: 2° 1' 9.01" S and 104° 8' 43.10" E (see Map 2).



Map 1. Location of the SMPP area in Sumatra, Indonesia.



Map 2. Location of the SMPP Project Area and Project Zone.

The SMPP project zone consists of the formal project area, the government delineated peatland hydrology unit (PHU), and has been extended to include the village areas where community development operations are taking place. The project zone includes active fishing grounds inside and near the boundaries of the SMPP, in addition to the two small farms located on the southeast border of the SMPP. The project zone covers all settlement areas associated with the villages of Kepayang and Muara Merang as these villages are beneficiaries of community development activities. From an ecological perspective, the PHU represents peatland areas that will benefit from improved functionality from SMPP hydrological interventions. Within the PHU, there are commercial forest plantations, palm oil plantations, and to a limited degree, smallholder farms. The project zone is a total of 85,182 hectares.

The SMPP project area is defined by the PAN/RAP license and covers a total area of 22,934 ha minus 12 ha of land that have been excised for the farms of the two families that continue to conduct small-scale palm oil production on the southeast border.

The SMPP sits within the Merang-Kepayang peat dome, the largest peat swamp dome in South Sumatra, which covers more than 150,000 ha.^{1,2} A number of critical climate and biodiversity assets are linked to the wider peat swamp forest zone that surrounds the SMPP, including the Sembilang-Berbak National Park to the northeast and the Muaro Jambi peat swamp to the north.

2.1.8 Title and Reference of Methodology

The SMPP applies the latest version of VCS Methodology VM0007 (version 1.5). Applicable modules are available in the table below. The table below indicates how the project meets all applicability conditions of VM0007 (version 1.5) and its associated modules.

Table 1. Summary of applicability conditions.

No	Module	Applicability Condition	Comment
1	REDD-MF, 4.3 ARR (Version 1.5)	The project area is non-forest land or land with degraded forest.	Condition met. See SMPP PD Section 2.1.5.
2	REDD-MF, 4.3 ARR (Version 1.5)	The project scenario does not involve the harvesting of trees. Therefore, procedures for the estimation of long-term average carbon stocks are not provided.	Condition met. See SMPP PD Section 2.1.11
3	REDD-MF, 4.3 ARR (Version 1.5)	ARR activities are not eligible if the project scenario does not involve the application of nitrogen fertilizers.	Condition met. The project does not involve the application of any fertilizers. See SMPP PD Section 2.1.11.
4	REDD-MF, 4.3 ARR (Version 1.5)	Where project activities on wetlands are excluded by the applicability conditions of applied modules or tools, these can be disregarded for the purpose of their use within this methodology, as quantification procedures for the peat soil are provided in modules BL-PEAT and M-PEAT.	Condition met. The project applies modules BL-PEAT and M-PEAT alongside all modules related to ARR.
5	REDD-MF, 4.4 WRC (Version 1.5)	This methodology is applicable to rewetting drained peatland (RDP) and conservation of undrained and partially drained peatland (CUPP) activities on project areas that meet the VCS definition for peatland. The scope of this methodology is limited to domed peatlands in the tropical climate zone.	Condition met. The project area contains peatland (see SMPP PD Section 2.1.5) which would be drained in the baseline, and which will be conserved and restored in the project scenario. The project therefore falls in the category of RDP and CUPP. The project meets the definition of domed peatlands (see SMPP PD Section 2.1.5) and is located in the tropical climate zone (see Section 2.1.5 (see SMPP PD Section 2.1.5)).
6	REDD-MF, 4.4 WRC (Version 1.5)	Fire reduction projects on peatland that exclude rewetting as part of the project activity are not eligible.	Condition met. The project includes extensive rewetting across the entire project area (see SMPP PD Section 2.1.11) in conjunction with WRC and ARR activities.
7	REDD-MF, 4.4 WRC (Version 1.5)	Rewetting of drained peatland and conservation of undrained or partially drained peatland may be implemented in combination with REDD project activities. REDD project activities on peatland must not increase drainage.	N/A. The project does not include any REDD components.
8	REDD-MF, 4.4 WRC (Version 1.5)	Rewetting of drained peatland may be implemented as a separate activity or in combination with ARR project activities. ARR activities must not enhance peat oxidation and	Condition met. The project includes extensive rewetting across the entire project area (see SMPP PD

No	Module	Applicability Condition	Comment
		therefore this activity requires at least some degree of rewetting.	Section 2.1.11) in conjunction with WRC and ARR activities.
9	X-STR (Version 1.1)	In case of REDD, aboveground biomass stratification is only used for pre-deforestation forest classes, and strata are the same in the baseline and the project scenario. Post-deforestation land-uses are not stratified. Instead, average post-deforestation stock values (e.g., simple or historical area-weighted approaches are used, as per Module BL-UP).	N/A. The project does not include any REDD components.
10	X-STR (Version 1.1)	For peatland rewetting and conservation project activities this module must be used to delineate non-peat versus peat and to stratify the peat according to peat depth and soil emission characteristics, unless it can be demonstrated that the expected emissions from the soil organic carbon pool or change in the soil organic carbon pool in the project scenario is de minimis.	Condition met. See application of X-STR in SMPP PD Section 3.1.3.
11	X-STR (Version 1.1)	In the case of peatland rewetting and conservation project activities, the project boundary must be designed such that the negative effect of drainage activities that occur outside the project area on the project GHG benefits are minimized.	Condition met. The project is taking significant steps to maintain the intactness of hydrology in the project area and to restore hydrology in areas which have been disturbed by existing drainage. The project is monitoring areas outside the project area which could be under threat of disturbance in order to minimize potential impacts in terms of drainage. See SMPP PD Section 3.2.3.
12	BL-ARR (Version 1.0)	The applicability conditions set out in AR-ACM0003 Afforestation and reforestation of lands except wetlands must be met.	See #25 & 17 below.
13	BL-ARR (Version 1.0)	Applicability conditions included in AR-ACM0003 Afforestation and reforestation of lands except wetlands and corresponding tools that exclude project activities on wetlands can be disregarded for the purpose of their use in this module, as accounting procedures for the peat soil are provided in module BL-PEAT.	Condition met. See #2 above.
14	BL-ARR (Version 1.0)	Where the ARR project activity is implemented on peatland, the peatland must be degraded in the baseline scenario as identified by the presence of drainage infrastructure (ditches, canals) and associated lowered water tables below the surface. In the case of forested peatland, degradation may be identified by the removal or degradation of the tree cover before the project start date.	Condition met. ARR project activities are only implemented on already degraded land which would be further degraded in the baseline as demonstrated in SMPP PD Sections 3.1.3 and 3.2.1.

No	Module	Applicability Condition	Comment
15	BL-ARR (Version 1.0)	The project scenario does not involve the harvesting of trees. Therefore, procedures for the estimation of long-term average carbon stocks are not provided.	Condition met. See #2 above.
16	ACM0003 (Version 2.0)	This methodology is applicable under the following conditions: (a) The land subject to the project activity does not fall in wetland category. (b) 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 this methodology.	Per #13 above, condition (a) can be neglected, as the project applies relevant wetland procedures. Condition (b) is not relevant, as the project does not cause soil disturbance.
17	ACM0003 (Version 2.0)	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.	Condition met. This table lists all relevant applicability conditions and describes how they are fulfilled.
18	BL-PEAT (Version 1.0)	This module is applicable to RDP and CUPP activities on project areas that meet the VCS definition for peatland. The scope of this module is limited to domed peatlands in the tropical climate zone	Condition met. See #5 above.
19	BL-PEAT (Version 1.0)	It must be demonstrated by using the latest version of the CDM A/R methodological tool: "Tool for testing significance of GHG emissions in A/R CDM project activities" (T- SIG) that N ₂ O emissions in the project scenario are not significant, or it must be demonstrated that N ₂ O emissions will not increase in the project scenario compared to the baseline scenario, and therefore N ₂ O emissions need not be accounted for	Condition met. The project does not cause an increase in N ₂ O emissions.
20	BL-PEAT (Version 1.0)	In the baseline scenario the peatland must be (partially) drained. At project start the peatland may still be undrained.	Condition met. Peatland will be drained in the baseline (see SMPP PD Section 3.2.1).
21	BL-PL (Version 1.2)	The module is applicable for estimating the baseline emissions on forest lands (usually privately or government owned) that are legally authorized and documented to be converted to non-forest land.	N/A. The project does not include any REDD components.
22	BL-PL (Version 1.2)	Where, pre-project, unsustainable fuelwood collection is occurring within the project boundaries modules BL-DFW and LK-DFW shall be used to determine potential leakage	N/A. Unsustainable fuelwood collection not occurring within the project boundaries.

No	Module	Applicability Condition	Comment
23	LK-ECO (Version 1.0)	This module is applicable under the following condition: • Leakage caused by hydrological connectivity is avoided by project design and site selection, as outlined in Chapter 5 (Procedures).	Condition met. Project does not cause ecological leakage. See application of LK-ECO in SMPP PD Section 3.2.3.
24	T-ADD (Version 1.0)	The tool is applicable under the following conditions: • 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. • This tool is not applicable to small - scale afforestation and reforestation project activities.	Condition met. Reforestation activities do not violate any applicable laws. indeed, they are required under the project scenario. The reforestation activities are not classified as small scale.
25	T-SIG (Version 1.0)	The tool shall be used in the application of an A/R CDM approved methodology to an A/R CDM project activity: a) To determine which decreases in carbon pool and increases in emissions of the greenhouse gases measured in CO ₂ equivalents that results from the implementation of the A/R project activity, are insignificant and can be neglected. b) To ensure that it is valid to neglect decreases in carbon pools and increases GHG emission by source stated as being insignificant in the applicability conditions of an A/R CDM methodology	Condition met. T-SIG was used, however no significance calculations needed to be performed as carbon pools and sources of GHG emissions were only neglected where it was demonstrably conservative.
26	E-BPB (Version 1.1)	This module is applicable to avoiding unplanned deforestation or degradation (AUDD), avoiding planned deforestation (APD) and avoiding degradation project activities, whether or not situated on peatland.	Condition met. Project includes WRC activities.
27	M-ARR (Version 1.0)	This module is applicable under the following conditions: • The applicability conditions provided in A/R CDM consolidated methodology AR- ACM0003 (Afforestation and reforestation of lands except wetlands) and associated tools. • Where exclusion of project activities on wetlands exists in the applicability conditions of methodologies and tools, these can be neglected for the purpose of their use in this module, as accounting procedures for the peat soil are provided in nodule M-PEAT.	Condition met. See #13 & #14 above
28	M-PEAT (Version 1.0)	This module is applicable to RDP and CUPP activities as defined in VCS AFOLU Requirements. The project area must meet the VCS definition for peatland. This module is limited to domed peatlands in the tropical climate zone.	Condition met. See #5 above.

No	Module	Applicability Condition	Comment
29	M-PEAT (Version 1.0)	Furthermore, the following applicability conditions apply: It must be demonstrated using tool T-SIG that N₂O emissions in the project scenario are not significant, or it must be demonstrated that N₂O emissions will not increase in the project scenario compared to the baseline scenario, and therefore N₂O emissions need not be accounted for. In the baseline scenario the peatland must be drained or partially drained. At project start the peatland may still be undrained. It must be demonstrated using Module LK-ECO that ecological leakage must not occur.	Condition met. See #19 regarding N₂O emissions. Baseline scenario includes draining of peatland. Project is partially drained at project start. Per SMPP PD Section 3.2.3 ecological leakage does not occur.
30	M-MON (Version 2.1)	Strata as defined in the relevant baseline modules are fixed and may not be changed without baseline revision.	Condition met. See SMPP PD Section 3.1.3.
31	M-MON (Version 2.1)	The module is always mandatory. Without application of this module the methodology shall not be used	Condition met. The module is applied as per the requirement.
32	M-MON (Version 2.1)	Where selective logging is taking place in the project case: - Emissions from logging may be omitted if it can be demonstrated the emissions are de minimis using T-SIG. - If emissions from logging are not omitted as de minimis, logging may only take place within forest management areas that possess and maintain a Forest Stewardship Council (FSC) certificate for the years when the selective logging occurs. - Logging operations may only conduct selective logging that maintains a land cover that meets the definition of forest within the project boundary. - All trees cut for timber extraction during logging operations must have a DBH greater than 30 cm. - During logging operations, only the bole/log of the felled tree may be removed. The top/crown of the tree must remain within the forested area. - The logging practices cannot include the piling and/or burning of logging slash - Volume of timber harvested must be measured and monitored.	Condition met. Project does not include selective logging.
33	X-UNC (Version 2.1)	The module is mandatory when using VCS methodology VM0007. It is applicable for estimating the uncertainty of estimates of emissions and removals of CO₂-e generated from REDD and WRC project activities. The module focuses on the following sources of uncertainty: Determination of rates of deforestation and degradation	Condition met. X-UNC has been used throughout to estimate uncertainties associated with this project. See SMPP PS Section 3.2.4.

No	Module	Applicability Condition	Comment
		• Uncertainty associated with estimation of stocks in carbon pools and changes in carbon stocks • Uncertainty associated with estimation of peat emissions • Uncertainty in assessment of project emissions	
34	X-UNC (Version 2.1)	Where an uncertainty value is not known or cannot be simply calculated, then a project must justify that it is using an indisputably conservative number and an uncertainty of 0% may be used for this component.	Condition met. The uncertainty value is known, see SMPP PD Section 3.2.4.

2.1.9 Other Programs (G5.9)

The SMPP's activities and GHG emission reductions do not fall under any other emissions trading program or other binding limit in relation to GHG emissions. The SMPP only seeks to generate VCUs under the VCS and has never received another form of GHG-related environmental credit. The SMPP does not participate under any other GHG program.

SMPP completed the application process for Indonesia's National Registration System ("Sistem Registrasi Nasional or SRN"), and has a project identification number (005-I-2020-1686). The SRN is a registry only and does not issue any form of credits.

2.1.10 Sustainable Development

The SMPP is aligned with a number of sustainable development and environmental protection targets designated by the Indonesian government. The following key policy components align directly with project objectives, including emphasizing climate action, supporting communities and protecting biodiversity.

Indonesia's Medium-Term Development Plan covers nine priorities, called *Nawacita*, which include references to sustainable development in the forestry sector. Specifically, the Environment and Forestry Development Strategic Priorities Plan for the period between 2020-2024³ aims to protect the quality of the environment to maintain ecosystem services function and to improve water security and community health. The strategy also aims to support better utilization of forest and environmental resources in a sustainable manner to improve the economy and prosperity of local people, and preserve the balance of ecosystems and biodiversity as a way to support sustainable development. These targets for reporting and monitoring are listed below.

2.1.10.1 Economic Growth and Development

The government seeks to improve the economic development of Indonesia with a target to increase the per capita income from US\$ 3,927 USD in 2018 to US\$5,780-6,160 USD by the end of 2024.⁴

The SMPP contributes to economic growth by providing project stakeholders with employment opportunities and a variety of livelihood enhancement activities. The project actively employs local stakeholders for forest protection and facility management and provides access to education for all project staff in addition to surrounding community members.

2.1.10.2 Poverty and Inequality

Indonesia's National Medium-Term Development Plan for 2020-2024 targets a decrease in poverty rates of 6.0-7.0% and a decrease in the unemployment rate of 3.6-4.3% by the end of 2024. In order to achieve these goals, the Indonesian government plans to improve access to job opportunities by increasing the productivity of industries that can create jobs, increasing workers' living standards and changing low-skilled industries to skills-based industries. The government is highly focused on lowering poverty levels in rural areas, to develop Indonesia from the periphery by strengthening regions and villages.⁵

The SMPP is supporting rural poverty reduction by generating employment for groups with low education levels which increases household income. The SMPP has a target to hire 80% of its field staff from communities in proximity to the project area. In 2020 the project employed 30 staff from surrounding areas out of total 42 field staffs or around 71.4%. In addition, the SMPP is working to ensure gender balance and aims to employ 25% women as project staff, along with a community development component targeting a number of women's groups in nearby villages and settlements. During this monitoring period, the project directly employed 21% or thirteen women as project staff, an increase of ~5% percent from last year. The project aims to reach the target in the next monitoring period.

2.1.10.3 Education

The Ministry of Education and Culture has a target to increase the capacity and quality of 14,000 educators throughout the country. The government also aims to improve infrastructure for education by building 210 new schools and 2,500 classroom; rehabilitating 41,000 classrooms and renovating 294 schools as well as building 2,140 laboratories and 1,332 libraries.⁶

The SMPP's educational program has been designed to support these development targets as it provides a university scholarship program for teachers, supports school infrastructure initiatives and funds additional adult education programs for community members to progress beyond middle school education levels and obtain high school diplomas.

2.1.10.4 Sustainable Forest and Land-use

The Indonesian Peat Restoration Agency (*Badan Restorasi Gambut* or BRG) has a target to restore two million ha of peatlands in the country. The project area is located in one of the agency's priority areas and is the center for hydrological interventions in the PHU that surrounds SMPP.⁷

2.1.10.5 Climate Change

Indonesia ratified the Paris Agreement as part of its commitment to address climate change and submitted its National Determined Contribution (NDC) which is also in line with *Nawacita* priorities that are integrated across the Medium-Term Development Plan. The SMPP aims to contribute to Indonesia's overall CO₂ emission reduction target by 2025 in conjunction with the appropriate monitoring and reporting.

2.2 Project Implementation Status

2.2.1 Implementation Schedule (G1.9)

The current monitoring period is for the year 2020. Provided below are the key milestones and activities that took place since the project start date up to the end of the monitoring period.

Table 2. Key milestones in the SMPP's development and implementation.

Date	Milestone(s) in the project's development and implementation
January 1, 2016	Project Start Date: January 1 st , 2016.
2016	The project constructed with a permanent field camp in the project area which is now the main camp of the project. The project also constructed three protection posts along the perimeter of the project boundary.
2016 - Present	Forest Protection: The project hired full time staff that resided in project facilities within the project boundary. This marked the beginning of routine patrolling of the project area that continued through the entire monitoring period.
2016 - Present	Community Engagement: The project-initiated community engagement meetings and activities in nearby villages in 2016.
2016	The project began its first phase of canal blocking construction and completed five temporary box dams in the eastern part of the project area.

Date	Milestone(s) in the project's development and implementation
2017	In 2017, the project began a more extensive canal blocking program and built an additional 75 temporary box dams throughout the project area. The project also greatly expanded its facilities by increasing the size of its office and built new living quarters, which included renovating and increasing the size of the protection posts. The project hired a full-time community development manager and additional technical staff to focus on biodiversity and forest restoration. The project also secured a long-term investment to scale up project activities in October of 2017. The project also began supporting educational programs in Muara Merang and Kepayang villages.
July 2018	The project completed its formal boundary demarcation (<i>tata batas</i>) with the government and received approval from the government.
September 2018	The project established a tree nursery at its main camp. It also increased the size of its protection posts and installed solar panels on all the protection posts.
December 2018	The project completed a peat depth survey and developed a detailed hydrology restoration plan. It also finalized the development of VCS/CCB project document. The project built a large protection post in the eastern part of the project area to protect and monitor the project's remaining secondary forest. The project continued to expand its support of education programs in the nearby villages.
May 2019	PD (Project Documentation) completed for VCS and CCB.
July 2019	Aster Global began field visit audit for joint Validation and Verification.
November 2019	Audit completed.
November 2019	Water table level monitoring system installed.
December 2019	97 peat compaction dams constructed.
December 2019	First VCU issuance.
January 2020	91 peat compaction dams constructed, totaling to 188 units.
February 2020	252 dip wells installed and monitored along with other weather parameters through an online project dashboard.
April 2020	Amid the wide-spread COVID-19 pandemic, community development programs continue under new health and safety guidelines. In addition, the project distributed medical supplies and equipment to four public health centers around the project area, which included PPE, face masks, sanitizers, and immune-building multivitamins.
July 2020	Anti-stunting program launched in collaboration with 1000 Days Fund, an NGO with a mission to end stunting by 2030.
August 2020	A comprehensive camera trap implementation guideline was completed and installed. A total of 12 additional camera traps were installed to complement the first batch installed in 2019. Photos from the camera trap have been regularly recorded by Biodiversity staff which include sightings of a Sumatran Tiger.
October 2020	66 additional automated dip well sensors deployed utilizing IoT network technology to measure water table level in near real-time. The measurement data are easily observed through the online monitoring dashboard.
October 30, 2020	Second VCU issuance for monitoring period Jan 1 st – Dec 31 st , 2019.
November 2020	A total of 52 rainwater catchment systems successfully installed in both Muara Merang and Kepayang village. The project also continues regular monitoring and training of the anti-stunting program. A new initiative to develop programs to increase students' engagement with libraries and reading interests in general also started.

Date	Milestone(s) in the project's development and implementation
December 2020	The third verification work launched, and the project appointed Aenor Internacional, S.A.U. as the VVB.

2.2.2 Methodology Deviations

No new deviation occurred during monitoring report period. The methodology deviation used in the PD, related to the baseline conversion/plantation establishment rate is still in effect until the baseline reassessment. This deviation was used because module BL-ARR and Methodology extension AR-ACM0003 do not include specific requirements for the justification of the plantation establishment rate. We therefore followed Module BL-PL to justify our conservative baseline conversion/plantation establishment rate (which is not deforestation) and to calculate leakage with a baseline deforestation rate, we followed Module BL-PL. The conservative approaches of BL-PL provided an analytical basis for the plantation establishment rate. Although this analysis was not needed for our baseline rate of conversion, we employed this approach to give our baseline rate more validity. A slight deviation from the requirements of BL-PL took place when justifying deforestation rate used for the subsequent LK-ASP. Further details can be found in the PD.

2.2.3 Minor Changes to Project Description (RULES 3.5.6)

There have been minor changes to the biodiversity monitoring plan during this monitoring period, such as the addition of detailed SOPs on data collection and more detail on the camera trap survey process and the use of SMART software. The minor changes are in conformance with the requirements of the Climate, Community & Biodiversity Standards criteria and indicators. Further details are outlined in section 5.3.1.

2.2.4 Project Description Deviations (RULES 3.5.7 – 3.5.10)

No new deviation since the last monitoring report occurred during the monitoring report period. The deviation related to data collection for the leakage analysis, as previously used, did not negatively impact the conservativeness of the quantification of GHG emission reductions or removals, the applicability of the methodology, additionality, or the appropriateness of the baseline scenario. This deviation was a minor change in the procedures for measurement and monitoring, which VCS lists as an acceptable example of deviation that can be included in a Monitoring Report.

The Ministry of Environment and Forestry (MoEF) statistics of total area (ha) of licensed Industrial Plantation Forests (*Hutan Tanaman Industri* or HTI) in the country is not yet available for 2020. In order to complete the initial non-spatial assessment of the government data compared to the PD estimates, we used the more conservative value from 2019.

2.2.5 Grouped Projects

This is not a grouped project.

2.2.6 Risks to the Project (G1.10)

The possible natural and human-induced risks that could impact the SMPP's climate, community, and biodiversity benefits are outlined in detail in Annex 1 Identification of Project Risks. Additional mitigation strategies will be developed if new risks emerge during project implementation. These risks should be considered in conjunction with the non-permanence risk assessment carried out in accordance with the most recent AFOLU Non-Permanence Risk Tool v4 (September 19th, 2019 version), which was completed as Annex 2: VCS AFOLU Non-Permanence risk analysis. A summary of this risk analysis is outlined in Table 3 below, indicates that in the SMPP Internal Risks have the highest score, followed by Natural Risks, with External Risks receiving a score of zero.

The only natural and human induced risks that are likely to happen are Fire and Geological Risk. Natural fires rarely occur on undisturbed peatlands due to naturally high-water table levels. Lightning strikes tend

to be the main cause of natural fires in the tropics. However, lightning is consistently accompanied by heavy rain and for this reason presents a low risk.

To mitigate natural fire risk such as in the event of a lightning strike, the hydrological interventions from canal blocking and active forest monitoring from patrol staff are the primary strategies. Anthropogenic causes of fire such as discarded cigarettes, flying embers from cooking fires, or fires used for cleaning agricultural fields are real sources of fire risk and are mitigated by limiting access to the site through active patrolling, signs and stakeholder engagement. Project staff are also highly trained on fire safety management, including proper disposal of cigarettes, protected cooking techniques and proper waste disposal.

The primary geological risk is of an earthquake and all staff are trained in emergency response, evacuation and first aid measures in the event of a significant geological event or other natural disaster.

During the 2020 monitoring period, the project implemented significant natural and human induced risk mitigation activities such as hydrology management through the construction of compacted peat dams, frequent forest patrols, implementation of an early warning fire detection system. Hydrology management through monitoring water table levels using dip wells throughout the project area, and rain fall measurements through a number of weather stations, further reduced natural and human caused risks to the project area. We summarize activities during the 2020 monitoring period relevant to natural risk mitigation in Table 39.

Table 3. Summary of non-permanence risk analysis for the SMPP.

VCS AFOLU non-permanence risk category	Score
a) Internal Risk	
Total Project Management (PM) Risk Value	-4.0
Total Financial Viability (FV) Risk Value	0.0
Total Opportunity Cost (OC) Risk Value	0.0
Total Project Longevity (PL) Risk Value	15
Total Internal Risk (PM + FV + OC + PL)	11
b) External Risk	
Total Land Tenure (LT) Risk Value	2.0
Total Community Engagement (CE) Risk Value	-5.0
Total Political (PC) Risk Value	0.0
Total External Risk (LT + CE + PC)	0.0
c) Natural Risk	
Fire (F) Risk Value	1.0
Pest and Disease Outbreak (PD) Risk Value	0.0
Extreme Weather (W) Risk Value	0.0
Geological Events (G) Risk Value	2.0
Other Natural Risk (ON) Value	0.0
Total Natural Risk (F + PD + W + G + ON)	3.0
Total Overall Risk Rating (a + b + c)	14

2.2.7 Benefit Permanence (G1.11)

There are no potential negative environmental impacts resulting from the project in either the project area or the surrounding region. The project also does not anticipate any negative socio-economic impacts. While the SMPP has a 25-year IUP PAN/RAP carbon storage and sequestration license that is extendable up to 50 years, the project's activities are designed to enhance the CCB benefits beyond the project's lifetime. Community development activities are designed to increase family incomes by creating opportunities for education and employment. The project is also making investments into small businesses and supporting an increase in education levels among residents in nearby settlements. By investing in the human capital of the region, SMPP can create more possibilities for formal employment with more reliable and higher wages. The project will also promote the importance of conservation and hydrology management to nearby villages as a way build local stewardship for the landscape. Youth will be targeted to promote a shift away from exploitative land-use practices to activities in the formal economy. These community development activities are outlined in more detail in Section 2.1.11 of the PD.

From a biodiversity permanence perspective, the SMPP is rewetting the degraded peatlands through the construction of permanent canal blocks which is a recognized approach to restore the hydrology of this degraded area, which will reduce the risk of fire in the landscape allowing the natural vegetation to be restored over the life of the project. This activity is explained in more detail in Section 2.1.11 of the PD.

2.3 Stakeholder Engagement

2.3.1 Stakeholder Access to Project Documents (G3.1)

To provide stakeholders with access to project documents, the SMPP Field Office maintains a full, printed version of the project description (PD) and monitoring report (MR) documents in English for public viewing. The executive summary of each of these documents is translated into Bahasa Indonesia and given to community leaders to make available in public places in the surrounding villages, and the full PD and MR with their executive summaries were posted in English and in Bahasa Indonesia on the VCS project database, which is now known as the Verra Registry.

2.3.2 Dissemination of Summary Project Documents (G3.1)

To disseminate project documents to communities, other stakeholders, and the public, the SMPP Field Office maintains a full, printed version of the PD and MR and associated annexes in English for public viewing. The executive summary was translated into Bahasa Indonesia and was given to community leaders to make available in public places in the surrounding villages, and the full PD and MR with their executive summaries were posted in English and in Bahasa Indonesia on the VCS project database, which is now known as the Verra Registry. In addition to publicly posting documents, the SMPP community development representative serves as a focal point for community inquiries and questions on the project, along with the many other staff that are actively employed in the project. The project provided a brochure in Bahasa Indonesia advertising the project, and an email address was posted in local villages and given to SMPP communities and other stakeholders as a point of contact. Finally, notices in Bahasa Indonesia advertising the public comment period for the project's third verification were posted in communities throughout the project area.

Monitoring results were discussed throughout the duration of project monitoring, and information was continually disseminated to the communities through consultation with actively involved individuals, particularly SMPP residents, fishermen, and village leaders, who were encouraged to further share project information throughout their wider community.

2.3.3 Informational Meetings with Stakeholders (G3.1)

The project continued to conduct follow-up meetings with key stakeholders that were identified at the beginning of the project throughout 2020. The purpose of these meetings was to continue to build trust and forge relationships with project stakeholders and engage in further efforts to understand local history, livelihoods potential and any community concerns. Identification of other social, religious, and economic factors that could potentially influence how the community responds to the project were also recorded, to

ensure effective engagement with surrounding communities and other stakeholders as implementation scales up.

The project publicized a variety of informational materials in both Bahasa Indonesia and English through the use of a combination of promotional materials such as letters, signs, banners, and announcements at community meetings and workshops.

2.3.4 Community Costs, Risks, and Benefits (G3.2)

The project has implemented a variety of social consultations, described further in Section 2.3.7, where information was provided on the potential costs, risks, and benefits to the identified communities. The SMPP works collaboratively with the identified communities of fishermen and farmers that traverse the project borders to ensure their engagement throughout the duration of the project (see PD Sections 2.1.6 and 2.1.9 for more details). These identified project communities are familiar with the project and its intentions as a result of continued consultative meetings and participation in development programming. The primary communication method with the communities is through in-person meetings, as many do not have mobile phones and are often located at their remote fishing areas or farms.

Despite the pandemic throughout 2020, the SMPP Community Development manager has successfully completed follow up consultations with the communities as defined by CCB (while maintaining strict COVID-19 health and safety protocols), namely the fisherman inside the concession and the farming operations in the south end of the project area. The meetings identified needs to improve their working capacity and consequently their overall incomes, which the project is addressing through its community development plan and targeted livelihoods assistance for fisherman. These interactions were also used to further inform and educate these stakeholders about the importance of canal blocking to restore and protect the site from further fires.

CCB-Defined “Other stakeholders” were also included in the consultative process and are a larger beneficiary group which includes residents of Muara Merang and Kepayang villages, along with other nearby settlements. While applying physical distancing follow-up meetings have taken place with other stakeholders in these villages through one-on-one discussions, small group meetings, and through participation in formal village meetings where village officials invited project representatives. These meetings with other stakeholders included discussions on project costs, risks and benefits to the relevant stakeholders. More details on the consultations including the dates, locations, and number of attendants, are provided in Section 2.3.7.

The SMPP field office, which has been open since 2016, now serves as an information hub that is open to community members and other stakeholders who wish to gain information about the project and/or submit comments or grievances.

2.3.5 Information to Stakeholder on Verification Process (G3.3)

To provide information to communities and other stakeholders on the validation and verification process, the SMPP Field Office maintains a full, printed version of the PD and MR and associated annexes in English for public viewing. The executive summary was translated into Bahasa Indonesia and was given to community leaders to make available in public places in surrounding villages, and the full PD and MR and its executive summary was posted in English and Bahasa Indonesia on the VCS project database. In addition to the executive summary, project staff provided a brochure in Bahasa Indonesia advertising the project, and an email address was posted in local villages and given to SMPP communities and other stakeholders as a point of contact. Finally, notices in Bahasa Indonesia advertising the public comment period and audit were posted in communities throughout the project zone. These notices included helpful instructions for on how to make a comment on the CCB version.

2.3.6 Site Visit Information and Opportunities to Communicate with Auditor (G3.3)

The SMPP staff frequently meet with the identified project communities and residents of nearby villages and settlements. Due to ongoing pandemic-related government lockdowns and travel restrictions, project staff will continue to coordinate closely with the auditor and finalize an audit plan to arrange for in-person

interviews if possible and for online video interviews or recordings as a backup contingency. In order to prepare for the audit, project staff will inform relevant stakeholders in advance about the details of the audit process and prepare local groups with ample time for another potential remote audit so these stakeholders have the opportunity to share their feedback with the auditor regardless of logistical and travel considerations. The project will arrange for in-person meetings wherever possible with all relevant stakeholders, while making contingency plans should travel restrictions continue.

2.3.7 Stakeholder Consultation (G3.4)

The project has conducted a combination of formal stakeholder consultations and informational meetings with the communities dating back to 2016 (see SMPP PD Section 2.3.3). Project staff will continue to facilitate these meetings throughout the duration of the project. The feedback and advice provided by these parties is critical to the long-term success of the SMPP, and therefore all information gathered in these meetings feeds into the project's adaptive management plan and Environmental and Social Performance framework. Additionally, this feedback is a valuable opportunity for the project to enhance and adapt all aspects of project design and implementation according to guidance from relevant identified stakeholders.

Participatory Rural Appraisals (PRA), a method used to conduct social surveys in rural settings in a quick and efficient manner, were implemented by the community development team, which is described further in PD Section 2.1.8. SMPP's community development team carried out extensive direct engagement with the communities and other stakeholders in the SMPP and surrounding villages and settlements. Overall, since the project started in 2016, this effort has consisted of a variety of meetings and discussions. This engagement ranged from formalized discussions to informal conversations without specific written agendas.

Throughout the 2020 monitoring period, project staff consulted with local communities and other stakeholders to ensure mutual understanding regarding all project activities and potential impacts. During the 2020 monitoring period at least seven engagements with community fishermen, two engagements with a community farmer, 32 engagements with school groups or other education facilitators, 19 engagements with village officials, 3 engagements with managers from nearby concessions, 5 engagements with local women's groups, and 41 engagements with village residents in the Muara Merang and Kepayang villages and other nearby settlements were documented. A summary of these meetings is outlined in Table 4 below. These stakeholder consultations and engagements consisted of one-on-one interviews, group interviews, formal meetings, and focus group discussions (FGDs).

Table 4. Summary of stakeholder consultations

Note: (One-on-one interviews, group interviews, meetings, and focus group discussions)

SMPP group	Stakeholder Groups	Number of times engaged (in the previous monitoring period: 2019)	Current engagement (In 2020 monitoring period)
Community	Fishermen	9	7
	Farmers	10	2
	Total formal community consultations:	19	9
Other stakeholders	School groups and education facilitators	30	32
	Officials from nearby villages	24	19
	Managers from nearby concessions	4	3
	Residents from nearby villages and settlements	21	41
	Women's groups from nearby villages and settlements	6	5
	Total formal other stakeholder consultations:	85	100

SMPP group	Stakeholder Groups	Number of times engaged (in the previous monitoring period: 2019)	Current engagement (In 2020 monitoring period)
Type of engagement	One-on-one interview	92	63
	Group interview	6	18
	Meeting	5	26
	Focus Group Discussion (FGD)	1	2
	Total number of consultations:	104	109

Through these consultations, the project has been able to implement programs that are based on the needs of the community members or stakeholders. Community health center support & renovation, rainwater catchment system installation and anti-stunting programs are the result of extensive consultation with the local health workers and community members. Library support and renovation is another example of a program that resulted from stakeholder consultations, specifically the school and education facilitators.

2.3.8 Continued Consultation and Adaptive Management (G3.4)

Throughout the lifetime of the project, staff will maintain a direct line of communication with community members and relevant stakeholders. This establishes a commitment to communication and consultation, which keeps stakeholders informed of project activities including restoration, maintenance, monitoring and the CCB validation and verification process. SMPP staff in the field maintain communications with the fishermen and farming community groups and other stakeholders through in-person meetings. Community engagement staff actively listen to recommendations made by any identified community members, or other stakeholder groups, and adapt and improve our methods as necessary.

The project has an adaptive management plan in place to facilitate growth as the project matures and that is used to systematically refine existing practices through monitoring and evaluation. All plans, methods, goals and objectives are reviewed to incorporate new lessons learned, available technology, and scientific knowledge. These strategies are in accordance with the project's Standard Operating Procedures (SOPs) and its monitoring plans (see PD sections 3.3.3, 4.4.1, 5.4.1).

During the 2020 monitoring period, the project had consistent meetings and engagement with project communities and other stakeholders on community development plans to listen and document all feedback. The information collected from these meetings showed that these stakeholders wanted the project to expand its health and education programs. Inputs from stakeholders are a major influence on the design and implementation of the community development program, as exemplified by the recent focus on fish farming as a livelihoods program for example.

2.3.9 Stakeholder Consultation Channels (G3.5)

All stakeholder engagement, including consultations and participatory processes has been conducted via face-to-face conversations with individual stakeholders from the nearby villages and settlements, which is the most effective method in an area where phone and internet connectivity are limited. Project staff have conducted participatory surveys with the Participatory Rural Appraisal (PRA) method during the community development process. This included focus group discussions, interviews with men and women living in nearby settlements and villages, observation and ground checks with local residents including participatory visits to a variety of important areas. Project staff share information consistently and openly with all stakeholders and community members. See PD Section 2.3.3 to learn more about informational meetings with stakeholders and PD Section 2.3.2 for more information on project information dissemination.

2.3.10 Stakeholder Participation in Decision-Making and Implementation (G3.6)

The SMPP engages in consistent consultations with project communities and other stakeholders on project implementation and design as a way to incorporate local knowledge into the project and account for unforeseen impacts. Consultations ensure inclusive engagement with both men, women and marginalized stakeholder groups, ensuring their participation in culturally appropriate ways to ensure that the project can accommodate a wide range of perspectives. Project consultations and methods are described in more detail in Section 2.3.7.

2.3.11 Anti-Discrimination Assurance (G3.7)

The project team holds every individual involved in project design and implementation to a high standard of integrity, to ensure no one is involved in, or complicit in, any form of discrimination or sexual harassment with respect to the project. This includes discrimination based on gender, race, religion, ethnicity, social class, or other aspects of human individuality. Throughout the project duration, the SMPP will abide by all relevant Indonesian labor laws and regulations on anti-discrimination. Further, the project has an equal opportunity policy that ensures that the project will not engage in or be complicit in any form of discrimination or sexual harassment. To ensure compliance, the project has a grievance system in place that will provide all project employees, identified community members, and other stakeholders with a quick-response system in the event that any discriminatory actions or sexual harassment does occur, to ensure grievances can be addressed quickly and appropriately.

2.3.12 Grievances (G3.8)

We recognize the importance of a grievance redress mechanism within the SMPP to keep the project running smoothly and free of conflict. If conflicts or grievances arise, the project relies on the feedback and the grievance redress mechanism, which has been outlined and shared as a formal policy. This process is designed to be an efficient, fair and accessible mechanism for resolving complaints and conflicts in a transparent and comprehensive manner. The mechanism can also address issues or conflict between the community and the project, or issues use related to employee rights, work practices, and employee safety raised by project staff or contractors.

If any grievances occur and are reported from surrounding communities or other relevant stakeholders, the appropriate staff will quickly respond to them by following the formal mechanism process. Grievances will be assessed to identify and verify the cause, actors and scale of grievances, and the project's senior management will recommend resolution options based on feedback from relevant stakeholders. If a grievance is not amicably resolved after this process, it will be submitted to an unbiased third party for a formal mediation and arbitration process, and subject to a hearing at which both parties can testify. All cases will be referred and examined to the extent allowed by Indonesian laws and regulations of the relevant jurisdiction before decisions are made.

This grievance policy is outlined in the document "Sumatra Merang Peatland Project Grievance Redress Mechanism" and has been described at community meetings and shared at key locations in the project area. The grievance policy has been translated to Bahasa and shared with project community members and stored in central communal locations where project community members and other stakeholders live. To ensure transparency, the project will maintain a record book of all grievances received and their resolutions, which can be viewed upon request by project stakeholders or auditors. There were no grievances reported during the 2020 monitoring period.

2.3.13 Worker Training (G3.9)

The SMPP has a target to have 80% of its field staff comprised of residents of nearby villages and settlements and has achieved 71.4% employment of locals (30 out of 42 field staff) during 2020, a 3% increase from the previous monitoring period. As part of the on-boarding process, the project provides all staff with an orientation program where it provides overviews of the project Standard Operating Procedures (SOPs) and policies with specific attention to health and safety. The employees also receive training in the use of technology such as GPS units, computers, solar energy, IoT sensors and firefighting equipment which will expand employee knowledge and increase their prospects of future employment. Local capacity

is constantly being supported through training programs and recruitment drives for full-time and part time employment opportunities to ensure strong local capacity despite staff turnover.

2.3.14 Community Employment Opportunities (G3.10)

The SMPP is an equal opportunity employer and is committed to engage with the identified community groups and local stakeholders on employment opportunities. To achieve this, the project has a policy to hire 80% of its staff from local areas as a way to increase community and stakeholder benefits. Further, the project has a target to have 25% of its work force comprised of women to ensure greater gender balance in a field traditionally viewed as a male-centric profession. During this monitoring period, the project directly employed 21% or thirteen women as project staff. The project aims to reach the target in the next monitoring period. To create opportunities for marginal groups, the project also has positions available for staff who have not obtained high school diplomas to ensure these vulnerable groups have access to meaningful employment opportunities. The project also makes the project-sponsored adult education program available for all staff to enable them to raise their education levels.

Job opportunities are publicly advertised in similar channels where other project news is publicized, such as community sign boards and announcements via community leaders. Meetings are convened within project stakeholder villages and settlements as part of the recruitment process in order to spread the word and attract candidates. The project has also communicated that it is always actively recruiting for forest patrol officers and that interested parties can apply directly at the project office.

Job applicants are selected for interviews based on their skills, experience and demonstration of potential required for the advertised positions. Successful candidates are then selected in accordance with the project's equal opportunity policy. Applicants who live in the local villages and settlements are given preference in the case where two applicants show the same capacity for a given position whereas one is from the local area and the other is not.

2.3.15 Relevant Laws and Regulations Related to Worker's Rights (G3.11)

The SMPP core principals require that all persons in the project are treated with dignity and respect. The SMPP complies with all national and provincial laws related to worker's rights, including: Law No. 13/2003 regarding Manpower. This is an umbrella law on labor relationship in Indonesia, which stipulates the working conditions and rights and obligations of the employees and the Company. The SMPP operations fully comply with these regulations in regard to the rights of workers, and the project seeks to ensure that the rights of all employees are upheld in a manner where all individuals are aware of their rights. The project has its own human resource policies containing the details of employment practices that are followed. These policies are explained to all staff during their orientation program and are available for review in the project's field office and posted at all forest patrol offices.

2.3.16 Occupational Safety Assessment (G3.12)

The project is committed to ensuring occupational safety for all project staff and follows all relevant Indonesian worker's rights laws and regulations, particularly those pertaining to health and safety. The project has created a comprehensive Health and Safety Plan and informs all staff on the workplace risks through a risk register and outlines safe practices to mitigate those risks during employee orientation and through ongoing training. A hard copy of the relevant project regulations is kept at the project office for reference by project staff. Project staff are exposed to a number of risks that include strenuous activity in wet, humid, and hot conditions, forest fires, transportation accidents, interactions with illegal loggers, encounters with dangerous wildlife, and exposure to mosquito borne sicknesses. The health and safety training for the project addresses these risks and also trains staff on the proper handling of equipment and other materials. In addition, project proponents maintain a public liability insurance of 9,000,000 EUR in case major accidents do occur.

Table 5. Actions to mitigate potential occupational risks

Potential Occupational Risks	Risk Mitigation Action
------------------------------	------------------------

Strenuous activity in wet, humid, and hot conditions	Proper attire for work condition and ample access to drinking water for hydration are provided.
Forest fires	Staff are trained in fire-fighting activities and are provided proper safety equipment.
Transportation accidents	Staff are trained in driving and are required to wear seatbelts at all times and wear helmets when driving motorbikes.
Interactions with illegal loggers	The project has a policy not to engage illegal loggers, instead involving local law enforcement to avoid any physical conflict.
Encounters with dangerous wildlife	The project has a policy on when to conduct forest patrols and carries noisemakers (such as air horns) to avoid encounters with dangerous wildlife or to scare them off if poachers were to arrive.
Exposure to mosquito borne sicknesses	All staff are provided with mosquito nets and access to bug repellent.

2.4 Management Capacity

2.4.1 Required Technical Skills (G4.2)

The project requires a range of technical and managerial skills in order to implement the project activities listed in Section 2.1.11 of the PD. Table 6 outlines the skills required per project activity.

Table 6. Key skills required to implement the project activities.

Project Activity	Sub-project Activity	Key Skills Required
Carbon stock measurements	Aboveground and belowground biomass measurement	Peatland science, forestry, GIS/remote sensing, forest and peatland inventories, statistics, and carbon monitoring, reporting, and verification (MRV).
FPIC and community engagement and development	Stakeholder consultation, livelihood development, and education program.	Community organizing, conflict resolution, business management, adult education, and livelihoods.
Biodiversity assessment and monitoring	Habitat conservation and management and biodiversity monitoring.	HCV mapping, forest conservation, conservation biology, and biodiversity monitoring
Monitoring skills	Land cover mapping, water level monitoring, subsidence monitoring, climate monitoring, biodiversity monitoring, community monitoring, and fire monitoring.	GIS/remote sensing, hydrology, peatland science, conservation biology and monitoring, social science surveys, and peatland forest fire management
Forest protection and enforcement	Enforcement and patrolling and forest fire prevention and control.	Forestry, peatland forest fire management, and community engagement.

Project Activity	Sub-project Activity	Key Skills Required
Forest and peatland conservation and restoration	Hydrological management, reforestation, enrichment planting, and habitat conservation.	Hydrology, peatland science, silviculture, forestry, and biodiversity conservation, engineering.
Project management and administration	Logistics, finance and accounting, human resources (HR), administration, and government reporting.	Finance and accounting, HR, business management, legal compliance, and administration.

The project has successfully maintained a team of experts on community engagement, biodiversity assessment and carbon measurement and monitoring skills throughout the monitoring period. The skillsets experience of the core technical team is listed in section 2.4.2.

2.4.2 Management Team Experience (G4.2)

The SMPP is implemented by two project proponents: PT Global Alam Lestari (PT GAL) and Forest Carbon. The joint development of the project is managed via a project management board that is composed of representatives of PT GAL and Forest Carbon with an observer from the investment partner, Mirova Natural Capital (previously Althelia Climate Fund/ACF).

At the implementation level, each proponent focuses on different areas of implementation. PT GAL, a subsidiary of an established Indonesian forestry company, specializes on the ground operations for forest restoration in the project area. Its staff have significant experience in overseeing the implementation of large-scale land management projects in Indonesia. As the holder of the PAN/RAP license, its role in the project is to implement field operations in line with the project design in addition to managing and overseeing community and stakeholder relations and ensuring compliance with all government regulations.

Forest Carbon is a leading forest conservation and restoration company that has been working in Indonesia since 2007. Forest Carbon has staff experienced in project management, VCS/CCB project design, Geographic Information Systems (GIS) and remote sensing, forest and biomass inventories, biodiversity mapping and monitoring, and community engagement. Forest Carbon's also leads project management, project design, field data collection and analysis, VCS/CCB certification monitoring and compliance, and technical advisory services.

2.4.2.1 Project Management Leads

Mr. Jeffrey Chatellier – CEO - Forest Carbon – SMPP Project Lead

Mr. Chatellier is Forest Carbon's CEO. He is an environmental scientist who has worked on environmental conservation, forestry, and sustainability for the past 10 years. With a combined background in economics and environmental science, Mr. Chatellier has advised major corporations and international environmental organizations on forest conservation, environmental risk mitigation, and sustainability. He has worked closely on the development of multiple REDD+ projects in Southeast Asia, which has given him in depth knowledge of various carbon standards and the technical and political challenges to conservation projects in the developing world. He has reviewed existing scientific carbon accounting methodologies and worked with companies on developing the necessary project documents to obtain carbon credits, including the Rimba Raya peatland project in Central Kalimantan, Indonesia, and the REDD+ project to protect the Keo Seima Wildlife Sanctuary in Cambodia.

2.4.2.2 Project Design, Monitoring, and Implementation

Dr. Ophelia Wang – Technical Advisor - Forest Carbon – SMPP MRV

Dr. Wang is Forest Carbon's Technical Adviser. A specialist in conservation entrepreneurship, Dr. Wang brings more than 17 years of experience in technical forestry and program management, backed by Ph.D. and M.Sc. studies in tropical conservation spatial planning in regions as diverse as Latin America and Southeast Asia. Dr. Wang brings deep technical expertise in program management system design and

strategic planning for conservation projects, in addition to multiple years of experience in Latin America, U.S. and Southeast Asia using GIS and remote sensing techniques to improve landscape-scale spatial planning, information system management, and conservation implementation. Dr. Wang's strengths lie in data analysis, specifically in integrating habitat and species data with peatland hydrology and fire risk analysis to provide comprehensive ecosystem service models.

Sebastian Persch – Emissions Science and Technology Lead – Forest Carbon – SMPP MRV

Mr. Persch is a tropical peat hydrology expert who has worked on various topics related to forestry, conservation, and climate change since 2011. He specializes in tropical peat ecology, including advanced data analysis and statistical programming using open-source software and has conducted research on peatlands in Sumatra on carbon stock and carbon dynamics estimation. Sebastian holds B.Sc. and M.Sc. in Tropical Forestry Ecology, all from the Georg-August Universität Göttingen in Germany. He conducted research at the Center for International Forestry Research (CIFOR), which focused on root dynamics within land-use change from forest to oil palm plantation in the tropical peat swamps of Berbak National Park and the *Taman Hutan Raya* in Jambi, Indonesia. He has held previous positions and consultancies with the Centre de coopération *Internationale en recherche agronomique pour le développement* (CIRAD), the James Hutton Institute, and the University of Göttingen. With Forest Carbon he has completed assignments modeling baseline and expected emissions from peat drainage in Berbak National Park and in the degraded peat lands of the Ex-Mega Rice project area in Central Kalimantan. For those assignments Sebastian modeled emissions from drainage, established proxies with calibrated GHG emission profiles in Strata I and identified possible canal blocking locations in conjunction with Forest Carbon GIS and Remote Sensing teams.

Reagen Pangestu – ISO Certification Lead – Global Alam Lestari – Member of Project Management Board

Mr. Pangestu leads the ISO certification team for Global Alam Lestari, where he oversees the implementation and the certification of the company's Environmental Management System under the ISO 14001 standard. He is also a member of the Project Management Board.

Agus Afijanto – General Operations – Global Alam Lestari – Forest Planting

Mr. Afijanto oversees general operations in SMPP including forest planting. He has worked in the forestry sector for over 20 years and has a degree in forestry from *Universitas Gajah Mada*, Indonesia.

Abdul Haris Marzuki – Field Site Manager – Global Alam Lestari – SMPP Field Site Manager

Mr. Marzuki oversees all field operations in the SMPP project area. He has 25 years' experience working in the forestry sector in Indonesia. His experience includes overseeing field staff and ensuring a safe and healthy work environment.

Ahmad Susilo – Community Engagement Manager – Global Alam Lestari – SMPP Community Engagement lead

Mr. Susilo has extensive experience in engaging with local communities and government officials. He leads all community engagement activities and implementation of the community development program for the SMPP.

Catur Prasetyo – Biodiversity Manager – Global Alam Lestari – SMPP Biodiversity lead

Catur is a trained biologist with extensive biodiversity conservation experience in Indonesia. Prior to joining SMPP as a Biodiversity program manager, he oversaw a team of forest patrol officers and was responsible for biodiversity monitoring at an Orangutan habitat protection project in West Kalimantan.

Mary Osmond – Legal Advisor – Forest Carbon – Legal Compliance for SMPP and Community Development Advisor

Ms. Osmond is a trained lawyer with a background in business and environmental law in Indonesia. She holds a law degree from Atmajaya University and an LLM from the University of Groningen in the Netherlands and is a member of the Indonesian Bar Association (PERADI). She is an expert on conservation law in Indonesia and acts as the primary legal compliance officer for the Sumatra Merang Peatland Project. As the Indonesian Presidential Office's UKP4 Representative in Jambi, she worked with

relevant entities to implement a transparent licensing system for the mining and plantation sectors, resulting in a provincial regulation mandating the system. She has also advised multiple NGOs on land tenure and licensing strategy and international investors on establishing business operations in Indonesia. She is supporting SMPP on legal compliance and monitoring and the implementation of its community development program.

Prasetya Mahardhitama – Remote Sensing Lead – Forest Carbon – MRV

Mr. Mahardhitama is an expert in GIS and remote sensing. His background in information technology systems enables him to build custom applications that leverage GIS & Remote Sensing data, including high-resolution satellite imagery from Light Detection and Ranging (LiDAR), Satellite and Unmanned Aerial Systems. He has developed custom web and mobile GIS applications for conservation projects and has supported forest landscape analysis and mapping across Southeast Asia and is also a certified drone pilot.

Angga Pratama – Monitoring and Investor Reporting Lead – Forest Carbon – VCS/CCB Certification and Project Management

Mr. Pratama is a project manager who oversees the SMPP validation and verification process. He leads the multi-facet project monitoring by engaging with all the relevant stakeholders and liaise with the operation teams at the field. He is a Certified Sustainability Reporting Specialist under the Global Reporting Initiative (GRI) Standards.

2.4.3 Project Management Partnerships/Team Development (G4.2)

All relevant project management experience is present in the current SMPP partners.

2.4.4 Financial Health of Implementing Organization(s) (G4.3)

Both project proponents, PT GAL and Forest Carbon, are financially stable companies, capable of implementing and maintaining a project of the scale of the SMPP. Additionally, the initial project activities are fully supported by an investment from Mirova Natural Capital (previously Althelia Climate Fund). See PD Section 2.1.20 for information on the financial sustainability of the project's funding. Project validators may request to see more specific financial statements to verify financial health.

2.4.5 Avoidance of Corruption and Other Unethical Behavior (G4.3)

The project is fully compliant with the US Foreign Corruption Practice Act (FCPA). As a collaborative effort, the SMPP team is committed to upholding a high level of integrity and professionalism throughout all aspects of project design and implementation. The project has a zero-tolerance attitude towards corruption and unethical behavior, and is not involved in, or complicit in, any form of corruption such as bribery, embezzlement, fraud, extortion, and collusion.

2.4.6 Commercially Sensitive Information (RULES 3.5.13 – 3.5.14)

Commercially sensitive information that is not publicly available includes:

- Agreements and contracts between project proponents, other project entities, and stakeholder groups – regarding implementation of project activities.
- Financial statements

Specific information is available privately to project validators upon request.

2.5 Legal Status and Property Rights

2.5.1 Recognition of Property Rights (G5.1)

The project is committed to recognizing, respecting, and supporting all property rights of communities and other stakeholders. An assessment of the project area showed that there are no groups living in the project area full time and that there were two small farms that overlap with the project license area, along with a

small number of fishermen that fish inside or near the project area. However, the project was specifically designed, following the identification of these customary rights holders, to ensure that no impingement upon these land rights holders or their livelihoods will occur.

2.5.2 Free, Prior and Informed Consent (G5.2)

As outlined previously, the project does not impinge on any rights holder's access or use of the project area. As per CCB requirements, FPIC is required only when these rights are negatively impacted. If it is ever determined that the project impacts these rights holders, either inadvertently or through the implementation of project activities, then an FPIC process will be initiated. The project continues to adopt a highly consultative engagement process, including the Participatory Rapid Assessment of local communities and ongoing consultations with all stakeholders which ensures that all stakeholders and communities have the opportunity to share their feedback in an informative and meaningful way.

2.5.3 Property Right Protection (G5.3)

Project activities do not lead to involuntary removal or relocation of property rights holders from their lands or territories and do not force rights holders to relocate activities important to their culture or livelihood. If in the future any relocation activities need to be undertaken, it will take place with a written agreement that demonstrates that the agreement was made with the free, prior, and informed consent of those concerned and includes provisions for just and fair compensation.

2.5.4 Identification of Illegal Activity (G5.4)

Small-scale illegal activities, such as illegal logging or hunting, were historically practiced in parts of the project area and could negatively impact the rehabilitation of the forest and reduce the returning levels of biodiversity. The project has constructed and staffed several forest protection posts along the boundary of the project area to ensure an equal distribution of forest patrol coverage across the project area. The SMPP is also reducing the risk of these illegal activities and negative impacts with the implementation of its forest protection plan and a community development plan that provides sustainable livelihoods options. With stronger economic alternatives, the project expects that the need to participate in illegal activities will be further reduced.

2.5.5 Ongoing Disputes (G5.5)

There are no ongoing disputes or any previously unresolved conflicts inside the project area.

2.5.6 National and Local Laws (G5.6)

The SMPP is designed to be in full compliance with national, regional, and local laws of the Republic of Indonesia, especially laws regulating forest conservation projects.

2.5.6.1 New Laws and Regulations

Indonesia issued Law No.11 of 2020 on Job Creation, known as "the Omnibus Law" in August of 2020. This law creates several changes to the licensing process in the forestry sector. While relevant to project developers, the new law does not affect the SMPP project. Specific, ministry-level guidelines and procedures are still developed in relation to the wide-ranging changes in law.

Prior to the enactment of the Omnibus law the right to sequester and store carbon was granted under a Business License for Carbon Sequestration and Carbon Storage (*Izin Usaha Pemanfaatan Penyerapan dan Penyimpanan Karbon* known as an IUP RAP-PAN Karbon).

The Omnibus law has created a universal license for multiple land use businesses, such as pulp/paper, palm oil, selective logging and carbon sequestration and storage. This new license type, known as "Forest Utilization Business License" or "*Perizinan Berusaha Pemanfaatan Hutan, PBPH*") now permits multiple types of forestry businesses to be conducted in a single concession area regarding to MoEF Regulation No. 8 of 2021 on Procedures and Preparation of Forestry Management

Plan, as well as Utilization of Forest in Protected and Productive Forest Area ("MoEF Reg. 8/2021"). This MoEF regulation from 8/2021 aims to reform and restructure forest concession licensing.

These wide-ranging changes apply to the licensing process for new projects and are not retroactive, therefore the existing forestry license (an IUP RAP-PAN Karbon license granted in 2013) for SMPP is still valid.

2.5.6.2 Compliance with Existing Laws and Regulations

The following laws and regulations apply to forestry concessions in general.

Fire Prevention:

- Law No. 32/2009 regarding Environmental Protection and Management.
- Government Regulation No. 45/2004 regarding Forest Protection.
- Government Regulation No. 71/2014 regarding Protection and Management of Peatland Ecosystem.
- Government Regulation No. 57/2016 regarding the Change of the Government Regulation No. 71/2014 regarding Protection and Management of Peatland Ecosystem.
- Ministry of Environment and Forestry Regulation No. 32/2016 regarding Controlling the Forest and Land Fire.
- South Sumatra Provincial Regulation No.1/2018 regarding the Peatland Ecosystem Protection and Management ("Peraturan Daerah No.1/2018"). This regulation stipulates the peatland management and protection including the obligations to prevent fire and avoid the damages of peatland.

The primary activity of SMPP forest patrols is fire prevention and mitigation. These teams run a landscape monitoring program which uses patrol activities, remote sensing, and infrared cameras. By preventing fires in the project area and mitigating fires in the wider project zone, the project is in compliance with these laws.

Canal Blocking:

- Ministry of Environment and Forestry Regulation Np. P.14/MENLHK/SETJEN/KUM.1/2/2017 regarding the Procedures for Inventory and Determination of the Function of Peat Ecosystems.
- Ministry of Environment and Forestry Regulation No. P.15/MENLHK/SETJEN/KUM.1/2/2017 regarding the Procedures of Water Table Measurement in the Peat Ecosystem's Monitoring Point.
- Ministry of Environment and Forestry Regulation No. P.16/MENLHK/SETJEN/KUM.1/2/2017 regarding the Technical Guidelines for Restoring the Function of Peat Ecosystems.
- Ministry of Environment and Forestry Regulation No. P10/MENLHK/SEKJEN/KUM.1/3/2019 regarding the Enactment and Management of Peat Dome Based on the Peatland Hydrology Unit.

Forest Carbon measures water table levels on a daily basis, has an active hydrology restoration program using canal blocks to restore natural water table levels and has conducted a full peat depth inventory and drainage model for the project site, which follow peatland management regulations from the Ministry of Environment and Forestry.

Community Development: GAL conducts the community development around its concession areas, which is line with the following regulations:

- Law No.11 of 2020 regarding the Work Creation jo. Law No. 40 of 2007 regarding the Limited Liability Company ("Company Law").
- Government Regulation No. 47 of 2012 on the Social and Environmental Responsibilities of the Limited Liability Company.

SMPP conducts community development around its concession areas, which is line with regulations that companies conduct CSR activities within their area of operations.

Forest Conservation Activities Business License: SMPP holds a PAN/RAP license that allows to conduct the carbon sequestration and stock activities. The laws and regulations specific to the PAN/RAP license are outlined in Table 7 below, including how the project complies with each requirement.

Table 7. Laws and regulations specific to the PAN/RAP license and the compliance activities.

Relevant Regulation or Law	Compliance Activity
MoEF Regulation No.71/MENLHK/Sekjen/KUM.1/12/2017 on Implementation of National Registration System for Climate Change.	SRN Registration: SMPP completed the application process for Indonesia's National Registration System ("Sistem Registrasi Nasional or SRN") in 2019. The system is still being established by the Indonesian government to manage carbon accounting at the project, jurisdictional and national levels. The SRN does not issue any form of credits or certificates.
MoEF Decree No: SK.949/Menhut-II/2013 on PAN/RAP Carbon License of PT Global Alam Lestari ("PT GAL"). MoEF Regulation No. 8 of 2021 on Procedures and Preparation of Forestry Management Plan, as well as Utilization of Forest in Protected and Productive Forest Area	Management Plan: SMPP is required to develop a 10-year management plan ("RKU") for the concession area. The updated 10-year plan was submitted on April 14, 2020, and the project most recently summarized the plan in a presentation to the MoEF on May 4, 2021, at the ministry offices. After this meeting, the MoEF gave comments on the draft and SMPP submitted a new revision of RKU draft based on the suggestion of MoEF on May 10, 2021.
MoEF Regulation No. 8 of 2021 on Procedures and Preparation of Forestry Management Plan, as well as Utilization of Forest in Protected and Productive Forest Area. MoEF Decree No: SK.949/Menhut-II/2013 on PAN/RAP Carbon License of PT Global Alam Lestari ("PT GAL").	Demarcation Approval: The MoEF conducted the boundaries demarcation in our project area in May 2018. All required information has been submitted to MoEF related to Regulation No 8. and Decree No. SK.949/Menhut-II/2013.
Government Regulation P.12/2014 on Types and Tariffs of Non-Tax State revenue (<i>Penerimaan Negara Bukan Pajak</i> or "PNBP")	Taxation and Levy: SMPP pays a 10% levy on all carbon transactions, and the local license holder Global Alam Lestari pays the Land and Building Tax every year.
MoEF Decree No: SK.949/Menhut-II/2013 on PAN/RAP Carbon License of PT Global Alam Lestari ("PT GAL"). Law No. 40 of 2007 regarding the Limited Liability Company ("Company Law"). Government Regulation No. 47 of 2012 on the Social and Environmental Responsibilities of the Limited Liability Company.	Community Development: SMPP implements number of communities development programs and collaborates with local leaders to ensure SMPP delivers lasting co-benefits for forest dependent and other surrounding communities. Our community development programs focus on health, sanitation, education and maternal and child health as well as efforts to improve local livelihoods.

	Currently, SMPP supports support the Local Government on Covid-19 prevention by supporting vaccination events, providing PPE and rapid test kit. This program builds on the project's existing support for local health centers and trainings for local health workers.
• MoEF Decree No: SK.949/Menhut-II/2013 on PAN/RAP Carbon License of PT Global Alam Lestari ("PT GAL"). • MoEF Regulation No. 8 of 2021 on Procedures and Preparation of Forestry Management Plan, as well as Utilization of Forest in Protected and Productive Forest Area	Reports to MoEF: As a license holder, SMPP submits periodic reports to MoEF both annually and monthly.

3 CLIMATE

3.1 Monitoring

3.1.1 Data and Parameters Available at Validation

The data and parameters for the SMPP that will be available at validation according to the VCS methodology VM0007 MF are provided in the tables below.

Data / Parameter	$\Delta C_{BSL-ARR}$
Data unit	t CO ₂ -e
Description	Net GHG removals in the ARR baseline scenario up to year t^*
Equations	PD Section 3.1.3.1.6 Equation 5
Source of data	Module BL-ARR
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-ARR
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$GHG_{BSL-WRC}$
Data unit	t CO ₂ -e
Description	Net GHG removals in the WRC baseline scenario up to year t^*
Equations	PD Section 3.1.3.1.6 Equation 6
Source of data	Module BL-PEAT
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-PEAT
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$D_{peatburn,i,t}$
Data unit	m yr ⁻¹
Description	Fire scar depth per year
Equations	PD Section 3.2.1.5.3 Equation 14, PD Section 3.2.1.5.5 Equation 20, PD Section 3.2.2.6 Equation 31
Source of data	Konecny et al. (2016) ⁸

Value applied	0.17 m, 0.1 m, 0.06 m, and 0.02 m, for 1 st , 2 nd , 3 rd , and subsequent burning, respectively.
Justification of choice of data or description of measurement methods and procedures applied	Literature
Purpose of Data	Calculation of baseline and project emissions
Comments	N/A

Data / Parameter	CC
Data unit	%
Description	Carbon concentration of the peat
Equations	N/A
Source of data	Own measurement
Value applied	0.53
Justification of choice of data or description of measurement methods and procedures applied	Sampling using standard field and laboratory techniques
Purpose of Data	Calculation of baseline and project emissions
Comments	N/A

3.1.2 Data and Parameters Monitored

The data and parameters for the SMPP that were monitored according to the VCS methodology VM0007 MF are provided in the tables below. Details of all relevant data and parameters are further elaborated in section 3.1.3 regarding the projects monitoring system.

Data / Parameter	$\Delta C_{WPS-ARR}$
Data unit	t CO ₂ -e
Description	Net GHG removals in the ARR project scenario up to year t^*
Equations	PD Section 3.1.3.1.6 Equation 5
Source of data	Module M-ARR
Description of measurements methods and procedures to be applied	See Module M-ARR
Frequency of monitoring/recording	See Module M-ARR
Value monitored	N/A
QA/QC procedures to be applied	See Module M-ARR
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-ARR
Comments	

Data / Parameter	ΔC_{LK-ARR}
Data unit	t CO ₂ -e
Description	Net GHG emissions due to leakage from the ARR project activity up to year t^*
Equations	PD Section 3.1.3.1.6 Equation 5
Source of data	Module LK-ARR
Description of measurements methods and procedures to be applied	See Module LK-ARR
Frequency of monitoring/recording	See Module LK-ARR
Value monitored	N/A
QA/QC procedures to be applied	See Module LK-ARR
Purpose of data	Calculation of leakage
Calculation Method	See Module LK-ARR
Comments	

Data / Parameter	$GHG_{WPS-WRC}$
Data unit	t CO ₂ -e
Description	Net GHG emissions in the WRC project scenario up to year t^*
Equations	PD Section 3.1.3.1.6 Equation 6
Source of data	Module M-PEAT
Description of measurements methods and procedures to be applied	See Module M-PEAT
Frequency of monitoring/recording	See Module M-PEAT
Value monitored	34,532
QA/QC procedures to be applied	See Module M-PEAT
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-PEAT
Comments	See Module M-PEAT

Data / Parameter	GHG_{LK-ECO}
Data unit	t CO ₂ -e
Description	Net GHG emissions due to ecological leakage from the WRC project activity up to year t

Equations	PD Section 3.1.3.1.6 Equation 6
Source of data	Module LK-ECO
Description of measurements methods and procedures to be applied	See Module LK-ECO
Frequency of monitoring/recording	See Module LK-ECO
Value monitored	0
QA/QC procedures to be applied	See Module LK-ECO
Purpose of data	Calculation of leakage emissions
Calculation Method	See Module LK-ECO
Comments	See Module LK-ECO

Data / Parameter	$E_{peatburn-WPS,i,t}$
Data unit	t CO ₂ -e yr ⁻¹
Description	GHG emissions from burning of peat within the project boundary in the project scenario in stratum <i>i</i> in year <i>t</i>
Equations	PD Section 3.2.2.6 Equation 30
Source of data	Literature values
Description of measurements methods and procedures to be applied	See Module E-BPB
Frequency of monitoring/recording	At each monitoring period
Value monitored	0
QA/QC procedures to be applied	See Module E-BPB
Purpose of data	Calculation of project emissions
Calculation Method	N/A
Comments	N/A

Data / Parameter	$E_{proxy-CO2,i,t}$
Data unit	t CO ₂ -e yr ⁻¹
Description	Soil emission of CO ₂ as land-use proxy in stratum <i>i</i> at year <i>t</i>
Equations	PD Section 3.2.2.4 Equation 27
Source of data	IPCC default factors
Description of measurements methods and procedures to be applied	See Module M-PEAT

Frequency of monitoring/recording	At each monitoring period
Value monitored	2,333
QA/QC procedures to be applied	See Module M-PEAT
Purpose of data	Calculation of project emissions
Calculation Method	N/A
Comments	N/A

Data / Parameter	$E_{proxy-CH_4,i,t}$
Data unit	t CO ₂ -e yr ⁻¹
Description	Soil emission of CH ₄ as land-use proxy in stratum <i>i</i> at year <i>t</i>
Equations	PD Section 3.2.2.4 Equation 28
Source of data	IPCC default factors
Description of measurements methods and procedures to be applied	See Module M-PEAT
Frequency of monitoring/recording	At each monitoring period
Value monitored	31,999
QA/QC procedures to be applied	See Module M-PEAT
Purpose of data	Calculation of project emissions
Calculation Method	N/A
Comments	N/A

Data / Parameter	A_i
Data unit	ha
Description	Total area of stratum <i>i</i>
Equations	PD Section 3.2.2.4 Equation 27 & 28
Source of data	Module X-STR
Description of measurements methods and procedures to be applied	See module X-STR
Frequency of monitoring/recording	See module X-STR
Value monitored	See Table 24

QA/QC procedures to be applied	See module X-STR
Purpose of data	Calculation of project emissions
Calculation Method	N/A
Comments	N/A

Data / Parameter	$E_{peatditch-CO2,i,t}$
Data unit	t CO ₂ -e yr ⁻¹
Description	Emission of CO ₂ from ditches and open water stratum <i>i</i> at year <i>t</i> in the project scenario
Equations	PD Section 3.2.2.5.1 Equation 29
Source of data	Literature values
Description of measurements methods and procedures to be applied	IPCC default factor for naturally drained organic soils
Frequency of monitoring/recording	At each monitoring period
Value monitored	200
QA/QC procedures to be applied	See Module M-PEAT
Purpose of data	Calculation of project emissions
Calculation Method	N/A
Comments	N/A

Data / Parameter	$A_{ditch-WPS,i,t}$
Data unit	ha
Description	Total area of ditch and other open water stratum <i>i</i> in year <i>t</i> in the project scenario
Equations	PD Section 3.2.2.5.1 Equation 29
Source of data	Module X-STR
Description of measurements methods and procedures to be applied	See Module X-STR
Frequency of monitoring/recording	See Module X-STR
Value monitored	69.42
QA/QC procedures to be applied	See Module X-STR
Purpose of data	Calculation of project emissions
Calculation Method	N/A

Comments	N/A
----------	-----

Data / Parameter	$A_{DefPA,i,u,t}$
Data unit	Ha
Description	Area of recorded deforestation in the project area in stratum i converted to land use u at time t
Equations	Equation 3 (Module M-MON)
Source of data	Remote sensing imagery
Description of measurements methods and procedures to be applied	See Module M-MON
Frequency of monitoring/recording	See Module M-MON
Value monitored	N/A
QA/QC procedures to be applied	See Module M-MON
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-MON
Comments	See Module M-MON

Data / Parameter	$C_{BSL,i}$
Data unit	t CO ₂ -e ha ⁻¹
Description	Carbon stock in all pools in the baseline in stratum i
Equations	Equations 5, 24 (Module M-MON)
Source of data	Module M-MON
Description of measurements methods and procedures to be applied	See Module M-MON
Frequency of monitoring/recording	See Module M-MON
Value monitored	N/A
QA/QC procedures to be applied	See Module M-MON
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-MON
Comments	See Module M-MON

Data / Parameter	$A_{RRL,forest,t}$
Data unit	ha

Description	Remaining area of forest in <i>RRL</i> at time <i>t</i>
Equations	
Source of data	Module M-MON
Description of measurements methods and procedures to be applied	See Module M-MON
Frequency of monitoring/recording	See Module M-MON
Value monitored	254.39 Ha
QA/QC procedures to be applied	See Module M-MON
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-MON
Comments	See Module M-MON

3.1.3 Monitoring Plan

3.1.3.1 Approaches for Climate Impact Monitoring

Climate impact monitoring includes monitoring changes in land cover, peat thickness and water table level, as per the VCS VM0007 methodological requirements. A summary of the main monitoring methods is given below.

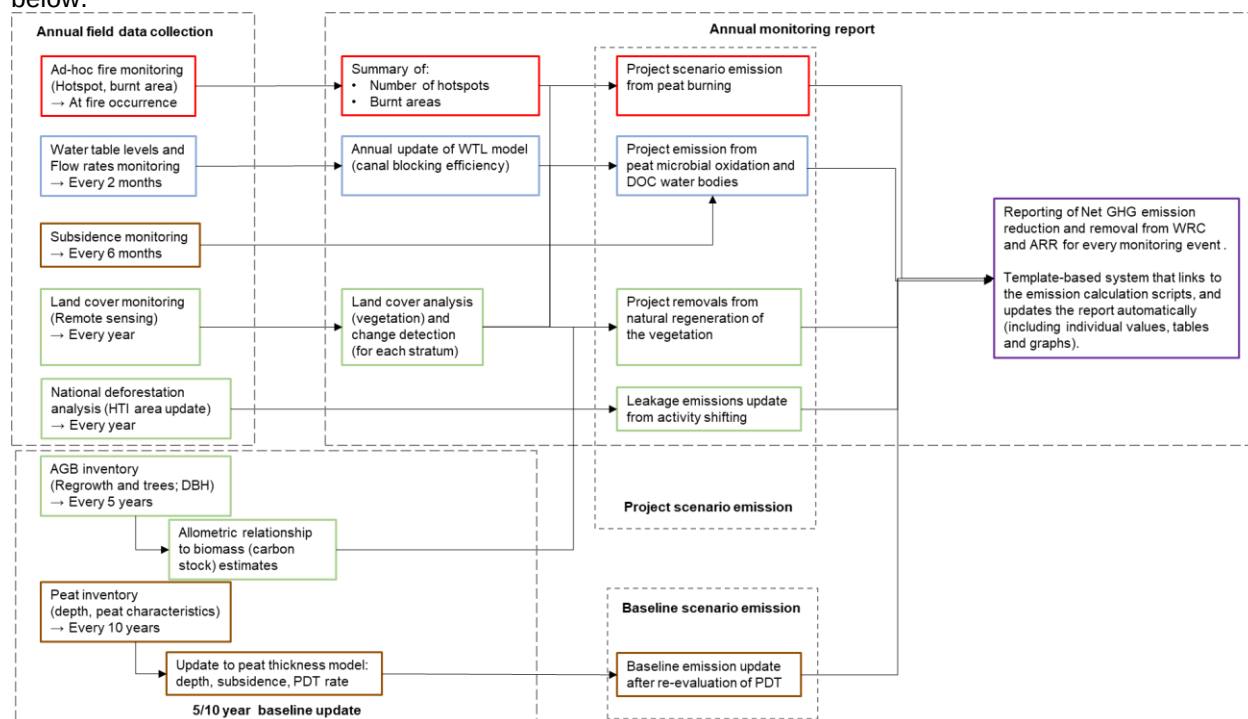


Figure 1 illustrates a workflow of field data collection activities, activity frequencies, data analysis or modeling associated with the activities, quantification of GHG emissions, and preparation for annual reporting. Details for sampling approaches and procedures are available in Annex 3 and Annex 4.

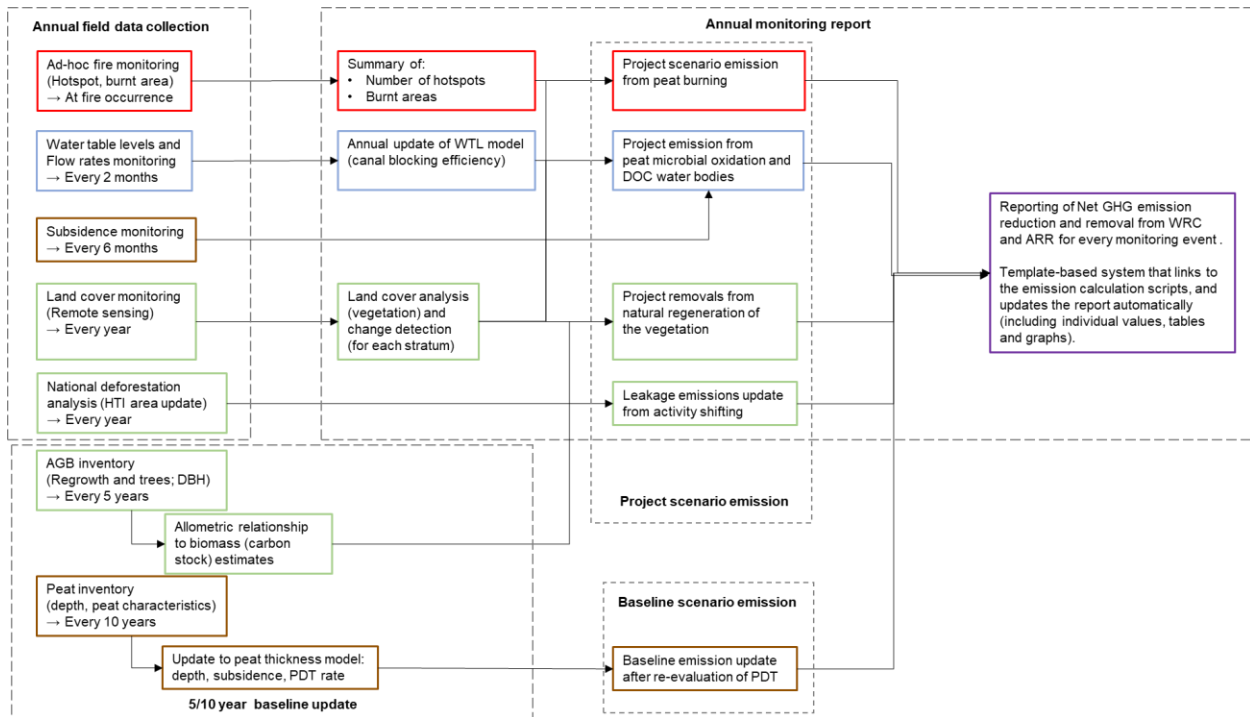


Figure 1. Schematic workflow of the GHG data collection, data management, and annual reporting

Project staff standardize data through standard operating procedures (SOPs) and perform multiple quality assurance and quality control (QA/QC) assessments. All data collected, recorded, stored, and reported are subject to review and approval by data analysts, data managers, the technical project lead, and the project team leader with reference to each level of data management. In order to ensure the security and traceability of data entry and QA/QC, all data in raw, intermediate, and final stages have access levels pre-defined for different types of users (Figure 2). Brief, regular monitoring reports are generated to assess the quality of data received from the field and investigations into any potential outliers. Any possible monitoring equipment failures will be carried out to ensure the data passes QA/QC.

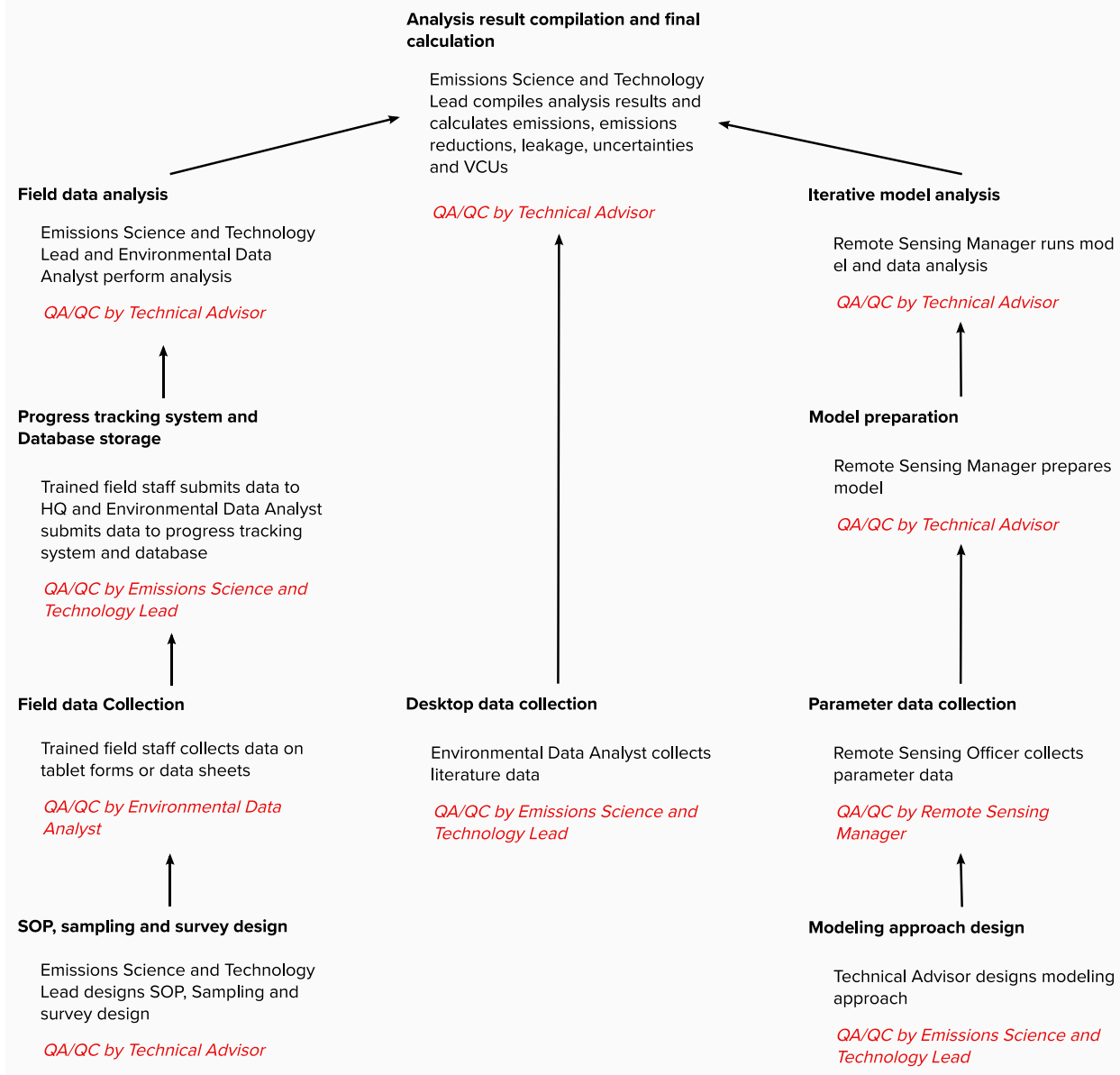


Figure 2. Data collection, QA/QC, and processing workflow.

The roles and responsibilities of each monitoring team member are listed below in Table 8.

Table 8. Roles and responsibilities of the monitoring team members.

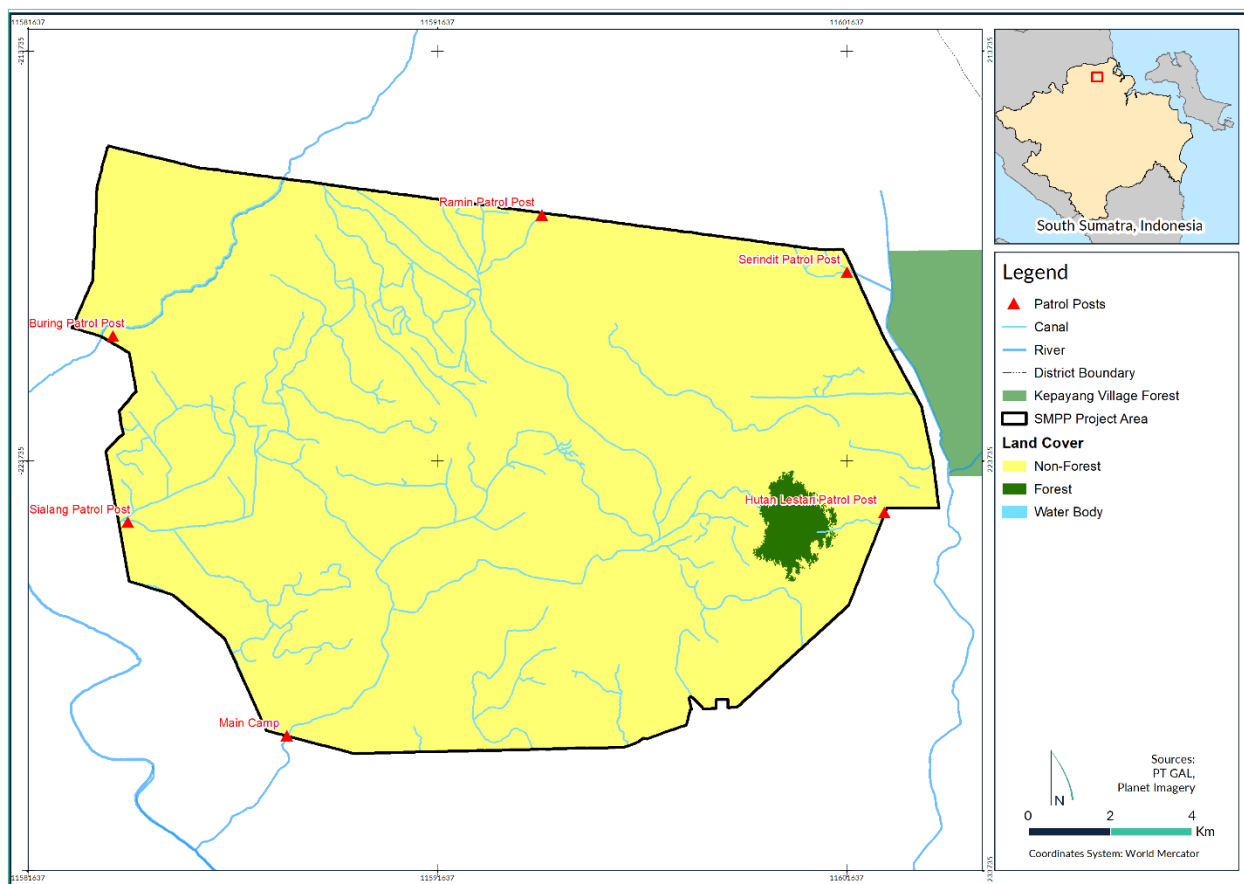
Position	Roles	Name	Short Resume
Technical Advisor	Modelling approach design, QA/QC of SOP, sampling and survey design, QA/QC of field data analysis, QA/QC of model preparation, QA/QC of iterative model analysis, and QA/QC of result compilation and final calculation	Dr. Ophelia Wang	Dr. Wang holds a PhD and MSc degrees in spatial planning for conservation and brings more than 17 years of experience in technical forestry and program management. Dr. Wang's expertise is in data analysis and spatial modelling, specifically in constructing complex models that integrate spatially explicit biophysical data within peatland hydrology and fire risk analysis to provide comprehensive ecosystem service models.
Emission Science and Technology Lead	SOP, sampling and survey design, Field data analysis, Analysis result compilation and final calculation, QA/QC of progress tracking and database storage, QA/QC of Desktop data collection, QA/QC of Modelling approach design	Sebastian Persch	Mr. Persch has 10 years of experience as a tropical peat hydrology expert. He specializes in tropical peat ecology, including advanced data analysis and statistical programming using open-source software. He has completed assignments modelling baseline and expected emissions from peat drainage, and established proxies which calibrated GHG emission. He leads the emission science team.
Remote Sensing Manager	Model preparation, Iterative model analysis, QA/QC of Parameter data collection	Prasetya Mahardhitama	Mr. Mahardhitama is an expert in GIS and remote sensing with more than 10 years of experience. His background in information technology systems enables him to conduct advanced GIS modelling activities that leverage GIS & Remote Sensing data, including high-resolution satellite imagery from Light Detection and Ranging (LiDAR) and Satellite and Unmanned Aerial Systems. He leads the remote sensing team.
Environmental Data Analyst	Progress tracking and database storage, Desktop data collection	Angga Pratama	Mr. Pratama is an engineer with a degree in Engineering Physics from the Institute of Technology Bandung, Indonesia. He has 13 years of experience and his work background in IT includes development and maintenance of a climate change mitigation and forest carbon sequestration web portal. This took data from across the Asia region, and it has enabled him to develop custom web GIS and land usage licensing applications. He is also a Certified Sustainability Reporting Specialist under the Global Reporting Initiative (GRI) Standards.

Position	Roles	Name	Short Resume
Remote Sensing Officer	Parameter data collection	Rizaldy Yudhista N	Mr Yudhista N is a GIS and Remote Sensing Specialist in Forest Carbon with 7 years of experience conducting forest landscape analysis, producing spatial analysis for design and assessment of peatland and tropical forest restoration projects.
Field Data Collection Lead	Field Data collection, Field data submission to HQ	Adi Jaya Prana	Mr. Adi JP carries out field monitoring and protection of peat swamp forest in the SMPP. His extensive experience has enabled him to routinely monitor the area utilizing drones, through roads and waterways to patrol for human activity and fire risk, as well as monitoring water levels in the SMPP area. Prior to SMPP he worked on a GIZ forest protection project and has a degree from University of Sriwijaya.
Field Staff	Field Data collection, Field data submission to HQ	Various	-

3.1.3.1.1 Remote Sensing

Project technical staff obtained and analyzed satellite imagery to detect land cover change, such as natural regeneration of vegetation, or (if any) vegetation loss was caused by fire or encroachment. For future monitoring events in cases where forest changes take place, the project will follow the procedures outlined in VCS methodology VM0007 Module M-MON to quantify the relevant parameters. The land cover map will be updated at each monitoring period as needed.

An initial benchmark of forest/non-forest areas has been created for the 2019 monitoring period and updated for the current monitoring period of 2020. Map 3 below shows the benchmark map of forest/non-forest area distribution for this monitoring period. For future monitoring periods, project staff will quantify the area of recorded deforestation by subtracting change areas of forest cover. The emissions from deforestation will then be calculated by multiplying areas of deforestation by the average forest carbon stock per hectare. The area of remaining forest will be based on subtracting non-forest area and will be recorded in a forest benchmark map, to be updated for each monitoring period.



Map 3. Forest cover benchmark in 2020.

In addition to the above, MODIS and VIIRS hotspot data were used to provide nearly real-time updates on potential fire activity in the project area and alert ground fire controlling/prevention team to examine the field conditions.

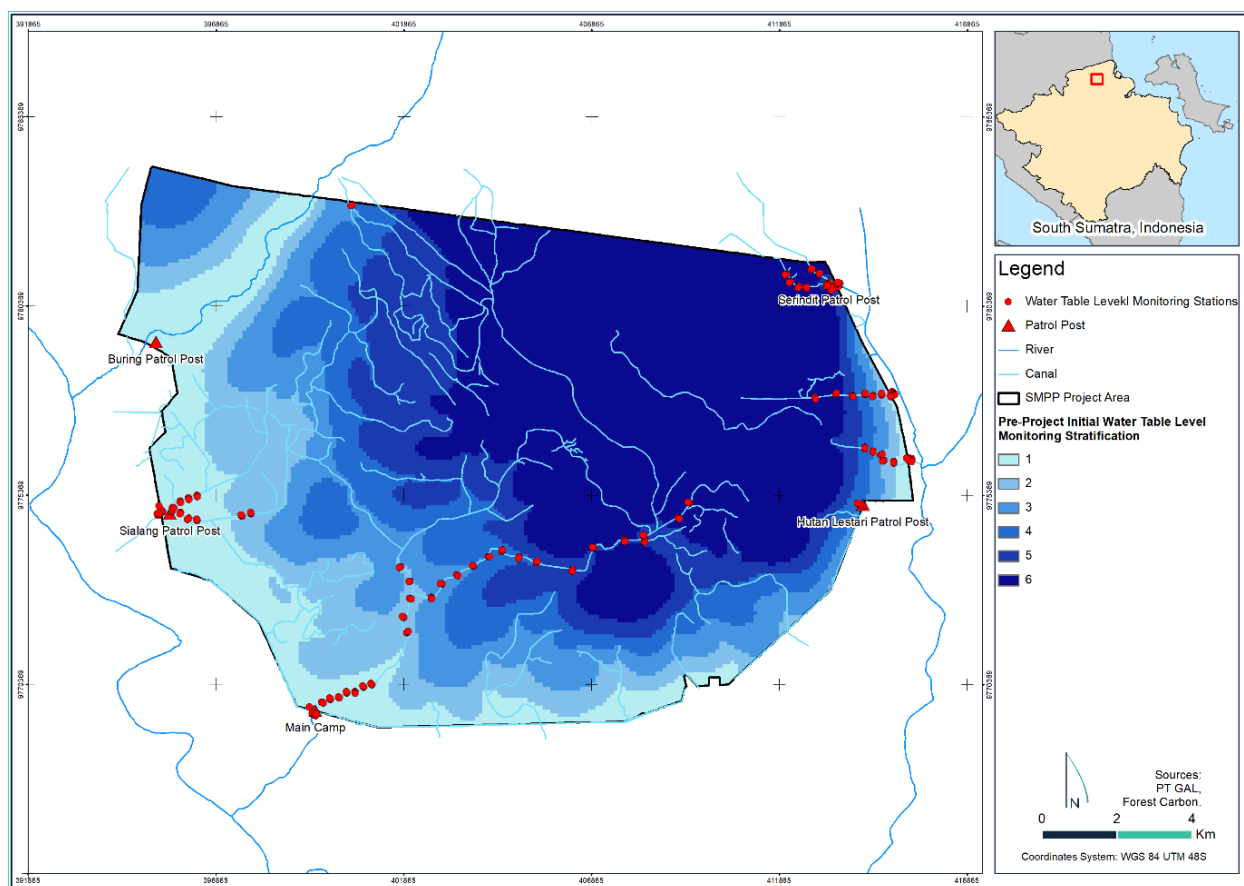
3.1.3.1.2 Field Measurement

3.1.3.1.2.1 Monitoring C Stock

In 2020 SMPP staff began monitoring change in carbon stocks of tree biomass through field measurements using a point sampling method with an allometric equation on tree diameter (diameter at breast height or DBH).⁹ Per the CDM A/R Methodological Tool “Calculation of the number of sample plots for measurements within A/R CDM project activities,”¹⁰ the project established monitoring plots for areas representing ARR activities in 2020, with plots monitored thereafter every five years. Allometric equations based on DBH will be the main parameter.

3.1.3.1.2.2 Monitoring GHG Emissions from Microbial Decomposition of Peat

In 2020 project staff began monitoring GHG emissions from microbial decomposition of peat by directly monitoring proxy variables for GHG flux that are used when calculating GHG emissions. For strata with less dynamic water table levels (e.g. undrained forested peatland) as well as strata where water table levels are more dynamic or without forest cover (e.g. initially drained deforested peatland), project staff monitored forest and non-forest cover as well as water table levels to update annual strata cover conditions and drainage status. Remote sensing methods in Section 0. informed changes in vegetation cover. To monitor drainage status, the project implemented point-based monitoring using dip wells installed and distributed along transects comprising each water table level stratum, which included 264 dip wells in total within six water table level strata (Map 4). A hydrological model was developed to extrapolate dip well measurements into a continuous water table level map.



Map 4. Location of the dip wells in the project area.

Since 94% (188 out of 199) of the planned permanent peat compaction dams were completed in 2019/2020, the project will examine changes in vegetation cover and water table levels to determine status change strata (if any), and efficacy of compacted peat dams for canal blocking. Annual GHG emissions from microbial decomposition of peat will be summarized by using IPCC default emission factor and follow procedures in the VSC methodology VM0007 Module M-PEAT.

3.1.3.1.2.3 Monitoring GHG Emissions from Water Bodies

Values for dissolved organic carbon (DOC) were taken from Wetlands Supplement of the IPCC (2013).¹¹ The value(s) were used to calculate emissions from water bodies by considering changes in area (i.e., channel widths and lengths derived from visual assessment with medium-high resolution remote sensing images).

3.1.3.1.2.4 Monitoring GHG Emissions from Peat Burning

In addition to the hotspot remote sensing data listed in Section 0, project staff also monitored GHG emissions from peat and biomass burning in conjunction with regular forest patrols. For future monitoring events, project staff will continue to update the fire monitoring, including integration of smoke detection cameras, soil moisture monitoring with remote sensing products and soil moisture sensors on the ground to assess fire risk areas. In all fire incidences, areas are checked through a combination of ground checking and visual assessment from remote sensing imagery. GHG emissions from burning are summarized annually following Module E-BPB.

3.1.3.1.2.5 Peat Characteristics

The baseline scenario requires updating every ten years. Future data collection will include additional peat inventory at sampling locations stratified by the project's digital terrain model (DTM). The inventory data collection will include peat depth, peat type, bulk density and carbon content. This field data will be added

to the existing peat depth data to refine the interpolated peat thickness map. This model informs the baseline emission characteristics.

3.1.3.2 Internal Auditing Procedures

Forest Carbon performs an internal audit of the financial, environmental, and social elements of the project each year. On environmental and social issues, any variance from the project-specific environmental and social management plans are highlighted to management and a plan to take corrective action is developed. In the event issues arise, these are noted and documented by the SMPP project management board, which is represented by the Investor (Althelia Climate Fund) License Holder (Global Alam Lestari) and Project Developer (Forest Carbon). The board authorizes a continuous improvement plan and progress is monitored against the plan by the project management board on all identified issues. On the internal audit for financials, accounts are reconciled quarterly by the finance staff assigned to SMPP and any issues are resolved before tax filing and government reporting is due. The internal financial audit process is also linked to an external audit by a certified accounting firm.

3.1.4 Dissemination of Monitoring Plan and Results (CL4.2)

The project climate monitoring plan is available for public review at the project office. The full results of the climate monitoring included in the monitoring report are linked in the monitoring report summaries. The project provided printed summaries of the monitoring reports to project community members, other stakeholders and beneficiaries of project activities, and provided printed copies to local government officials and posted them in community center locations and at all protection post in the project area. The project also publicized a variety of informational materials in both Bahasa Indonesia and English through the use of a combination of promotional materials such as letters, signs, banners, and announcement at community meetings and workshops.

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline Emissions

In this section baseline emissions are derived from the VCS methodology VM0007 (version 1.5) REDD+ MF and its modules BL-PL, BL-ARR, AR-ACM0003, BL-PEAT, and E-BPB.

3.2.1.1 General Assumptions

An analysis of the most likely baseline scenario is used to assess baseline emissions as well as the resulting changes on carbon stocks.

These emissions sources included:

1. Changes in aboveground biomass stocks (characterized by conversion to plantations);
2. Peat microbial decomposition;
3. Peat burning; and
4. Dissolved organic carbon from bodies of water.

All the assumptions and omissions of emissions that are described here are conservative efforts that result in lower emissions to maintain validity of calculations and estimates of a baseline scenario.

Project staff assumed that no other events of rewetting would occur in the baseline scenario. Examples of natural events that we excluded in our analysis may include canal collapses, progressive subsidence that could lead to changes in relative water table depths, or reduced CO₂ emission rates with increasingly thinner aerobic soil layers.

Project staff also assumed that regular canal maintenance activities typically carried out for drainage and transportation would continue.

As information on the volume and frequency of dredging is unavailable (for example if dredging activities caused the peat to be exposed to aerobic decomposition), these emissions have been omitted. This is a conservative omission as water body emissions are lower than those resulting from microbial decomposition in peat, and therefore results in lower emission estimates in the water body stratum than strata at the same location in the project scenario.

In the baseline scenario, project staff calculated the annual emissions for carbon dioxide (CO₂) and methane (CH₄) as these emissions are impacted directly by changes in land cover class and drainage status over time. However, nitrous oxide (N₂O) and GHG emissions derived from biomass burning were conservatively omitted.

3.2.1.2 Proxy Area Analysis

Module BL-ARR and Methodology extension AR-ACM0003, do not include specific requirements to justify the plantation establishment rate. To substantiate the conservative baseline conversion/plantation establishment rate (which is not deforestation) and to calculate leakage with a baseline deforestation rate, technical staff followed Module BL-PL. As there is not a verifiable plan for conversation of the project area for the conversion/deforestation rate, project staff selected the minimum six areas to determine the baseline rate of conversion/deforestation per BL-PL requirements. These were further used to demonstrate the risk of abandonment.

This section describes the analytical processes to determine the conservative baseline rate of plantation establishment as per Module BL-PL which was used subsequently in LK-ASP.

3.2.1.2.1 Data Collection and Compilation

Project staff selected suitable proxy areas as reference regions through an iterative process of data collection, compilation, review and processing of global or national-level datasets. A description of the globally and nationally available datasets used for performing iterative analyses to select appropriate proxy areas, as well as details on the methodology, is available in Annex 4.

3.2.1.2.2 Similarity Analysis to select Proxy Areas

According to the methodology, all proxy areas must meet the following criteria:

1. Land conversion practices shall be the same as those used by the baseline agent or class of agent.
2. The post-deforestation land-use shall be the same in the reference regions as expected in the project area under business as usual.
3. The reference regions shall have the same management and land-use rights type as the proposed project area under business as usual.
4. If suitable sites exist, they shall be in the immediate area of the project; if an insufficient number of sites exists in the immediate area of the project, sites shall be identified elsewhere in the same country as the project; if an insufficient number of sites exists in the country, sites shall be identified in neighboring countries.
5. Agents of deforestation in reference regions must have deforested their land under the same criteria that the project lands must follow (legally permissible and suitable for conversion).
6. Deforestation in the reference region shall have occurred within the 10 years prior to the baseline period, and

The methodology also requires that the three following conditions shall be met:

1. The forest types surrounding the reference region or in the reference region prior to deforestation shall be in the same proportion as in the project area ($\pm 20\%$),
2. Soil types that are suitable for the land-use practice used by the agent of deforestation in the project area must be present in the reference region in the same proportion as the project area ($\pm 20\%$). The ratio of slope classes "gentle" (slope < 15%) to "steep" (slope $\geq 15\%$) in the reference regions shall be ($\pm 20\%$) the same of the ratio in the project area, and

3. Elevation classes (500-m classes) in the reference region shall be in the same proportion as in the project area ($\pm 20\%$).

The reason for a slight deviation from Module BL-PL has been described in in PD Section 3.1.6. Requirements for the reference regions had to meet the following criteria in Table 9.

Table 9. Reference region selection criteria.

Project area at project start date	Reference region requirement
59.6% forest cover as per MoEF 2013	39.6-79.6% forest cover
100% peat	At least 80% peat
100% of area in the 0 - 500 m class	At least 80% of the area must fall in the 0-500 m class
100% of area has "gentle" (slope < 15%) slopes	At least 80% of the area must have "gentle" slopes

The selection reference areas followed a stepwise elimination approach by examining one item on the criteria list at a time. After the final step of elimination from the land-use, management practice, elevation, slope, and soil (peat) criteria, 28 shortlisted reference regions remained for the forest cover similarity analysis.

As the dataset from the Indonesian MoEF was not consistently available on an annual basis (only for 2006, 2009, 2011, 2012, 2013 and 2015) during the ten years prior to the project starting date, not all the potential proxy area license areas were covered by MoEF data. Ten of the 28 shortlisted concessions had their license start in 2007. Since the MoEF data did not cover this year, technical staff chose to use the MoEF forest cover in 2006 as a proxy of 2007, based on two assumptions. First, it was assumed that large-scale, major planned conversion/deforestation would only begin after the licenses were issued. Second, by using a credible data source from a single year, technical staff avoided uncertainty resulting from mixing datasets across different time periods, which were derived using different methods by the source provider.

The first assumption was verified by using two independent satellite-derived datasets produced by the Indonesian government and by the project technical team, namely the forest cover (Indonesian National Carbon Accounting System or INCAS) and pixel-based change detection analysis of Landsat-8 NDVI for 2006-2007. INCAS and MoEF datasets had a mean 78% agreement between forest/non-forest areas.¹² Because the INCAS dataset used the same satellite platform (Landsat) as the MoEF and the data development involved standards, inputs and staff from the MoEF,¹³ using INCAS data as a verification reference was viable.

Project staff first compared the INCAS data of 2006-2007 with the MoEF 2006 percentage forest cover and eliminated one site that showed a very high difference between the two data sources (MoEF: 5.8%; INCAS: 78.8% in 2006 and 81.6% in 2007) as this discrepancy indicated significant difference in the definition of forest or analysis bias/errors. Project staff also confirmed by using the INCAS dataset to examine if there was any major forest cover difference between 2006 and 2007. Another site was eliminated that presented a moderate difference between the two years (INCAS: 90.4% in 2006 and 81.5% in 2007) because this indicated potential industrial deforestation/conversion between 2006-2007.

The remaining group of concessions for possible reference areas all had > 1% of forest cover difference in INCAS 2006-2007, and for these candidates we performed a change detection analysis by comparing the difference in vegetation reflectance (i.e., NDVI value) between 2006 vs. 2007 using the ENVI software version 5.3. Differencing NDVI (dNDVI) has been a well-known pre-classification change detection method to identify discernible shift in vegetation or land-use types.¹⁴ Project staff produced a dNDVI map in the cloud-free areas of each 2006-2007 pair, smoothed the output map with a majority filter algorithm, and categorized the standard deviation of dNDVI. The categorization identified multiple spatial clusters that represented several different types of vegetation change: 1) industrial deforestation/conversion; 2) crop/plantation to harvest; 3) plantation rotation cycle; 4) smallholder activities; and 5) no change (i.e., no loss or gain in dNDVI). Project staff cross-checked between the dNDVI category map and Landsat-8 surface reflectance bands (in composite band combination of 6-5-4) to assign the spatial clusters into a dNDVI category by visually inspecting the imagery texture, color, pattern, patch size, patch shape, land features and adjacent patch types.

When the visual interpretation showed possibly different conclusion of forest cover or land-use change among dNDVI, Landsat-8 surface band composite, INCAS and MoEF datasets, project staff compared them with two more global satellite-derived datasets in 2007: 1) vegetation loss (Terra-i); or 2) tree cover loss (University of Maryland). One additional site was eliminated with almost 100% forest cover in the INCAS and MoEF datasets but showed moderate level of tree cover loss in the University of Maryland data and industrial-level deforestation/conversion in the dNDVI analysis.

The summary comparison of sites analyzed in this process can be found in Annex 4. From this iterative process project staff confirmed that the remaining seven sites did not show major planned deforestation/conversion activities from 2006-2007. Project staff concluded that their forest cover shown in the MoEF 2006 could serve as a good proxy to represent their 2007 cover. Project staff then proceeded with forest cover similarity analysis using these seven sites.

3.2.1.2.3 Conversion/Deforestation Rate Calculation

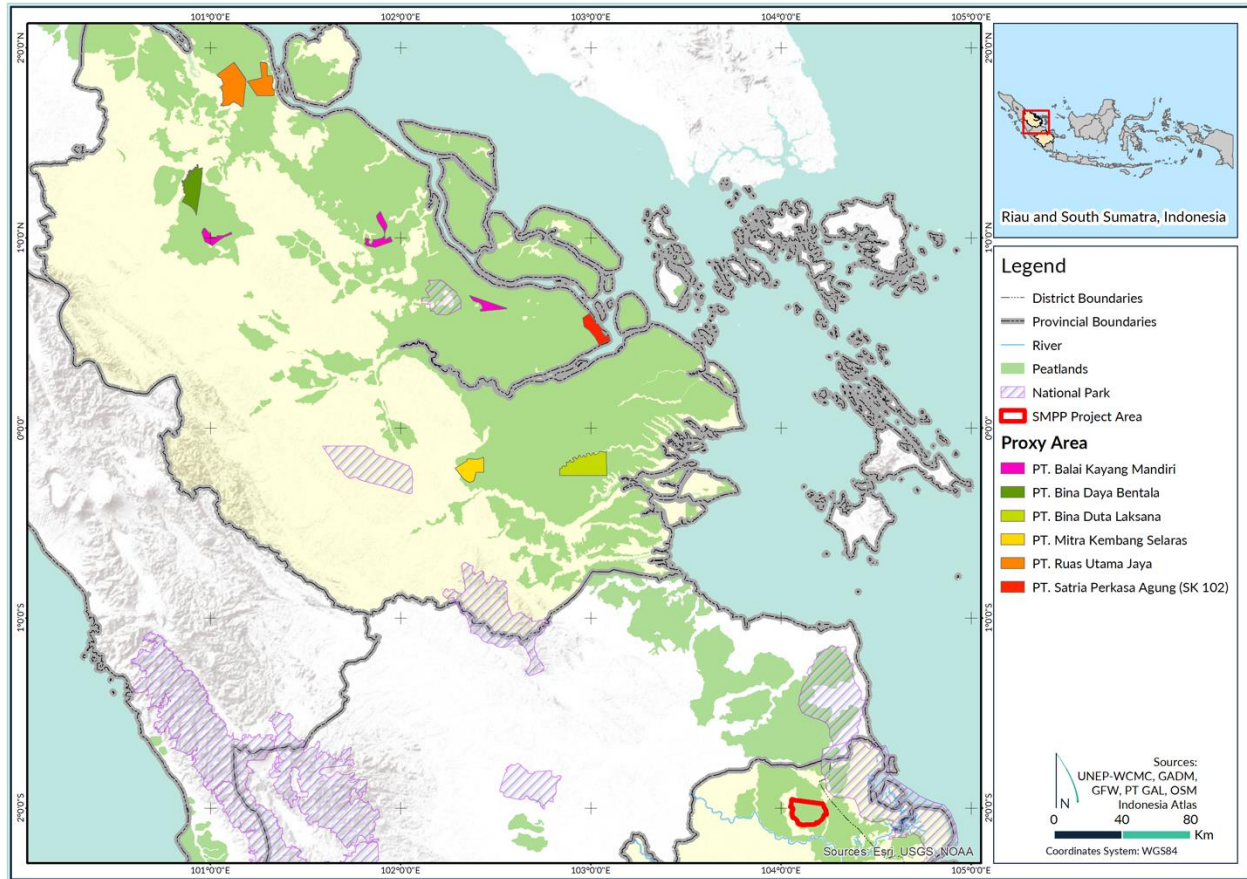
After the final elimination step using the MoEF forest cover data, seven proxy areas remained. One concession only had a 1.31% average annual forest loss rate from 2009 (the licensed year) to 2015 (prior to our project start date on 01/01/2016), which is very different from the other six sites. According to a visual inspection by examining Landsat medium-resolution imagery in the licensed year and in 2015, this site did not show prominent expansion of large-scale conversion/deforestation and development activities compared to the other sites. Instead, irregular, patchy and small-size deforestation/conversion indicated smallholder activities and/or natural hazards/disasters. It is likely that the 1.31% mean annual forest loss rate may not result from industrial concession operations, but could be a result of smallholder practices, forest succession from hazards, or natural disasters. Thus, the area was eliminated, as the land conversion practice and post-deforestation land-use of this site would not meet the similarity criteria when compared to the project area baseline scenario.

The visual inspection also confirmed that the other six sites showed signs of continuing conversion/deforestation activities consistent with industrial plantations, and thereby these areas were not subject to risk of abandonment. Considering their similarity to the project area's baseline scenario, technical staff selected these six remaining sites as the proxy area for calculating the conversion/deforestation rate.

The summary comparison of sites analyzed in this visual inspection process can be found in Annex 4. The six final reference regions are summarized below in Table 10 and Map 5.

Table 10. Summary of suitable reference regions.

Province	Concession name	Area (ha)	License year	Peat (%)	Forest area in licensed year or 2006 (2007's proxy) (ha)	Forest area in 2015 (ha)	Total forest loss (%)	Average annual conversion/ deforestation rate (%)
Riau	PT Balai Kayang Mandiri	21,165.29	2007	95.97	14,779.51	9,952.86	32.66	4.08
Riau	PT Bina Daya Bentala	20,007.71	2006	88.66	8,484.97	0	100.00	11.11
Riau	PT Bina Duta Laksana	29,153.01	2006	100.00	17,837.11	7,084.26	60.28	6.70
Riau	PT Mitra Kembang Selaras	14,717.45	2007	100.00	10,031.47	2,740.08	72.69	9.09
Riau	PT Ruas Utama Jaya	44,794.62	2007	99.94	20,934.68	4,674.85	77.67	9.71
Riau	PT Satria Perkasa Agung (SK 102)	11,863.52	2006	100.00	5,271.74	2,235.25	57.60	6.40



Map 5. Location of the project area and the six reference regions selected for proxy areas.

3.2.1.2.4 Conversion/Deforestation Analysis

The annual conversion/deforestation was calculated (1) as:

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

Where:

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

Project staff estimated the average annual conversion/deforestation rate for these six proxy areas to be 7.85%. a review of common Industrial Plantation Forest (*Hutan Tanaman Industri* or HTI) concession practices based on document research and concession manager interviews indicated a typical conversion/deforestation rate of 12-13%. Since project staff took conservative approaches analytically during the similarity analysis to set an estimated rate lower than known practices, the baseline rate of conversion/deforestation uncertainty was set to zero.

3.2.1.2.4.1 Likelihood of Deforestation and Risk of Abandonment

As HTI concessions are designated by zoning for deforestation and are not under any particular government control while licensed, project staff assumed the likelihood of deforestation (L-Di) to be 100%.

Project staff assessed the risk of abandonment using the six proxy areas selected above for calculating the average annual conversion/deforestation rate. After confirming the criteria in the proxy area analysis, project staff accessed and visually interpreted Landsat satellite images to determine if any of them experienced abandonment for forest regrowth. All proxy areas showed clear signs of continued conversion/deforestation and plantation activities throughout 2006-2015, therefore the BL-PL Module is applicable.

3.2.1.2.4.2 Area of Conversion/Deforestation

The annual area of conversion/deforestation in the baseline case (2) is:

$$AA_{planned,i,t} = (A_{planned,i} \times D\%_{planned,i,t}) \times L - D_i \quad (2)$$

Where:

$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum i at time t ; ha
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i during year t . If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; %
$A_{planned,i}$	Total area of planned deforestation over the baseline period for stratum i ; ha
$L-D_i$	Likelihood of deforestation for stratum i ; %

3.2.1.3 Projection of conversion under baseline scenario

Project staff spatially allocated the project area to produce a map based on the calculation of total annual area converted in the baseline ($AA_{planned,i,t}$), shown in the baseline scenario in Map 6. Technical staff then stratified the project area into five strata (Table 11), using an iterative, spatially explicit delineation process with four land-use types, two drainage statuses, and one water body class. The spatial allocation consisted of the following steps:

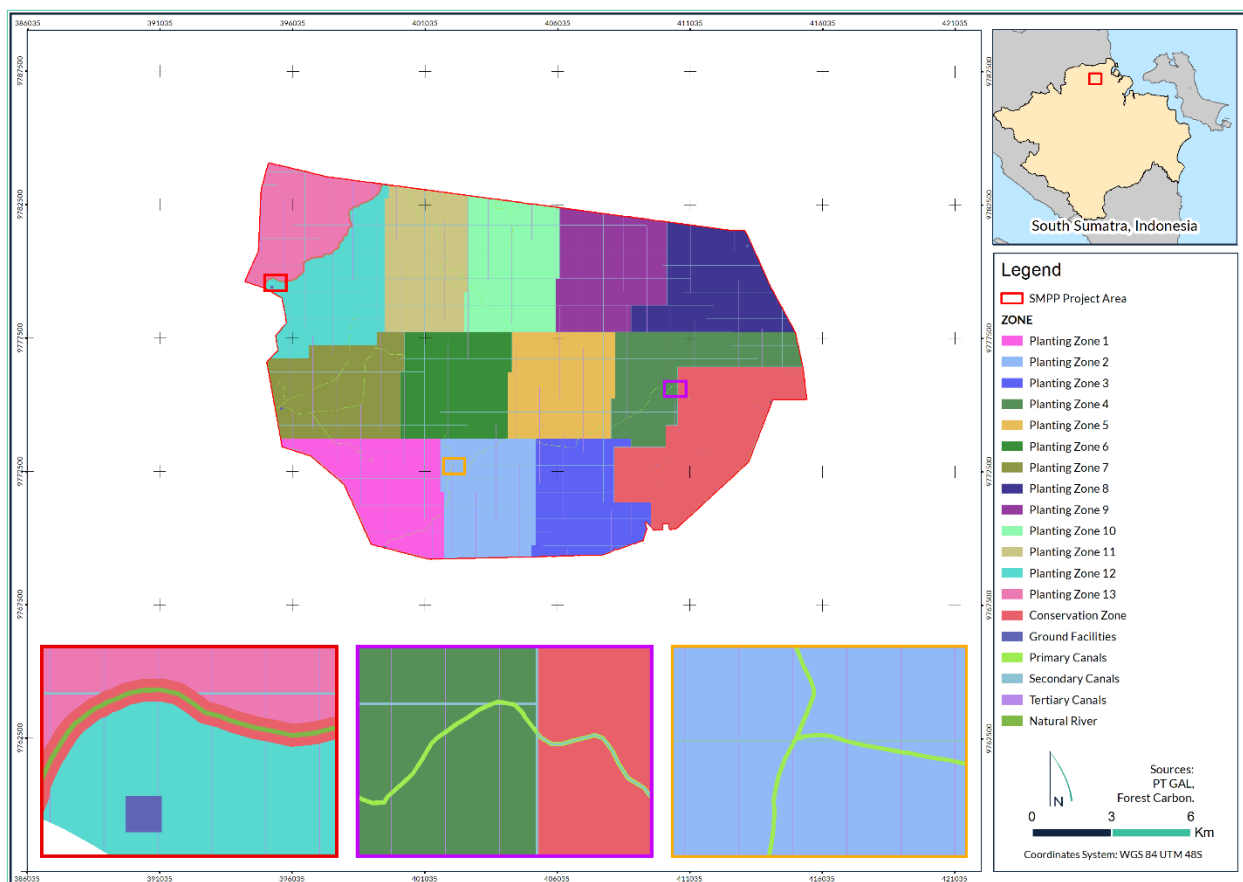
1. Define the maximum area allowed for development. According to MoEF,^{15,16} 10% of the project area must be set aside for conservation, while the remaining 90% can be developed.
2. Define allowable infrastructure areas. Of the 90% of the project area available for development, a maximum of 5% could be designated as ground facilities and infrastructure (camps, guard posts, access roads, canals, and log collection ports), based on common practice analysis obtained through interviews and remote sensing data.
3. Delineate water bodies:
 - a. Delineation of water bodies present at the project start date (i.e. natural river such as Buring river). The natural water body stratum does not change for the entire project period.
 - b. Delineation of secondary (≤ 7 m) and tertiary (≤ 2 m) canals that existed prior to the project start date. These canals were then converted into 1) baseline primary canals, 2) secondary canals, 3) tertiary canals based on their locations in the zoning design and the conversion year, 4) Acacia planting zone. The widths of canals were based on common practice,

observations from the field, and Google Earth high-resolution imagery of the project area and its surroundings.

- c. Delineation of baseline primary canals (12 m) converted in the first year of baseline scenario, widened from the initial secondary canals and aimed to serve for water surface control, log, seedling and worker transportation.
 - d. Delineation of 7-m wide baseline secondary canals that enclosed planting blocks. We divided the secondary canal development into the first four years of conversion, corresponding to review of a plantation work planning document.
 - e. Delineation of 2-m wide baseline tertiary canals that enclosed one planting block. The tertiary canals were assumed to be developed in the same year as the corresponding planting zone's conversion.
4. Delineation of drained/undrained areas:
 - a. Various academic studies show that close proximity to canals influences water table level, peat subsidence, burned area depth and probability of high frequency fire events. Observed impact of canal proximity varied across different regions, from 300 m (size class of secondary canals)¹⁷, 600 m (size class of primary canals)¹⁸, up to 1,300 m.^{18–20} Based on the literature, we employed a conservative approach to assume that areas within a 300-m distance from secondary canals and a 600-m distance from primary canals would be drained. Lacking literature that studied the distance impact of canals in the size class of tertiary canals, we took a conservative approach to prorate an assumed distance (150 m) within which drainage occurred.
 - b. We created a 600-m, 300-m, and 150-m buffer around both sides of the primary, secondary, and tertiary canals, respectively, to account for peatland drained at the project start date and in the subsequent years of baseline scenario.
 - c. The distinction between drained and undrained areas was also considered for emission characteristics and calculations.
 5. Delineation of conservation area:
 - a. Delineation of intact dense forest and nearby closed or open canopy tree/shrub mix areas and the surroundings at the project start date. Summary and details of the land cover classification are available respectively in PD Section 3.1.3.1.1 and PD Annex 3.
 - b. A 25-m buffer zone on both sides of the natural water bodies was added to the conservation area according to MoEF regulations.²¹
 6. Delineation of ground facilities:
 - a. We created a 100-m buffer around camps and guard posts.
 7. Delineation of planting zones:
 - a. Conversions to canals, ground facilities and planting zones followed the annual conversion rate of 7.85% determined in the proxy area analysis in Section 3.2.1.2. The remaining project area after deducting the conservation area, water bodies and ground facilities was available for planting zones. We delineated a total of 13 planting zones, with a several zones to accommodating conversions for ground facilities and secondary canal development.
 - b. Each planting zone consisted of multiple 150 X 500 m (75 ha) planting blocks based on common practice, as observed in the neighboring concession planting blocks using Google Earth high-resolution imagery.
 8. Annual land-use change:
 - a. Ground facilities (camps, posts, log ponds) were constructed on year 1, based on common practice analysis and data from interviews with plantation managers.

- b. Baseline primary canals were developed in year 1, expanded from the existing secondary canals prior to the project start.
- c. Baseline secondary canals were developed in four stages (year 1 to 4).
- d. Baseline tertiary canals were developed in the year of the planting zone development at which the tertiary canals were located.
- e. Existing secondary and tertiary canals that overlapped with a planting zone were converted to planting zone at the year of zone development. Canals that overlapped with baseline secondary canals were converted to secondary canals at the year of secondary canal development. Canals that overlapped with baseline tertiary canals were converted to tertiary canals at the year of corresponding zone development. Canals inside the conservation area remained unchanged for the project period.
- f. One planting zone was converted and planted immediately per year.
- g. Each planting zone was harvested and immediately replanted every four years, following the Acacia planting cycles known from common practices. For example, year 1 conversion was also set as the same year to plant and in year 5 the harvest was also set for replanting immediately.

The baseline strata of emission characteristics are shown in the baseline scenario designation map (Map 6) by incorporating (1) spatial coverage of land-use and drainage status; and (2) year of land-use and drainage status change.



Map 6. Baseline scenario map of the project area.

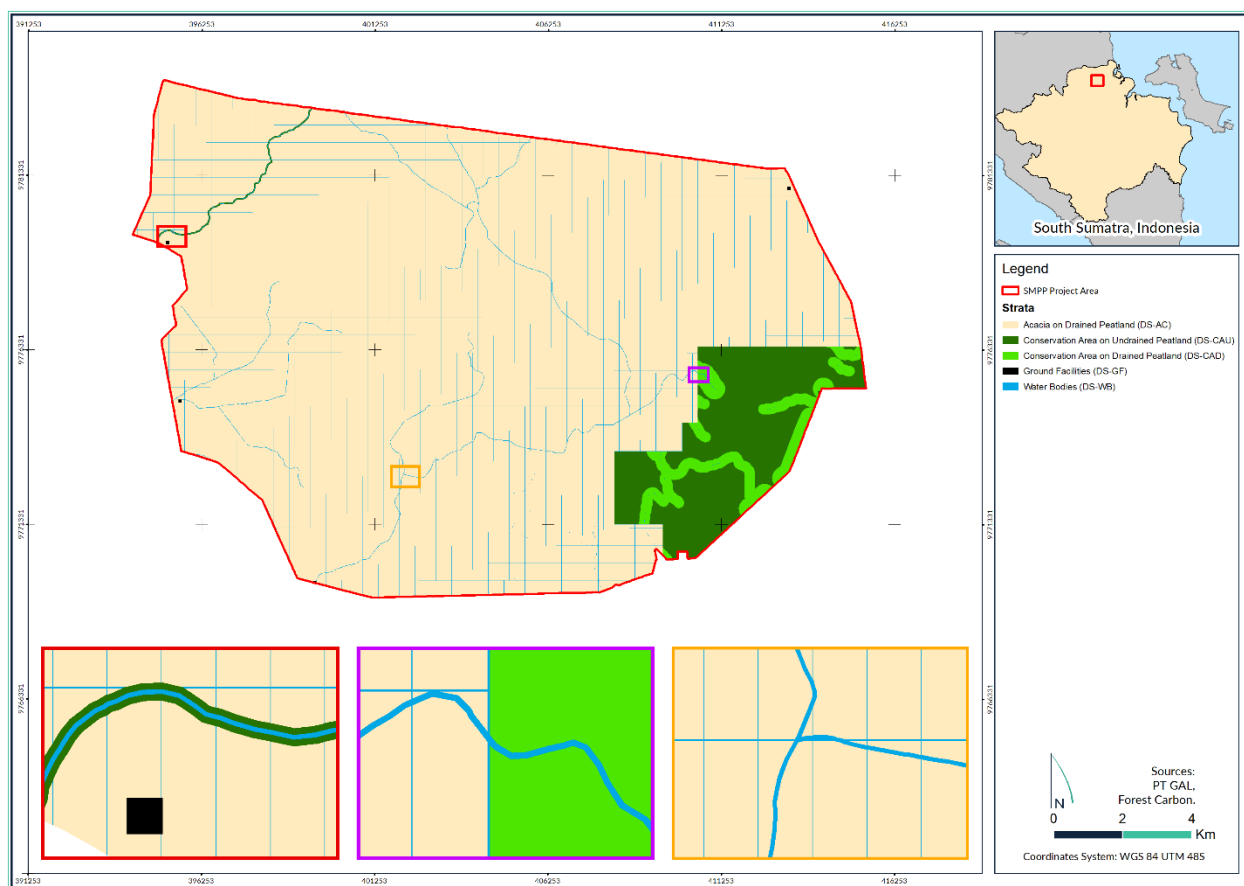
3.2.1.4 Emission Characteristics in the Baseline Scenario

3.2.1.4.1 Emission characteristics stratification for WRC activities under the baseline scenario

Table 11 and Map 7 present the baseline stratification summary based on emission characteristics. A summary of dynamics of these strata is shown in Annex 6.

Table 11. Baseline stratification of peatlands and water bodies based on emission characteristics.

Strata	Type	Description	Area (ha)	Percentage of Project Area (%)
DS-CAU	Conservation Area on Undrained Peatland	Peatlands where forest cover is not removed, and drainage is absent. This stratum remains unchanged since the project start date. The locations are in areas where dense forest was present at the project start date with river buffers surrounding natural water bodies (Buring river), and deforested areas surrounding the dense forest.	1,652.10	7.21
DS-CAD	Conservation Area on Drained Peatland	Peatlands where forest cover is not removed, and drainage is present. This stratum remains unchanged since the project start date. The locations are in areas where dense forest was present at the project start date with areas surrounding the forest having been deforested	643.04	2.81
DS-WB	Water Body	This stratum represents rivers and drainage canals. Rivers remains unchanged during the project period. Initial secondary and tertiary canals existed at the project start date. Baseline primary canals are built in year 1, expanded from initial secondary canals. Baseline secondary canals are built in year 1-4. Baseline tertiary canals are built in the year of planting zone development. Existing canals that are on baseline secondary canals are converted to secondary canals according to the secondary canals' development phase. Existing canals that are on baseline tertiary canals are converted to tertiary canals in the year of planting zone development. Existing canals that are on a planting zone are converted to planting zone according to the year of zone development.	707.51	3.09
DS-GF	Infrastructure	Infrastructure on drained peatland. This stratum represents lands used for concession operations, such as base camps, station camps, log yards, and access roads between planting blocks. The locations are as close as possible to transportation access (rivers).	4.09	0.02
DS-AC	Planting Zone	Acacia plantation on drained peatland. Acacia planting starts in the same year as conversion. The development of drainage constructions is assumed to happen just before - or in the same year as conversion/planting.	19,915.65	86.88
Total			22,922.39	100.00



Map 7. Baseline stratification of the project area based on emission characteristics.

3.2.1.4.2 Emission characteristics stratification for ARR activities under the baseline scenario

The baseline above ground carbon stock accumulation and subsequent loss related to Acacia planting and harvesting is accounted for under the ARR component. As detailed in PD Sub-subsection 3.2.1.3, a total of 19,916 ha of the project area would be converted to Acacia plantation with a rotation cycle of four years (Table 12). A summary of dynamics is shown in Table 12.

Table 12. Land use strata change in the baseline scenario for ARR

Strata	Land use	Area (Ha)	Planting Start year
DS-AC	Acacia	19,916	2016

3.2.1.5 Baseline emissions from microbial decomposition of peat, peat burning, and water bodies

3.2.1.5.1 Spatial and Temporal Variations

Project staff quantified GHG emissions from microbial decomposition of peat, peat burning, and water bodies across spatial and temporal scales. Each baseline stratum included small units of land parcels with a combination of variables (described in Table 13 below).

Project staff calculated annual strata changes, variability of GHG emission factors, and any restrictions to GHG emissions (Table 13). Project staff also accounted for spatial and temporal scales with GHG emission factors.

Table 13. Variables used for quantifying baseline GHG emissions from microbial decomposition of peat, peat burnings and dissolved organic carbon from water bodies.

Variables	Description
(A) Spatial Variables	
(A1) Soil Type	Distinction between peat or non-peat. This was used to exclude all non-peat parcels from GHG calculation (99.99% of the project area includes peat with depth $\geq 50\text{cm}$).
(A2) Initial peat thickness available for microbial decomposition and burnings	Derived from DTM, drainage elevation limit (DEL), and Peat Thickness maps as described in Sub-subsection 3.1.3.1.4 of the PD. These maps were used to determine the initial condition for subsequent calculations of the remaining peat layer available for microbial decomposition and burning.
(A3) Initial stratum	Stratum of the corresponding parcel at the project start date (as derived in Annex 6) before conversion into the baseline stratum takes effect. This was used to determine the correct emission factor for the corresponding parcel for the duration before B1 and B2 (see below) take effect.
(A4) Peat burning tag	This was used to identify whether the corresponding parcel was marked as a possible area for peat burning and the frequency of total years of historical and simulated burns.
(B) Temporal Variables	
(B1) Year of drainage	Determines the onset of conversion from initial stratum to a drained stratum and set all the drainage related parameters/variables accordingly, such as initial consolidations, bulk density changes, etc. This does not take effect if the initial stratum of the parcel was already a drained stratum. Together with B2 this was used to determine the correct emission factor for the corresponding parcel.
(B2) Year of conversion/planting of the baseline land cover	Determines the onset of conversion of initial stratum to converted/planted stratum. Together with B1 this was used to determine the correct emission factor for the corresponding parcel.
(B3) PDT	The PDT defines the period of time that it takes to deplete the remaining peat layer by microbial decomposition and burning. Once the PDT is reached in a given stratum all GHG emissions in that stratum are set to zero.
(B4) Year tag for burning	Determines whether the corresponding parcel was marked to catch peat burning for the corresponding year and counting the number of burn scars (and any repetitions) of the parcel since year 1. This was used to set the correct

Variables	Description
	burn scar depth and other related burning parameters for the corresponding parcel accordingly.
(B5) Burning restriction	If the corresponding parcel was marked for burning in the corresponding year (as being checked in B4), this restriction further checked whether GHG emissions from burning would still be possible based on variables: B1 (Year of drainage), B2 (Year of conversion/planting) and B3 (Remaining peat thickness available for microbial decomposition and burning).

3.2.1.5.1.1 Emission Calculations

The net carbon dioxide equivalent (CO₂-e) emissions from the peat (microbial decomposition and burning) and water body were calculated as per VCS Module BL-PEAT (3):

$$GHG_{BSL-WRC} = \sum_{t=1}^{t^*} \sum_{i=1}^M (E_{peatsoil-BSL,i,t} + E_{peatditch-BSL,i,t} + E_{peatburn-BSL,i,t}) \quad (3)$$

Where:

$GHG_{BSL-WRC}$	Net GHG emissions in the CUPP baseline scenario up to year t^* (t CO ₂ -e)
$E_{peatsoil-BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$E_{peatditch-BSL,i,t}$	GHG emissions from water bodies in the baseline scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$E_{peatburn-BSL,i,t}$	GHG emissions from burning of peat in the base line scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
i	1, 2, 3, ... M strata in the baseline scenario (unitless)
t	1, 2, 3, ... t^* times elapsed since the project start (yr)

For all strata i where the project duration exceeds the peat depletion time (PDT or t_{PDT}), for $t > t_{PDT-BSL,i}$ the following equations (4) apply:

$$E_{peatsoil-BSL,i,t} = 0 \quad (4)$$

$$E_{peatditch-BSL,i,t} = 0$$

$$E_{peatburn-BSL,i,t} = 0$$

Where:

$t_{PDT-BSL,i}$	Peat Depletion Time in the baseline scenario in stratum i in years elapsed since the project start (yr)
$E_{peatsoil-BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$E_{peatditch-BSL,i,t}$	GHG emissions from water bodies at year t (t CO ₂ -e yr ⁻¹)
$E_{peatburn-BSL,i,t}$	GHG emissions from burning of peat in the base line scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
i	1, 2, 3, ... M_{BSL} strata in the baseline scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (yr)

GHG emissions from peat soils, water bodies and peat burning are elaborated in detail in the PD subsections 3.2.1.5.4, 3.2.1.5.5 and 3.2.1.5.6. A summary of the quantified GHG emissions from peat microbial decomposition, uncontrolled peat burning and water body under the baseline scenario is presented in Table 14.

Table 14. A summary of the annual GHG emissions from peat microbial decomposition, uncontrolled peat burning and water bodies in the project area under the baseline scenario in 2020.

Year	CO ₂ from peat microbial decomposition (t CO ₂ -e yr ⁻¹)	CH ₄ from peat microbial decomposition (t CO ₂ -e yr ⁻¹)	CO ₂ from peat burning. (t CO ₂ -e yr ⁻¹)	CH ₄ from peat burning. (t CO ₂ -e yr ⁻¹)	CO ₂ from DOC (t CO ₂ -e yr ⁻¹)	Total (t CO ₂ -e yr ⁻¹)
2020	599,638	6,488	436,408	41,755	1,644	1,085,934

3.2.1.5.1.2 Subsidence Related to Initial Compression, Microbial Decomposition, and Peat Burning

Project staff assumed that the initial peat thickness in the baseline scenario is equal to the initial peat thickness as mapped at the project starting date (PD Sub-subsection 3.1.3.1.4).

Peat loss due to initial compression and microbial decomposition was calculated by using the stratification of the project area on initial drainage, the year of conversion, and specific subsidence rates that took into account the compaction after initial drainage (Annex 6). For peat loss due to burning, project staff first assessed the number of times the individual pixels of the fire simulation were burned in the 10-year period before project start date and subsequently applied an associated burn scar depth (Annex 6). Technical staff quantified the annual peat loss rates in the baseline scenario as the sum of the burn scar depth (in areas where peat burning was simulated) and the subsidence rate, using the equation (5):

$$Rate_{peatloss-BSL,i,t} = D_{peatburn-BSL,i,t} + Sub_{i,t} \quad (5)$$

Where:

$Rate_{peatloss-BSL,i,t}$	Rate of peat loss due to microbial decomposition and burning in baseline scenario of stratum i at year t (m yr ⁻¹)
$D_{peatburn-BSL,i,t}$	Burn scar depth under baseline scenario in stratum i at year t (m)
$Sub_{i,t}$	Subsidence rate in stratum i in year t (m)
i	1, 2, 3, ... M_L strata in the baseline scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (yr)

Project staff assessed the remaining peat depth annually for the project period based on the rate of peat loss due to microbial decomposition of and burning incidents using the equation (6):

$$Depth_{peat-BSL,i,t^*} = Depth_{peat-BSL,i,t_0} - \sum_{t=1}^{t^*} Rate_{peatloss-BSL,i,t} \quad (6)$$

Where:

$Depth_{peat-BSL,i,t^*}$	Remaining peat thickness in the baseline scenario in stratum i at year t^* (m)
$Depth_{peat-BSL,i,t_0}$	Peat thickness at the baseline scenario in stratum i at year t_0 = project start date (initial peat thickness) (m)
$Rate_{peatloss-BSL,i,t}$	Rate of peat loss due (subsidence) due to microbial decomposition of peat and peat burning in the baseline scenario in stratum i in year t (m yr ⁻¹)
i	1, 2, 3, ... M_L strata in the baseline scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (yr)

By tracking annual peat thickness in the baseline scenario, project staff assured that no GHG emissions have been accounted for within any parcel of each stratum once the available carbon stock in peat has been depleted.

3.2.1.5.1.3 Emissions from Microbial Decomposition

Project staff assumed that the annual rate of conversion of undrained to drained peatland in the baseline scenario was based on the rate of conversion/deforestation agents as described in Subsection 3.2.1.2 and Annex 4 (7.85% a year). The temporal variability of the emissions from peat microbial decomposition are directly related to land-use and drainage changes in the baseline scenario. Table 15 below provides details on the WRC-related baseline stratification per stratum.

Table 15. The stratification used for the calculation of GHG emissions per stratum, the area per each stratum and the CO₂ and CH₄ default factors used for the specific land-use.

Strata	Description	Area (ha)	IPCC default factor for CO ₂ (t CO ₂ -e ha ⁻¹ yr ⁻¹)	IPCC default factor for CH ₄ (t CO ₂ -e ha ⁻¹ yr ⁻¹)	IPCC default factor for ΔDOC (t CO ₂ -e ha ⁻¹ yr ⁻¹)
Initial					
IN-UPSF	Undrained Dense Peatland Forest	234.08	0	1.02	
IN-UDP	Undrained Deforested Peatland	15,205.17	5.5	0.66	
IN-DPSF	Drained Dense Peatland Forest	20.26	19.43	0.12	
IN-DDP	Drained Deforested Peatland	7,393.59	19.43	0.12	
IN-WB	Water bodies (river and canals) present at project start	69.30			2.09
After conversion					
DS-AC	Acacia on drained peatland	19,915.65	73.33	0.07	
DS-CAU	Conservation area on undrained peatland	1,652.10	0	1.02	
DS-CAD	Conservation area on drained peatland	643.04	19.43	0.12	
DS-GF	Ground facilities on drained peatland	4.09	19.43	0.12	
DS-WB	Water bodies (river and canals)	707.51			3.01
Note: Annex 6 Annex 6on Default Factors for Quantification of GHG emissions in the baseline and project scenarios provides more details on the emission factors used and the respective references.					

Project staff calculated baseline GHG emissions for different emission strata by using the conservative TIER 1 IPCC default emission factors for each stratum, following the equations defined by the Module BL-PEAT (7):

$$E_{peatsoil-BSL,i,t} = E_{CO_2-BSL,i,t} + E_{CH_4-BSL,i,t} \quad (7)$$

Where:

$E_{CO_2-BSL,i,t}$	CO ₂ emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$E_{CH_4-BSL,i,t}$	CH ₄ emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
i	1, 2, 3, ... M_{BSL} strata in the baseline scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (yr)

Project staff calculated the CO₂ emissions from microbial decomposition for each stratum of the peat within the SMPP using the equation (8):

$$E_{peatsoil-BSL,CO_2,i,t} = A_{i,t} \times EF_{CO_2,i,t} \quad (8)$$

Where:

$E_{peatsoil-BSL,CO_2,i,t}$	CO ₂ emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$EF_{CO_2,i,t}$	Emission factor for CO ₂ emissions corresponds to each stratum i , as provided by IPCC (t CO ₂ -e yr ⁻¹)
$A_{i,t}$	Area of stratum i at time t (ha)
i	1, 2, 3, ... M_{BSL} strata in the baseline scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (yr)

Project staff calculated the CH₄ emissions from the peat soil for each stratum of the peat within the SMPP using the equation (9):

$$E_{peatsoil-BSL,CH_4,i,t} = A_{i,t} \times GWP_{CH_4} \times EF_{CH_4,i,t} \quad (9)$$

Where:

$E_{peatsoil-BSL,CH_4,i,t}$	CH ₄ emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$EF_{CH_4,i,t}$	Emission factor for CH ₄ emissions corresponds to each stratum i , as provided by IPCC (t CO ₂ -e ha ⁻¹ yr ⁻¹)
$A_{i,t}$	Area of stratum i at time t (ha)
GWP_{CH_4}	Global Warming Potential for CH ₄
i	1, 2, 3, ... M_{BSL} strata in the baseline scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (yr)

The annual GHG emissions from microbial decomposition in the baseline scenario are shown below in Table 16.

Table 16. GHG emissions from microbial decomposition of peat in the baseline.

Year	CO ₂ from peat microbial decomposition (t CO ₂ -e yr ⁻¹)	CH ₄ from peat microbial decomposition (t CO ₂ -e yr ⁻¹)	Total (t CO ₂ -e yr ⁻¹)
2020	599,638	6,488	606,126

3.2.1.5.1.4 Emissions from Peat Burning

According to Module E-BPB, GHG emissions from biomass burning can result from:

1. Conversion of forest land to non-forest land using fire;
2. Periodic burning of grassland or agricultural land after deforestation;
3. Controlled burning in forest land remaining forest land;
4. Uncontrolled fire in drained peat swamp forest; and
5. Uncontrolled peat burning in (abandoned) drained peat sites.

Project staff assumed that there was no controlled peat burning during plantation activities, as burning to clear forests on Acacia plantations is illegal. Therefore, project staff only accounted for emissions from unintentional or uncontrolled burnings in the baseline scenario. In addition, we omitted AGB lost by combustion.

To quantify GHG emissions from uncontrolled peat burnings, project staff followed procedures from the VCS methodology VM0007 Module E-BPB with the following equation (10):

$$E_{peatburn-BSL,i,t} = \sum_{g=1}^G \left((A_{peatburn-BSL,i,t} \times P_{BSL,i,t} \times P_{BSL,g,i}) \times 10^{-3} \right) \times GWP_g \quad (10)$$

Where:

$E_{peatburn-BSL,i,t}$	Greenhouse emissions due to peat burning under baseline scenario in stratum i in year t of each GHG (CO ₂ , CH ₄) (t CO ₂ -e)
$A_{peatburn-BSL,i,t}$	Area peat burnt under baseline scenario in stratum i in year t (ha)
$P_{BSL,i,t}$	Average mass of peat burnt (dry matter or DM) under baseline scenario in stratum i , year t (t DM ha ⁻¹)
$G_{g,i}$	Emission factor in stratum i for gas g (kg t ⁻¹ DM burnt)
GWP_g	Global warming potential for gas g (t CO ₂ t ⁻¹ g ⁻¹)
g	1, 2, 3, ... G greenhouse gases including carbon dioxide, methane, and nitrous oxide (unitless)
i	1, 2, 3, ... M strata (unitless)
t	1, 2, 3, ... t time elapsed since the start of the project activity (year)

For repeated burns, scar depths of the 1st, 2nd, 3rd and 4th subsequent burnings are assumed as 0.17 cm, 0.1 cm, 0.06 cm, and 0.02 cm, respectively. Detailed parameters for quantifying GHG emissions from uncontrolled burning are available in Annex 6. The average mass of peat burnt for a particular stratum was calculated using the equation (11):

$$P_{BSL,i,t} = D_{peatburn-BSL,i,t} \times BD_{upper} \times 10^{-4} \quad (11)$$

Where:

$P_{BSL,i,t}$	Average mass of peat burnt under baseline scenario in stratum i , year t (t DM ha ⁻¹)
$D_{peatburn-BSL,i,t}$	Average burn scar depth under baseline scenario in stratum i in year t (m)
$BD_{upper,i}$	Bulk density of the upper peat in stratum i (g cm ⁻³)
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t time elapsed since the start of the project activity (years)

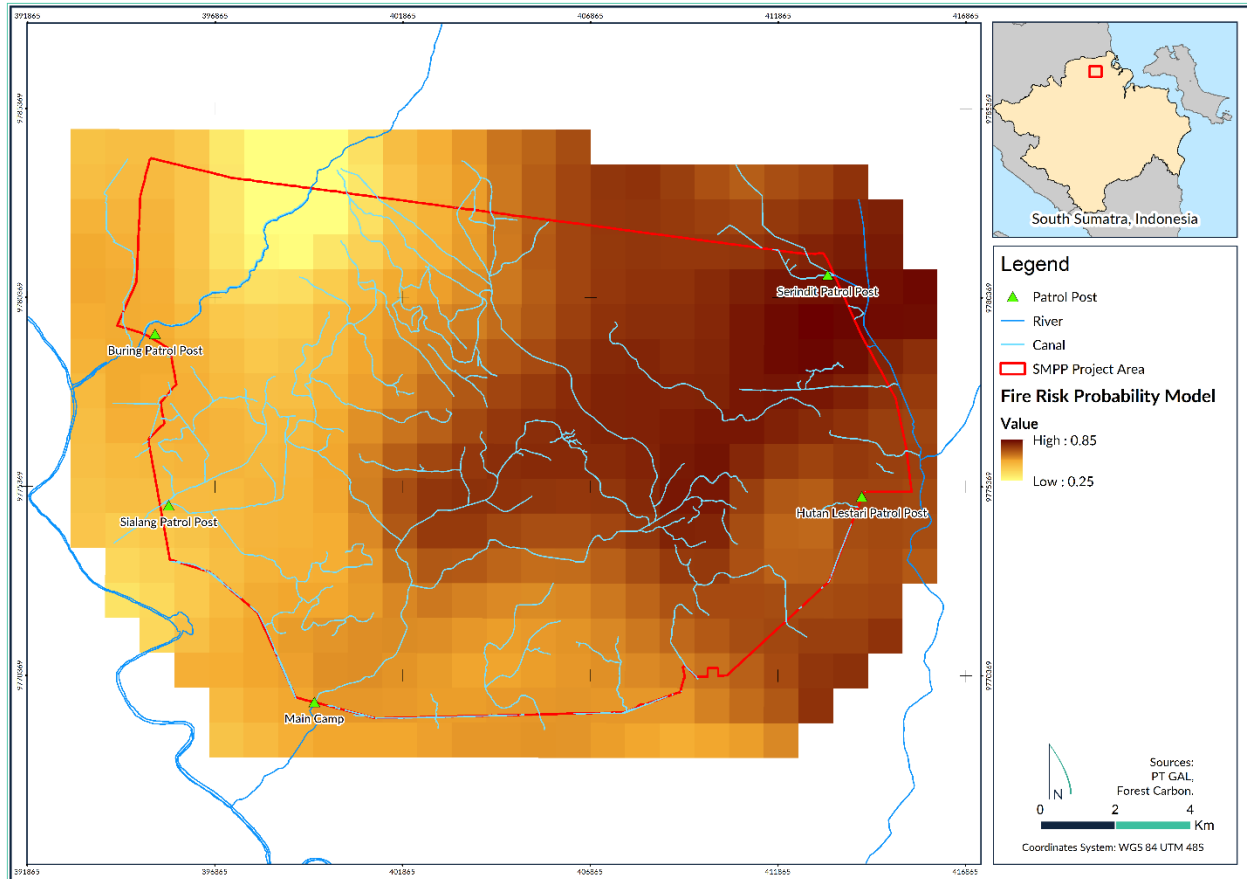
Emissions from peat burning in the baseline are derived from the mass of peat lost by combustion and emission factors from scientific literature (see Annex 6 for the default values used for the calculations of baseline carbon losses and emissions from burning).

For fire emissions, project staff assumed that the likelihood of random, uncontrolled or repeated peatland burnings would be higher in areas with greater probability of fire risks. To identify areas of greater fire risk in the baseline of the project area, project staff performed spatially explicit suitability modeling to examine the distribution of fire probability.

Previous fire probability models showed that in general, higher fire likelihood is related to predictor variables of human development activities, climate, topography, vegetation and ignition. In particular, human population density, distance to roads, bioclimate, annual precipitation, elevation, slope, and land cover types associated with agricultural activities had the greatest model contribution and are the strongest predictors of fire occurrence probability. Many models of fire risk use historical fire detection data derived from satellite imagery products to calibrate. For the SMPP study, to align periods of fire risk probability modeling and burn scar area calculation (for estimating average burn area per year), project staff decided to use remote sensing data from a 10-year span prior to project start (2006-2015).

The initial input data included point locations and 31 environmental variables, including NASA MODIS and VIIRS 2006-2015 hotspots, WorldClim bioclimatic variables, NASA SRTM elevation and derived slope and aspect, LandScan population count, distance to road, distance to river, and land cover change produced by the Ministry of Environment and Forestry for 2006-2015. Land cover type, precipitation and seasonality, population, and distance to roads were the most important contributing variables to the final model.

The detailed fire risk probability data, model inputs preparation, iterative modeling process, model evaluation and final model result are available in Annex 7.



Map 8. Fire occurrence suitability that predicted risk probability.

Project staff then calculated annual percentage of burn rate in the study area for 2006-2015, by using historical MODIS and VIIRS hotspot data. Project staff assumed each hotspot occurred with a conservative burn area estimate or estimate coefficient based on literature values. The calculation produced the average 6.12% of burnt area (1,402.85 ha) per year. This value was used as a parameter in estimating the annual area burnt threshold in the baseline scenario.

Project staff assumed that uncontrolled burnings in peatlands repeat randomly in places that are 'high risk' areas. To determine where the 'high risk areas' are in the baseline of the project area, project staff used the fire occurrence risk probability model, as well as the average annual burnt area estimate above, to simulate the spatial position of burning for 100 years. This simulation did not show the "actual area burnt" in the baseline scenario, and instead shows possible locations where peat burning can be expected to occur randomly.

The location of possible burn areas in each year of the baseline scenario was simulated as using the probable areas of fire risk from the model as weight, by randomly selecting parcels annually over 100 years in such a way that the annual average area of the selected parcels approximately equaled (but did not exceed) the area of average annual burn area. Parcels that had higher fire risk probability had greater chance to be randomly selected in the simulation model.

Project staff examined the hotspot history based on MODIS and VIIRS data from year 2006-2015 to document the number of times when a selected parcel was burnt. Project staff then examined the 100-year fire simulation of burn frequency and combined with the 2006-2015 data to record the overall history/projection of burning. If a parcel had no hotspot record in 2006-2015 and was selected randomly in the first time of simulation, the parcel was marked as "catching the 1st burning". If it had a hotspot record and was randomly selected once over the 100 years, it was marked as "catching the 2nd burning", and so forth.

The detailed methodologies, justifications, and calculations of annual burnt area and 100-year fire simulations can be found in Annex 8.

The peat burning baseline will be re-assessed every 10 years based on observations of burning frequency and extent in reference region and/or based on the latest scientific findings of 'repeated burnings' pattern.

The total GHG emission from uncontrolled peat burning in the baseline scenario per stratum are shown in Table 17 below, and annual emissions and total emission per stratum are shown in Table 18.

Table 17. Total GHG emissions from uncontrolled peat burning in the baseline scenario per stratum.

Strata	Description	Total Area burnt in 2020 (ha)	GHG Emissions from peat burning in 2020 (t CO ₂ -e)
IN-UPSF/DS-CAU	Dense Forest (undrained)	107.52	48,400.27
IN-UDP	Deforested peatland (undrained)	433.02	139,749.11
IN-DPSF	Dense Forest (drained)	6.92	3,180.09
IN-DDP	Deforested peatland (drained)	355.36	121,269.59
DS-AC	Acacia (drained peatland)	374.11	157,202.82
DS-GF	Ground facilities (drained peatland)	-	-
WB	Water bodies (river and canals)	21.44	8,360.98
Total		1,298.38	478,162.86

Table 18. Annual GHG emissions from peat burning in the baseline scenario.

Year	CO ₂ from peat burning (t CO ₂ -e ha ⁻¹ yr ⁻¹)	CH ₄ from peat burning (t CO ₂ -e ha ⁻¹ yr ⁻¹)	Total (t CO ₂ -e ha ⁻¹ yr ⁻¹)
2020	436,408	41,755	478,163

3.2.1.5.1.5 Emissions from water body in peatland

The only type of open water bodies present in the baseline scenario are river and drainage canals, as it was assumed that the baseline agent would not create ponds or lakes. The area of river and canals in the baseline scenario was determined based on common practice observed in Acacia concessions adjacent to SMPP, as well as direct measurements from high-resolution satellite imagery. The water bodies were temporally and spatially stratified for the PD. In short, primary canals were set as existing canals before baseline conversion, whereas secondary and tertiary canals were to be constructed when new canals appeared starting in Year 1 and when converting an area into a planting zone, respectively. IPCC does not provide default emission factors for CO₂ and CH₄ emissions from water bodies, thus project staff used the default values for dissolved organic carbon (Δ DOC) (for detail see Annex 6).

The only natural river in the project area is the Buring river, hence in the baseline this is the only WB area, on which the default value for natural water bodies is applied (0.57 t C ha⁻¹ yr⁻¹). For all other water bodies, i.e. canals, the default values for drained peatland (0.82 t C ha⁻¹ yr⁻¹) was applied.

Project staff used the approach as set out in the VCS methodology VM0007 Module BL-PEAT (equation 12), and replaced $E_{peatditch-CO_2,i,t} + E_{peatditch-CH_4,i,t}$ with into CO₂-equivalents converted DOC emission default factors:

$$E_{peatditch-BSL,i,t} = A_{ditch-BSL,i,t} \times EF_{DOC-BSL,i} \quad (12)$$

Where:

$E_{peatditch-BSL,i,t}$	GHG emissions from canals and other open water stratum i at year t in the baseline scenario (t CO ₂ -e ha ⁻¹ yr ⁻¹)
$A_{ditch-BSL,i,t}$	Total area of canals and other open water stratum i at year t in the baseline scenario (ha)
$EF_{DOC-BSL,i}$	PCC emission factor for Dissolved Organic Carbon from canal and open in the baseline scenario in stratum i (t CO ₂ -e ha ⁻¹ yr ⁻¹)
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t time elapsed since the start of the project activity (years)

Annual GHG emissions from Dissolved Organic Carbon in water bodies in baseline scenario are shown in Table 19.

Table 19. GHG emissions from Dissolved Organic Carbon in water bodies in the baseline scenario.

Year	CO ₂ from DOC (t CO ₂ -e ha ⁻¹ yr ⁻¹)
2020	1,644

3.2.1.6 Baseline emissions from ARR Activities

Under the baseline scenario, the area designated for Acacia plantation would sequester carbon in trees through growth (emission removals) and release it again after harvesting. Project staff accounted for the growth of Acacia as baseline ARR activities. The conversion and thus planting of Acacia would be carried out sequentially during the first 13 years of the project, resulting in a total planted area of 19,916 ha. Project staff assumed a rotation cycle of 4 years. The annual area changes under the baseline scenario are detailed in PD Annex 3 and summarized in Table 20 below.

Table 20. The assumed annual planting and harvesting under ARR activities within the monitoring period in the baseline scenario.

Year	Planting	Harvesting
2020	3,029	1,505

Net GHG emissions and removal in the baseline ARR scenario were estimated using the procedure provided in AR-ACM0003 Afforestation and reforestation lands except wetlands and associated pool,²² as outlined in Module BL-ARR, using the equation (13):

$$\Delta C_{BSL-ARR} = \sum_{t=1}^{t^*} (\Delta C_{BSL,t,ACM003}) \quad (13)$$

Where:

$\Delta C_{BSL-ARR}$	Net GHG removals under the ARR baseline scenario up to time t (t CO ₂ -e)
$\Delta C_{BSL,t,ACM003}$	Baseline net GHG removal by sinks in year t (from AR-ACM0003) (t CO ₂ -e)
$EF_{DOC-BSL,i}$	IPCC emission factor for Dissolved Organic Carbon from canal and open in the baseline scenario in stratum i (t CO ₂ -e ha ⁻¹ yr ⁻¹)
t	1, 2, 3, ... t^* time elapsed since the start of the project activity (years)

Net GHG removals under the ARR baseline scenario within the project period are estimated to be 978,846 t CO₂-e. Annual GHG removals under ARR within the monitoring period are shown in Table 21 below. Details on calculations are provided in Annex 9.

Table 21. Baseline net GHG removal from ARR activities in project area within monitoring period in the baseline scenario.

Year	NET GHG removal from ARR (t CO ₂ -e yr ⁻¹)
2020	25,430

3.2.1.7 Significant sources of Baseline Emissions

Project staff have determined that all sources of carbon not included in the baseline or project scenarios can be conservatively excluded. Significance tests were not necessary as all of the required pools of carbon and other GHG emissions within the SMPP have already been included in the calculations.

3.2.2 Project Emissions

To determine project scenario emissions and changes in carbon stocks within the SMPP analysis was based on a combination of field-based data, proxy analyses, and default emissions factors from the IPCC.¹¹

Project staff accounted emissions in the project scenario from:

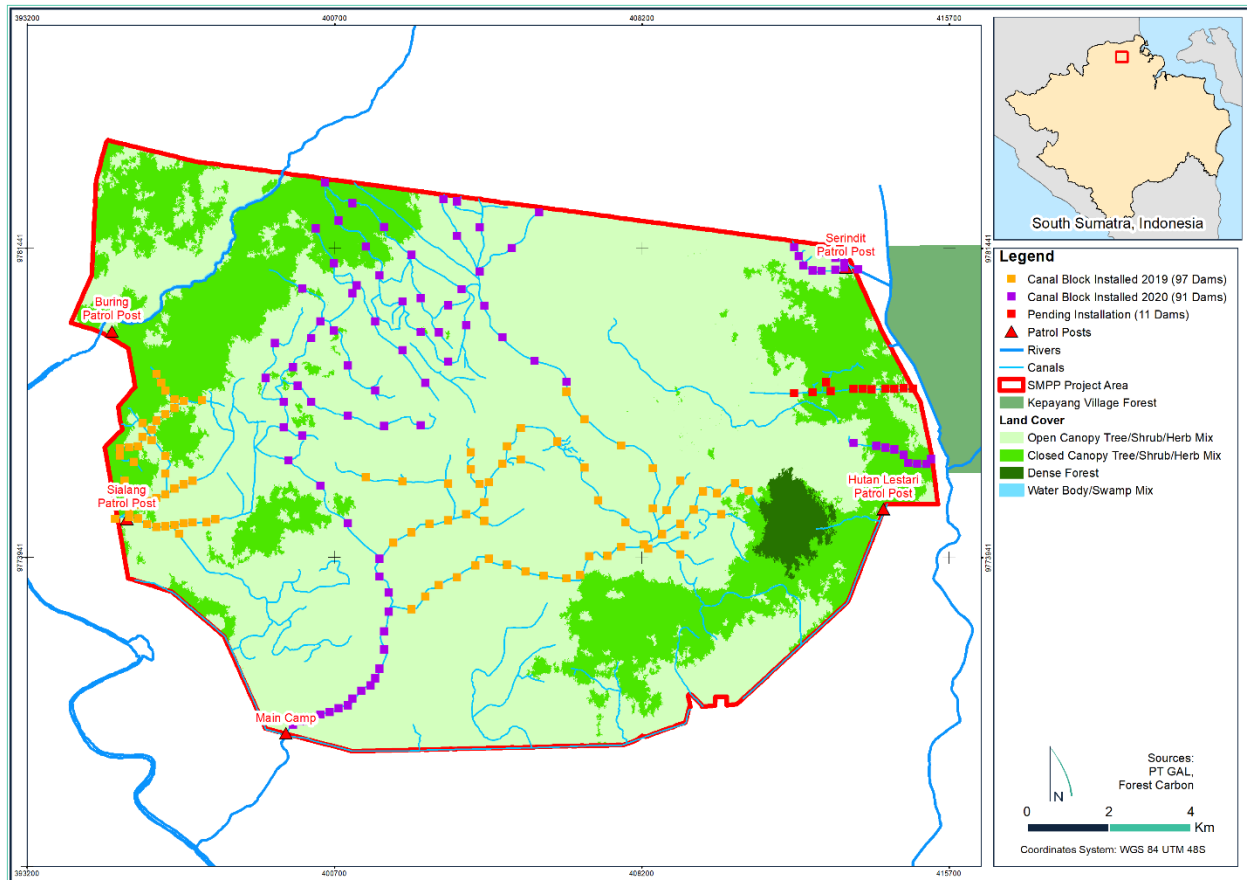
1. Peat microbial decomposition;
2. Peat burning; and
3. Dissolved organic carbon from bodies of water.

The project will account for above-ground biomass (AGB) stock changes due to ARR activities from 2021 onwards as 2020 was the first year the project conducted an AGB inventory.

Project activities specifically related to climate are described in the PD Section 2.1.11 and include rewetting drained peatland areas, conservation of existing natural peat areas, natural regeneration of vegetation, and fire control measures with a target of zero burning in the SMPP.

The project has operated consistent fire patrols since the start of the SMPP and has an online satellite-based early warning system (EWS) in place to detect possible fires as quickly as possible. Project activities include active patrolling, border protection and training, and as a result of the project there is a reduction of human activity in the project area. For future monitoring events, if any uncontrolled burning does occur in the SMPP during the project period, an extensive fire monitoring plan is in place, and calculations will be adjusted to account for these emissions. Compacted peat dams have also been constructed over existing

canals throughout the project area in late 2019, supporting the assumption that there will not be any non-human induced rewetting in the project scenario (Map 9).



Map 9. Planned and completed canal blocks in late 2019 through early 2020.

3.2.2.1 Emission Characteristics Stratification Monitoring

3.2.2.1.1 Land Cover Classification

In PD Section 3.1.3.1 project staff stratified the project area into land cover classes based on vegetation types that are indicative of varying aboveground carbon stocks as a result of the 2016 land cover classification. The classification informed the appropriate emission characterization and emission factors. This land cover classification updates the existing land cover classification for 2020. Annex 10 provides details on the employed methodology and results.

3.2.2.1.1.1 Data Acquisition

Project staff performed land cover classification on high-resolution Planet Tropical Normalized Analytic Monthly Monitoring imagery product (Tile 1615-1012, 1616-1012, and 1617-1012, acquisition date: September 2020).

Through Norway's International Climate & Forests Initiative (NICFI), the public can now access Planet's high-resolution, analysis-ready mosaics of the world's tropics in order to help reduce and reverse the loss of tropical forests, combat climate change, conserve biodiversity, and facilitate sustainable development. Planet Tropical Normalized Analytic Monthly Monitoring imagery product is derived from PlanetScope Surface Reflectance Mosaics (Analysis Ready) which is optimized for scientific and quantitative analysis.²³

Each Surface Reflectance Basemaps consists of normalized surface reflectance for four spectral bands (blue, green, red, and NIR) in separate rasters. Project staff computed four additional spectral indices using

the normalized surface reflectance bands: Normalized Difference Vegetation Index (NDVI), Modified Soil Adjusted Vegetation Index (MSAVI2), Modified Triangular Vegetation Index (MTVI2), and Normalized Difference Water Index (NDWI).

Project staff transformed the original surface reflectance bands 1-4 by conducting principal component analysis (PCA) to reduce dataset dimensionality for the 2020 image. With PCA, the original four normalized bands that were correlated, were transformed into a simpler dataset of uncorrelated variables representing the most important variance from the original dataset.²⁴ Project staff included the first and second PCA axis (PCA-1 and PCA-2) into the change detection, which accounted for 94.35% and 5.29% variance of the original surface reflectance bands 1-4 for 2020 respectively.

3.2.2.1.1.2 Reference Data Acquisition

In February to March 2021, project staff collected high-resolution aerial photographs using a fixed-wing drone, with 2015 Skywalker frame, a Sony A7R camera, and 35-mm lens which produced 6 strips of orthomosaic of 7cm/pixel spatial resolution. The drone strips covered 14,359 ha of the project area.

3.2.2.1.1.3 Classification Training Sample Development

A Multiresolution Segmentation algorithm was employed to consecutively merge image pixels into image objects or segments based on the relative homogeneity of the pixel with the neighboring pixels. This homogeneity criterion is a combination of spectral and shape criteria and was calculated as a combination of the color and shape properties of the initial and resulting image objects of the intended merging. The resulting image objects were later exported as vector shapefile and then clipped with the coverage LiDAR and drone photographs across the study area. The resulting clipped vector shapefile were then randomly selected and assigned a class value based on their representation of the vegetation class.

The classification model required iterative refinement on training samples in order to improve classification accuracy. Project staff conducted the classification runs with anticipation to merge a few classes in the final output.

3.2.2.1.1.4 Classification Modeling

Project staff employed Random Forest, a supervised, decision tree-based classifier. Earlier studies have used Random Forest for classification of multi-sensor remote sensing and geographic data.²⁵ Random Forest proved a robust tool for yielding accurate land cover classifications, training data reduction and noise in addition to identifying the most important variables.^{26,27}

Project staff compared preliminary classification results to determine the best input variable combination. The best performing input variables were all spectral, indices, and both PCA axes (ten bands in total). Therefore, we continued and finalized the Random Forest classifier with these ten variables.

3.2.2.1.1.5 Accuracy Assessment

The reference data for accuracy assessment included the 2021 drone photos. Given the need to balance thematic accuracy with positional accuracy, technical staff employed a clustered pixel approach, creating a cluster of pixels (i.e. virtual plots in 10 x 10 pixel size = 50 m) using a stratified random sampling design to place testing samples in each of the land cover classes.²⁸

To ensure that the virtual testing samples contained homogeneous information of a land cover class within each sample, project staff excluded classification features that were smaller than the virtual plots to avoid multiple classes seen within one reference sample. Within the remaining map, project staff created stratified random virtual testing samples relatively proportionate to the land cover class of each area, following best practices for random sample size.²⁹

In the Sampling Design Tool,³⁰ project staff allocated sample sizes for each class ranging from 10 to 200 virtual plots. With the criteria of minimum distance (200 m) between samples within each stratum, random samples that were spatially clustered were eliminated.

Project staff conducted the accuracy assessment by visual interpretation to evaluate whether each virtual plot belonged to its corresponding land cover class, according to the reference data. Agreement and disagreement were summarized in an error matrix, with calculation of overall accuracy, user accuracy (complement of commission error), producer accuracy (complement of omission error) and kappa

coefficient per guidance of Global Observation for Forest Cover and Land Dynamics (GOFC-GOLD)³¹ and Global Forest Observations Initiative (GFOI).³²

3.2.2.1.1.6 Accuracy Assessment Results

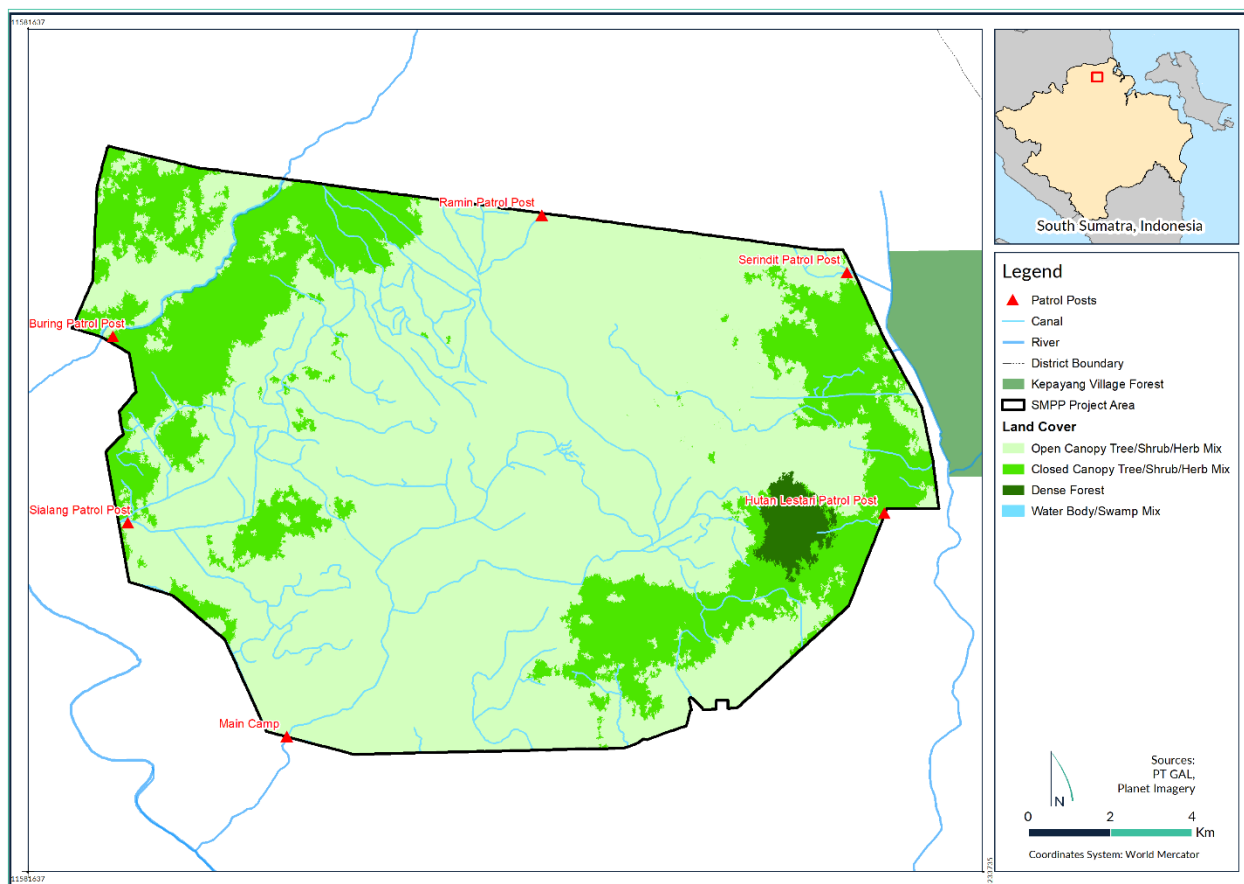
The final classification of four land cover classes showed that 73.32%, 23.56%, 1.26% and 1.86% of the project area were 1) Open canopy tree/shrub/herbaceous mix, 2) Close canopy tree/shrub/herbaceous mix, 3) Dense forest, and 4) Water/swamp mix, respectively. This classification achieved 91.7% overall accuracy and a kappa coefficient of 0.83, indicating 83.0% reduction in error generated by the classification in comparison with a completely random process (Table 11). This final classification for forest/non-forest classes showed that 1.26% and 98.74% of the project area contained forest and non-forest areas, respectively.

Table 22. Summary of accuracy in the error matrix

	Error of commissions	User's accuracy	Error of omissions	Producer's accuracy
KtBM	3.5%	96.5%	7.2%	92.8%
KbBM	13.3%	86.7%	12.4%	87.6%
SF	13.3%	86.7%	0.0%	100.0%
WB	50.0%	50.0%	0.0%	100.0%
	Overall accuracy	91.7%		

(KtBM = Open canopy tree/shrub/herbaceous mix, KbBM = Closed canopy tree/shrub/herbaceous mix, SF = Secondary forest, WB = Water bodies).

The known canals and rivers which often did not appear in the image due to the image resolution, were added to the final classification by overlaying with our GIS canal/river network layer with buffer value derived from field and remote sensing observations. Further, Water/swamp mix class were later reclassified as Open canopy tree/shrub/herbaceous mix after consideration that this class covers mostly inundated shrub area and is not considered to be a water body. This resulted in a final map showing 74.92%, 23.52%, 1.26%, 0.30% of the project area were 1) Open canopy tree/shrub/herbaceous mix, 2) Closed canopy tree/shrub/herbaceous mix, 3) Secondary forest, and 4) Water bodies, respectively (See Map 10 below).



Map 10. Land cover classification in the project area for 2020

3.2.2.2 Hotspot and Fire Occurrence Screening

The project continued to monitor fire occurrences by using both remote sensing data and forest patrols to monitor for fire risk on the ground. As outlined in the PD Section 3.2.1.5 for the fire risk probability modeling, annual burnt area estimates, and burn scar depth post-simulation models, project staff used Moderate Resolution Imaging Spectroradiometer (MODIS) Collection 6 (MCD14DL) at 1-km resolution (hotspots with confidence $\geq 80\%$) and Visible Infrared Imaging Radiometer Suite (VIIRS) at 375-m resolution (hotspots with confidence = High) (VNP14IMGTDL_NRT, available starting in 2012), and available starting in 2020, a joint NASA/NOAA Suomi National Polar-orbiting Partnership (Suomi NPP) and NOAA-20 satellites at 375 m resolution (VJ114IMGTDL_NRT) to determine the presence of fires.³³ No hotspots were detected in this monitoring period across all confidence levels of source fire hotspot datasets.

Table 23. MODIS and VIIRS hotspots (high confidence, i.e. $\geq 80\%$) with records detection in the project area showing no detected hotspots in 2020.

Year/month of MODIS hotspots detected	July	August	September	October	November	Total
2020	0	0	0	0	0	0
Total	0	0	0	0	0	0

Year/month of VIIRS hotspots detected	August	September	October	November	Total
2020	0	0	0	0	0
Total	0	0	0	0	0

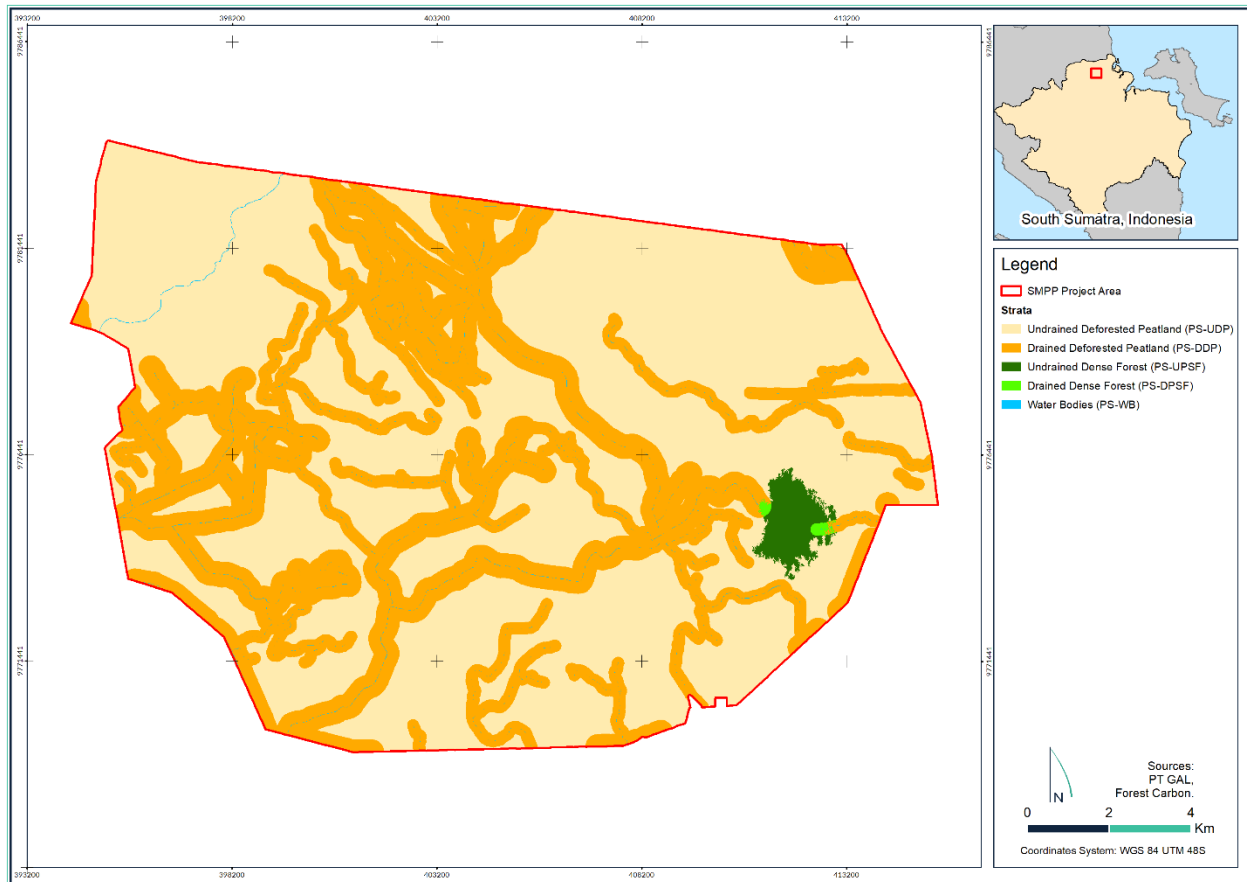
3.2.2.3 Emission Characteristics Stratification for WRC Activities Under the Project Scenario

For the project scenario, technical staff stratified the project area based on two land cover classes (forest and non-forest), two drainage statuses (drained and undrained) and one water body class. through a spatially explicit delineation process. Table 24 and Map 11 below show stratification of the project area based on emission characteristics. The mapping process involved the following steps:

1. Delineation of water bodies:
 - a. Delineation of natural water bodies present at the project start date (i.e. natural river such as Buring river). The natural water body stratum did not change for the entire project period.
 - b. Delineation of secondary and tertiary canals that existed prior to the project start date and did not change for the current project period. The widths of canals were based on observations from the field and Google Earth high-resolution imagery of the project area.
2. Delineation of drained/undrained areas:
 - a. Following the literature studies of canal proximity impact on peatland (as discussed in Section 3.2.1.3), we employed a conservative approach to assume that areas within a 300-m distance from secondary canals and 150-m distance from tertiary canals would be drained.
 - b. We created a 300-m and 150-m buffer around both sides of the secondary and tertiary canals, respectively, to account for peatland drained during this monitoring period. The distinction between drained and undrained areas was taken into account for emission characteristics and calculation.
3. Delineation of forested area:
 - a. Delineation of dense forest during this monitoring period was based on the land cover classification summarized in Section 3.2.2.1.1 and detailed in Annex 10.

Table 24. Stratification of project area based on emission characteristics from peat and water bodies in 2020.

Strata	Type	Description	Area (ha)	Percentage of project area (%)
PS-UPSF	Undrained Dense Forest	Intact dense forest on undrained peatland	265.83	1.02
PS-DPSF	Drained Dense Forest	Intact dense forest on drained peatland	22.01	0.09
PS-DDP	Drained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on drained peatland	8,259.77	66.33
PS-UDP	Undrained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on undrained peatland	14,305.36	32.25
PS-WB	Water Bodies	River and secondary or tertiary canals that existed before project start date.	69.42	0.30
Total			22,922.39	100.00



Map 11. Stratification based on emission characteristics for WRC in 2020.

Project staff continued to collect site-specific hydrological monitoring data to predict spatially explicit estimates of water table level for each monitoring period. Direct measurements from the field will continue to serve as a proxy to calculate GHG emissions. The hydrological monitoring plan is detailed in Annex 3. Together, land cover stratification based on updated land cover classification and change detection from remote sensing imagery and site-specific emission proxies will be used to re-stratify non-forest, if any changes occur.

3.2.2.4 Emission Characteristics Stratification for ARR Activities Under the Project Scenario

Although the project activities will include reforestation (nursery and replanting, see PD Section 2.1.11). For delineating ARR emission characteristics technical analysis only accounted for natural regeneration of vegetation. The eligible area for ARR crediting is all the non-forest areas where the project would carry out activities to facilitate natural regeneration of vegetation, including rewetting, fire avoidance, etc. Based on the spatial analysis, the area eligible for crediting from ARR activities is 20,601 ha, as shown in PD Section 3.1.3.1.7.

3.2.2.5 Emissions from Peat and Water Bodies (WRC)

The 2020 land cover classification (detailed in Annex 10) served as a basis for developing strata for WRC activities (see Table 24).

The strata for the project scenario analysis include:

1. Drained forested peatland;
2. Undrained forested peatland;

3. Drained non-forested peatland;
4. Undrained non-forested peatland; and
5. Water bodies.

Project staff then quantified the GHG emissions from microbial decomposition of peat and DOC loss through water bodies in peatlands.

3.2.2.5.1 Emission Calculations

Project staff estimated the net CO₂-equivalent emissions from the peat microbial decomposition and water bodies for each parcel, spatially explicitly as detailed in Table 24. Using the procedures provided in Module BL-PEAT and Module M-PEAT, we established the equation (14):

$$GHG_{WPS-WRC} = \sum_{t=1}^{t^*} \sum_{i=1}^M (E_{peatsoil-WPS,i,t} + E_{peatburn-WPS,i,t} + E_{peatditch-WPS,i,t}) \quad (14)$$

Where:

$GHG_{WPS-WRC}$	Net CO ₂ equivalent peat GHG emissions in the project scenario up to year t^* (t CO ₂ -e)
$E_{peatsoil-WPS,i,t}$	GHG emissions from microbial decomposition of the peat soil within the project boundary in the project scenario in stratum i in year t (t CO ₂ -e yr ⁻¹)
$E_{peatburn-WPS,i,t}$	GHG emissions due to peat burning under project scenario in stratum i in year t of each GHG (CO ₂ , CH ₄) (t CO ₂ -e yr ⁻¹)
$E_{peatditch-WPS,i,t}$	GHG emissions from water bodies within the project boundary in the project scenario in stratum i in year t (t CO ₂ -e yr ⁻¹)
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* time elapsed since the start of the project activity (years)

Procedures for quantifying the dynamics of carbon stock and peat losses are similar to those applied in the baseline scenario (see section 3.2.1.5.1). The only differences include stratification.

GHG emissions from peat soils, and water bodies are elaborated in detail in sections 3.2.2.6 and 3.2.2.7. A summary of the quantified GHG emissions from peat microbial decomposition, uncontrolled peat burning and water bodies under the project scenario are presented in Table 25.

Table 25. A summary of the annual GHG emissions from peat and water bodies under the project scenario in 2020.

Year	CO ₂ from peat microbial decomposition (t CO ₂ -e ha ⁻¹ yr ⁻¹)	CH ₄ from peat microbial decomposition (t CO ₂ -e ha ⁻¹ yr ⁻¹)	Emissions (CO ₂ and CH ₄) from uncontrolled burning (t CO ₂ -e ha ⁻¹ yr ⁻¹)	CO ₂ -e from DOC (t CO ₂ -e yr ⁻¹)	Total (t CO ₂ -e ha ⁻¹ yr ⁻¹)
2020	2,333	31,999	0	200	34,532

3.2.2.6 Emissions from Microbial Decomposition of Peat

Project staff calculated the project GHG emissions for different emission strata using the conservative and scientifically robust (TIER 1) IPCC default emission factors for each stratum i (Annex 6 on Emission Factors), following the equations defined by the VCS methodology VM0007 Module M-PEAT (17):

$$E_{\text{peatsoil-WPS},i,t} = E_{\text{CO}_2\text{-WPS},i,t} + E_{\text{CH}_4\text{-WPS},i,t} \quad (17)$$

Where:

$E_{\text{CO}_2\text{-WPS},i,t}$ CO₂ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO₂-e yr⁻¹)

$E_{\text{CH}_4\text{-WPS},i,t}$ CH₄ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO₂-e yr⁻¹)

i 1, 2, 3, ... M_{WPS} strata in the project scenario (unitless)

t 1, 2, 3, ... t^* time elapsed since the project start (yr)

For each stratum, the CO₂ emissions from microbial decomposition of the peat within the project boundary are calculated by using the equation (18):

$$E_{\text{peatsoil-WPS,CO}_2,i,t} = A_{i,t} \times EF_{\text{CO}_2,i,t} \quad (18)$$

Where:

$E_{\text{peatsoil-WPS,CO}_2,i,t}$ CO₂ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO₂-e yr⁻¹)

$EF_{\text{CO}_2,i,t}$ Emission factor for CO₂ emissions corresponds to each stratum i , as provided by IPCC (t CO₂-e yr⁻¹)

$A_{i,t}$ Area of stratum i at time t (ha)

i 1, 2, 3, ... M_{WPS} strata in the project scenario (unitless)

t 1, 2, 3, ... t^* time elapsed since the project start (yr)

For each stratum, the CH₄ emission from the peat soil within the project boundary are calculated by using the equation (19):

$$E_{\text{peatsoil-WPS,CH}_4,i,t} = A_{i,t} \times GWP_{\text{CH}_4} \times EF_{\text{CH}_4,i,t} \quad (19)$$

Where:

$E_{\text{peatsoil-WPS,CH}_4,i,t}$ CH₄ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO₂-e yr⁻¹)

$EF_{\text{CH}_4,i,t}$ Emission factor for CH₄ emissions corresponds to each stratum i , as provided by IPCC (t CO₂-e ha⁻¹ yr⁻¹)

$A_{i,t}$ Area of stratum i at time t (ha)

GWP_{CH_4} Global Warming Potential for CH₄

i 1, 2, 3, ... M_{WPS} strata in the project scenario (unitless)

t 1, 2, 3, ... t^* time elapsed since the project start (yr)

Table 26 below provides details on the WRC related project emission factors and stratification.

Table 26. The stratification used for the calculation of GHG emissions per stratum, the area per each stratum and the CO₂ and CH₄ default factors used for the specific land-use.

Strata	Type	Description	Area (ha)	Percentage of project area (%)
PS-UPSF	Undrained Dense Forest	Intact dense forest on undrained peatland	265.83	1.02
PS-DPSF	Drained Dense Forest	Intact dense forest on drained peatland	22.01	0.09
PS-DDP	Drained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on drained peatland	8,259.77	66.33
PS-UDP	Undrained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on undrained peatland	14,305.36	32.25
PS-WB	Water Bodies	River and secondary or tertiary canals that existed before project start date.	69.42	0.30
Total			22,922.39	100.00

3.2.2.6.1 Current projections for project emissions at the start of the project

With sufficient long-term, field-based measurements of peat-related emissions available for estimating the overall emissions in the monitoring period of 2020, a combination of GHG emission factors provided in Annex 6 and efficacy factors derived from the hydrological model were used as a conservative approach. Detailed explanations on the hydrological model and its results can be found in Annex 13. The effect of rewetting was taken into account by multiplying the emission factor for each stratum by an efficacy factor derived from the annual water table changes predicted by the hydrological models that compares the pre-project WTL by stratum with the WTL in pristine (i.e. undrained) peat forests (for details see Annex 14). Projected annual GHG emissions from microbial decomposition of peat is shown in Table 27.

Table 27. GHG emissions from microbial decomposition of peat in the project scenario in 2020.

Year	CO ₂ from peat microbial decomposition (t CO ₂ -e ha ⁻¹ yr ⁻¹)	CH ₄ from peat microbial decomposition (t CO ₂ -e ha ⁻¹ yr ⁻¹)	Total (t CO ₂ -e ha ⁻¹ yr ⁻¹)
2020	2,333	31,999	34,332

3.2.2.6.2 Future approaches for calculating project emissions

To determine carbon and GHG fluxes from peat microbial decomposition in the project scenario, we will take approaches with varying levels of resolution (IPCC TIER 1 – TIER 3).¹¹ Throughout project implementation, we will conduct measurements in the field (IPCC TIER 2 and TIER 3) and collect data to reduce emission uncertainties and account for spatial and temporal variation in the water tables.¹¹

Project staff will develop site-specific TIER 3 emission factors and apply these to estimate project emissions. These methods work together to thoroughly reduce uncertainty (see Annex 15).

Project staff began initial, preliminary water table level monitoring in the project area in 2018 and expanded the point-based monitoring using dip wells installed and distributed along transects comprising each water table level stratum, which included 264 dip wells in total within six water table level strata in 2019 following

canal blocking implementation (see Annex 3). Monitoring of all variables will be continued throughout 47-year project duration.

3.2.2.7 Emissions from water bodies in peatlands

3.2.2.7.1 Current projections for project emissions

The water bodies present in the project scenario are rivers and pre-existing drainage canals. The project emissions from DOC are shown in Table 28. As a conservative estimate both water bodies are treated the same, and the DOC IPCC default factor for natural water bodies was applied using the equation (20):

$$E_{peatditch-WPS,t} = A_{ditch-WPS,t} \times EF_{DOC-WPS} \quad (20)$$

Where:

$E_{peatditch-WPS,i,t}$	GHG emissions from canals and other open water at year t in the project scenario (t CO ₂ -e ha ⁻¹ yr ⁻¹)
$A_{ditch-WPS,i,t}$	Total area of canals and other open water at year t in the project scenario (ha)
$EF_{DOC-WPS,i}$	IPCC emission factor for Dissolved Organic Carbon from canal and open in the project scenario (t CO ₂ -e ha ⁻¹ yr ⁻¹)
t	1, 2, 3, ... t time elapsed since the start of the project activity (years)

Table 28. GHG emissions from Dissolved Organic Carbon in water bodies in the project scenario in 2020.

Year	CO ₂ -e from DOC (t CO ₂ -e y ⁻¹)
2020	200

3.2.2.7.2 Future approaches for calculating project emissions

Values for DOC will be continued to be taken from Wetlands Supplement of the IPCC (2013). The value(s) will be used to calculate emissions from water bodies by re-assessing the annual area changes, i.e., channel widths and lengths derived from visual assessment with medium-high resolution remote sensing images.

3.2.2.8 Emissions from uncontrolled burning

Project staff are implementing a variety of project activities to address burning, such as peatland rewetting and best-practice fire management, with goals of zero burning, fire control, and fire prevention (PD Section 2.1.11).

The project has operated consistent fire patrols since the start of the SMPP, and also has an online satellite-based early warning system (EWS) in place to detect possible fires as quickly as possible. If uncontrolled burning does occur in the SMPP during the project period, staff map the area of the fire scar and the burn scar depth soon after the burning event. In addition, the project has compiled historical tracking of hotspots and direct observation data in the project area to determine the repetition of burning in the SMPP. In the event of a burn event, project staff will quantify equivalent GHG emissions from uncontrolled burning and deduct these from project emission reductions.

In addition, project staff calculate GHG emissions that result from peat burning using dry mass loss based on burn scars, depth, bulk density of peat, combustion factors, and GHG potential of GHG species. GHG emissions from biomass loss from burning are determined using land cover type, combustion factors, and GHG potential of GHG species. Bulk density of peat is assumed constant throughout the project period and was found to be relatively homogeneous throughout horizontal and vertical peat soil profiles (Annex 12).

In cases where there were repeated burns within the SMPP, scar depths of the 1st, 2nd, 3rd, 4th, and subsequent burnings are assumed as 0.17 cm, 0.1 cm, 0.06 cm, and 0.02 cm, respectively. The detailed parameters we used to quantify GHG emissions from uncontrolled burning are given in Annex 6.

To quantify GHG emissions from uncontrolled peat burnings, project staff followed procedures in the VCS methodology VM0007 Module E-BPB using the following equation (21):

$$E_{peatburn-WPS,i,t} = \sum_{g=1}^G \left((A_{peatburn-WPS,i,t} \times P_{WPS,i,t} \times P_{WPS,g,i}) \times 10^{-3} \right) \times GWP_g \quad (21)$$

Where:

$E_{peatburn-WPS,i,t}$	GHG emissions due to peat burning under project scenario in stratum i in year t of each GHG (CO ₂ , CH ₄) (t CO ₂ -e)
$A_{peatburn-WPS,i,t}$	Area peat burnt under project scenario in stratum i in year t (ha)
$P_{WPS,i,t}$	Average mass of peat burnt under project scenario in stratum i , year t (t DM ha ⁻¹)
$G_{g,i}$	Emission factor in stratum i for gas g (kg t ⁻¹ DM burnt)
GWP_g	Global warming potential for gas g (t CO ₂ t ⁻¹ g ⁻¹)
g	1, 2, 3, ...G greenhouse gases including carbon dioxide, methane and nitrous oxide (unitless)
i	1, 2, 3, ...M strata (unitless)
t	1, 2, 3, ...t time elapsed since the start of the project activity (year)

Project staff estimated the average mass of peat burnt for a particular stratum using the equation (22):

$$P_{WPS,i,t} = D_{peatburn-WPS,i,t} \times BD_{upper} \times 10^{-4} \quad (22)$$

Where:

$P_{WPS,i,t}$	Average mass of peat burnt under project scenario in stratum i , year t (t DM ha ⁻¹)
$D_{peatburn-WPS,i,t}$	Average burn scar depth under project scenario in stratum i in year t (m)
$BD_{upper,i}$	Bulk density of the upper peat in stratum i (g cm ⁻³)
i	1, 2, 3, ...M strata
t	1, 2, 3, ...t time elapsed since the start of the project activity (years)

3.2.2.8.1 Current projections for project emissions

No hotspots were detected in this monitoring period for both all confidence and high confidence levels of source fire hotspot datasets, thus no emissions from uncontrolled peat burning occurred (see Section 3.2.2.2).

3.2.2.8.2 Future approaches for calculating project emissions

The project will continue using fire patrols and the EWS in the future. Additionally, smoke detection cameras are planned to be installed in 2021 to improve on the existing fire monitoring system and increase detection time and accuracy.

3.2.2.9 Project Emissions from ARR Activities

As stated under Sub-section PD 1.1.2.3 the project activities will include reforestation (nursery and replanting, see PD Section 2.1.11), however for delineating ARR emission characteristics we only accounted for the natural regeneration of vegetation.

All ex-ante GHG emissions and removals follow Module M-ARR in the AR-ACM0003 procedures for afforestation and reforestation lands. Net GHG removals under the ARR project scenario up to time t^* ; t CO₂-e ($\Delta C_{WPS-ARR}$) equal the summation from $t = 1$ to t^* of the baseline net GHG removals by sinks in year t ; (ΔC) in AR-ACM0003. We assume that non-CO₂ GHG emissions under the project scenario are zero, and shrubs, dead wood, and litter are not significant in the C pool calculations.

Net GHG emission related to WRC activities in the project scenario in ARR area ($GHG_{WPS-WRC}$) are presented separately in the peat Section 5.3.1. Net GHG removals under the ARR project scenario are calculated using the equation (23):

$$\Delta C_{WPS-ARR} = \sum_{t=1}^{t^*} (\Delta C_{ACTUAL,i,ACM0003}) = \sum_{t=1}^{t^*} (\Delta C_{TREE,PROJ,t}) \quad (23)$$

Where:

$\Delta C_{WPS-ARR}$	Net GHG removals under the ARR project scenario up to time t ; t CO ₂ -e
$\Delta C_{ACTUAL,t,ACM0003}$	Actual net GHG removal by sinks in year t (from AR-ACM0003) (t CO ₂ -e)
$C_{TREE,PROJ,t}$	Change in carbon stock in tree biomass in project, in year t ; t CO ₂ -e
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* time since project start

IPCC default factors for annual C stock increment were used in the calculation (see Annex 6). Cumulative net GHG removals related to ARR activities in the project scenario within the project period were estimated to be 6,894,688 t CO₂-e (see PD Table 31). Changes in carbon stock in the project scenario were not accounted for in the first five years of the project, as the first AGB inventory was conducted only in 2020. The second AGB inventory will be conducted in 2021, and as such, 2021 will represent the first year from which actual gains can be monitored and accounted for. The project is conducting frequent AGB inventories from 2020 onwards.

Table 29. Project scenario net GHG removals by ARR activity within the project period in 2020.

Year	Change in carbon stocks in the ARR area (tCO ₂ -e)
2020	N/A

3.2.3 Leakage

Project staff determined leakage according to the requirements in Module LK-ASP in the VCS methodology VM0007 REDD+ MF. As expressed in Section 3.2.1, baseline scenario activity in the SMPP includes planned conversion to industrial Acacia plantations and resulting peatland drainage. Project activities combine Avoiding Planned Deforestation (APD), Reforestation (ARR), in combination with Conservation of Undrained and Partially drained Peatland (CUPP) and Rewetting of Drained Peatland (RDP).

Accordingly, potential sources of leakage emissions from displacement of planned deforestation activities and pre-project activities on non-forest land are possible. These potential sources and the corresponding applicable modules for quantifying total leakage emissions are listed in PD Section 3.1.2 and Table 31 below.

Table 30. Applicability of leakage modules

Module	Applicability
Estimation of emissions from activity shifting for avoiding planned deforestation and planned degradation (LK-ASP)	Applicable. The project may cause activity shifting of avoided planned deforestation.
Estimation of emissions from activity shifting for avoiding unplanned deforestation (LK-ASU)	Not applicable. The project is not categorized as avoiding unplanned deforestation.
Estimation of emissions from displacement of fuelwood extraction (LK-DFW)	Not applicable. The project is not categorized as avoiding unsustainable fuelwood extraction.
Estimation of emissions from displacement of pre-project agricultural activities (LK-ARR)	Applicable. The project is categorized as afforestation, reforestation, and revegetation and may cause displacement of pre-project agricultural activities.
Estimation of emissions from market-effects (LK-ME)	Not applicable. The project does not reduce the production of timber, fuelwood, or charcoal.
Estimation of emissions from ecological leakage (LK-ECO)	Applicable. The project is categorized as WRC and may cause ecological leakage

3.2.3.1 Estimation of emissions from activity shifting for avoiding planned deforestation and planned degradation (LK-ASP)

Activity shifting leakage was monitored against the leakage baseline defined in the PD Section 3.2.3. As per the methodology, and the steps defined in the PD, “area deforested by the baseline class of agents through the years in which planned deforestation was forecast to occur” ($A_{defLK,i,t}$) was monitored and compared to the baseline leakage scenario (Step 3 as per PD Section 3.2.3.1), using the following methods.

In PD Section 3.2.3.1, based on a historical trend of licensed HTI concessions in the country for the period 2006-2015, project staff estimated an additional 489,073 ha of land per year would be licensed for HTIs. However, the published statistics from the MoEF showed that in 2016 licensed HTI concessions only increased by 142,132 ha (from 10,700,842 ha in 2015 to 10,842,975 ha in 2016). In 2017 licensed HTI concessions increased by 335,627 ha (from 10,842,975 ha in 2016 to 11,178,601 ha in 2017)³⁴. In 2018 licensed HTI concessions increased by 836 ha (from 11,178,601 ha in 2017 to 11,180,437 ha in 2018). In 2019 licensed HTI concessions increased by 125,753 ha (from 11,180,437 ha in 2018 to 11,306,190 ha in 2019). In 2020 licensed HTI concessions decreased by 99,165 ha (from 11,306,190 ha in 2019 to 11,207,025 ha in 2020)³⁵. This indicated that deforestation in the absence of the project ($WoPR_{i,t}$ in PD Section 3.2.3.1) and the new area of annual deforestation ($NewR_{i,t}$ in PD Section 3.2.3.1) calculated using the government statistics data was lower than the baseline estimates set in the PD (Table 31 below).

Table 31. Comparison between the estimated and the actual parameters in 2016-2020.

Year	Area licensed (ha)	$WoPR_{i,t}$	$NewR_{i,t}$
Estimated parameters set as the baseline in PD			
2016	11,560,797	816,770	815,151
2017	12,049,870	851,323	849,704
2018	12,538,944	885,876	884,257
2019	13,028,017	920,429	918,810
2020	13,517,091	954,982	953,363
Actual parameters based on government statistics of licensed areas			
2016	10,842,975	766,056	764,437
2017	11,178,601	789,768	788,149
2018	11,180,438	789,898	788,278
2019	11,306,191	798,782	797,163
2020	11,207,026	791,776	790,095

The above non-spatial comparison suggested that the actual deforestation caused by baseline class of agents in this monitoring period would be lower than the PD estimates. To provide continuous and spatially explicit quantification for this monitoring period as summarized below, technical staff obtained and compiled the most up-to-date and available datasets on licensed HTI concession boundaries (i.e. Acacia and other industrial-level HTI types, or HTI unspecified that could include Acacia) and its subset of HTI-wood fiber (i.e. pulp wood including Acacia) in Indonesia. These HTI-wood fiber and HTI concession boundaries were compiled from multiple datasets updated up to 2020, including the MoEF 2019-2020 HTI boundary datasets and Global Forest Watch HTI- wood fiber boundary updated in November 2020.³⁶ The datasets contain the spatial delineation of concessions, the year of granted license for each, and the company that owns it (if known). In some cases where the concession date is not available, we assumed conservatively that they were granted prior to 2015, so that any deforestation was included in the PD calculation of $NewR_{i,t}$. One of the long existing challenges in Indonesia's land use management and spatial planning has been the incomplete, inconsistent, mismatched and outdated concession boundaries, as observed in the acquired HTI-wood fiber and HTI concession boundaries. Prior to the analysis, technical staff examined all the boundaries to remove topology errors and spatial overlap between neighboring parcels.

Project staff quantified annual area deforested throughout all HTI-wood fiber and HTI concessions during the monitoring period by using remote sensing data. In late year 2021 official annual land use land cover data from the MoEF from year 2016-2020 had become available. Deforestation was quantified as loss of natural forest cover of primary and secondary dry forest, swamp forest and mangrove forest from one year to the next. In addition, an annual global dataset from the Global Forest Change derived by the University of Maryland was available from year 2016-2020 for comparison.^{37,38} This dataset is a proxy as it quantifies tree cover loss, thereby not differentiating harvesting/replanting rotation cycles within a plantation. Therefore, our approach to use this dataset was conservative as a plantation's rotation cycle might have been considered deforestation. For both government and global datasets, project staff then extracted all the HTI-wood fiber and HTI concession boundaries to quantify the annual deforested area (i.e. tree cover or natural forest cover loss detected from this dataset) throughout the monitoring period.

Project staff determined areas of deforestation and leakage using the equation below, as prescribed in module LK-ASP. The actual area of deforestation attributable to peatland and non-peatland areas in HTI-wood fiber and HTI concessions was based on spatial analysis using the 2008 national peatland distribution data.³⁹ The allocation of projected $NewR_{i,t}$ on peatland and non-peatland followed the summary described in the PD Section 3.2.3.1, whereby we proportionally allocated 24.65% to peatland and 75.35% to non-

peatland. Project staff used the equation 24 below for calculating the difference between deforestation occurred in HTIs and estimated as $NewR_{i,t}$, and summarized results in Table 32.

$$LKA_{planned,i,t} = A_{defLK,i,t} - NewR_{i,t} \quad (24)$$

Where:

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

Table 32. Deforested areas and leakage calculations as occurred in HTI concessions (ha), based on the MoEF land use land cover dataset. Values in parentheses = deforestation detected in HTI-wood fiber concessions.

Year	HTI concessions (ha)		PD estimated $NewR_{i,t}$ (ha)		$LKA_{planned}$	
	Peat	Non-peat	Peat	Non-peat	Peat	Non-peat
2016	14,739 (12,638)	98,057 (71,532)	200,935	614,216	-186,196	-516,159
2017	4,590 (3,793)	78,092 (61,724)	209,452	640,252	-204,862	-562,160
2018	6,906 (4,683)	31,940 (22,795)	217,969	666,288	-211,063	-634,348
2019	3,022 (333)	-16,727 (-33,706)	226,487	692,323	-223,465	-709,050
2020	-40,560 (-33,345)	-96,577 (-42,465)	235,403	719,579	-275,963	-816,156

Table 33. Deforested areas and leakage calculations as occurred in HTI concessions (ha), based on the global tree cover loss dataset. Values in parentheses = deforestation detected in HTI-wood fiber concessions.

Year	HTI concessions (ha)		PD estimated $NewR_{i,t}$ (ha)		$LKA_{planned}$	
	Peat	Non-peat	Peat	Non-peat	Peat	Non-peat
2016	100,116 (88,081)	334,238 (274,559)	200,935	614,216	-100,819	-279,978
2017	30,018 (27,667)	196,753 (169,665)	209,452	640,252	-179,434	-443,499
2018	19,523 (18,119)	170,129 (140,692)	217,969	666,288	-198,446	-496,159
2019	24,440 (21,420)	158,461 (133,275)	226,487	692,323	-202,047	-533,862

	HTI concessions (ha)		PD estimated NewR _{i,t} (ha)		LKA _{planned}	
2020	86,502	109,097	235,403	719,579	-148,901	-610,482

The government data (Table 32), natural forest cover had increased in non-peat forest in 2019 and in both peat and non-peat forest in 2020 (shown as negative deforestation values in HTI concessions), whereas the global tree loss dataset (Table 33) showed cover loss in all years. Because both Table 32 and Table 33 above confirmed there was no leakage throughout the monitoring period (shown as all values of $LKA_{planned,i,t}$ in Table 32 and Table 33 are negative), Steps 4 through 7 as described in the PD were not required and no leakage was assumed to have occurred for the monitoring period.

3.2.3.2 Estimation of emissions from displacement of pre-project agricultural activities (LK-ARR)

The VM0007 Module LK-ARR requires the use of the CDM tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity” area. Step 1 of the CDM tool requires that the area subject to pre-project agricultural activities that is expected to be afforested/reforested (therefore the activities having to be displaced) be identified. In the areas identified for ARR activities, the SMPP project area did not have any pre-project agricultural activities taking place within the project area. As a result, no pre-project agricultural activities will be displaced by ARR project activities, and hence $Change_C_LK-ARR = 0$.

3.2.3.3 Estimation of emissions from ecological leakage (LK-ECO)

During this monitoring period, the project implemented rewetting activities. The hydrological model results of the mean annual water table levels in a 1 km buffer around the project area were significantly (at $p < 0.001$) different in the year 2019, before the canal blocking and in 2020 after the canal were blocked, with a difference in water table levels of 3 cm. At the same time precipitation between 2019 and 2020 was significantly different ($p = 0.003$), with annual means of 1877.20 mm and 2601.36 mm, respectively. As the water table levels are highly dependent on the available precipitation, the difference in water table levels between the years are highly likely due to the difference in precipitation between the same years. Therefore, the ecological leakage (LK-ECO) is zero. Project staff will continue to monitor the effectiveness of rewetting activities to confirm that no ecological leakage is occurring at each future monitoring event, by installing monitoring dip wells within the vicinity of canal block positions inside and bordering the project area (see details in Annex 13).

3.2.4 Net GHG Emission Reductions and Removals

This section provides an overview of total net emission reductions and details activity specific calculations in the subsections. Project staff calculated Net GHG emission reductions as the sum of total net GHG emission reductions of the WRC project activity and total net GHG removals of the ARR project activity (25).

$$NER_{REDD+} = NGR_{ARR} + NER_{WRC} \quad (25)$$

Where:

NER_{REDD+}	Total net GHG emission reductions of the REDD+ project activity up to year t^* (t CO ₂ -e)
NGR_{ARR}	Total net GHG removals of the ARR project activity up to year t^* (t CO ₂ -e)
NER_{WRC}	Total net GHG emission reductions of the WRC project activity up to year t^* (t CO ₂ -e)

3.2.4.1 Uncertainty Analysis

Using Module X-UNC as a guideline, technical staff calculated WRC uncertainty of the SMPP in both the baseline and project scenarios. SMPP does not have a REDD component, so REDD uncertainty calculations were not necessary. The X-UNC equation (21) was modified to the following equation (26):

$$NER_{REDD+ERROR} = \frac{\sqrt{(Uncertainty_{WRC_{BSL},t*} \times GHG_{BSL-WRC,t*})^2 + (Uncertainty_{WRC_{WPS},t*} \times GHG_{WPS-WRC,t*})^2}}{(GHG_{BSL-WRC,t*} + GHG_{WPS-WRC,t*})} \quad (26)$$

Project staff calculated CO₂ and CH₄ emission uncertainties from microbial decomposition of peat and dissolved organic carbon (DOC) from water bodies in the baseline and project scenarios, using the standard error data from the peat emission factors in the IPCC Wetlands Supplement 2013 (see Annex 6).¹¹ Project staff established that CH₄ emission uncertainty was zero, as it was conservatively excluded from emission calculations. Project staff also established that uncertainty from GHG emissions from peat burning was also zero in the project scenario and assumed full fire prevention in the project area. However, project staff calculated uncertainty from GHG emissions from peat burning in the baseline using the dry mass burnt per stratum per year and standard deviations converted to 95% confidence intervals. Emissions data from CO₂ and CH₄ burning was combined to produce an overall uncertainty in CO₂ equivalent, because Module X-UNC does not distinguish between these emissions.

Project staff calculated the uncertainty for WRC in 2020 as 11.78%, and 0.96%, for the baseline and project scenario, respectively. This resulted in a total error in this project activity at 9.64%. Assuming a threshold of 15% uncertainty, no deduction of VCUs was necessary. Further details on all calculations are provided in Annex 15.

3.2.4.2 Total net GHG emission reductions of the WRC project activity

Project staff calculated net GHG emission reductions related to WRC project activities by subtracting project emissions and emissions due to leakage from baseline emissions (see Table 34).

Table 34. Total net GHG emission reductions of the WRC project activities.

Year	Estimated Baseline Emissions (t CO ₂ -e)	Estimated Project Emissions (t CO ₂ -e)	Estimated Leakage Emissions (t CO ₂ -e)	Estimated NET GHG Emission Reductions (t CO ₂ -e)
2020	1,085,934	34,532	-	1,051,401

3.2.4.3 Total net GHG removals from ARR project activity

Project staff calculated net GHG removals related to ARR project activities by subtracting baseline removals and emissions due to leakage from the project removals (see Table 35).

Table 35. Total net GHG removals of the ARR project activities.

Year	Estimated Baseline Removals (t CO ₂ -e)	Estimated Project Removals (t CO ₂ -e)	Estimated Leakage Emissions (t CO ₂ -e)	Estimated NET GHG Emission Reductions (t CO ₂ -e)
2020	25,430	-	-	(25,430)

3.2.4.4 Total net GHG removals from WRC and ARR project activity

Project staff calculated net GHG removals related to WRC and ARR project activities by subtracting baseline removals and emissions due to leakage from the project removals (Table 36).

Table 36. Total net GHG emissions from WRC and ARR project activities.

Year	Estimated Baseline Emissions (t CO ₂ -e)	Estimated Project Emissions (t CO ₂ -e)	Estimated Leakage Emissions (t CO ₂ -e)	Estimated NET GHG Emission Reductions (t CO ₂ -e)

2020	1,060,503	34,532	-	1,025,971
------	-----------	--------	---	-----------

3.2.4.5 Calculation of the VCS non-permanence risk buffer withholding

The combined non-permanence risk buffer for the project was determined as 14%. Per VCS methodology VM0007, the annual buffer withholding for all activities was determined as a percentage of the total carbon stock benefits which excludes emissions due to leakage (see Table 37). Direct N₂O emissions and emissions from biomass burning were omitted from calculations, because the project does not account for emissions from fossil fuel combustion

Table 37. Annual non-permanence risk buffer withholding.

Year	WRC NET GHG Emission Reductions (t CO ₂ -e)	ARR NET GHG Emission Reductions (t CO ₂ -e)	Non-Permanence Risk Buffer (14%)
2020	1,051,401	(25,430)	143,635

3.2.4.6 Calculation of Verified Carbon Units

Project staff calculated VCUs by subtracting the VCS non-permanence risk buffer from the uncertainty adjusted net emission reductions for each project activity (see Table 38).

Table 38. Calculation of estimated verified carbon units.

Year	NER_{WRC}	NGR_{ARR}	$Adjusted_NER_{WRC} + NGR_{ARR}$	Non-Permanence Risk Buffer (14%)	Estimated VCUs
2020	1,051,401	(25,430)	1,025,971	143,635	882,336

3.3 Optional Criterion: Climate Change Adaptation Benefits

3.3.1 Activities and/or processes implemented for Adaptation (GL1.3)

The project area and project zone are vulnerable to the potential impacts of climate change, which will negatively impact the delivery of ecosystem services and functioning, livelihoods and health. In the project zone, interventions aim to strengthen community (human) and environmental (non-human) resilience by implementing adaptation interventions through a variety of project activities (see details in PD Section 2.1.11). A summary of activities during the 2020 monitoring period relevant to climate change adaptation and their respective benefits have been provided in Table 39 below.

The hydrological restoration activities within the SMPP concession boundaries directly reduce fire occurrence and improve the health of the watershed. This subsequently strengthens ecosystem services for the fisherman and farmers identified as community members who are vulnerable to the impacts of more variable weather and rainfall patterns associated with climate change. To address the human health risks of climate change, the project has invested in a community health center with new staff and supplies to respond to conditions such as respiratory illness associated with wildfire haze. To build stronger long-term livelihoods capacity, the project is investing in the long-term education of community stakeholders to foster greater career mobility for those who may have their current livelihoods adversely impacted by climate change. The project also provides an alternative livelihood for those who are employed directly by the project, injecting stable income into the households of local staff, who are also able to access continuing education resources for career mobility.

Table 39. Climate change adaptation benefits from project activities.

Project activity	Components	Project achievements during the monitoring period	Adaptation benefits
Forest Patrolling	- Project boundary demarcation - Guard posts - Radio communication system for reporting - Foot, bicycle, boat, and vehicle patrolling - Data collection and analysis on threats - Drone monitoring - Local law enforcement	- Prevention of potential fire vectors and extraction of biodiversity features. - Elimination of illegal logging, poaching, exploitative fishing, and conversion to small-scale agriculture inside the project area.	- The activity reduces fire risk, which is heightened by longer dry seasons and hot windy conditions, to surrounding ecosystems and speeds fire response time to mitigate fires before they spread by having a dedicated patrol staff. - The activity provides mechanisms for prevention, monitoring, reporting and response to minimize risks and damage caused by climate change. - The risk minimization enhances resilience to potential climate change impacts.
Fire Prevention and Monitoring	- Patrol activities - Early Warning System for potential fires - Fire Response and Suppression teams	Due to patrol activities, the Early Warning System, and cooperation agreements with neighboring concessions, no fire events took place during the monitoring period.	- Fire prevention is critical to maintain and improve the health of the watershed, particularly for direct community members that source fresh water for agriculture and fishing from within the SMPP. These community members would otherwise have their livelihoods adversely impacted by climate change. - The activity provides mechanisms for prevention, monitoring, and rapid response to minimize fire risks and damage exacerbated by climate change. - The risk minimization enables healthy conditions to maintain biodiversity and ecosystem functioning, hence enhances resilience to potential climate change impacts.

Project activity	Components	Project achievements during the monitoring period	Adaptation benefits
Canal Blocking and Hydrology Management	• Technical assessment • Canal blocking plan • Peat dam installation • Hydrology monitoring • Collaboration with adjacent concessions	• Canal blocking completed to 98% (188 out of 199 dams). • Monitoring completed to 87% (164 out of 188 completed dams). Details can be found in Annex 3.	• The activity provides robust, replicable mechanisms to combat degradation of water resources and elongated dry seasons by preventing water subsidence from canal drainage and improving soil and water quality, to strengthens biodiversity and ecosystem services features. • The biophysical improvement prepares the site facing climate change, hence generates resilience to potential impacts.
Reforestation and Assisted Natural Regeneration (ANR)	• Tree nurseries • ANR trial approaches • Annual ANR and replanting • Technical support to nearby <i>Hutan Desa</i>	• Nursery construction and operation is an ongoing process. • ANR trials began in 2020. • Monitoring will begin in 2021 and be reported for the next monitoring period.	• The activity conserves genetic diversity that could be threatened by climate change, supports assisted gene flow especially for more resilient locally adapted species, and raises awareness in the communities. • Knowledge transfer also supports community forests. • The activity also promotes habitat regeneration for important species affected negatively by forest conversion, frequent wildfires and loss of habitat connectivity.

Project activity	Components	Project achievements during the monitoring period	Adaptation benefits
Community Development	• Education opportunities • Improved livelihoods and quality of life • Youth and local employment • Waste clean-up • Co-financing rainwater catchment system • Community health center supported	• Improvement of sanitation and washing facilities at the elementary schools and public health facilities. • Supported students to attend <i>Universitas Terbuka</i> who will become future teachers. • Students are attending adult continuing education programs supported by the SMPP. • Fishermen and farmers are utilizing the area for their livelihoods. The SMPP directly employs local people including females. • Facilitation of the construction of water pump, water tank, and pipes at school. • Community health center supported, and PPE distributed to respond to COVID-19	• The activity diversifies communities' opportunities for livelihoods and employment, and thereby generating resilience to challenges brought by climate change. • The improved sanitation and water usage also enhance the well-being and community health. • Project hydrological interventions also improve water quality and quantity for the fisherman and farmers that rely on the project area for their livelihoods, reducing the risk of watershed degradation caused by climate change. • Project investments in the community health center promote greater community resilience to climate-related health crises, such as respiratory issues linked to wildfire smoke. The activity also strengthens the community response to the global pandemic which can be linked to human pressure on ecosystems and thus some of the core drivers of climate change.

Project activity	Components	Project achievements during the monitoring period	Adaptation benefits
Biodiversity Management and Monitoring	- Detecting, identifying and understanding the characteristics, distribution, sensitivity and vulnerability of HCVs - Biodiversity feature monitoring design - Biodiversity monitoring implementation	- Biodiversity scoping surveys were conducted covering flora and fauna, and the identification of areas providing ecosystem services. - The surveys helped to identify and understand the characteristics, distribution, sensitivity, and vulnerability of HCVs 1, 2, 3 and 4. - Biodiversity monitoring plan in place. - Monitoring started in 2019 and the results of the first systematic monitoring are reported in section 5.3 of this monitoring report.	- The activity establishes a data-driven, traceable system to monitor changes in biodiversity features in response to climate change. - The system provides basis for predicting climate change impact on biodiversity and for developing conservation planning adjusted to address the impacts. - The system also monitors the occurrence of key prey for the Sumatran Tiger which has been documented at the site. Hunting grounds for the Sumatran Tiger are increasingly threatened by climate-caused wildfires and the project increases the availability of food for this trigger species.
Cross-cutting	- Adaptive management - Effective administration and human resources - Financial management - Legal compliance	- Reorganization of the management team and senior technical leads to better project development and operations. - Recruited a new biodiversity manager to execute activities following the project planning. - The project management board holds regular meetings to assess budget and project performance and adapt needs for large-scale activities	- The activity ensures that the decision-making process to address climate change impacts is backed by sustainable business management and operations. - Therefore, a mechanism to generate business resilience to climate change is in place.

4 COMMUNITY

4.1 Net Positive Community Impacts

4.1.1 Community Impacts (CM2.1)

The SMPP is in an isolated area with comparatively little interaction with local people. However, there are still some important groups that interact with the project landscape and activities. In the Climate, Community & Biodiversity Standards, Third Edition, a “community” refers to any group of people that derive any income, livelihood, cultural values, or other contributions to well-being from within the project area. There are no individuals living within the SMPP area and few that rely on it for their livelihood or ascribe cultural value to the zone. The SMPP interacts with a total of two community groups, as defined by the CCB standard: a group of 16 fishermen, distributed across the Kepayang river, the Buring river, the Tembesu Daro canal, and two small-scale oil palm farmers and their families.

Following the CCB methodology, project staff have defined the residents of nearby settlements, including from the formally recognized Muara Muang and Kepayang villages, as well as other unofficial settlements along the rivers, as “other stakeholders” as they do not derive their livelihoods from the project area. However, these communities are an important aspect of the social development component of the project and thus the community profiles and community program objectives for them are covered in detail in section 4.3 which covers other stakeholder groups.

Fishing activities are spread across three main areas, including those used by four fishermen along the Kepayang river, three fishermen along the Buring river, and the remaining along the Tembesu Daro canal. Proximity of large industrial activities among other factors, has resulted in the Lalan river becoming too polluted to fish safely. Fishing communities therefore rely on the cleaner waters in and around the SMPP for safe and productive fishing, despite the considerable distance away from their homes. The smallholder farmers cultivate oil palm on the eastern border of the project boundary and the project team has an on-going and open dialogue with them about the impact and potential benefits of the project.

Fishing communities and the smallholder farmers have participated in the evaluation of the impacts through dialogues and consultations as summarized in Section 2.3.7. We have specifically implemented increased engagement with consistent notetaking with direct observation and monitoring of the fishermen and farmer communities that derive their livelihoods from within the SMPP area. The project also carried out these stakeholder consultations with community fishermen from Kepayang, Tebing Harapan, Buring, Pal 8, and Bakung.

The project has provided a variety of positive impacts to these two communities during the monitoring period, as outlined in Table 40 below. Due to the lack of individuals living near or within the SMPP, the majority of community development programming was focused on those defined by the CCB as other stakeholders, who live primarily in the Muara Merang and Kepayang villages. These activities are outlined in detail throughout Section 4.2. Given that the direct community members also live in these same surrounding areas, our work to provide benefits to other stakeholders in neighboring settlements and villages will also benefit community members beyond what has been immediately identified below.

Table 40. Impacts for specific community groups in the SMPP during the monitoring period

Community Group	Fishermen and their Families
Impact(s)	- Reduced fires in the region. - Protection of and access to fishing grounds; and - Improved water quality within the project area will benefit fish stocks long-term.
Type of Benefit/Cost/Risk	Direct Benefits
Change in Well-being	Improvement to livelihoods and overall quality of life

Community Group	Small-Scale Farmers and their Families
Impact(s)	• Reduced fires in the region reduces risk of farm destruction; and • Long-term livelihood security as the SMPP and farmers have an agreement to ensure the farmers can maintain access to their existing plots of land that overlap with the project area. • Provision of farming equipment
Type of Benefit/Cost/Risk	Direct benefits
Change in Well-being	Improvement to livelihoods and overall quality of life

4.1.2 Negative Community Impact Mitigation (CM2.2)

The SMPP communities of fishermen and farmers do not reside within the SMPP but they do frequent the project area for activities related to their livelihoods. It is possible that as biodiversity returns to the SMPP area, fishermen or farmer communities may be impacted by large wildlife such as sun bears or tigers. To deal with this potential negative impact, the project has developed a wildlife-human conflict reduction strategy and is actively engaging with community members to reduce this risk. Project staff also continue to maintain direct lines of communication to ensure any issues that arise can be addressed through the project's adaptive management plan.

Increased water levels from canal blocking and other peat rewetting strategies could potentially impact farmer productivity, but through in-person interviews, farmer community members have expressed a sentiment that the decreased risk from fire from mitigation activities by the project outweighs any inconvenience caused by higher water levels. The biggest risk to smallholder farming assets is wildfires, which could completely wipe out their investment, as evidenced by the 2015 fire which degraded a large portion of the area.

Throughout the 2020 monitoring period, the project has continued to directly engage with the community small-scale farmers, including on socialization of the canal blocking construction which started at the end of 2019. The project maintains consistent communication with the farmer when he is living and working on his farm which is not his primary source of income or his livelihood.

Using the same approach, direct engagement with community fishermen consistently occurred throughout the 2020 monitoring period. As part of the socialization for the project's plan to construct canal dams which begin in December 2019, the project discussed options with one of the fishermen as access to fishing grounds in the Tembesu Daro canal were going to become more difficult. Project representatives expressed support to him and discussed other areas in the project area along the Buring river in the Northwest portion of the SMPP, or the Lalan or Kepayang rivers that are easier to access.

During the previous monitoring period, the project made plans to support the fisherman with funds for fishing equipment and access other fishing grounds in the project zone to support improved fishing activities. These plans were achieved early in the 2020 monitoring period and the project continues to monitor all impacts of the canal dams on the community fishermen.

In Muara Merang Village, the project has begun working with a local fish farming group (Kelompok Perikanan Sumber Makmur Talangsari) starting with an initial survey and discussion of needs in November 2019. As this group needed assistance to improve production, the project supported the construction of four new fishponds and the acquisition of fish stock. In 2020, SMPP continues to support this fish farmer group through regular visits and evaluation of the initial investment. During the last interview in September 2020, this cooperative is now successfully producing fish as a source of income. However, the visit revealed that the cooperative was lacking knowledge of best practices in fish cultivation, and thus the community development team has planned several technical assistance sessions to increase yield in 2021.

4.1.3 Net Positive Community Well-Being (CM2.3, GL1.4)

The project aims to generate significant net positive impacts for the fishing and farming communities within the SMPP. Since the project start date (Section 2.1.5), and as the project progresses, the project has ensured that fishermen are able to maintain access to their fishing grounds and supported the development of local fish farmer group. In addition, the project purchases fish to support these individual's livelihoods and provide sustenance for project staff. The project also offers employment opportunities for this community to those that are interested.

Better hydrology management through canal blocking implemented during the monitoring period, is expected to improve the water quality in the project area which will create more abundant and protected fishing grounds. The project also reduced fires throughout the wider project landscape, by deploying a fully equipped fire-fighting team and early warning system (EWS) for fires. These efforts to protect the concession also protect vital community assets, reducing the risk of fishing grounds or farms being destroyed. The identified farmer community has improved long-term livelihoods security through an agreement with the project that guarantees land tenure for their existing plots of land that overlap into the project boundaries. These stakeholders are engaged in project activities and have been trained in fire monitoring and other forest patrol practices. The project also maintained coordination with the community fire prevention team (KMPA) and planned to hold fire prevention training together in the next monitoring period. All these efforts have assisted communities to adapt to the threat of wildfires and heat stress due to climate change impacts.

Additionally, the well-being of nearby stakeholders has improved through the project community development plan during the monitoring period, which promotes community-focused programs in surrounding villages and settlements. Positive impacts from the SMPP community development program targeting other stakeholders also benefit the fishermen and farmers that rely on the project area, as these community members live in the villages and settlements surrounding the SMPP area. Benefits from this community development program during the monitoring period include improved access to clean water, effective waste management, healthcare, and education (see Section 4.2). Continuous activities including patrols and dam construction with monitoring have laid the groundwork for a long-term improvement in ecosystem services in the project area. When compared to the without-project scenario, the communities and other stakeholders in the region are benefitting from an overall increased quality of life and improved livelihoods because of project activities.

The project has assisted communities to adapt to climate change, which can be seen through the improved hydrological and fire risk management. Rewetting of peat areas reduces heat stress on forests and maintains ecosystem function on which the community relies. It also acts to mitigate the severity of flooding events in the catchment. Floods can have large impacts on communities by causing production losses, crop failure, the loss of topsoil through erosion and decreased water quality. Improved hydrological management also decreases the severity of elongated dry seasons, thus ensuring that local communities have sufficient water supply for domestic consumption in the dry season. The comprehensive EWS for wildfires and the fully equipped fire-fighting team, reduces fire risks in and around the project area, reducing the exposure of the local communities to toxic haze during the fire season and an improvement in health and livelihood outcomes. Further, reduced and prevented wildfires increasing biodiversity and ecosystem services that local communities are partially depended on the forest and an intact peatland ecosystem.

4.1.4 Protection of High Conservation Values (CM2.4)

No HCVs related to community well-being will be negatively affected by the SMPP during the monitoring period. The identified communities that interact with SMPP rely heavily on the protection of the HCV 5 areas for fishing and small-scale farming. The other stakeholders in nearby villages benefit from the protection of the peat swamp forest and other areas within the SMPP for overall improved water quality. The project's main objective is to protect and enhance these areas, and therefore there were no predicted negative impacts on these HCVs in the Project Document. The SMPP utilized its community development team on the ground to continuously monitor for any potential negative impacts on these HCVs in the project area during the monitoring period.

4.2 Other Stakeholder Impacts

The project defines “other stakeholders” as any groups other than communities that will be affected by project activities, namely proactive social development efforts and livelihoods programming. During the monitoring period, the SMPP worked with residents of nearby settlements and villages, including those primarily from the formally recognized Muara Muang and Kepayang villages, as well as other unofficial settlements along the rivers, all of which are defined as other stakeholders.

Approximately 5,460 people comprising 1,661 households reside in Muara Muang, and 2,628 people in 574 households reside in Kepayang.⁴⁰ It is important to emphasize that these stakeholders are still fairly removed from the project site, at a significant distance from the SMPP. However, SMPP is committed to robust development activities in the villages and settlements that surround the project site, despite their distance. Not only are these efforts a key part of the benefit sharing strategy for the project, but the creation of strong and supportive relationships with local stakeholders also prevents risks associated with future encroachment, in the case where the project’s restored ecological functions become an attractive target for illegal activities such as logging or poaching.

The majority of SMPP community development activities are focused on the project’s other stakeholders, who are residents of nearby settlements and villages surrounding the SMPP. Community development staff do not anticipate any negative impacts to this group of other stakeholders as a result of project activities, especially as the majority of these stakeholders do not derive their livelihoods from project area and reside a considerable distance away from the SMPP. The SMPP’s community development activities generate positive impacts for other stakeholders as the activities are designed to strengthen family livelihoods by creating local employment opportunities, making new investments into small businesses and increasing the quality of education in nearby villages.

Detailed progress on the SMPP’s community development since the start date of this monitoring period can be found in Section 4.3.1. The project continued to implement the following community development activities during the monitoring period that will positively impact other stakeholders including:

- Education support through continued education opportunities for local teachers through Open University (*Universitas Terbuka*), after school programs for elementary school children, adult education for employees who do not hold a high school diploma, improvement of elementary and middle school sanitation facilities, and enrichment and maintenance of school libraries.
- Health support through the launch of an anti-stunting socialization and training programs in both Muara Merang and Kepayang villages with a collaboration with 1000 Days Fund, an NGO with a mission to end stunting by 2030. The program is scheduled to continue its programs through the subsequent monitoring period. In addition to this, as a wider COVID-19 pandemic response the project continues its support to the local health facilities by distributing Personal Protective Equipment (PPE), basic medical equipment, medicines and also foods to those hit the most by the pandemic in both villages.
- Improved livelihoods and quality of life through local food sourcing for project employees and training for craftsmen/women, as well as investments in women’s groups in both Muara Merang and Kepayang villages and support to community health programs.
- Youth and local employment to increase the number of SMPP field staff recruited locally in addition to the creation of educational development and capacity building opportunities for employees.
- Providing access to clean water through the installation of 50 units of household rainwater catchment system in both Muara Merang and Kepayang villages. One unit was also installed in Kepayang elementary school and one unit in Muara Merang village health facility, which made the total installation number to 52 during this monitoring period.

Community investments are designed to be an integral part of the SMPP’s operating expenses. The project aims to deliver tangible benefits to surrounding communities through community-based business development programs and education initiatives. To support these efforts, the project will continue to

allocate a significant portion of its operating budget for community development throughout its long-term operations.

4.2.1 Mitigation of Negative Impacts on Other Stakeholders (CM3.2)

Identified “other stakeholders”, principally the residents of the settlements and villages closest to the SMPP rarely engage in activities in the project area and who reside far away from the SMPP, which reduces the risk of negative impacts from project activities. Thus, no negative impacts to other stakeholders were documented during the 2020 monitoring period.

However, it is possible that as biodiversity returns to the SMPP area, local stakeholders may be impacted by large wildlife such as sun bears or tigers, but we have assessed this risk as low. To deal with this potential negative impact, SMPP has been developing a wildlife human conflict reduction strategy and has trained stakeholders on how to reduce this potential negative risk. In December 2020, the project conducted a two-day Human-Wildlife Conflict Mitigation refresher training course. The training was carried out by a collaboration of trainers from the South Sumatra BKSDA (Natural Resources Conservation Department - MoEF) and Forum Harimau Kita, an NGO which focuses on the protection of Sumatran tiger and conflict mitigation.

Project staff will also continue to maintain direct lines of communication with local stakeholders, and should any other negative impacts emerge, the project will adjust operations as part of the adaptive management plan to effectively mitigate negative impacts.

4.2.2 Net Impacts on Other Stakeholders (CM3.3)

As described in Section 4.2.1 above, the SMPP has no current net negative impacts to other stakeholders during the 2020 monitoring period. While there could be a potential negative impact from human wildlife conflicts in the future as described in section 4.2.1, this is not currently a net negative impact on stakeholders of the project. All positive impacts to other stakeholders are discussed in Section 4.2.

4.3 Community Impact Monitoring

4.3.1 Community Monitoring Plan (CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

The SMPP has created a monitoring plan to track community and other stakeholder impacts generated by the project. This monitoring plan addresses the following core issues: improved livelihoods, education support, and health (Table 41). This plan considers the components necessary to conduct successful monitoring of all stakeholders and the impacts of the SMPP throughout the duration of the project. The community monitoring plan considers the overall requirements of the project combined with the financial, logistical, and staff capacity constraints, starting with the specific fishing and farming communities and widening to the equally important group of other stakeholders who live in nearby settlements and villages. Further information about how SMPP will address social impacts related to the HCVs 4 and 5, please refer to Section 4.1.4.

Evaluation of the monitoring results by the community are done in parallel through engagements and stakeholder consultations as summarized in Section 2.3.7. This method of evaluation is considered important to the project as it gives continuous improvement directly from the communities and stakeholders involved with each of the programs run by SMPP. Consequently, feedback from the communities and other stakeholders will be used to improve the programs in the next monitoring period. There has been no deviation from the validated monitoring plan. The results and impacts of the SMPP's community development project activities during the 2020 monitoring period are outlined below in Table 41.

Table 41. Details of the SMPP's community monitoring plan with results from the 2020 monitoring period.

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
Improved livelihoods	Access to primary resource for community livelihood is maintained	# of fishermen utilizing the area	Community survey	Community fishermen	- Reduced fires in the region. - Protection of and access to fishing grounds. - Improved water quality within the project area will benefit fish stocks long-term.	Every three months	16 fishermen identified; five previously identified fishermen have either moved out or are working on something else.
		# of farmers utilizing the area	Community survey	Community small-scale farmers	- Reduced fires in the region reduces risk of farm destruction; and - Long-term livelihood security as the SMPP and farmers have an agreement to ensure the farmers can maintain access to their existing plots of land that overlap with the project area.	Every six months	Two farmers (one active, one non active)

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
	Community income improved	Gains achieved from the sale of fish	Community survey	Community fishermen	Protection of and access to fishing grounds	Every three months	During 2020, estimated average weekly catch is 30 kg. In the dry season, peak weekly catch could reach up to ~50 kg. Fresh fish are sold at ~25,000 IDR (\$1.73 USD) per kg.
		% of SMPP food budget sourced from SMPP community and other stakeholders	Internal report	Community fishermen, community small-scale farmers, and other stakeholders-residents of settlements and villages near SMPP	Employment opportunities within the SMPP including sale of fish to SMPP field staff	Every 12 months	During 2020, food supplies for basecamp and guard posts were from local shops in both Muara Merang and Kepayang Village. Chicken and fish eaten by SMPP staff are from a village community member.
	Project employment increased	# of people directly employed by the SMPP	Internal data records (employment contracts)	Other stakeholders-residents of settlements and villages near SMPP	Employment opportunities within the SMPP	Every 12 months	62 employees as of December 2020, of which 42 were assigned full time at the field.
	Local employment or livelihoods increased	# of local people employed by the SMPP	Internal data records (employment contracts)	Other stakeholders-residents of settlements and villages near SMPP	Employment opportunities within the SMPP	Every 12 months	There are 30 (out of 42) SMPP field staff members from nearby villages and settlements (including

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
							four women) as of December 2020.
		# of investments and agreements with other stakeholders signed by the SMPP	Internal report & contracts	Other stakeholders- residents of settlements and villages near SMPP	Employment opportunities within the SMPP	Every 12 months	In 2020 the project supported the establishment of a community organization that focuses on small-scale fishpond development. The project supported the ten founding members to build four ponds by providing tools and equipment, including fingerling-size fish. The fish farm is expected to have its first fish harvesting in 2021.
	Gender equity and economic success increased	# of investments and agreements with local women's groups signed by the SMPP	Internal report & contracts	Women's groups in Muara Merang and Kepayang villages	Improved livelihood for craftsmen/women	Every 12 months	Due to COVID-19 pandemic, the effort on this was paused temporarily to avoid crowd gatherings. Further activities are scheduled for the next monitoring period.
		% of women directly employed by SMPP	Internal data records (employment contracts)	Other stakeholders- female residents of	Employment opportunities within the SMPP	Every 12 months	21% - Given the remoteness of the project site and the fact that it is an

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
				settlements and villages near SMPP			unaccompanied post (not appropriate for families) gender balance for patrol and project teams has been difficult to achieve.
Education Support	Quality of, or access to, education increased	# schools repaired or equipped	Internal report	Kepayang and Muara Merang schools	Improved access to education	Every 12 months	By the end of 2020, the project started a collaboration work with <i>Taman Bacaan Pelangi</i> to renovate two school libraries in both Muara Merang and Kepayang villages. The work will include workshop and training for students, teachers and parents and is planned to roll out in the subsequent monitoring period.
		# of university students supported	Data record, proof of enrollment to university	Voluntary teachers in Kepayang and Muara Merang schools with insufficient education background	Improved access to education	Every 12 months	We are now supporting 12 students to attend <i>Universitas Terbuka</i> . 8 of which are women.

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
		# of students attending afterschool programs supported by the SMPP	Enrollment Records	Kepayang and Muara Merang schools	Improved access to education	Every 12 months	135 SD students (47 in Kepayang and 88 in Merang as of December 2020)
		# of students continuing their education in adult programs supported by the SMPP	Enrollment Records	Hidayah and Intan Learning Centers (<i>Pusat Kegiatan Belajar Masyarakat</i> or PKBM)	Improved access to education	Every 12 months	Total of 77 students (21 women and 19 men in Class C; 7 women and 17 men in Class B; 1 woman and 12 men in Class A).
		# of books in each school library in surrounding villages	Survey	Kepayang and Muara Merang elementary schools	Improved access to education	Every 12 months	Initial work to renovate and equip two elementary school libraries started at the end of 2020. Delivery of books to those libraries is planned to happen in 2021.
	Access to clean water improved	# of individuals attending trainings in household rainwater catchment systems construction	Internal report	Other stakeholders-residents of settlements and villages near SMPP	Improved access to clean water	Every 12 months	In 2020 SMPP has installed 52 rainwater catchment systems. 5 community members (2 from Muara Merang and 3 from Kepayang) received training to construct

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
							the system as a livelihoods activity. Further training and construction are scheduled for the next monitoring period.
Health		# of households with improved rainwater catchment systems	Survey	Other stakeholders-residents of settlements and villages near SMPP	Improved access to clean water	Every 12 months	52 rainwater catchment systems have been installed in both Muara Merang and Kepayang villages. The units were installed in 50 households, one public school and one village health facility. The project planned to expand the construction to more households in the next monitoring period.
		# of health facilities improved	Internal report	Other stakeholders-residents of settlements and villages near SMPP	Improved access to health facility	Every 12 months	One rainwater catchment system is installed in Muara Merang village health facility that sees around 30-50 patients per month. In addition to that, one community health facility in Kepayang and two in Muara

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
							Merang are supported by the project with medical equipment and regular medicines delivery.
	Medical and sanitation facilities and services improved	# of constructed and operational sanitation facilities	Internal report	Kepayang and Muara Merang schools	- Improved access to health facility - Improved access to clean water - Improved waste management	Every 12 months	One rainwater catchment system is installed in Kepayang elementary school.
		# of people registered into Indonesia's national healthcare system with SMPP support	Internal report	Other stakeholders-residents of settlements and villages near SMPP	Improved access to health facility	Every 12 months	27 individuals have been registered into Indonesia's national healthcare system with SMPP support by the end of 2020. 20 of which come from nearby village.
		# of children vaccinated with SMPP support	Internal report	Other stakeholders-residents of settlements and villages near SMPP	Improved access to health facility	Every 12 months	132 households have been successfully engaged by the project in collaboration with 1000 Days Fund, an NGO with a mission to end stunting by 2030. The workshops include raising awareness on the

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
							importance of vaccination, proper infant nutrition and how to avoid stunting.
		# of community clean-up events held	Internal report	Other stakeholders- residents of settlements and villages near SMPP	Improved waste management	Every 12 months	Due to COVID-19 pandemic and in order to avoid crowd gathering, the focus shifted to provide Personal Protective Equipment (PPE) to local health center workers. The project also provided food supplies to Muara Merang and Kepayang for distribution to those most affected by the pandemic. The food supply package comprised of rice, oil, sugar, tea, coffee and noodles. The project donated 200 packages and each village received 100 packages, distributing them in coordination with local government representatives
		# of plastic recycling and	Internal report	Other stakeholders-	Improved waste management	Every 12 months	Temporarily paused due to COVID-19

Focal issue	Key results	Indicator/variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2020 monitoring period)
	Waste management improved	trash collection programs implemented		residents of settlements and villages near SMPP			pandemic: initial discussion and planning has been carried out. The project aims to start these programs in 2021.
		Kg of plastic waste processed as recycling	Internal report	Other stakeholders-residents of settlements and villages near SMPP; and SMPP field sites.	Improved waste management	Every 12 months	Temporarily paused due to COVID-19 pandemic: initial discussion and planning has been carried out. The project aims to start these programs in 2021.
	Fire safety improved	Frequency of fire safety or prevention trainings	Internal report	SMPP staff and other stakeholders-residents of settlements and villages near SMPP	Reduced fires in the region	Every three months	During 2020, the SMPP fire brigade responded directly to two hotspot instances outside of the concession area. Periodical fire readiness training is conducted regularly.

4.3.2 Monitoring Plan Dissemination (CM4.3)

The project community monitoring plan was disseminated to project communities, other stakeholders, and the public. To disseminate project documents, including information specifically related to community development and monitoring, to communities, other stakeholders, and the public, the SMPP Field Office maintains a full, printed version of the PD and MR and associated annexes in English for public viewing. The executive summary was translated into Bahasa Indonesia and was given to community leaders to make available in public places in the surrounding villages, and the full PD and MR its executive summary was posted in English and in Bahasa Indonesia on the VCS project database. In addition to the executive summary, staff provided a brochure in Bahasa Indonesia advertising the project, and an email address was posted in local villages and given to SMPP communities and other stakeholders as a point of contact. Finally, notices in Bahasa Indonesia advertising the public comment period and field verification were posted in communities throughout the project area.

4.4 Optional Criterion: Exceptional Community Benefits

The project is not seeking to be validated to the Gold Level for the Community component as the majority of the residents in local villages near the project area are not below the national poverty line.⁴¹ Additionally, the project is not owned or co-managed by local communities, and as a result the project does not meet the CCB criteria to obtain this distinction. Despite this, the project has delivered substantial net positive impacts for the identified project communities and other stakeholders who live in nearby villages and settlements through the implementation of the project's community development plan.

4.4.1 Short-term and Long-term Community Benefits (GL2.2)

N/A

4.4.2 Marginalized and/or Vulnerable Community Groups (GL2.4)

N/A

4.4.3 Net Impacts on Women (GL2.5)

N/A

4.4.4 Benefit Sharing Mechanisms (GL2.6)

N/A

4.4.5 Governance and Implementation Structures (GL2.8)

N/A

4.4.6 Smallholders/Community Members Capacity Development (GL2.9)

N/A

5 BIODIVERSITY

5.1 Net Positive Biodiversity Impacts

Through long-term project activities, the SMPP aims to maintain and enhance biodiversity and biodiversity-related HCVs in the project area.

Tropical biodiversity is in rapid decline globally, driven largely by habitat destruction and over exploitation as well as a range of interacting drivers including climate change, invasive species, and habitat degradation.⁴² The terrestrial biomes of Southeast Asia have been identified as some of the most at risk biomes on the planet,⁴² and Indonesia has suffered significant forest and biodiversity loss over the last 40 years.⁴³

Sumatra is the sixth largest island in the world and the second largest island in Indonesia after Borneo. The remaining forests of Sumatra still maintain a rich biodiversity with high levels of endemism. However, Sumatra globally has one of the highest deforestation rates in the world, driven largely by transmigration and expansion of commercial agricultural production in the form of pulp/paper and palm oil production. Between 1985 and 2001, Sumatra lost 12 million hectares of natural forest, or 48% in 22 years. In 2007, Sumatra only had 30% forest cover remaining or about 13 million hectares of forest. The forests in the eastern plains of Sumatra, where the project site is located, are especially vulnerable to species extinction risk, and natural forest cover in the area has already declined by 70%.⁴⁴

The SMPP began to reverse this trend in recent years by protecting and restoring an almost 23,000-ha area of globally significant, degraded tropical peatland and peat swamp forest and high conservation value species. Protection and restoration efforts during this and previous monitoring periods laid a foundation for ecological regeneration, which should lead to a long-term increase in the diversity and extent of the peat swamp forest in the project area and the species that inhabit it.

5.1.1 Biodiversity Changes (B2.1)

Assessing changes in biodiversity changes over time requires standardized repeatable surveys of biodiversity conducted over two or more comparable time periods. During the current monitoring period, the first standardized, repeatable biodiversity monitoring survey methods were initiated (see section 5.3.1 for more details).

As this is the first year in which these standardized survey methods were used, only the biodiversity changes that are evident with the current data available are presented in the tables below. Early data suggests that the previously degraded project area has managed to maintain many high conservation value species (see section 5.3.1 and section 5.4.1), and project activities are likely enhancing biodiversity in the project area and the project zone. Table 42 and Table 43 outline the changes to biodiversity observed during the current monitoring period.

Table 42. Direct changes to biodiversity during the 2020 monitoring period.

Changes in Biodiversity	Increased number of both floral and faunal species identified in the SMPP project area
Monitored Change	The species inventory was updated with new survey data from this monitoring period. These the full inventory of all the species recorded in the SMPP can be seen in Annex 16. The species inventory now includes: 27 mammals (increase of 9 species from previous monitoring report)

	• 102 birds (increase of 32 species) • 21 reptiles (increase of 5 species) • 11 amphibians (no increase; not surveyed) • 2 fish (no increase; not surveyed) • 39 arthropods (dragonflies and damselflies) (no increase; not surveyed) • 101 plant species (63 of which are trees) (increase of 46 species)
Justification of Change	Robust and repeatable surveying methodologies were developed in 2019 and to support long term monitoring of the project biodiversity baselines. The surveys conducted in the 2020 monitoring period were designed to expand the inventory of species at SMPP through increased sampling effort and the rollout of several standardized and repeatable biodiversity monitoring methods (see Table 45 for more details). For this reason, the increased number of species identified and inventoried in this monitoring period can be attributed to increased sampling effort. Further, intensive canal damming activities and fire management activities from 2018-2020 have likely increased the habitability of the project area through regeneration of the natural vegetation to the extent that some species are returning.

Change in Biodiversity	Increased mammal diversity and abundance
Monitored Change	Likely increase in mammal diversity and abundance. Definite changes in their status over time will be reported when multi-year data is available.
Justification of Change	Camera trap surveys were used to monitor mammal populations during this monitoring period, through which 18 mammal species were recorded during this monitoring period (9 of which were recorded for the first time this year). Several of diversity metrics (see Table 49) and abundance metrics (see Table 50) were calculated for this monitoring period, but it is not possible to ascertain mammal population trends without having multi-year data. However, mammals in the project area are likely benefitting from ongoing project activities. Fire management, canal blocking, enrichment planting, and patrolling activities are resulting in increases in secondary forest and closed canopy cover and the resources they provide, while likely reducing illegal activity pressures. See section 5.3.1 and section 5.4.1 for more details.

Change in Biodiversity	Increased apex predator populations
Monitored Change	During this monitoring period, the first definitive photographic records have been obtained of Sumatran tiger individuals (at least two individuals) using the project area. Changes in their status over time will only be possible in future reports when multi-year data is available.

Justification of Change	Camera trap surveys were used to monitor tiger populations during this monitoring period, through which two different male Sumatran tigers were identified in the project area. They are distinguishable from one another mostly because of clear pictures of their unique striping patterns. While it is not possible to ascertain these apex predator's population trends without having multi-year data, they are likely benefitting from ongoing project activities. Fire management, canal blocking, enrichment planting, and patrolling activities are resulting in increases in secondary forest and closed canopy cover, likely enhancing prey species populations, while likely reducing illegal activity pressures. See section 5.3.1 and section 5.4.1 for more details.
-------------------------	--

Table 43. Indirect changes to biodiversity during the 2020 monitoring period.

Changes in Biodiversity	Maintenance of secondary forest land cover, closed canopy land cover, and open canopy land cover.
Monitored Change	The land cover classification analysis for the monitoring period of 2020 was performed in February 2021 to assess changes in land cover classification between this monitoring period and previous monitoring periods. This analysis revealed an emerging positive trend of: - Enhanced secondary forest cover (2016 = 259.64 ha; 2019 = 259.64 ha; 2020 = 287.84 ha) - Enhanced closed canopy cover (2016 = 330.2 ha; 2019 = 330.2 ha; 2020 = 5,391.75ha) - Decreased open canopy cover (2016 = 21,986.95 ha; 2019 = 21,986.95 ha; 2020 = 17,173.38 ha) This suggests that natural regeneration of vegetation in SMPP is already underway, which should benefit the faunal species who rely on this vegetation for their survival.
Justification of Change	The data source for the land cover change detection analysis for this monitoring period was Planet satellite imagery data. This differs from the data used in the 2016 and 2019 land cover change detection analysis, which used Landsat 8 Level 2 Surface Reflectance satellite imagery data and Landsat Analysis Ready (ARD) data respectively. The decision to change the data source came from the increased resolution and accuracy offered by the Planet data, i.e., 4.75-meter pixel spatial resolution versus the 30-meter pixel spatial resolution offered by Landsat. A full land cover classification on the new Planet high-resolution image was performed to capture the changes in the vegetation in detail. This new positive trend is likely attributable to the intensive canal dam constructions, fire management activities, and the patrol activities, which resulted in the assisted natural regeneration of the vegetation in SMPP. This monitoring period also saw a major reduction in fire hotspots from the previous monitoring period to zero peat fires in the project area, which may

	be attributed to combination of climatic factors and restorative and protective land management. Potential fires are currently identified using a mix of regular patrols, scanning the horizon from strategically placed guard posts, and daily checks on open access fire hotspot data from the VIIRS and MODIS spectroradiometer remote imaging sensors which are attached to two different satellites orbiting earth (section 3.2.2.2). During this monitoring period, a new agreement with an adjacent concession has resulted in improved access for project fire management teams to suppress nearby fires that are not within the project boundaries, and thus prevent fires before they have a chance to spread to the project area. This is the second such agreement in last two years, and it provides access for the project fire management teams to all concessions which border the project area.
--	--

Change in Biodiversity	Increased aquatic species abundance and diversity
Monitored Change	Likely increase in aquatic species abundance and diversity.
Justification of Change	While aquatic species in the project area were surveyed for the species inventory (see Annex 16) in previous monitoring periods, ongoing monitoring of changes in aquatic species abundance and diversity are measured indirectly by monitoring several factors that are likely to contribute to changes in aquatic species populations. It is assumed that decreased fire hotspots (determined by climatic variables and fire management efforts), increased protection from illegal human activities (determined by patrolling activities), more natural and stable water table depth levels (determined by climatic variables, canal blocking and maintenance activities), and increased forest and closed canopy cover will all contribute to positive trends in aquatic species populations in the long-term. This monitoring period saw increases in both secondary forest and closed canopy cover, no fire hotspots in the project area, the constructed 91 canal dams (to make a total of 188 dams), and roughly 1,500 patrols carried out with no incidents of illegal activities recorded, all of which suggest that aquatic species are likely being maintained or enhanced due to project activities. While there is potential for canal dams to have short-term negative impacts on fish that have populated these man-made canals, these

	impacts are highly likely to be ecologically positive in the medium and long-term (see section 5.1.2 and section 5.2.1 for more detail).
Change in Biodiversity	Increased invertebrate diversity and abundance
Monitored Change	Likely increase in invertebrate diversity and abundance.
Justification of Change	While invertebrate species in the project area were surveyed for the species inventory (see Annex 16) in previous monitoring periods, ongoing monitoring of changes in invertebrate species abundance and diversity are measured indirectly by monitoring several factors that are likely to contribute to changes in invertebrate species populations. It is assumed that decreased fire hotspots (determined by climatic variables and fire management efforts), increased protection from illegal human activities (determined by patrolling activities), more natural and stable water table depth levels (determined by climatic variables, canal blocking and maintenance activities), and increased forest and closed canopy cover will all contribute to positive trends in aquatic species populations in the long-term. This monitoring period saw increases in both secondary forest and closed canopy cover, no fire hotspots in the project area, the constructed 91 canal dams (to make a total of 188 dams), and roughly 1,500 patrols carried out with no incidents of illegal activities recorded, all of which suggest that invertebrate species are likely being maintained or enhanced due to project activities.

5.1.2 Mitigation Actions (B2.3)

The threats to biodiversity in the SMPP area are considered low, however the project continued to monitor threats through active management and patrol activities to ensure no negative impacts. There were no negative impacts on biodiversity recorded during this monitoring period. To ensure the maintenance and enhancement of HCV attributes in the SMPP project area, the project will continue the activities outlined in Figure 3.

These activities all follow the precautionary principal in that they are rooted in sound ecological principles concerning ecological succession and tropical peatland restoration and are based on previous research on the threats to the species found in the project area and the habitat in which they live.

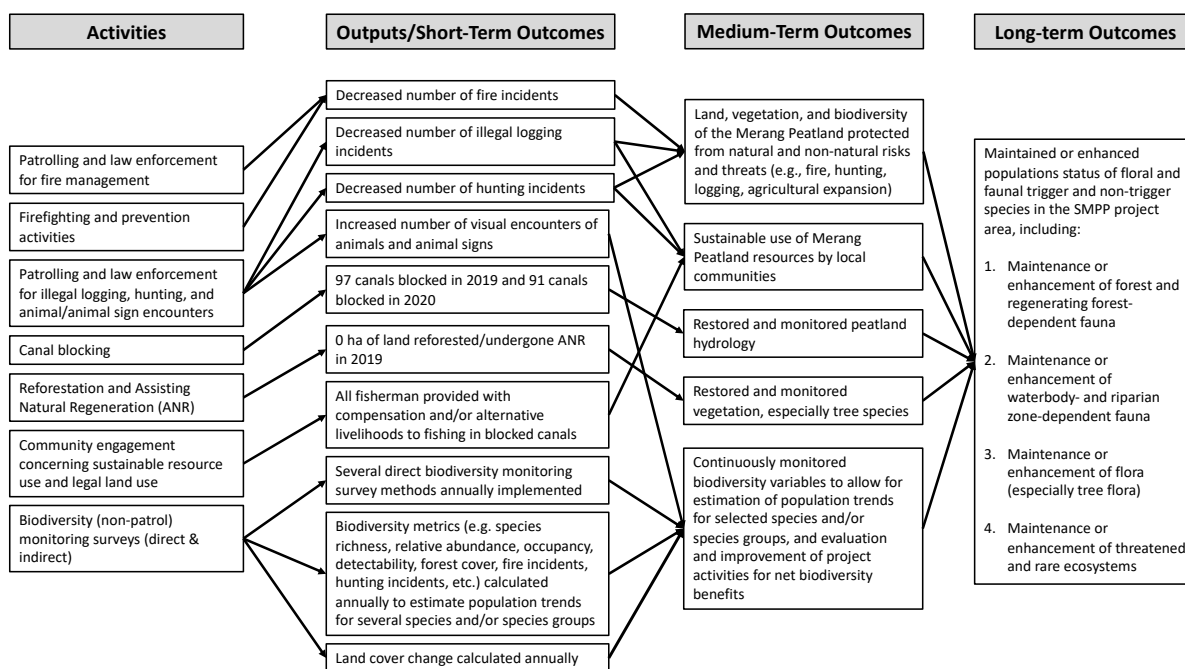


Figure 3. SMPP Causal model for SMPP biodiversity program

5.1.3 Net Positive Biodiversity Impacts (B2.2, GL1.4)

In the without-project scenario, the area would have undergone conversion to Acacia plantation, further degrading the remaining, peatland, vegetation, and forest which would at a minimum result in:

- Further habitat degradation and homogenization
- Continued use of the canals for drainage which heavily impacts hydrology of the peatland
- Potential unchecked hunting and illegal logging practices
- Continued poor fire management practices
- Exacerbated drought and increased fire incidence in the area

All of which would have contributed to the ongoing decline of biodiversity in the project area. In 2020 the ecological integrity of the peatland in the project area was gradually restored through activities including:

- Canal blocking,
- Reforestation and assisted natural regeneration
- Fire management
- Increased monitoring and enforcement (see Figure 3).

In 2020, the project team:

- Constructed 91 canal dams (to make a total of 188) (see Figure 3)
- Consistently monitored and managed fires, with no fires occurring within the project area during this monitoring period.
- Began enrichment planting with the first 3,240 nursery seedlings planted in the project area.
- Conducted standardized and systematic biodiversity monitoring (Table 45)
- Continued daily patrols of the project area from each protection post.

The impacts of the above activities can already be seen through the changes in land cover between the satellite imagery, with secondary forest land cover being enhanced by ~10%. It is assumed that intensive

fire management throughout this monitoring period to suppress fires in or around the SMPP project area was a key determining factor for the regeneration of vegetation.

As this reporting period saw the beginning of systematic biodiversity monitoring and establishment of biodiversity data baselines, population trends in biodiversity cannot yet be ascertained. However, with positive trends in vegetation cover and some promising baseline biodiversity data collected during this monitoring period (see sections 5.1.1, 5.3.1, and 5.4.1), it appears that biodiversity levels are at least being maintained, and most likely being enhanced, in the project area. Clear evidence of biodiversity trends in any direction resulting from project activities will likely take several years to emerge at a statistically significant scale, but again early data and ground observations suggest biodiversity is benefitting from project activities.

With enrichment planting only making up a small part of project activities, the positive trends in vegetation cover are likely due to efforts to restore the natural peatland hydrology with canal dams and due to careful fire monitoring and management, with this year seeing a marked reduction in fires around the project area compared to last year.

With extreme droughts and rising temperatures becoming increasingly common under climate change, raising the risk of fires, heat stress, and food and water resource insecurity, increasing vegetation cover, improving peatland hydrology, and practicing careful fire monitoring and management will continue to be essential in assisting the biodiversity to adapt to the probable impacts of climate change.

As noted in the Project Document, three potential negative impacts or issues concerning biodiversity were identified that could eventually arise from project activities, and mitigation measures for each of these are already planned.

1. Canal dams could potentially negatively impact extant fish populations, which will be offset through the benefits for both aquatic and terrestrial species derived from canal dams and restoring peatland hydrology in the area. However, no negative impacts to extant fish populations were observed in 2020.
2. Potential increases in illegal logging and hunting in the area as biodiversity is restored and species abundance and diversity increases. No hunting was observed inside the project area in 2020.
3. Increased human-wildlife conflict with local communities. This assumes that significant increases in biodiversity in the medium and long-term may result in more human-wildlife conflict with local communities. However, given that no communities live within the project area, and very few live within the project zone, conflict is likely to be minimal. The project has already begun to prepare for the unlikely event that communities in the project zone will experience human-wildlife conflict by conducting the first human-wildlife conflict training for project staff during the monitoring period. No human wildlife conflicts were reported within the project area in 2020.

Predicted large increases in species abundance and diversity across all ecosystem types within the SMPP project area driven through ongoing habitat restoration means that any potential negative impacts can be deemed to be negligible.

5.1.4 High Conservation Values Protected (B2.4)

During a High Conservation Value (HCV) assessment between 22 May and 1 June 2018, four of the six High Conservation Values (HCVs)—defined under the High Conservation Value Resource Network's (HCVRN) guidelines on HCV identification—were identified in the SMPP:

- HCV 1: Species diversity, i.e., Concentrations of biological diversity including endemic, rare, endangered or threatened species that are significant at the global, regional and national levels.
- HCV 3: Ecosystems and habitats, i.e., Rare, Threatened, or Endangered ecosystems, habitats or refugia
- HCV 4: Ecosystem services, i.e., Basic ecosystem services in critical situations, including protection of water catchments and the control of fires.

- HCV 5: Community Needs, i.e., Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for livelihoods, health, nutrition, water etc.), identified through the engagement with these communities or indigenous peoples.

Updates for this monitoring period relating to latter two HCVs (HCV 4 and HCV 5) are community-related HCVs and can be found in section 4.1.4 of this monitoring report.

For HCV 1 (species diversity), it is very unlikely that species diversity has been negatively affected by the project during the 2020 monitoring period. The 2020 land cover classification revealed that vegetation cover has been improved, where the closed canopy tree/shrub/herbaceous mix and secondary forest saw an increase in area covered. This suggests that natural regeneration of vegetation in the SMPP project is already underway. This should increase the diversity and abundance of floral species and consequently lead to increases in faunal species through a number of biotic interactions. There has been a marked increase in the number of species recorded in the SMPP project area over the current monitoring period, this is likely due mostly to an increased sampling effort rather than a sharp increase in species biodiversity over a short timescale (see section 5.1.1).

For HCV 3, the remaining fragment of secondary forest within the SMPP has increased its coverage in 2020. The entire project area lies within the 150,000 ha Merang-Kepayang peat dome—the largest peat swamp dome in South Sumatra—located 5 km west of the forests of the Sembilang-Berbak National Park. The maintenance and enhancement of the project area is therefore key to maintaining or enhancing HCVs within the wider landscape. The current trend of regrowth or minimum regrowth in open and closed canopy covers and maintained secondary forest cover across the project area suggests that HCV 3 is not being negatively impacted by project activities during this monitoring period. There is a high probability that project activities have positively impacted HCV 3 areas, primarily through effective fire management activities.

5.1.5 Invasive Species (B2.5)

The project did not introduce any invasive species to the SMPP project area during the 2020 monitoring period. As the project aims to restore the natural ecological processes in the project area, while also aiming to increase the survival rate in enrichment planting areas, all of the species that will be used in enrichment planting activities in the coming years are already found naturally growing in the project area. In 2020, 3,240 native tree species seedlings were planted as part of enrichment planting activities that aim to boost the assisted natural regeneration of vegetation already occurring in the project area (see Annex 17).

5.1.6 Impacts of Non-native Species (B2.6)

The project did not introduce any non-native species to the SMPP project area during this monitoring period. As the project aims to restore the natural ecological processes and to increase the survival rate in enrichment planting areas. All species used in enrichment planting activities are sourced from natural populations in the project area.

5.1.7 GMO Exclusion (B2.7)

The project did not introduce any GMO species to the SMPP project area during this monitoring period.

5.1.8 Inputs Justification (B2.8)

The project does not use any agricultural inputs, including fertilizers, chemical pesticides, or biological control agents.

5.2 Offsite Biodiversity Impacts

5.2.1 Negative Offsite Biodiversity Impacts (B3.1) and Mitigation Actions (B3.2)

There are no predicted negative offsite biodiversity impacts derived from project activities. Furthermore, there is no evidence that any negative offsite biodiversity impacts have occurred within this monitoring period. The small number of potentially negative impacts of project activities on biodiversity in the future, which may impact offsite biodiversity and their associated mitigation actions, are outlined in section 5.1.3.

The only potential negative offsite biodiversity impact from our project activities that may have started to occur during this monitoring period is outlined in Table 44 below:

Table 44. Negative offsite biodiversity impacts and mitigation measures.

Negative Offsite Impact	Mitigation Measure(s)
Certain populations of fish now living in man-made canals may have their lifecycles, feeding strategies, mating strategies negatively affected, and their canal habitats fragmented by canal dam construction.	Certain fish species use the canals in the project area for at least part of their lifecycle, but their ecology is poorly understood, so taking mitigation measures against the potential negative impacts of canal dam construction on these species is difficult. The type of canal dam that is being constructed in the project area has the potential to fragment the canal ecosystem during dryer months and impact both on-site and offsite fish species. However, it is important to remember that these canals are not a natural ecosystem, that these species often rely on flooded peatland with high water-table depths for use as nurseries and ecological corridors, which have been enabled through the hydrological restorations, i.e., raising the WTL to its natural state. Similarly, the canal dams are 200 m to 1000 m apart (depending on the slope of the land), which should provide ample habitat for these species at least in the short- to medium-term. Additionally, the vegetation in canal riparian zones should also gradually regenerate and improve the health of these wetland ecosystems. Furthermore, there is flooding and spill over near peat compaction dams allows for fish to pass. Any potential net negative impact of the canal-living fish species is more than offset by the benefits of blocking the canals for the wider peatland ecosystem (particularly terrestrial species), meaning that project activities should result in clear net biodiversity benefits, both onsite and offsite.

5.2.2 Net Offsite Biodiversity Benefits (B3.3)

See section 5.1.3 and section 5.1.2 for an overview of the net biodiversity benefits from project activities. In the 2020 monitoring period these benefits are already evident within the project. As none of the potential, albeit negligible, negative biodiversity impacts require mitigation as this stage of the project, the net effect of the project on offsite biodiversity during this monitoring period is likely positive and should remain positive for the remainder of the project.

5.3 Biodiversity Impact Monitoring

5.3.1 Biodiversity Monitoring Plan (B4.1, B4.2, GL1.4, GL3.4)

During this monitoring period, the project worked to enhance and expand the biodiversity monitoring plan based on the overall project causal model (see Figure 3). This targeted causal model for biodiversity supports the implementation of the biodiversity monitoring plan described in the Project Document and there has been no deviation from the validated monitoring plan. Key activities conducted during this monitoring period on biodiversity monitoring, include:

- Recruitment of new staff to support project biodiversity functions
- Preparation of training materials and implementation of patrol data collection to support a project-wide rollout and training on SMART in the next monitoring period
- Plans established for camera-trap locations, installations, and recording methods
- Vegetation surveys conducted at multiple project locations
- Transect surveys conducted for birds and other species
- Management of all data collected across all methods

Table 45 below provides a summary of the biodiversity monitoring activities carried out during this monitoring period. The results for each type of biodiversity monitoring are discussed in more detail in the subsections that follow.

The 2020 monitoring period used standardized, repeatable survey methods, and thus estimates of diversity and population can be made. Some of results generated from the analyses performed on the survey data will only become truly useful when comparing data over time or possibly with other sites. It is also important to note that ecological succession in tropical peatlands undergoing assisted natural regeneration is poorly understood, particularly with regards to faunal species succession. Therefore, care must be taken not to make unsubstantiated inferences as this succession plays out. For example, some species may naturally decline in abundance while others may increase in abundance as the project area becomes more diverse over time.

Table 45. Summary of biodiversity monitoring in 2020.

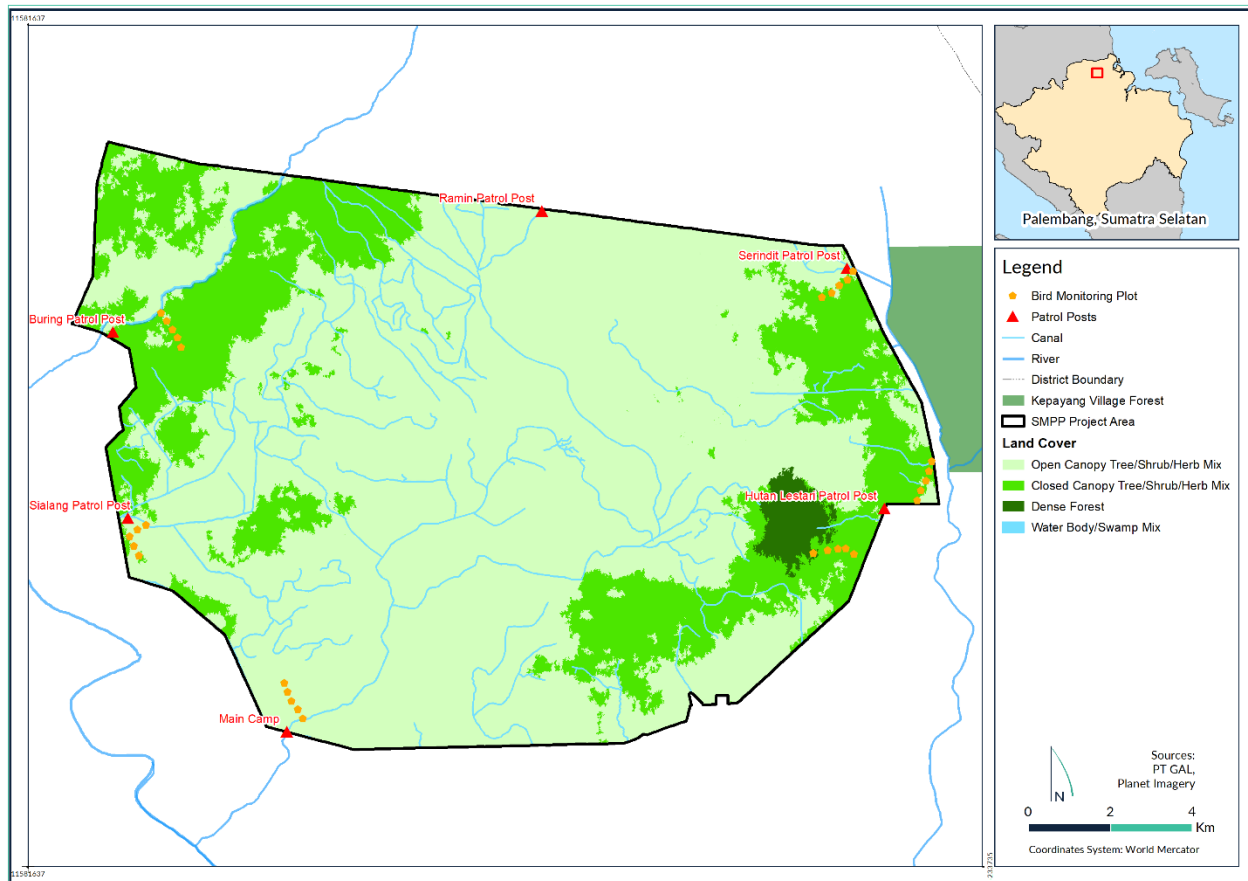
No.	Monitoring Type	Potential Target Species	Sampling Method & Frequency	Sampling Date(s)	Analysis Type	Biodiversity Variable(s) Measured	2020 Result
1	Point Transect Surveys	Birds	- Six 1-km-long point transects were surveyed. - Each point transects had five point transect counting stations/points spaced 250 m apart (for a total of 30 counting stations). - Two five-minute counts were performed at each transect station, once in the morning and once in the evening (total of 60 counts). - All the above was conducted twice in 2020, once in the wet season and once in the dry season (for a total of 120 five-minute counts equally distributed across morning and evening and wet seasons and dry season).	April to June, and August to September 2020	Species richness-evenness; Distance Sampling	Bird species diversity metrics	Table 46
						Bird trigger species densities	Table 47 & Section 5.4
2	Vegetation Plot Surveys	Plants (especially tree flora)	24 permanent, nested vegetation plots along six transects (i.e., four nested vegetation plots on each of the 6 transects) were marked and surveyed annually - The 4 nests plots are spaced at 0 m, 100, m, 400 m, and 700 m along each transect. - Using predetermined DBH and height categories, all mature trees in the 32 m x 32 m plot nest, all poles in the 16 m x 16 m plot nest, all saplings in the 8 m x 8 m plot nest, and all seedlings in the 2 m x 2	August to September 2020	Species richness-evenness; Nested Plot Sampling	Plant species diversity metrics	Table 48
						Density of trees by tree maturity category	Table 49

No.	Monitoring Type	Potential Target Species	Sampling Method & Frequency	Sampling Date(s)	Analysis Type	Biodiversity Variable(s) Measured	2020 Result
			m plot nest in each plot were counted, with all counted trees being identified to species level where possible. % fern cover and % shrub cover was estimated for each 8 m x 8 m plot nest in each plot and verified with an aerial photograph taken from a drone where possible.			Average fern cover & average shrub cover	Table 49
						Density of tree trigger species by tree maturity category	Table 50 & Section 5.4
3	Camera Trap Surveys	Mostly medium-to-large sized mammals	22 camera trap stations surveyed using 18 camera trap units. - Camera trap stations were chosen for accessibility from project area guard posts, perceived suitability as mammal walkways, and proximity to focal species spoors, e.g., tiger tracks. - Each camera station was surveyed for an average of 56 days (target was 60 days each)	August to December 2020	Species richness-evenness; RAI; Species presence	Mammal species diversity metrics	Table 51
						Mammal trigger species Relative Abundance Index (RAI)	Table 52 & Section 5.4
						Mammal trigger species Native Occupancy	Table 52 & Section 5.4

5.3.1.1 Point Transect Surveys

Point transect surveys were designed following Sutherland (2006)⁴⁵ and Buckland et al. (2008)⁴⁶. Across six point transects (Map 12), 1,401 individuals were recorded across 70 bird species during this monitoring period, 29 of which were recorded for the first time in the project area and 22 of which were trigger species (see Table 46). One observation of particular note was the first record of a wrinkled hornbill (*Rhabdotorrhinus corrugatus*) in the project area, a species listed as Endangered (EN) on the IUCN RED List⁴⁷ and endemic to the Sundaland Bioregion.

An additional seven bird species, three of which were first records for the project area, were recorded during this monitoring period through means other than point transect surveys, as such, were not included in the analyses outlined in Table 46 and Table 47. This brings the total number of bird species identified during this monitoring period to 77 and brings the total number of bird species identified in the project area up to 102 (see Annex 16 for the full species inventory).



Map 12. Map of SMPP area showing the location of point count transects during this monitoring period.

Table 46. Summary of biodiversity metrics assessed for bird species surveyed in point transect surveys in year 2020.

No.	Biodiversity Metric	Metric Type	Value
1	Total No. of species recorded in the project area (S)	Species Richness	70
2	First records of a given species	Species Richness	29
3	Trigger species	Species Richness	22
4	Total no. of individuals across all species recorded in the project area (N)	Species Abundance	1401
5	Margalef's Species Richness Index (D_{mg})	Species Richness Index	9.52
6	Shannon-Wiener Diversity Index (H')	Species Richness-Evenness Index	3.06
7	Shannon's Equitability (or Species Evenness) (E)	Species Evenness Index	0.72
8	Effective Number of Species (ENS)	Species Richness-Evenness Index	21.41
7	Simpson's Index of Diversity (D_s)	Species Richness-Evenness Index	0.91

All the metrics included in Table 46 are metrics of biodiversity adapted from Magurran (2004).⁴⁸ Some of these metrics use species richness to measure diversity, while other use evenness, and some use both (see Annex 18 for additional details on the metrics). Margalef's Species Richness Index (D_{mg}) is a measure of species richness that aims to compensate for differences in sampling effort. It is most useful when comparing between sampling periods or sites rather than for use as a standalone metric of true diversity. However, with a total of 70 bird species recorded during point transect surveys in this monitoring period and a D_{mg} of 9.52, it appears as if species richness aspects of diversity in the project are at least moderate and are likely being maintained with project activities.

Shannon's Equitability (or Species Evenness) (E) is measure of species evenness. The results from this monitoring period suggest moderate to high evenness across bird species in the area despite some notably larger abundances recorded for certain species, e.g., *Collocalia linchi*, *Prinia flaviventris*, *Pycnonotus goiavier*, and *Treron vernans*. Some of these larger abundances may be explained by variations in spatial and temporal flocking behavior in birds, which can result in very large counts of the same species during brief point counts.

The Shannon-Wiener Diversity Index (H'), Effective Number of Species (ENS), and Simpson's Index of Diversity (D_s) are all composite diversity measures using species richness and species evenness. D_s is more weighted toward species evenness than H' or ENS are and can be used as both a standalone figure and for spatial and temporal comparisons, whereas H' and ENS are most useful for comparisons. ENS is particularly useful for showing proportional change in diversity over time.

The D_s of 0.91 recorded for this monitoring period suggests low dominance, more evenness, and high diversity in the project area, despite the high relative abundances for some species mentioned above. A H' of 3.06 and an ENS of 21.41 suggests at least moderate bird species diversity in the project area.

Of the 22 bird trigger species identified during point transect surveys in this monitoring period, 17 were recorded within 25 meters of the observer conducting the point transect observations. Using the 'Point

Count Fixed-Radius Formula',⁴⁶ density of individuals per ha was estimates for each of these bird trigger species (see Table 47).

Table 47. Density of the 17 bird trigger species in individuals per ha for in year 2020.

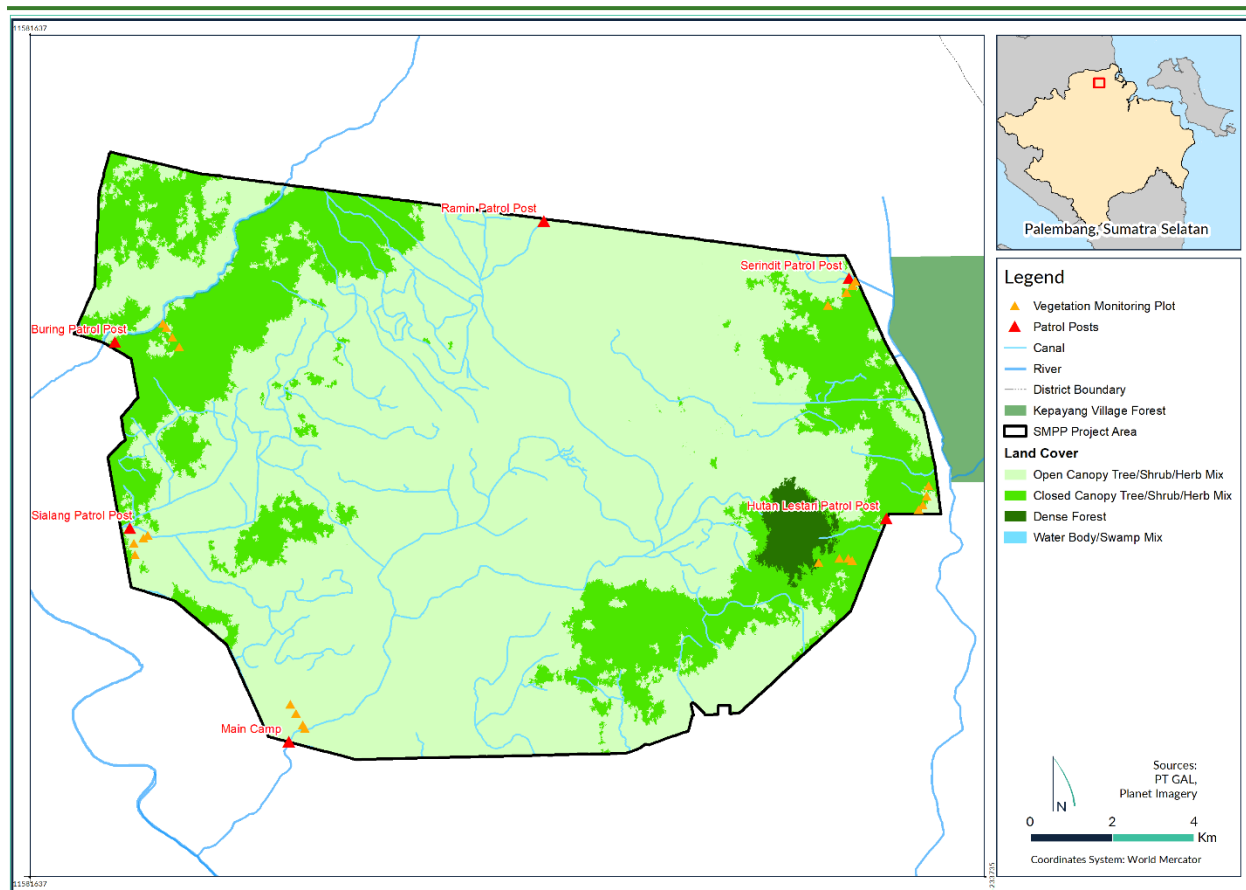
No.	Bird Trigger Species	Density of individuals per ha
1	<i>Chrysophlegma miniaceum</i>	0.34
2	<i>Collocalia linchi</i>	25.99
3	<i>Cyanoderma erythropterum</i>	1.53
4	<i>Cyornis umbratilis</i>	0.17
5	<i>Dendrocopos moluccensis</i>	1.36
6	<i>Hemicircus concretus</i>	0.17
7	<i>Malacocincla sepiaria tardinata</i>	0.68
8	<i>Malacopteron magnum</i>	0.17
9	<i>Microhierax fringillarius</i>	3.57
10	<i>Phaenicophaeus diardi</i>	1.87
11	<i>Picus puniceus</i>	0.34
12	<i>Prinia familiaris</i>	1.53
13	<i>Psittacula longicauda</i>	0.17
14	<i>Pycnonotus brunneus</i>	3.57
15	<i>Pycnonotus simplex</i>	0.34
16	<i>Rhabdotorrhinus corrugatus</i>	0.68
17	<i>Zanclostomus javanicus</i>	0.17

The population trends of these trigger species and the actions taken to maintain or enhance their population status and reduce threats to them are described in more detail in Table 53 in section 5.4.1 of this report. With the establishment of permanent point transects in the project area, the completion of all point transect survey activities planned, and large amount of new data collected that will be invaluable to systematic annual monitoring of bird species in the project area.

5.3.1.2 Vegetation Plot Surveys

Vegetation plot survey design was adapted from Graham et al. (2014).⁴⁹ Across 24 nested vegetation plots on six transects (Map 13), there were 1,664 individuals (282 of which were trees) recorded across 57 plant species (44 of which were tree species) during this monitoring period. Of these 57 plant species, 47 were recorded for the first time in the project area, and 15 were trigger species (see Table 48). Some observations of note include *Gonstylus bancanus* (Ramin) which is listed as Critically Endangered (CR) on the IUCN Red List⁴⁷ and *Shorea uliginosa* (Meranti Kelungkum) which is listed as Vulnerable (VU) on the IUCN Red List,⁴⁷ with both species being endemic to the Sundaland Bioregion.

Total number of plant species identified in the monitoring period 2020 in the project area up to 101, of which 63 are tree species and 25 of which are trigger species (see Annex 16 for the full species inventory).



Map 13. Map of SMPP area showing the location of transects with nested vegetation plots during this monitoring period.

Table 48. Summary of biodiversity metrics assessed for tree and non-tree plant species surveyed in nested vegetation plot surveys in year 2020.

No.	Biodiversity Metric	Metric Type	Species	Value
1	Total no. of species recorded in the project area (S)	Species Richness	All	57
			Trees	44
			Non-Trees	13
2	First records of a given species	Species Richness	All	47
			Trees	38
			Non-Trees	9
3	Trigger species	Species Richness	All	16
			Trees	16

No.	Biodiversity Metric	Metric Type	Species	Value
			Non-Trees	0
4	Total no. of individuals across all species recorded in the project area (N)	Species Abundance	All	1664
			Trees	282
			Non-Trees	1382
5	Margalef's Species Richness Index (D_{mg})	Species Richness Index	All	7.55
			Trees	7.62
			Non-Trees	1.66
6	Shannon-Wiener Diversity Index (H')	Species Richness-Evenness Index	All	2.05
			Trees	2.55
			Non-Trees	1.40
7	Shannon's Equitability (or Species Evenness) (E)	Species Evenness Index	All	0.51
			Trees	0.67
			Non-Trees	0.55
8	Effective Number of Species (ENS)	Species Richness-Evenness Index	All	7.79
			Trees	12.81
			Non-Trees	4.07
9	Simpson's Index of Diversity (D_s)	Species Richness-Evenness Index	All	0.78
			Trees	0.84
			Non-Trees	0.68

Plant species diversity appears to be relatively low in the SMPP project area (see Table 48 for range of plants species diversity metrics). Tree species in the project area account for most of the plant species diversity in the project area, with both species' richness metrics (e.g., D_{mg}) and species evenness (e.g., E) metrics being higher for tree species than for non-tree species or than for tree and non-tree species combined. Much of this lack of evenness is caused by a few species of non-tree species, namely ferns, dominating much of the project area. Most tree species only contain a handful of individuals, across a small number of species, e.g., *Macaranga pruinosa* and *Melicope lunu-ankenda*, being notably more abundant during this monitoring period.

All species richness-evenness metrics from Table 48 suggest a low plant diversity, especially for non-tree species which often dominate in areas outside the small area of secondary forest in the project area. The ENS of 12.81 is likely representing a low diversity level, which is reduced to an ENS of 7.79 when non-tree species are included in the ENS calculations.

Fern cover averaged a very high 75% during this monitoring period while shrub cover averaged 24% (see Table 49), and tree individuals from younger tree maturity categories (i.e., saplings and seedlings) were present at a much higher density than older tree maturity categories (i.e., poles and trees; see Table 49), suggesting possible evidence of early ecological succession and regeneration. Data collected in subsequent monitoring periods will support this early evidence of ecological succession leading to increased diversity on the project area.

Table 49. Density of individuals per ha of each tree maturity category, and average fern cover (%) and average shrub cover (%) in year 2020.

No.	Year	Density/Tree Maturity Category (ha ⁻¹)				Avg. Fern Cover %	Avg. Shrub Cover %
		Trees	Poles	Saplings	Seedlings		
1	2020	24	171	599	2813	75%	24%

Table 50 shows abundance and density data for each tree maturity category for each of the 15 tree trigger species identified during this monitoring period. The population trends of these trigger species and the actions taken to maintain or enhance their population status and reduce threats to them are described in more detail in in Table 53 in section 5.4.1 of this report.

Table 50. Tree trigger species abundance and density per hectare (ha) for each tree maturity category for all trigger species observed during vegetation plots in year 2020.

No.	Tree Trigger Species	Tree Maturity	Year 2020	
			Abundance	Density/ha
1	<i>Actinodaphne macrophylla</i>	Tree	0	0.00
		Pole	0	0.00
		Sapling	0	0.00
		Seedling	1	104.17
2	<i>Dillenia excelsa</i>	Tree	0	0.00
		Pole	2	3.26
		Sapling	0	0.00
		Seedling	0	0.00
3	<i>Diospyros maingayi</i>	Tree	1	0.41
		Pole	4	6.51
		Sapling	0	0.00
		Seedling	0	0.00
4	<i>Dyera costulata</i>	Tree	2	0.81
		Pole	0	0.00
		Sapling	0	0.00
		Seedling	0	0.00

No.	Tree Trigger Species	Tree Maturity	Year 2020	
			Abundance	Density/ha
5	<i>Endospermum malaccense</i>	Tree	2	0.81
		Pole	1	1.63
		Sapling	0	0.00
		Seedling	0	0.00
6	<i>Gonystylus bancanus</i>	Tree	0	0.00
		Pole	0	0.00
		Sapling	1	6.51
		Seedling	0	0.00
7	<i>Ilex cymosa</i>	Tree	1	0.41
		Pole	0	0.00
		Sapling	0	0.00
		Seedling	0	0.00
8	<i>Lithocarpus lucidus</i>	Tree	0	0.00
		Pole	1	1.63
		Sapling	0	0.00
		Seedling	0	0.00
9	<i>Litsea machilifolia</i>	Tree	0	0.00
		Pole	0	0.00
		Sapling	1	6.51
		Seedling	0	0.00
10	<i>Macaranga pruinosa</i>	Tree	12	4.88
		Pole	51	83.01
		Sapling	12	78.13
		Seedling	7	729.17
11	<i>Melicope glabra</i>	Tree	0	0.00
		Pole	2	3.26
		Sapling	4	26.04
		Seedling	0	0.00
		Tree	2	0.81

No.	Tree Trigger Species	Tree Maturity	Year 2020	
			Abundance	Density/ha
12	<i>Payena acuminata</i>	Pole	0	0.00
		Sapling	0	0.00
		Seedling	0	0.00
13	<i>Quassia borneensis</i>	Tree	0	0.00
		Pole	0	0.00
		Sapling	1	6.51
		Seedling	0	0.00
14	<i>Shorea uliginosa</i>	Tree	1	0.41
		Pole	0	0.00
		Sapling	0	0.00
		Seedling	0	0.00
15	<i>Stemonurus secundiflorus</i>	Tree	1	0.41
		Pole	0	0.00
		Sapling	1	6.51
		Seedling	0	0.00
16	<i>Tetramerista glabra</i>	Tree	1	0.41
		Pole	0	0.00
		Sapling	1	6.51
		Seedling	0	0.00

With the establishment of nested vegetation plots in the project area, the completion of one complete survey of all vegetation plots, the creation of a project area herbarium that will continuously be expanded and refined with new data, and a large amount of new data collected that will be invaluable to systematic annual monitoring of tree species in the project area, this monitoring period can be considered a success for biodiversity monitoring in the project area using vegetation plot surveys. Next year, there will be two complete surveys of all vegetation plots to cover both the wet and dry seasons, giving a more accurate picture of plant diversity across the year.

5.3.1.3 Camera Trap Surveys

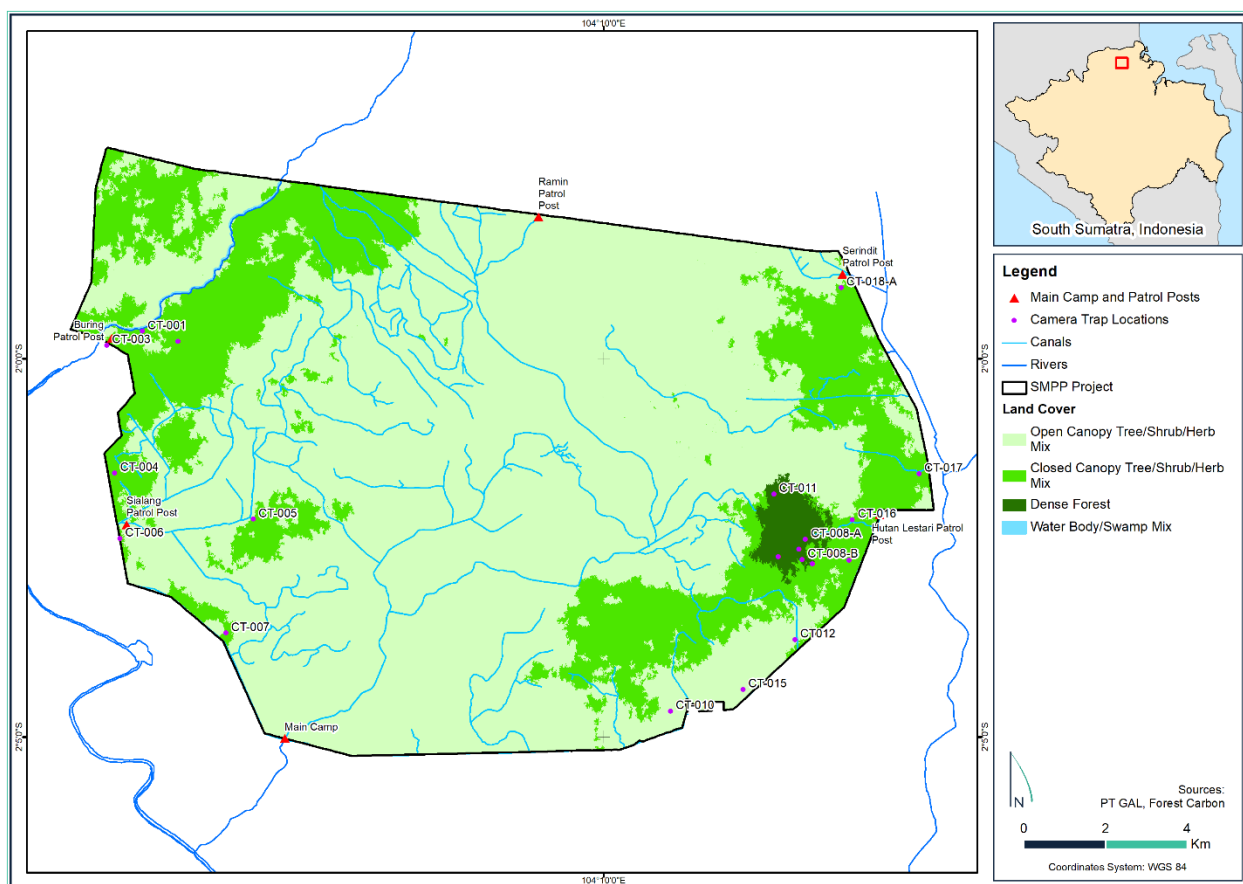
Camera trap surveys were conducted to assess mammal diversity and population trends in the project area. While certain reptile and bird species can be captured on the camera traps, the camera trap surveys were designed to capture mammal species, mostly medium to large mammal species that are likely to use walkways. Certain mammal species are likely to go under-detected or undetected (e.g., highly arboreal species and small species).

Medium to large sized mammals are often indicators for hunting pressures, food resource availability, and overall ecosystem functioning. The presence of mammalian apex predators such as tigers can indicate an

abundance of prey species and can indicate the potential of these predators to increase species diversity by keeping prey species abundances relatively even.

While systematic camera trap surveying at permanent camera trap stations in the project area is planned, this monitoring period mostly focused on increasing the mammal species inventory in the project area. Nonetheless, an analysis of mammal species diversity and population trends was conducted and is presented here.

Using 18 camera trap units across 22 camera trap stations (Map 14), 406 individuals across 18 mammal species were captured in camera trap images across 1227 active camera trap days. With nine of these species being recorded for the first time in the project area, this brings the total number of mammal species observed in the project area to 27 (see Annex 16 for the full species inventory). An additional 14 bird species and three reptile species were accidentally captured in camera trap images, but these species have not been included in the analyses that follow (see Annex 16).



Map 14. Map of SMPP area showing camera traps surveyed during this monitoring period.

With a D_{mg} of 2.94 and an E of 0.71, mammal species in the SMPP appear to have a relatively low species richness and a moderate species evenness (see Table 51). These results are supported by a relatively low H' of 2.04 and ENS of 7.69 but a moderate to high D_s of 0.81, with the latter metric being weighted a little more toward species evenness and dominance than species richness.

In a heavily disturbed, newly regenerating area such as the project area, low mammal species richness is to be expected. Moderate to low mammal species evenness is also to be expected with some hardy, generalist, omnivore mammal species, such as, macaques (*Macaca fascicularis* and *Macaca nemestrina*) and wild boar (*Sus scrofa*) are more likely to thrive in heavily disturbed habitats. Indeed, these species were more abundantly captured on camera traps than many of the other mammal species occurring in the project area.

Table 51. Summary of biodiversity metrics assessed for mammal species surveyed in camera trap surveys in year 2020.

No.	Biodiversity Metric	Metric Type	Value
1	Total no. of species recorded in the project area (S)	Species Richness	18
2	First records of a given species	Species Richness	9
3	Trigger species	Species Richness	12
4	Total no. of individuals across all species recorded in the project area (N)	Species Abundance	323
5	Margalef's Species Richness Index (D_{mg})	Species Richness Index	2.94
6	Shannon-Wiener Diversity Index (H')	Species Richness-Evenness Index	2.04
7	Shannon's Equitability (or Species Evenness) (E)	Species Evenness Index	0.71
8	Effective Number of Species (ENS)	Species Richness-Evenness Index	7.69
7	Simpson's Index of Diversity (D_s)	Species Richness-Evenness Index	0.81

Camera trap surveys are a powerful tool for assessing mammal diversity and population trends in a way that is non-invasive, can cover large areas with relatively little effort, and can detect species likely to actively avoid human observers. Despite these obvious benefits, camera traps do suffer from unpredictable detection rates and the analyses that can be used to account for imperfect detection and accurate estimates of species abundance from camera trap survey data is somewhat limited. The two species abundance estimates presented here for mammal trigger species (see Table 52) use the Relative Abundances Index (RAI, equation 27)⁵⁰ and Naïve Occupancy.⁵¹ They do not account for imperfect detection or model for factors that may influence detectability but are still useful as rough estimates of species abundance trends.

The RAI is the number of independent images of a focal species per 100 camera trap days of sampling effort. The formula used to calculate RAI can be seen below. As it is often correlated with species and density, it is often used a proxy for these population estimate metrics. It is essentially a measure of relative abundance adjusted for sampling effort, and this adjustment makes it useful for comparing abundance over space and time where sampling efforts are often different. However, caution should be taken when using RAI to estimate species population trends as it does not account for differences in detectability arising from variations in camera trap sites, species behavior, or physical characteristics.⁵²

$$RAI = \frac{n_i}{\sum TN} \times 100 \quad (27)$$

Where:

RAI = Relative Abundance Index per 100 trap days
 n_i = Number of independent images the species of i
 $\sum TN$ = Number of active camera trap days

Occupancy is defined as the proportion of sampling units (camera trap stations in this case) that are occupied by a particular species. It is measured on a scale of 0 to 1 and is a measure of species presence that can be thought as the probability that a randomly selected sampling unit in an area of interest is occupied by at least one individual of a particular species). This probability of presence estimate is often

used as a proxy for abundance. Inference from occupancy data is most powerful when factors affecting detection probability are included in the statistical model. When detection probability factors are not included in the model, the occupancy estimate is referred to as Naïve Occupancy. Table 52 shows RAI values and the Naïve Occupancy values for each of the 12 mammal trigger species identified during this monitoring period. The population trends of these trigger species and the actions taken to maintain or enhance their population status and reduce threats to them are described in more detail in Table 53 in section 5.4.1 of this report.

Table 52. Relative Abundance Index (RAI) and Naïve Occupancy by year for each of the 18 mammal trigger species recorded in the project area, 12 of which were recorded during this monitoring period.

No.	Order	Species Name (Scientific (Common))	Year 2020	
			RAI	Naïve Occupancy
1	Rodentia	<i>Callosciurus notatus</i> (Plantain Squirrel)	1.06	0.18
2	Carnivora	<i>Helarctos malayanus</i> (Sun Bear)	3.91	0.59
3	Carnivora	<i>Herpestes brachyurus</i> (Short-tailed Mongoose)	0.08	0.05
4	Primata	<i>Hylobates agilis</i> (Agile Gibbon)	NA	NA
5	Rodentia	<i>Hystrix sumatrae</i> (Sumatran Porcupine)	0.08	0.05
6	Carnivora	<i>Lutrogale perspicillata</i> (Smooth-Coated Otter)	NA	NA
7	Primata	<i>Macaca nemestrina</i> (Southern Pig-Tailed Macaque)	8.88	0.73
8	Artiodactyla	<i>Muntiacus muntjak</i> (Southern Red Muntjac)	NA	NA
9	Carnivora	<i>Mustela nudipes</i> (Malay Weasel)	0.08	0.05
10	Carnivora	<i>Panthera tigris sumatrae</i> (Sumatran Tiger)	0.49	0.23
11	Primata	<i>Presbytis melalophos</i> (Sumatran Surili)	NA	NA
12	Rodentia	<i>Rhinosciurus laticaudatus</i> (Shrew-Faced Squirrel)	NA	NA
13	Artiodactyla	<i>Rusa unicolor</i> (Sambar Deer)	0.65	0.18
14	Rodentia	<i>Sundasciurus lowii</i> (Low's Squirrel)	0.24	0.09
15	Artiodactyla	<i>Sus barbatus</i> (Bearded Pig)	0.49	0.23
16	Primata	<i>Trachypithecus cristatus</i> (Silvery Lutung)	NA	NA
17	Artiodactyla	<i>Tragulus napu</i> (Greater Mouse-Deer)	0.08	0.05
18	Scandentia	<i>Tupaia tana</i> (Large Treeshrew)	2.36	0.32

With the testing and trialing of a substantial number of camera traps and potential camera trap stations, extensive camera trap survey training for field staff, a significant expansion of the mammal species inventory, including some rare and elusive species, and the establishment of a systematic camera trap data management and analysis protocol, this monitoring period can be considered a success for biodiversity monitoring in the project area using camera trap surveys.

Next year, there will be two complete surveys of all camera trap stations to cover both the wet and dry seasons, giving a more accurate picture of mammal diversity across the year. For future monitoring periods, the number of camera trap units will be expanded, and permanent camera trap stations will be established to improve consistency, repeatability, and comparability between surveys. Future monitoring

periods may also include more accurate, detectability-adjusted analyses of abundance for species which have relatively easily identifiable individuals (namely tigers) using capture-recapture methods.

5.3.2 Biodiversity Monitoring Plan Dissemination (B4.3)

Each monitoring report will be made available online through the Verra Registry (<https://www.registry.verra.org>).

Both and English and Bahasa Indonesia versions of the Executive summary of the Project Description (which includes details of the biodiversity monitoring plan) were distributed to project community members.

The Executive Summary of each monitoring report was translated into Bahasa Indonesia and given to all relevant stakeholders (including local community leaders in the project zone, adjacent concessions, and local authorities).

5.4 Optional Criterion: Exceptional Biodiversity Benefits

The SMPP aims to achieve exceptional biodiversity benefits and maintain its validation at the Gold Level based on the presence of ecologically important IUCN Red Listed species in the project area.

5.4.1 Trigger Species Population Trends (GL3.3)

A 'trigger species' is a species which 'triggers' the designation of an area as a Key Biodiversity Area (KBA) by possessing some key characteristics relating to species population status, IUCN Red List status,⁴⁷ and species distribution (as proxies for species vulnerability and irreplaceability). This definition follows IUCN definitions as prescribed by the CCB Standards.⁵³ The definition of 'endemic' with regard to trigger species designation for this project pertains to species extant in Indonesia and/or the Sundaland Bioregion (i.e., primarily Sumatra, Borneo, Java, and Peninsular Malaysia and Peninsular Thailand).

Changes in the number of trigger species for the animal and plant groups listed here are the result of new species records or updated species data. Most of the data relating to potential trigger species status for each species in the project area species inventory is obtained from the following databases:

- IUCN Red List of Threatened Species (<https://www.iucnredlist.org/>)
- Avibase (<https://avibase.bsc-eoc.org/avibase.jsp?lang=EN>)
- The Reptile Database (<http://www.reptile-database.org>)
- Ecology Asia (<https://www.ecologyasia.com/>)
- Global Biodiversity Information Facility (<https://www.gbif.org/>)
- Kew Science Plants of the World Online (<http://www.plantsoftheworldonline.org/>)
- The Plant List (<http://www.theplantlist.org/>)

By the end of this monitoring period, the project had recorded a total of 93 trigger species (68 faunal species, and 25 floral species), which are summarized by taxonomic class below (Table 53, and Annex 16 for a full list of trigger and non-trigger species):

- 18 mammals (increase of eight species from previous monitoring period)
- 35 birds (increase of 26 species)
- Seven reptiles (increase of two species; not actively surveyed)

- Two amphibians (no increase; not actively surveyed)
- One fish (no increase; not actively surveyed)
- Five arthropods (dragonflies and damselflies) (increase of Three species; not actively surveyed)
- 25 plant species (24 of which are tree species; increase of 15 species)

While not all species groups are actively surveyed or directly assessed as part of the biodiversity monitoring plan, data on all species groups is updated in the species inventory each year. Newly recorded species which are recorded ad hoc, on patrols, or as bycatch during other survey methods are also added to the species inventory.

The population trends of trigger species within the project area and the actions taken to maintain or enhance the population status of these species in the project zone are discussed in the species population trends tables below. How species population trends will naturally progress for each species in a regenerating tropical peatland is still poorly understood, and while there is not enough data collected yet to ascertain clear trends yet, it is likely that trigger species have experienced net positive benefits during this monitoring period from recent project activities.

Table 53. Trigger species in the SMPP.

Trigger Species	Mammals (18): 1. <i>Callosciurus notatus</i> (Plantain Squirrel) 2. <i>Helarctos malayanus</i> (Sun Bear) 3. <i>Herpestes brachyurus</i> (Short-tailed Mongoose) 4. <i>Hylobates agilis</i> (Agile Gibbon) 5. <i>Hystrix sumatrae</i> (Sumatran Porcupine) 6. <i>Lutrogale perspicillata</i> (Smooth-Coated Otter) 7. <i>Macaca nemestrina</i> (Southern Pig-Tailed Macaque) 8. <i>Muntiacus muntjak</i> (Southern Red Muntjac) 9. <i>Mustela nudipes</i> (Malay Weasel) 10. <i>Panthera tigris sumatrae</i> (Sumatran Tiger) 11. <i>Presbytis melalophos</i> (Sumatran Surili) 12. <i>Rhinosciurus laticaudatus</i> (Shrew-Faced Squirrel) 13. <i>Rusa unicolor</i> (Sambar Deer) 14. <i>Sundasciurus lowii</i> (Low's Squirrel) 15. <i>Sus barbatus</i> (Bearded Pig) 16. <i>Trachypithecus cristatus</i> (Silvery Lutung) 17. <i>Tragulus napu</i> (Greater Mouse-Deer) 18. <i>Tupaia tana</i> (Large Treeshrew)
Population Trend at Start of Project	The agile gibbon (<i>Hylobates agilis</i>), occupying Sumatra, Kalimantan, Peninsular Malaysia and Thailand, and the Sumatran Surili (<i>Presbytis melalophos</i>), endemic to the island of Sumatra, are both listed as endangered and IUCN indicates that the populations of these species are decreasing. The other mammals mentioned above are listed as vulnerable species. These species reside throughout Asia, and the IUCN Red List indicates that the populations of these species are also in decline.

Without-project Scenario	Without the presence of the project, it is likely that species diversity would be negatively affected by increasing development and land-use change within the SMPP area.
With-project Scenario	As primarily forest-dependent and regenerating forest-dependent mammal species, all of the 18 mammal trigger species listed above stand to benefit from key project activities undertaken during this monitoring period. These activities include canal blocking, fire management in and around the project area, enrichment planting and assisted natural regeneration. Many of these species are at risk from hunting for the illegal wildlife trade, particularly the Sumatran tiger (<i>Panthera tigris sumatrae</i>), the sun bear (<i>Helarctos malayanus</i>), and the sambar deer (<i>Rusa unicolor</i>). The project field team conducted 1,500 individual patrols using this monitoring period and observed no evidence of illegal hunting, thus acting as a deterrent to hunting activities in the area. To bolster and streamline these patrolling efforts, additional training of staff regarding biodiversity, threats to biodiversity, and SMART software was carried out during this monitoring period. During this monitoring period 12 mammal trigger species were recorded during camera trap surveys, and Relative Species Abundance (RAI) and Naïve Occupancy were estimated for these (see Table K). See the Camera Trap Surveys sub-section of section 5.3.1 for more details on these species abundance proxy measures. Some estimates of note for this monitoring period include relatively high RAI and Naïve Occupancy estimates for the southern pig-tailed macaques (<i>Macaca nemestrina</i>) (RAI = 8.88; Naïve Occupancy = 0.73) and the sun bear (<i>Helarctos malayanus</i>) (RAI = 3.91; Naïve Occupancy = 0.59), and the first photographic evidence of the Sumatran tiger (<i>Panthera tigris sumatrae</i>) in the project area. Southern pig-tailed macaques are listed as Vulnerable (VU) on the IUCN Red List, endemic to the Sundaland Bioregion, and threatened by habitat loss and hunting as pests and for the illegal wildlife trade. Sun bears, the world's smallest bear, are listed as Vulnerable (VU) on the IUCN Red List, extinct across most of their historical range, and are threatened by habitat loss, habitat fragmentation, and hunting for the illegal wildlife trade. The Sumatran tiger is a critically endangered subspecies of the Endangered tiger (<i>Panthera tigris</i>). It is the world's smallest tiger species and the world's rarest tiger subspecies with an estimated 300-400 individuals left in the wild. Tigers are apex predators whose presence can indicate an abundance of prey species and can help increase species diversity by keeping prey species abundances relatively even. The relatively high abundance of wild boar (<i>Sus scrofa</i>) as well as the occurrence of other potential prey species, such as, bearded pigs (<i>Sus barbatus</i>) and sambar deer (<i>Rusa unicolor</i>) seem to support this hypothesis. The camera trap surveys during this monitoring period recorded two different male Sumatran tigers in the project area, distinguishable from one another mostly because of clear pictures of their unique striping patterns. For animals with typical home ranges of 60-100 km², having at least two individuals using the roughly 230 km² project area is significant. The protection of these individuals will play a vital role in the conservation of this species and may well

	play an important role maintaining balanced mammal diversity in the project area. Early camera trap survey data combined with positive patrol and land cover change detection analysis suggests that mammal trigger species are likely being maintained and enhanced under the with-project scenario.
--	---

Trigger Species	Birds (35): 1. <i>Acridotheres javanicus</i> (Javan Myna) 2. <i>Alophoixus finschii</i> (Finsch's Bulbul) 3. <i>Annorhinus galeritus</i> (Bushy-Crested Hornbill) 4. <i>Buceros rhinoceros</i> (Rhinoceros Hornbill) 5. <i>Chloropsis cyanopogon</i> (Lesser Green Leafbird) 6. <i>Chrysophlegma miniaceum</i> (Banded Woodpecker) 7. <i>Collocalia linchi</i> (Cave Swiftlet) 8. <i>Copsychus pyrrropygus</i> (Rufous-Tailed Shama) 9. <i>Cyanoderma erythropterum</i> (Chestnut-winged Babbler) 10. <i>Cyornis umbratilis</i> (Grey-Chested Jungle-Flycatcher) 11. <i>Dendrocopos moluccensis</i> (Sunda Pygmy Woodpecker) 12. <i>Hemicircus concretus</i> (Grey-And-Buff Woodpecker) 13. <i>Leptoptilos javanicus</i> (Lesser Adjutant) 14. <i>Lophura erythrophthalma</i> (Malay Crestless Fireback) 15. <i>Loriculus galgulus</i> (Blue-Crowned Hanging-Parrot) 16. <i>Macronus ptilosus</i> (Fluffy-Backed Tit-Babbler) 17. <i>Malacocincla malacense</i> (Short-Tailed Babbler) 18. <i>Malacocincla sepiaria tardinata</i> (Horsfield's Babbler) 19. <i>Malacopteron affine</i> (Sooty-Capped Babbler) 20. <i>Malacopteron magnum</i> (Rufous-Crowned Babbler) 21. <i>Microhierax fringillarius</i> (Black-Thighed Falconet) 22. <i>Nisaetus nanus</i> (Wallace's Hawk-Eagle) 23. <i>Pellorneum capistratum</i> (Rufous-browed Babbler) 24. <i>Phaenicophaeus diardi</i> (Black-Bellied Malkoha) 25. <i>Phaenicophaeus sumatranus</i> (Chestnut-Bellied Malkoha) 26. <i>Picus dedemi</i> (Sumatran woodpecker) 27. <i>Picus puniceus</i> (Crimson-Winged Woodpecker) 28. <i>Prinia familiaris</i> (Bar-Winged Prinia) 29. <i>Psittacula longicauda</i> (Long-Tailed Parakeet) 30. <i>Psittinus cyanurus</i> (Blue-Rumped Parrot) 31. <i>Pycnonotus brunneus</i> (Red-Eyed Bulbul) 32. <i>Pycnonotus simplex</i> (Cream-Vented Bulbul) 33. <i>Rhabdotorrhinus corrugatus</i> (Wrinkled Hornbill) 34. <i>Setornis criniger</i> (Hook-Billed Bulbul) 35. <i>Zanclostomus javanicus</i> (Red-billed Malkoha)
Population Trend at Start of Project	These species of birds occur throughout Asia, and IUCN Red List indicates that populations of all of these species are decreasing and

	lists them as vulnerable. Hornbills in particular are at significant and ongoing risk from illegal wildlife trade.
Without-project Scenario	Without the presence of the project, it is likely that species diversity would be negatively affected by increasing development and land-use change within the SMPP area. These species are threatened by habitat loss and disturbance.
With-project Scenario	As forest-dependent, regenerating forest-dependent, waterbody-dependent, and riparian zone-dependent bird species, all of the 35 bird trigger species listed above stand to benefit from key project activities undertaken during this monitoring period. These activities include canal blocking to restore the natural peatland water table depth, fire management in and around the project area (bolstered by new agreements signed in 2019 and 2020 with adjacent concessions), enrichment planting and assisted natural regeneration. In addition to this, many of these species are at risk from hunting for the illegal wildlife trade, for example, the long-tailed parakeet (<i>Psittacula longicauda</i>), the Malay Crestless Fireback (<i>Lophura erythrophthalma</i>), the rhinoceros hornbill (<i>Buceros rhinoceros</i>), the wrinkled hornbill (<i>Rhabdotorrhinus corrugatus</i>), and Wallace's Hawk-Eagle (<i>Nisaetus nanus</i>). The project field team conducted an estimated 1,500 individual patrols during this monitoring period and observed no evidence of illegal hunting. The act of conducting regular patrols is likely acting as a deterrent to hunting activities in the area. To bolster and streamline these patrolling efforts, additional training of staff regarding biodiversity, threats to biodiversity, and SMART software was carried out during this monitoring period. During this monitoring period, 25 of these trigger species were observed, 22 of which were observed during point transect surveys, with 17 of these being observed within 25 meters of the observer, allowing for an estimate of species population density to be calculated for these 17 species (see Table 49). As this is the first such analysis for the project area and these species, it is not possible to comment on what these data may mean for population trends over longer time periods for these species. However, species such as <i>Collocalia linchi</i> (Cave Swiftlet), <i>Microhierax fringillarius</i> (Black-Thighed Falconet), and <i>Pycnonotus brunneus</i> (Red-Eyed Bulbul) appear to have healthy population densities in the project area, with the density of individuals per ha standing at 25.99, 3.57, and 3.57 individuals/ha respectively.

Trigger Species	Plant Species (24) 1. <i>Actinodaphne macrophylla</i> 2. <i>Anisoptera marginata</i> 3. <i>Aquilaria microcarpa</i> 4. <i>Cantleya corniculata</i> 5. <i>Combretocarpus rotundatus</i> 6. <i>Dillenia excelsa</i> 7. <i>Diospyros maingayi</i>
-----------------	---

	8. <i>Dyera costulata</i> 9. <i>Dyera polyphylla</i> 10. <i>Endospermum malaccense</i> 11. <i>Gonystylus bancanus</i> 12. <i>Ilex cymosa</i> 13. <i>Lithocarpus lucidus</i> 14. <i>Litsea machilifolia</i> 15. <i>Macaranga pruinosa</i> 16. <i>Melicope glabra</i> 17. <i>Payena acuminata</i> 18. <i>Quassia borneensis</i> 19. <i>Shorea dasyphylla</i> 20. <i>Shorea platycarpa</i> 21. <i>Shorea teysmanniana</i> 22. <i>Shorea uliginosa</i> 23. <i>Stemonurus secundiflorus</i> 24. <i>Tetramerista glabra</i>
Population Trend at Start of Project	<i>Shorea platycarpa</i> is listed as critically endangered, while <i>Anisoptera marginata</i> , <i>Shorea dasyphylla</i> , and <i>Shorea teysmanniana</i> are listed as endangered and the remaining species above are listed as vulnerable. There is insufficient data in the IUCN Red List concerning the population trends of these species.
Without-project Scenario	Without the presence of the project, it is likely that species diversity would be negatively affected by increasing development and land-use change within the SMPP area. These species are threatened by single species <i>Acacia</i> plantations and continued land conversion and degradation.
With-project Scenario	All 24 plant trigger species have likely benefitted from key project activities undertaken during this monitoring period. These activities include canal blocking to restore the natural peatland water table depth, fire management in and around the project area (bolstered by new agreements signed in 2019 and 2020 with adjacent concessions), enrichment planting and assisted natural regeneration. The majority of these tree species are at risk of illegal logging. The project field team conducted an estimated 1,500 individual patrols using this monitoring period and observed no evidence of illegal logging. The act of conducting regular patrols is likely acting as a deterrent to illegal logging activities in the area. To bolster and streamline these patrolling efforts, additional training of staff regarding biodiversity, threats to biodiversity, and SMART software was carried out during this monitoring period. During this monitoring period 16 of these trigger species were recorded in nested vegetation plot surveys, allowing for estimates of density of individuals per hectare (ha) to be calculated for each tree maturity category for each of these 16 species (see Table 50). Most of these tree trigger species occurred at very low densities as expected because of their rare and threatened status and the heavy degradation of the project area which has only recently seen the

	initiation of project assisted natural regeneration activities. However, some tree trigger species were notably abundant, such as <i>Macaranga pruinosa</i>, particularly for younger tree maturity categories. Other observations of note include a Critically Endangered (CR) <i>Gonstylus bancanus</i> (Ramin) sapling, a Vulnerable (VU) <i>Shorea uliginosa</i> (Meranti Kelungkum) tree, and a Vulnerable (VU) <i>Tetramerista glabra</i> (Punah) sapling and tree, all of which are endemic to the Sundaland Bioregion. Sufficient long-term data is not yet available to tree trigger species population trends over longer time periods. However, early vegetation plot survey data combined with positive land cover change detection analysis suggests that tree trigger species are likely being maintained and enhanced under the with-project scenario.
--	--

6 ADDITIONAL PROJECT IMPLEMENTATION INFORMATION

No additional information is required to document how the project has been implemented.

7 ADDITIONAL PROJECT IMPACT INFORMATION

No additional information is required to document results of monitoring for CCB standards.

8 REFERENCES

1. Moder, F., Siegert, F. & Schlessinger, P. *Carbon Stock Estimation in Peat Swamp Forest Area of Merang - Kepayang. Area.*
2. Lalan, H. P. Merang REDD Pilot Project. **2010**, 1–13 (2010).
3. Kementerian Lingkungan Hidup dan Kehutanan. Peraturan Menteri Lingkungan Hidup dan Kehutanan RI No P/16/MENLHK/SETJEN/SET.1/8/2020 tentang Rencana Strategis Kementerian Lingkungan hidup dan Kehutanan Tahun 2020-2024. *J. Chem. Inf. Model.* **53**, 1689–1699 (2018).
4. Peraturan Presiden Republik Indonesia. Peraturan Presiden No 18 Tahun 2020 tentang Rencana Pembangunan Jangka Menengah Tahun 2020-2024. *Peratur. Pres. Republik Indones. Nomor 18 Tahun 2020* 313 (2019).
5. Presiden Republik Indonesia. *Peraturan Presiden No 2 Tahun 2015 tentang Rencana Pembangunan Jangka Menengah Tahun 2015-2019.* (2015).
6. Nasional Tempo.co. Ini Enam Target Kementerian Pendidikan. Tempo.co (2016).
7. Presiden Republik Indonesia. *Peraturan Presiden Republik Indonesia Nomor 1 Tahun 2016 Tentang Badan Restorasi Gambut.* (2016).
8. Konecny, K. et al. Variable carbon losses from recurrent fires in drained tropical peatlands. *Glob. Chang. Biol.* **22**, 1469–1480 (2016).
9. Manuri, S. et al. Tree biomass equations for tropical peat swamp forest ecosystems in Indonesia. *For. Ecol. Manage.* **334**, 241–253 (2014).
10. United Nations Framework Convention on Climate Change (UNFCCC) - CDM Executive Board. *A/R Methodological Tool “Calculation of the number of sample plots for measurements within A/R CDM project activities” (Version 02.1.0).* (2010).
11. Intergovernmental Panel on Climate Change - IPCC. *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands.* (2014).
12. Margono, B. A., Usman, A. B., Budiharto & Sugardiman, R. A. Indonesia’s forest resource monitoring. *Indones. J. Geogr.* **48**, 7–20 (2016).
13. Lembaga Penerbangan Dan Antariksa Nasional (LAPAN). *The Remote Sensing Monitoring Program of Indonesia’s National Carbon Accounting System: Methodology and Products, Version 1.* (2014).
14. Ayele, G. T. et al. Time Series Land Cover Mapping and Change Detection Analysis Using Geographic Information System and Remote Sensing, Northern Ethiopia. *Air, Soil Water Res.* **11**, 117862211775160 (2018).
15. Peraturan Menteri Lingkungan Hidup Dan Kehutanan. Peraturan Menteri Lingkungan Hidup Dan Kehutanan Republik Indonesia Nomor P.12/Menlhk-II/2015. 1–14 (2015).
16. Peraturan Menteri Lingkungan Hidup Dan Kehutanan. Peraturan Menteri LHK RI No. P.17/MenLHK/Setjen/Kum.1/2/2017 tentang Perubahan atas P.12/MenLHK-II/2015 tentang Pembangunan Hutan Tanaman Industri. 1–16 (2017).
17. Evans, C. D. et al. Rates and spatial variability of peat subsidence in Acacia plantation and forest landscapes in Sumatra, Indonesia. *Geoderma* **338**, 410–421 (2019).
18. Hooijer, A. et al. Carbon Emissions from Drained and Degraded Peatland in Indonesia and Emission Factors for Measurement , Reporting and Verification (MRV) of Peatland Greenhouse Gas Emissions. *Indones. For. Carbon Partnersh.* 50 (2014).
19. Ritzema, H., Limin, S., Kusin, K., Jauhiainen, J. & Wösten, H. Canal blocking strategies for

-
- hydrological restoration of degraded tropical peatlands in Central Kalimantan, Indonesia. *CATENA* **114**, 11–20 (2014).
20. Page, S. E. & Hooijer, A. In the line of fire: the peatlands of Southeast Asia. *Philos. Trans. R. Soc. Lond. B. Biol. Sci.* **371**, (2016).
 21. Peraturan Menteri Lingkungan Hidup Dan Kehutanan. *Nomor P.21/Menhut-II/2014*. (2014).
 22. United Nations Framework Convention on Climate Change (UNFCCC) - CDM Executive Board. A/R Large-scale Consolidated Methodology Afforestation and reforestation of lands except wetlands Version 2.0. (2013).
 23. Planet Surface Reflectance Basemaps. <https://developers.planet.com/docs/data/sr-basemaps/>.
 24. Jensen, J. R. & Lulla, K. Introductory digital image processing: A remote sensing perspective. *Geocarto Int.* **2**, 65 (1987).
 25. Gislason, P. O., Benediktsson, J. A. & Sveinsson, J. R. Random forests for land cover classification. in *Pattern Recognition Letters* vol. 27 294–300 (North-Holland, 2006).
 26. Rodriguez-Galiano, V. F., Ghimire, B., Rogan, J., Chica-Olmo, M. & Rigol-Sanchez, J. P. An assessment of the effectiveness of a random forest classifier for land-cover classification. *ISPRS J. Photogramm. Remote Sens.* **67**, 93–104 (2012).
 27. Pal, M. Random forest classifier for remote sensing classification. *Int. J. Remote Sens.* **26**, 217–222 (2005).
 28. Congalton, R. & Green, K. *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices, Third Edition*. (2019). doi:10.1201/9780429052729.
 29. US Department of the Interior. Thematic Accuracy Assessment Procedures. 116 (2010).
 30. ArcGIS. Sampling Design Tool (ArcGIS 10.4.1). <https://www.arcgis.com/home/item.html?id=28f08ca526ae44e8ac107a2a0d5f50e3>.
 31. Gofc-Gold. A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals associated with deforestation,. {GOFC-GOLD} Rep. version {COP15-1} (2012) doi:GOFC-GOLD Report version COP18-1.
 32. Global Forest Observations Initiative (GFOI). Integration of Remote-Sensing and Ground-Based Observations for Estimation of Emissions and Removals of Greenhouse Gases in Forests Methods and Guidance from the Global Forest Observations Initiative. *Food Agric. Organ. Edition* **2.**, 260 (2016).
 33. NASA Earth Data. Fire Information for Resource Management System (FIRMS) - Archive Download. (2018).
 34. Direktorat Jenderal Pengelolaan Hutan Produksi Lestari Kementerian Lingkungan Hidup dan Kehutanan. *Ditjen PHPL- Statistik Direktorat Jenderal PHPL Tahun 2017*. (2018).
 35. Kementerian Lingkungan Hidup dan Kehutanan. *Basis Data Geospasial Lingkungan Hidup dan Kehutanan Tahun 2020*. (Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan, Direktorat Jenderal Planologi Kehutanan dan Tata Lingkungan, Kementerian Lingkungan Hidup dan Kehutanan, 2020).
 36. Global Forest Watch. Wood Fiber Concessions. <https://data.globalforestwatch.org/datasets/gfw::wood-fiber-concessions/about> (2020).
 37. University of Maryland. Global Forest Change 2000-2018.
 38. Hansen, M. C. *et al.* High-Resolution Global Maps of 21st-Century Forest Cover Change. *Science (80-.)*. **342**, (2013).
 39. Wahyunto, I., Nyoman N Suryadiputra; & Wetlands International Indonesia Programme. *Peatland distribution in Sumatra and Kalimantan : explanation of its data sets including source of information*,

-
- accuracy, data constraints, and gaps. (2008).
40. Forest Carbon and PT Global Alam Lestari. *Muara Merang and Kepayang Villages field visits*. (2018).
 41. Biro Pusat Statistik. *Kabupaten Musi Banyuasin Dalam Angka - Garis Kemiskinan dan Penduduk Miskin di Kabupaten Musi Banyuasin, 2011-2017*. (2018).
 42. Brook, B. W., Sodhi, N. S. & Bradshaw, C. J. A. Synergies among extinction drivers under global change. *Trends Ecol. Evol.* **23**, 453–60 (2008).
 43. Sodhi, N. S. *et al.* The state and conservation of Southeast Asian biodiversity. *Biodivers. Conserv.* **19**, 317–328 (2010).
 44. World Wildlife Fund Indonesia (WWF). Quick Facts About Sumatra. (2009).
 45. Sutherland, W. J. *Ecological Census Techniques: a Handbook*.
 46. Buckland, S. T., Marsden, S. J. & Green, R. E. Estimating bird abundance: making methods work. *Bird Conserv. Int.* **18**, S91—S108 (2008).
 47. IUCN. The IUCN Red List of Threatened Species. Version 2020-3. (2020).
 48. Magurran, A. Measuring Biological Diversity. *Blackwell Publishing* 256 (2004).
 49. Graham, L. L. B. *et al.* KFCP Vegetation Monitoring: Rates of Change for Forest Characteristics, and the Influence of Environmental Conditions, in the KFCP Study Area. 75 (2014).
 50. O'Brien, T. G., Kinnaird, M. F. & Wibisono, H. T. Crouching tigers, hidden prey: Sumatran tiger and prey populations in a tropical forest landscape. *Anim. Conserv.* **6**, 131–139 (2003).
 51. MacKenzie, D. I. *et al.* *Occupancy Estimation and Modeling. Occupancy Estimation and Modeling (Second Edition)* (Elsevier, 2005). doi:10.1016/C2012-0-01164-7.
 52. Sollmann, R., Mohamed, A., Samejima, H. & Wilting, A. Risky business or simple solution  Relative abundance indices from camera-trapping. *Biol. Conserv.* **159**, 405–412 (2013).
 53. Verified Carbon Standard - VCS. *Climate, Community and Biodiversity Standards (CCB): v3.1. CCB Standard* (2017) doi:10.1002/ejoc.201200111.

9 LIST OF ANNEXES

Annex 1. Identification of Project Risks

Annex 2. VCS AFOLU Non-Permanence Risk Analysis

Annex 3. Canal Blocking Plan, Canal Blocking Condition Survey and Hydrological Monitoring Planning Standard Operation Procedures

Annex 4. Peat Characteristics and Subsidence Monitoring SOPs

Annex 5. Proxy Analysis of Reference Region for Conversion/Deforestation Rate

Annex 6. Default Factors for Quantification of GHG Emissions in the Baseline and Project Scenario

Annex 7. Regional Fire Probability Modeling for Predicting Fire Risk

Annex 8. Estimate of Annual Area Burnt and Simulation of 100-Year Fire Occurrence

Annex 9. Justification of Eligibility of the ARR Project Area

Annex 10. Land Cover Classification for 2020 in the Project Area

Annex 11. Lidar-derived Digital Terrain Model (DTM) Overview

Annex 12. Peat Inventory of the Project Area

Annex 13. Hydrological Modeling of the Water Table Levels in the Project Area during the Monitoring Period 2020

Annex 14. Project Scenario Emission from Peat Decomposition Calculation

Annex 15. Uncertainty in WRC Estimates

Annex 16. SMPP Species Inventory Showing Taxonomic Class, Species Name, IUCN Status, Trigger Species Status, and Record Origin Activity

Annex 17. Replanting Activities during the 2020 Monitoring Period

Annex 18. Overview of Species Diversity Metrics to Assess Biodiversity in the Project Area

Annex 19. Strata Changes in the Baseline Scenario