

SUMATRA MERANG PEATLAND PROJECT (SMPP)

MONITORING REPORT



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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 have drained 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 25 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. The forest cover was maintained 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.

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List of Acronyms

Abbreviation	Meaning
A/R	Afforestation/Reforestation
AFOLU	Agriculture, Forestry, and Other Land-Use
AGB	Aboveground biomass
ALOS	Advanced Land Observing Satellite
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
DOC	Dissolved Organic Carbon
DRM	Disaster Risk Management
DTM	Digital Terrain Model
EN	Endangered
ENSO	El Niño/Southern Oscillation
EORC	Earth Observation Research Center
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

Abbreviation	Meaning
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
ha	Hectare
HCV	High Conservation Value
HP	<i>Hutan Produksi</i> / Production Forest
HR	Human Resources
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
JAXA	Japan Aerospace Exploration Agency
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
NEK	<i>Nilai Ekonomi Karbon</i> / Carbon Economic Value

Abbreviation	Meaning
NER	Net GHG Emission Reductions
NGR	Net GHG Emission Removals
NTFP	Non-Timber Forest Products
OC	Total Opportunity Cost
OLI	Landsat 8 Operational Land Imager
ON	Other Natural Risk
PALSAR	Phased Array L-band Synthetic Aperture Radar
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
SMPP	Sumatra Merang Peatland Project
SOP	Standard Operation Procedure
SRN	Sistem Registri Nasional / National Registry System
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

Abbreviation	Meaning
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	In 2021 the project successfully completed the construction of an additional 15 dams, bringing the total to 203 peat compaction dams across the concession. Consequently, water table levels throughout 2021 were raised and maintained.		203 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 2021, the project detected zero fire hotspots in the SMPP Project Area (using a Satellite-based early warning system). The occurrence of hotspots in the Project Zone increased slightly, from eight in the previous monitoring period to 11 in this monitoring period. - The project held a four-day firefighting training with Manggala Agni —fire brigade under the Indonesian Ministry of Environment and Forestry (MoEF). The project also supported the Village Fire Prevention Community (KMPA) from Muara Merang & Kepayang villages to attend the training. - The project supported fire safety training for each SMPP field staff member upon their induction into the project.	PD Section 2.1.11 and 4.3.1 in this document	- The project has maintained zero fire hotspots in the SMPP area since 2020. - 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 for fire in the SMPP and wider area. - Firefighting training for SMPP staff working inside the project area was held with Manggala Agni —fire brigade under the Indonesian Ministry of

Outcome or Impact	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	Reduction in human activity within the SMPP area has led to reduced fire risk		Environment and Forestry (MoEF). - The project facilitated the Village Fire Prevention Community (KMPA) from Muara Merang & Kepayang villages to attend the firefighting training with Manggala Agni. - Fire response training for nearby concessions and SMPP stakeholders. - Continued engagement with neighboring concessions on fire safety coordination and joint training. - Continue minimizing the impact of fires within the project area and maximizing fire resilience in the SMPP and surrounding landscape. - Ensure natural forest ecosystems/habitats recover that support key species, - 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	Net estimated emission removals in the project area, measured against	478,726	3.2.4.3	157,202

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
reductions or removals	the without-project scenario			
	Net estimated emission reductions in the project area, measured against the without-project scenario	1,140,985	3.2.4.2	4,600,460
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	22.64 Hectares (ha)	3.1.3.1.7	22.64 Hectares (ha)
Improved land management	Number of hectares of existing production forest land in which IFM ⁴ practices are expected to occur as	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
	a result of the project's activities, measured against the without-project scenario			
	Number of hectares of non-forest land in which improved land management 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
Training	Total number of community members who have improved skills and/or knowledge resulting from training provided as part of project activities	15 health workers and cadres from Muara Merang and Kepayang villages received a refresher training program covering anti-stunting, health administration (Kartu Menuju Sehat), and the importance of breastfeeding and postnatal infant care. Four people from Muara Merang and Kepayang village fire prevention communities took part in a four-day fire prevention training with Manggala Agni and the SMPP staff. Two people from Tebing Harapan, a	2.1.11; 4.3.1	15 health workers and cadres from Muara Merang and Kepayang villages, received a refresher training program covering anti-stunting, health administration (Kartu Menuju Sehat), and the importance of breastfeeding and postnatal infant care. 132 households of either pregnant women or mothers with babies received training on identifying the dangers of stunting and how to avoid them. Four people from Muara Merang and Kepayang village fire prevention

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
		hamlet under the Muara Merang village, were trained to assemble and install rainwater catchment systems as a livelihood opportunity. 25 households received training on the usage and maintenance of rainwater catchment systems.		communities took part in a four-day fire prevention training with Manggala Agni and the SMPP staff. Seven people from Muara Merang and Kepayang villages were trained to assemble and install rainwater catchment systems. 75 households received training 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 resulting from training provided as part of project activities of project activities	15 health workers and cadres from Muara Merang and Kepayang villages, received a refresher training program covering anti-stunting, health administration (Kartu Menuju Sehat), and the importance of breastfeeding and postnatal infant care. 132 households which consisted of either pregnant women or mothers with babies received training on	2.1.11.5	15 health workers and cadres from Muara Merang and Kepayang villages, received a refresher training program covering anti-stunting, health administration (Kartu Menuju Sehat), and the importance of breastfeeding and postnatal infant care. 132 households which consisted of either pregnant women or mothers with babies received training on

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
		identifying the dangers of stunting and how to avoid them. An estimated 48% or 12 individuals of the 25 household members that received rainwater catchment systems also received training on the usage and maintenance of the rainwater catchment system.		identifying the dangers of stunting and how to avoid them. An estimated 49% or 37 individuals of the 75 household members 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	63 employees as of December 2021, of which 43 were assigned at the project site.	2.1.11.5; 4.2.1; 4.4.1	151 people total have been employed since project inception as of December 2021.
	Number of women employed as a result of project activities, expressed as number of full-time employees	19% of employees = 12 women currently employed	2.1.11.5; 4.2.1; 4.4.1	35 women total have been employed since project inception as of December 2021.
Livelihoods	Total number of people with improved livelihoods ⁷ or income generated as	14 community fishermen and one farmer family-maintained livelihoods through the protection of, and access to	2.1.11.5; 4.2.1; 4.3.4	30 recorded community fishermen and two farmer families-maintained livelihoods through the protection of and

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])

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
	a result of project activities	fishing grounds and farming land. Seven elementary school teachers, eight afterschool teachers, and two librarians are also supported by the project financially, as well as nine teachers and staff from the adult education program. The project also provides a monthly salary to two health workers from each village. During this monitoring period, 12 women were directly employed by SMPP.		access to fishing grounds and farming land. Ten fish farmers are supported through the establishment of a fish farmer group, pond construction equipment, fish spat, and fish food. Ten elementary school teachers, eight afterschool teachers, and two librarians are also supported by the project financially, as well as nine teachers and staff from the adult education program. The project provides a monthly salary to two health workers from each village. Up until this monitoring period, 35 women have been directly employed by SMPP since project inception.
	Number of women with improved livelihoods or income generated as a result of project activities	Eight women, including one SMPP staff, are currently supported with scholarships to continue their higher education at Open University.	2.1.11.5; 4.2.1; 4.3.1	Eight women, including one SMPP staff, are currently supported with scholarships to continue their higher education at Open University.

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
		Six women as afterschool program teachers are also supported by the project, as well as two librarians, and five teachers from the adult education program. Two health workers from the two villages are also provided with a monthly salary so they can continue providing free health services to the community.		Six women as afterschool program teachers are also supported by the project, as well as two librarians, and five teachers from the adult education program. Two health workers from the two villages are also provided with a monthly salary so they can continue providing free health services to the community.
Health	Total number of people for whom health services were improved as a result of project activities, measured against the without-project scenario	The project has expanded its support during the COVID-19 pandemic by providing PPE, antigen kits and facilitated antigen sampling training to three health facilities in Muara Merang and Kepayang villages as well as facilitating three separate COVID-19 vaccination events administering 843 shots of vaccine to residents of the villages. The project has also provided medical equipment and regularly delivers medicines that will benefit approximately	2.1.11.5; 4.3.1	The project has so far supported three health facilities in Muara Merang and Kepayang villages, with renovation as required. The project has expanded its support during the COVID-19 pandemic by providing PPE, antigen kits and facilitated antigen sampling training to three health facilities in Muara Merang and Kepayang villages as well as facilitating three separate COVID-19 vaccination events administering 843 shots of vaccine to residents of the villages.

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
		8,000 residents of both villages.		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 Muara Merang and Kepayang villages.	2.1.11.5; 4.2.1; 4.3.1	Approximately 50% or ~4,000 female residents in 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	255 total students supported, including nine 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. 29 teachers and volunteers received library training. 82 students received scholarships to attend adult continuing education programs. The adult education programs were funded	2.1.11.5; 4.2.1; 4.3.1; 4.4.1; 4.3.1	258 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. 29 teachers and volunteers received library training. 82 students received scholarships to attend

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
		by the project to be conducted in the villages to allow higher attendance and reduce cost of attendance for community members.		adult continuing 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	130 total female students, including 7 students who received scholarships to <i>Universitas Terbuka</i> and who will become future teachers in both villages. 72 (> 50%) of 135 <i>Sekolah Dasar</i> (SD) students attending afterschool programs were females. 22 female teachers and volunteers received library training. 29 female 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	131 total female students, including, eight students who received scholarships to <i>Universitas Terbuka</i> and who will become future teachers in both villages. 72 (> 50%) of 135 <i>Sekolah Dasar</i> (SD) students attending afterschool programs were females. 22 female teachers and volunteers received library training. 29 female students received scholarships to attend adult continuing education programs.
Water	Total number of people who	25 rainwater catchment systems	2.1.11.5; 4.3.1	77 rainwater catchment systems

Category	Metric	Achievements during the Monitoring Period	PD Section Reference	Achievements during the Project Lifetime
	experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	were installed in houses in Tebing Harapan, a hamlet under the Muara Merang village. Residents from 77 households with improved water resources = ~200-300 people.		were installed in houses in Muara Merang and Kepayang villages. One was installed in Kepayang elementary school. One is installed in each of the village health facilities which both see an average of 30-50 patients per month. Total Residents with improved household water resources = ~400-500 people.
	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 (i.e., ~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 (i.e., ~200-250).
Well-being	Total number of community members whose well-being ⁸ was improved as a	The livelihoods of 14 community fishermen and one farmer family were improved and the education reached 255	4.2.1; 4.3.1; 4.4.1	The livelihoods of 30 community fishermen, ten fish farmers and two farmer families was improved, and the

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 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
	result of project activities	students (see Education section above).		education reached 258 students (see Education section above).
	Number of women whose well-being was improved as a result of project activities	The well-being of the women in the families of the 14 community fishermen and one farmer were improved and female participation in the education program reached 130 students (see Education section above). Seven women were supported with scholarships for higher education at Open University. Six women were supported as afterschool program teachers. During the monitoring period, 12 women were directly employed by SMPP.	4.2.1; 4.3.1; 4.4.1	The well-being of the women in the families of the 30 community fishermen, 10 fish farmers, and two farmers were improved and all-time female participation in the education program reached 131 students (see Education section above). Eight women were supported with scholarships for higher education at Open University. Six women were supported as afterschool program teachers. Up until this monitoring period, 35 women have been directly employed by SMPP since project inception.
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

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 25 Vulnerable species occurring in the project area.	5.5.1	13 Critically Endangered or Endangered species and 25 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 in a regenerating but 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 delivered positive net benefits in terms of participation and expansion.

This report covers the monitoring period from January 1st, 2021, to December 31st, 2021. Throughout this period, the project has supported a daily forest patrol system, and with daily weather monitoring. The project continued to implement community development activities and other programs achieving positive impacts for stakeholders. During the monitoring period an additional 15 dams were successfully constructed, bringing the total to 203 permanent canal blocking dams.

Water table level was monitored in dip wells along 22 transects up to 1 km outside of the project boundary. Data was collected at the main canal outflows and was included in hydrological modeling. The project also installed 30 camera traps (compared to 18 camera traps installed in 2020), which has increased the scope for monitoring positive biodiversity impacts.

Section 3.2.3.1 describes estimation of emissions from activity shifting for avoiding planned deforestation and planned degradation (LK-ASP), by comparing estimated parameters set as the baseline in PD versus actual parameters based on annual government statistics of licensed areas, as well as comparing deforested areas estimated through an annual global tree cover loss dataset versus estimates in the PD, and leakage calculations in HTI concessions (ha). Section 3.2.3.2 describes why change in estimation of emissions from displacement of pre-project agricultural activities (LK-ARR) was zero. Section 3.2.3. describes estimation of emissions from ecological leakage (LK-ECO) by monitoring water table levels affected by rewetting activities.

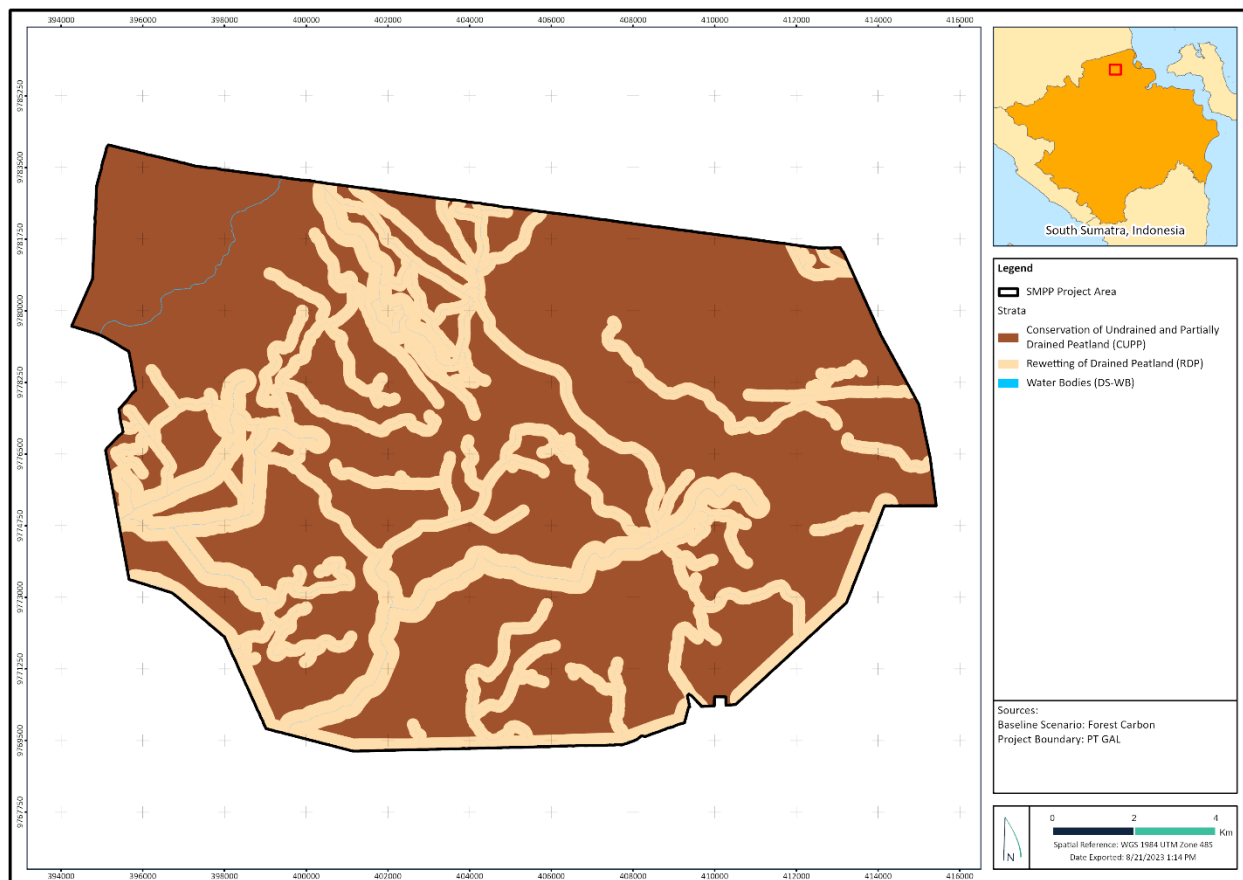
In this monitoring report the non-permanence analysis was updated using the most updated Non-Permanence Risk Tool (v4.0), as detailed in project's supporting documents. The Internal Risk has been monitored through tracking project's financial and management models, The External Risk was monitored by tracking updates in the World Bank Governance Indicators of Indonesia, policy, or regulatory changes, as well as changes in community and land tenure. The Natural Risk was monitored through tracking incidents of hazard occurrences. The total Internal Risk score was 11, External Risk score was 0, and Natural Risk score was 3, totaling the overall risk rating to 14. Therefore, the combined non-permanence risk buffer for the project was determined as 14% and was applied to both WRC and ARR net emission reductions.

Overall, from the beginning of this fourth monitoring period in January 2021 through the end of the monitoring period in December 2021, the SMPP estimates that 1,619,710 metric tons (t) CO₂-e in emission reductions or removals 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 the sub-categories Conservation of Undrained and Partially Drained Peatland (CUPP) under Conservation

of Intact Wetlands (CIW) and Rewetting of Drained Peatland (RDP) under Restoration of Wetland Ecosystems (RWE) . The SMPP is not a grouped project.



Map 1. Stratification of the project area based on WRC sub-categories.

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.

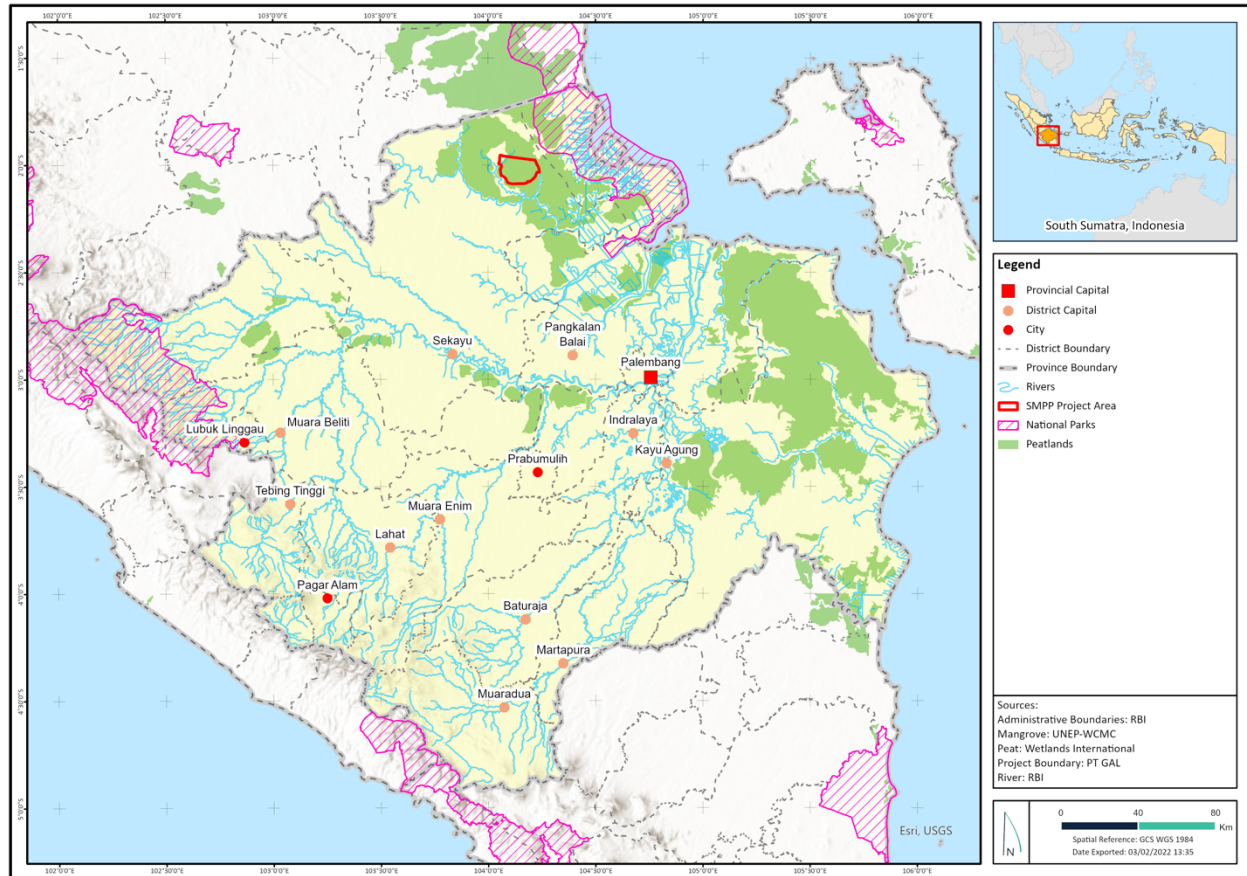
2.1.6 Project Crediting Period (G1.9)

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.

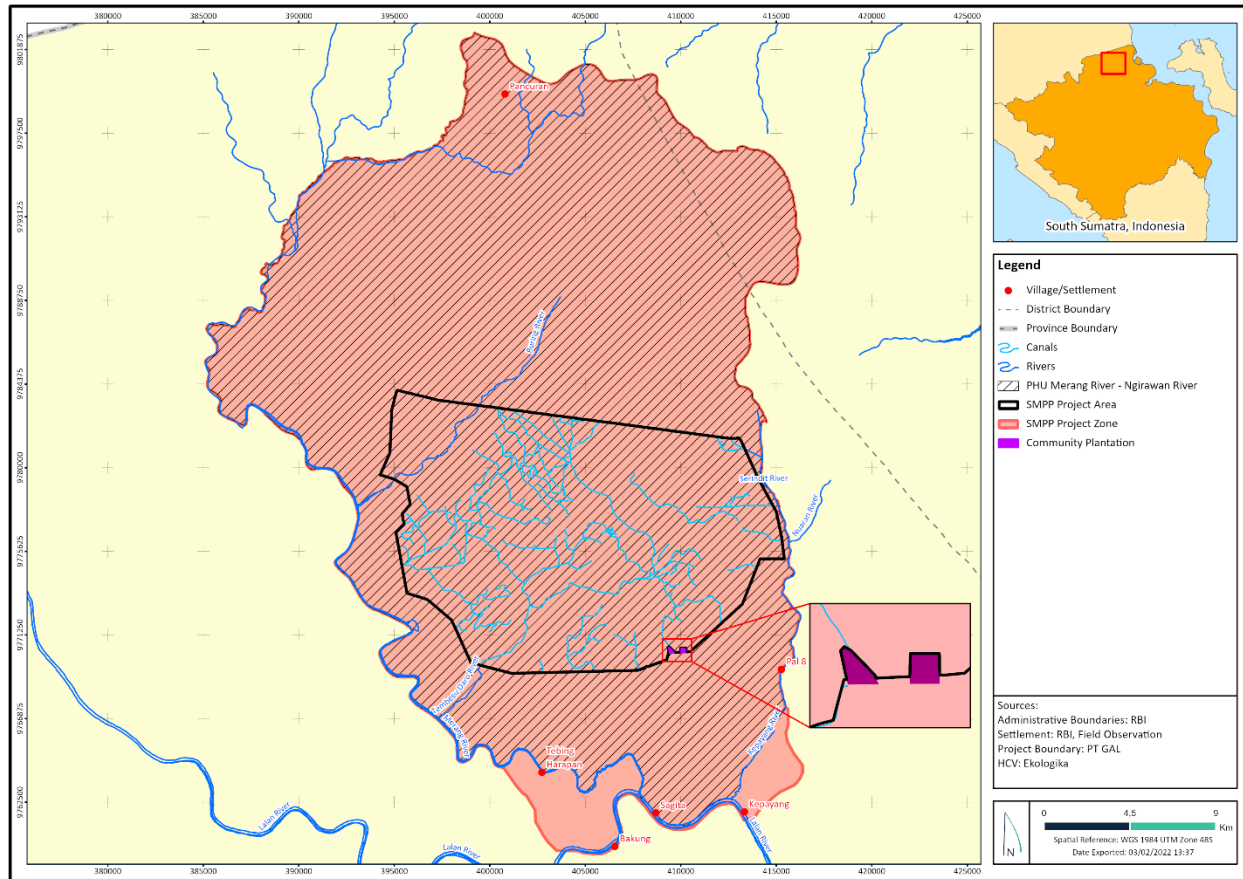
As per the updated VCS Standard v4.2 (2022), the baseline reassessment period is every six years for avoided planned deforestation and degradation (APDD) projects, where the deforestation agent is unknown. For projects that are registered on or before 19 January 2022, this update is effective at the subsequent baseline reassessment period. Therefore, for the SMPP project the first baseline reassessment will be ten years after the start date, and then subsequently every six years.

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 2). The Musi Banyuasin regency is in the northern part of South Sumatra province and is between 103° 10' - 104° 45' East (E) and 1.3° - 4° South (S), it covers a total area of 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 3).



Map 2. Location of the SMPP area in Sumatra, Indonesia.



Map 3. Location of the SMPP Project Area and Project Zone.

The SMPP project zone consists of the formal project area and the government delineated peatland hydrology unit (PHU). It has also been extended to include the village areas where community development activities 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 (Map 3). 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 covers 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 150,000 ha.¹ A number of critical climate and biodiversity assets are linked to the wider peat swamp forest area 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 version 1.5 of VCS Methodology VM0007, as per VCS Standard (v4.5, section 3.22.2). 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 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 1.2)	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 1.2)	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 1.2)	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 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 1.1)	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 1.1)	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 1.1)	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 1.1)	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 1.1)	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 1.1)	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 1.3)	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 1.3)	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 1.1)	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 3.0)	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 1.2)	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 1.1)	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 1.1)	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 1.1)	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-REDD (Version 2.2)	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-REDD (Version 2.2)	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-REDD (Version 2.2)	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 1.2)	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 1.2)	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 several 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 2020-2024² 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 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 2024.³

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. 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.⁴

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 2021 the project employed 26 staff from surrounding areas out of total 43 field staffs or around 60.5%. 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 several women's groups in nearby villages and settlements. During this monitoring period, the project directly employed 19% or 12 women as project staff. 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.⁵

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.⁶

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 2021. 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 reside 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.
January 2021	The project has successfully launched a new program in collaboration with <i>Taman Bacaan Pelangi</i> , a non-profit organization working to establish children's libraries in remote areas, to increase students' engagement with libraries and reading interests in general. The program comprises multiple stages of activities such as teacher training, library renovation, supplying children's books, and parents engagement workshop.
February 2021	The project completed the installation of additional 15 dams, bringing the total number of permanent canal blocking constructed since 2019 to 203 unit.
February 2021	The project recorded the presence of the Sunda Pangolin in SMPP, which is a critically endangered species and one of the most highly trafficked species.
February 2021	The project has successfully installed two SmokeD smoke detection cameras at the main camp, which are working very well. This strengthens the fire monitoring system of the SMPP project tremendously and helps to detect fires within minutes day and night. A total of almost 20 kWp photovoltaic solar panel system installation has been completed to practically avoid the use of fossil fuel for the main camp and forest protection posts electricity needs.
April 2021	The project held a four-day fire prevention training with Manggala Agni —fire brigade under the MoEF. The training was also attended by the Village Fire Prevention Community from both Muara Merang & Kepayang villages by the project's invitation.
September 2021	The project completed a trial for gibbon survey using AudioMoth sensors installed in five locations in the dense forest. The gibbon song data will then be analyzed in the accompanying software to estimate the number of groups/individuals of the Gibbon.
September 2021	The 2020 MR verification audit has been successfully completed and the verification report has been published and uploaded to the Verra registry.
December 21, 2021	Third verification issued for monitoring period Jan 1 st – Dec 31 st , 2020.

2.2.2 Methodology Deviations

The project proponent has made a minor adjustment from the methodology for CDM tool “AR-AM-Tool-14”⁷ on the monitoring and measurement of carbon stock changes in the project scenario. This adjustment for “carbon stock estimates in trees at a point of time” now combines inventory and remote sensing methods to complement the approach outlined in the methodology. This adjustment has resulted in increased accuracy by decreasing uncertainty to below 5%.

The approach for the project scenario is adjusted slightly from section 8.1 “*Estimating carbon stock in trees at a point of time*”, as tree biomass at the plot level was used to extrapolate biomass and subsequent carbon stock at the stratum level following VCS tool VT0005. The inventory data was also used to develop a project specific wall-to-wall map of AGB (for 2021), assess carbon stock changes between 2016–2021, as described above. This does not impact the baseline scenario, project additionality, or the applicability of methodology.

The only adjustment was the change to equation 13 of “AR-AM-TOOL-14” which is replaced with equation 2.1 below, where B_{TREE} is replaced with $\sum_{i=1}^n B_{TREE}$, which is required for deriving the AGB estimates of each pixel for wall-to-wall biomass maps.

$$C_{TREE} = \frac{44}{12} \times CF_{TREE} \times \sum_{i=1}^n B_{TREE} \quad (2.1)$$

Where:

C_{TREE}	Change in carbon stock in trees in the project area (t CO ₂ -e)
$\frac{44}{12}$	Molecular ration of CO ₂ to C (unitless)
CF_{TREE}	Carbon fraction of tree biomass; t C (t Dry Matter, DM) ⁻¹
B_{TREE}	Tree biomass in the tree biomass estimation pixel i (t DM)
i	1, 2, 3, ... n pixel of the wall-to-wall map (unitless)

The tool VT0005 prescribes estimating aboveground live vegetation biomass by using remote sensing samples (e.g., airborne Light Detection and Ranging (LiDAR)) combined with *in-situ* inventory plots to extrapolate to the strata level (such as land use land cover classes) or project area of interest (AOI). This tool is being used as intended in terms of the sampling approach and can be used for wall-to-wall mapping if remote sensing data covers the entire AOI and therefore the deviation is justified.

The applicability conditions of VT005 are met because the project activity ARR requires the estimation of aboveground tree biomass. Remote sensing data were collected for the periods 2016 and 2021. The predictive model relates remote sensing metrics to aboveground tree biomass parametrically (see MR Annex section 18.2.2, equation A 18.3). The tool was not used to determine change in biomass density over time, but rather used two distinctive points in time to determine the difference between biomass between these points in time.

In line with the tool, the SMPP has utilized inventory plots (for year 2021) and airborne LiDAR samples (for year 2016) and complemented the LiDAR readings from a spaceborne database, modelled a relationship with wall-to-wall radar and optical satellite images, created a per-pixel vegetation height estimate map, then applied the model relating vegetation height to aboveground biomass (AGB), to produce the wall-to-wall per-pixel estimates of AGB (see Annex 18 for details).

This approach decreases uncertainty around the carbon stock estimation by calculating the total uncertainty as the relative error of combined uncertainties from modeled tree height and plot-based AGB, resulting in an uncertainty below 5% for this monitoring period (see Annex 18 for details).

The project will monitor and model carbon stock changes in AGB in the project scenario through carbon stock mapping and analysis. The analysis will compare maps between monitoring periods. The calibrated model produces accurate wall-to-wall AGB maps with low uncertainty levels, when integrated with new remote sensing datasets. Uncertainties will be monitored and reported for each monitoring period to ensure that the highest uncertainty will not exceed the 10% threshold.

2.2.3 Minor Changes to Project Description (RULES 3.5.6)

One community or biodiversity change to project design that does not require a project description deviation occurred during this monitoring period. This change relates to the updating and improvement of the biodiversity monitoring plan. Beginning in the second verification period, the biodiversity monitoring plan has been updated and improved according to adaptive management and continuous improvement principles to include more detail and standardization on how biodiversity is monitored over time and how biodiversity data is analyzed. The latest version of the biodiversity monitoring plan can be seen in Annex 23.

The originally planned bird surveys, camera trap surveys, and vegetation surveys were all improved and refined, but the originally planned targeted gibbon and hornbill listening surveys were deemed no longer necessary or logistically feasible to monitor changes in biodiversity over time.

Listening post surveys were assessed to be expensive and posed an unnecessary safety risk in tiger habitat. In any case, hornbills are monitored through point transect surveys for birds, and gibbon populations can be monitored indirectly through indicator species proxies and threats (e.g., forest cover loss, fire hotspots, illegal hunting incidents, etc.).

Monitoring patrols and illegal activities through the SMART software application, as planned in the project description, is not currently included in the most recent version of the monitoring plan or is not currently being implemented, but patrols and illegal incidents are still monitored manually. Some training in SMART and a web-based alternative called EarthRanger has taken place and will likely be implemented in the future to improve patrol efficiency and effectiveness. If or when this happens, SMART or EarthRanger will be included in the biodiversity monitoring plan.

These minor changes are in conformance with the CCB Standards. The improved biodiversity monitoring more effectively meets and exceeds the minimum CCB Standards for monitoring biodiversity by including more detail on survey methodology and data analysis, and more clearly demonstrating changes in biodiversity resulting from project activities under the with-project scenario in the project zone and more clearly describing the population trends of many trigger species.

2.2.4 Project Description Deviations (RULES 3.5.7 – 3.5.10)

There are no Project Description deviations to report for this monitoring period.

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 v4.0 (September 19th, 2019, version), shown in Annex 2: VCS AFOLU Non-Permanence risk analysis. A summary of this risk analysis is outlined in Table 3 below and 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 occur 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, signages 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 2021 monitoring period, the project continued to implement significant natural and human induced risk mitigation activities such as hydrology management through the construction of compacted peat dams, frequent forest patrols, operation, and improvement of an early warning fire detection system and fire mitigation and prevention training. Hydrology management through monitoring water table levels using dip wells throughout the project area, and rain fall measurements through several weather stations, further reduced natural and human caused risks to the project area. Activities relevant to natural risk mitigation for the 2021 period are summarized in Table 42.

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 are being engaged, 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 degraded peatland areas through the construction of permanent canal blocks. This is a recognized approach to restore the hydrology of degraded areas and will reduce the risk of fire in the landscape allowing the natural vegetation to be restored over the life of the project, which significantly improves the habitat. 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 in 2021, 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 2021. The purpose of these meetings was to continue building trust and fostering relationships with project stakeholders, and to engage in further efforts towards understanding 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 project implementation scales up.

The project publicized a variety of informational materials in both Bahasa Indonesia and English using 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 conducted a combination of formal stakeholder consultations and informational meetings with the communities dating back to 2016 as part of the FPIC process, as mentioned in the SMPP PD (Section 2.3.7). At this time the project demonstrated how relevant and adequate information about potential costs, risks and benefits to communities was provided to communities prior to any decision making on their behalf as it related to project participation.

Since then, no additional stakeholders have been identified that would require FPIC to be revisited and the only impacted stakeholders remain the fishermen and the single farmer. Similarly, there has been no changes to the types and scale of project activities that would necessitate FPIC processes be repeated with the current suite of impacted stakeholders. There has been no addition to the stakeholder groups and no changes to the relative impact of the activities. Should any new or previously unidentified stakeholder

be identified, additional participatory process will be carried out to ensure ongoing compliance with CCB standards.

The variety of social consultations conducted are 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 because 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 2021, the SMPP Community Development manager successfully completed follow-up consultations with the communities as defined by CCB (while maintaining strict COVID-19 health and safety protocols), namely the fishermen inside the project area and the farming operations within the southern project boundary. The meetings identified the need 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 fishermen. These interactions were also used to further inform and educate stakeholders about the importance of canal blocking to restore and protect the site from future fires.

CCB-Defined “Other stakeholders” were also included in consultations and are a larger beneficiary group which includes residents of Muara Merang and Kepayang villages, along with other nearby settlements. Follow-up meetings took place with other stakeholders in these villages through one-on-one discussions, small group meetings and through participation in formal village meetings to which village officials invited project representatives. The meetings 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 announcing the public comment period and audit were posted in communities throughout the project zone. These notices included helpful instructions on how to submit a public 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 project communities and residents of nearby villages and settlements. 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 a potential remote meeting or in person consultation. This will ensure, stakeholders can share their feedback with the auditor regardless of logistical or travel limitations. The project will arrange 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 since 2016 (see SMPP PD Section 2.3.3). Project staff will continue to facilitate these meetings throughout the project duration. 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) were conducted by the SMPP community development team and are described further in PD Section 2.1.8. using this approach again in 2021, the team carried out extensive direct engagement with the communities and other stakeholders across the project zone. Since the project started in 2016, the engagement effort has consisted of both formal discussions and informal conversations without specific agendas.

Throughout the 2021 monitoring period, project staff consulted with local communities and other stakeholders to ensure mutual understanding regarding all project activities and potential impacts. During the 2021 monitoring period the project engaged with at three community fishermen, nine farmers, 40 school groups or other education facilitators, 24 village officials, eight managers from nearby concessions, five local women's groups, and 50 village residents. These engagements took place across the project zone in the Muara Merang and Kepayang villages and other nearby settlements. 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, including one-on-one interviews, group interviews, meetings, and focus group discussions.

SMPP group	Stakeholder Groups	Number of times engaged (in the previous monitoring period: 2020)	Current engagement (In 2021 monitoring period)
Community	Fishermen	7	3
	Farmers	2	9
	Total formal community consultations:	9	12
Other stakeholders	School groups and education facilitators	32	40
	Officials from nearby villages	19	24
	Managers from nearby concessions	3	8
	Residents from nearby villages and settlements	41	50
	Women's groups from nearby villages and settlements	5	5
	Total formal other stakeholder consultations:	100	127
Type of engagement	One-on-one interview	63	102
	Group interview	18	5
	Meeting	26	29
	Focus Group Discussion (FGD)	2	3
	Total number of consultations:	109	139

Through these consultations, the project has been able to implement programs that are based on the needs of community members and stakeholders. Community health center support and renovation, installation of rainwater catchment systems 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 resulting 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, farming community groups, and other stakeholders through in-person meetings. Community engagement staff actively listen to recommendations made by community members, or other stakeholder groups, and adapt and improve methods/programs 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 lessons learned, technological advancements, and scientific knowledge. These strategies are in accordance with the project's SOPs and its monitoring plans (see PD sections 3.3.3, 4.4.1, 5.4.1).

During the 2021 monitoring period, the project had consistently engaged with project communities and other stakeholders on community development plans to collect feedback. The information collected showed that stakeholders requested project expansion of health and education programs. Inputs from stakeholders continue to be a major influence on the design and implementation of the community development program, as exemplified by the new program launch on library management and literacy improvement as part of education support 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. This is the most effective method in an area where phone and internet connectivity are limited. Project staff have conducted participatory surveys with the PRA method throughout the community development process. This includes focus group discussions, interviews with men and women living in nearby settlements and villages, observation and ground checks of 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 consistently with project communities and other stakeholders on project implementation and design. This allows for the incorporation of local knowledge and local aspirations into the project design aspects and helps the project mitigate unforeseen impacts. Consultations ensure inclusive engagement with men, women, and marginalized groups, encouraging 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.

As per the CCB standard (G3.6 and G5.2), FPIC processes are for people whose access or other rights may be affected by project activities. Towards the end of the 2021 monitoring period, four additional seasonal fishermen were encountered in the project area and are currently being engaged to obtain FPIC and will be covered in the next monitoring report. Any future FPIC processes that may be required by CCB Standards (if additional affected rights holders or communities are identified) will ensure gender—and culture—sensitive inclusion of stakeholders in participatory decision-making and project implementation processes.

Outside of the CCB requirements to demonstrate culture and gender sensitive project implementation as it relates to impacted communities, the SMPP has an established community development program in the wider project zone that targets communities and community groups defined as “other stakeholders”. In

these endeavors the SMPP has put a strong emphasis on inclusive, fair, and equitable engagement with programs specifically targeted at women in the form of maternal health and anti-stunting programs, and children through anti-stunting and education programs for both adults and youth (see Section 4.2). The SMPP also implements an equitable and gender sensitive hiring policy with targeted gender ratios for staff and a preference for local hires where possible (see Section 2.3.14).

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 which ensures no one is involved, or complicit in, any form of discrimination or sexual harassment with respect to the project and its communities. 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. Furthermore, the project has an equal opportunity policy that aims to facilitate a more even ratio of male to female employees. To ensure compliance, the project has a grievance system in place that provides all project employees, community members, and other stakeholders with a quick-response system if any discriminatory actions or sexual harassment does occur. This ensures any grievances can be addressed quickly and appropriately.

2.3.12 Grievances (G3.8)

The grievance redress mechanism within the SMPP plays an important role in keeping the project running safely, smoothly, and equitably. If conflicts or grievances do arise, the project relies on the feedback and this mechanism, which has been outlined and shared as a formal project policy as part of stakeholder consultations. 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 is designed to capture issues or conflict between the community and the project, issues related to employee rights and work practices, and employee health and safety.

Where grievances occur and are reported, the appropriate staff will quickly respond by following the formal mechanism process. Grievances will be assessed to identify and verify the cause, actors, and scale of grievances. 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 formal mediation and arbitration and be subject to a hearing at which both parties can testify. All cases will be examined to the extent allowed by Indonesian laws and regulations in the relevant jurisdiction before decisions are made and grievances resolved.

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 Indonesia 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 and resolutions. This can be viewed upon request by project stakeholders or auditors. There were no grievances reported during the 2021 monitoring period.

2.3.13 Worker Training (G3.9)

The SMPP has a target to have 80% of field staff being residents of nearby villages and settlements and has achieved 60.5% employment of locals (26 out of 43 field staff) during 2021. As part of the on-boarding process, the project provides all staff with an orientation program where it provides overviews of the project 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 panels, IoT field 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, as an equal opportunity employer, is committed to engage with the 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 to increase community and stakeholder benefits. Furthermore, the project has a target to have 25% of its work force comprising women to ensure greater gender balance in a field traditionally male dominated. During this monitoring period, the project directly employed 12 women as project staff (19%). The project aims to reach the 25% target in the next monitoring period. To create opportunities for marginalized groups, the project also has positions available for staff who have not obtained high school diplomas to ensure these 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 further their education.

Job opportunities are publicly advertised in similar channels as to 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 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 filtered in accordance with the project's equal opportunity policy. Where candidates show similar or equal capacity, experience or potential for the same role, local and female candidates will be given preference.

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 relationships in Indonesia, which stipulates the working conditions and rights and obligations of the employees and the Company. The SMPP fully complies with these regulations regarding 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 also follows its own human resource policies on employment practices. 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 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 several risks including strenuous activities in wet, humid, and hot conditions, forest fires, transportation accidents, interactions with illegal loggers, encounters with dangerous wildlife, and exposure to mosquito borne sicknesses. Project health and safety training addresses these risks and 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 conditions 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.

Potential Occupational Risks	Risk Mitigation Action
Transportation accidents	Staff are trained in driving and are required to always wear seatbelts and wear helmets when driving motorbikes.
Interactions with people conducting illegal natural resource extraction/destruction in the project area (e.g., loggers or poachers)	All project field staff (particularly patrol staff) are trained according to the project patrol SOP. This SOP gives guidance on how patrol staff should act during encounters with different types of actors that may enter the project area, including people engaged in illegal natural resource extraction/destruction. Because project patrol teams are unarmed, they are trained to distinguish between armed and unarmed actors, and to assess the risk of engaging them. If the patrol teams are faced with armed actors or outnumbered by these actors, patrol teams are trained to move away to a safe distance and coordinate with management staff in the field to document and report these incidents to local authorities.
Encounters with dangerous wildlife	All project field staff are trained in line with Dangerous Wildlife Encounter Safety Guidelines made specifically for this project. These guidelines assess the risk posed by the most dangerous species present in the project area, improves field staff understanding of these species' behavior and ecology, and gives species-specific guidance on how to avoid encounters, react to encounters, and react to attacks.
Exposure to mosquito borne sicknesses	All staff are provided adequate clothing, 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 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).

Project Activity	Sub-project Activity	Key Skills Required
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.
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, carbon measurement and monitoring skills throughout the monitoring period. The skillsets experience of the core technical team is listed in section 2.4.2. Furthermore, since project inception in 2016 and the submission of the PD in 2019, the team of experts has grown from eight in 2019 to 12 in the 2021 monitoring period. Although some positions have evolved and roles expanded, all key technical skill have been maintained or enhanced (Table 7).

Table 7. Key technical staff in 2019 and 2021

2019			2021		
SMPP Role	Name	Title	SMPP Role	Name	Title
SMPP Project Lead	Mr. Jeffrey Chatellier	Managing Director	SMPP Project Lead	Mr. Jeffrey Chatellier	CEO
SMPP Project Lead	Dr. Riza Suarga	President Director	Member of Project Management Board	Reagen Pangestu	President Director
SMPP MRV	Dr. Ophelia Wang	Technical Director	SMPP MRV	Dr. Ophelia Wang	Director of Project Design and Development

2019			2021		
SMPP Role	Name	Title	SMPP Role	Name	Title
SMPP MRV	Sebastian Persch	Forest and Peatland Scientist	SMPP MRV	Sebastian Persch	Emissions Science and Technology Lead
SMPP Head of Field Operations	Abdul Haris Marzuki	Field Site Manager	SMPP Field Site Manager	Abdul Haris Marzuki	Field Site Manager
SMPP Community Engagement Lead	Ahmad Susilo	Community Engagement Manager	SMPP Community Engagement Lead	Ahmad Susilo	Community Engagement Manager
Legal Compliance for SMPP	Mary Osmond	Legal Advisor	Legal Compliance for SMPP and Community Development Advisor	Mary Osmond	Legal Advisor
MRV	Prasetya Mahardhitama	Remote Sensing Manager	SMPP MRV	Prasetya Mahardhitama	Remote Sensing Lead
-	-	-	Forest Planting	Agus Afijanto	General Operations
-	-	-	SMPP Biodiversity lead	Catur Prasetyo	Biodiversity Manager
-	-	-	SMPP Technical Manager	Zainuddin	Carbon Credit Production Manager
-	-	-	VCS/CCB Certification and Project Management	Angga Pratama	Monitoring and Investor Reporting Lead

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 in on the ground operations for forest

restoration. 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 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.

Reagen Pangestu – President Director – Global Alam Lestari – Member of Project Management Board

Mr. Pangestu is the President Director of PT Global Alam Letari and leads the ISO certification team, 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.

2.4.2.2 Project Design, Monitoring, and Implementation

Dr. Ophelia Wang – Director of Project Design and Development - Forest Carbon – SMPP MRV

Dr. Wang is Forest Carbon's Director of Project Design and Development. A specialist in conservation entrepreneurship, Dr. Wang brings more than 20 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 cooperation *Internationale en recherche agronomique pour le developpement* (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.

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

Mr. 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.

Zainuddin – Carbon Credit Production Manager

Mr. Zainuddin leads the field management and implementation of conservation plans. He has extensive working experience in the conservation sector. Prior to SMPP, he worked for KKI Warsi and WWF Indonesia. He holds a master's degree in environmental science of Jambi University.

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 also obtained a certificate from Yale University as part of the Environmental Leadership and Training Initiative Program on Tropical Forest Landscapes, Conservation, Restoration and Sustainable Land Use. 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 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. There are no people living in the project area and no overlapping statutory rights holders. Over time, some customary use of project area resources by seasonal fishermen has been identified, FPIC processes were initiated and was obtained to ensure that no impingement upon the rights of these individuals occurred. Project staff continuously monitor the project area to identify any new or previously unidentified potential rights holders that may be affected by the project.

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

The SMPP project site is remote and located multiple hours away from any settlements. As a result, the project is visited by only a small number of individuals, and an even smaller group whose access rights could potentially be impacted by project activities. These project community members are artisanal, mostly seasonal, fishermen, who fish in the project area. These individuals have been engaged in FPIC processes since they were identified as potential rights holders, starting in 2016, as recorded in the fishermen data logs, consultation documents, and agreements supplied to auditors.



Figure 1: Consultations with fishermen using the project area in 2017

The start of the SMPP project was January 2016 when the project proponents responded to formal written request from the government of Indonesia to prevent any further damage from catastrophic fires that destroyed 99% of the forest in the project area. At that time, there were no communities or people known to be operating in what was an ecological wasteland (see PD Sections 2.1.1, 2.1.5.5, 3.1.3.1.7, and 5.2.1 for more information on fires in the project area and the resulting land cover). The project began conservation activities through forest fire patrols with staff on site as outlined in the PD. As the area began to recover from the severe fire event and staff were present at the site, consultations and engagements with the fishermen started towards the end of 2016 as they began to fish at the site.

Following these engagements and to ensure precautionary principles were followed, the project conducted an additional wide-ranging social assessment in June and July 2018 to ensure no potential rights holders were overlooked, this study indicated that only a handful of fishermen were likely to be impacted by project activities and confirmed that the project was taking the correct approach in working with any fishermen that were periodically encountered in the project area (the social scoping study has been provided to auditors).

In late April 2019, fishermen gave their FPIC—in the form of signed agreements—for the construction of permanent canal blocks which started in December the same year (agreements have been made available to auditors). Obtaining consent from these impacted stakeholders prior to the construction of permanent canal blocks was a key project milestone for ensuring the SMPP could deliver on its climate benefits through rewetting activities. Since then, project staff have continued to patrol the area to ensure any new potential rights holders are identified. Towards the end of the 2021 monitoring period, four additional seasonal fishermen who may be affected by project activities were encountered in the project area and are currently being engaged in the FPIC process and will likely be included in the next monitoring report (details of these fishermen and their engagements are included in the fisherman data log and consultation documentation recorded by project staff, which have been supplied to auditors).

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, they will be conducted with written agreements to demonstrate 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 through its forest protection and community development plans that provide sustainable livelihoods options. With stronger economic alternatives, the project expects that the incentive 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 being 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*, 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 for SMPP (i.e., IUP RAP-PAN Karbon license granted in 2013) is still valid.

Furthermore, Indonesia issued Presidential Regulation No. 98 of 2021 regarding Carbon Economic Value ("Perpres 98/21").¹⁰ This regulation aims to set guidelines across all sectors of the Indonesian economy to support the Paris Agreement and to eventually require the conducting of greenhouse emission inventories in all major sectors. This Perpres 98/21 requires that voluntary carbon market projects be registered under the National Registry System ("*Sistem Registrasi Nasional* or SRN"). The SMPP has now received a project identification number under the SRN (005-I-2020-1686) and is fully compliant with the requirements of the registration process.

Indonesia's Ministry of Environment and Forestry ("MoEF") released a new regulation as a follow up implementing regulation to the Perpres 98/21 on Carbon Economic Value. Regulation No. 21/2022 (Procedure for Implementation of Carbon Economic Value) provides guidance on implementing the Presidential Regulation on Carbon Economic Value. Under Regulation No. 21/2022, overseas trading of carbon credits is permitted as long as such credits registered in the SRN, are not counted towards another country's NDC and do not otherwise negatively impact Indonesia's NDC targets (Article 18(3)). Once credits are issued by Verra for this monitoring period the project will register the emission reductions with the SRN as it has done for all previous monitoring periods. Because the project will not be selling credits issued by Verra on the compliance market, all credits will count towards Indonesia's NDCs and will not require corresponding adjustments. To this end the project will be in full compliance with the regulations on international trade.

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 following 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 daily, 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: PT 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.

The 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: The SMPP holds a PAN/RAP license that allows for carbon sequestration and carbon stock related activities. The laws and regulations specific to the PAN/RAP license are outlined in Table 8 below, including how the project complies with each requirement.

Table 8. 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. • President Regulation No.98/2021 on the Carbon Economic Value	SRN Registration: SMPP completed the application process for Indonesia's National Registration System (<i>Sistem Registrasi Nasional</i> 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. The Project has received a project identification number (005-I-2020-1686).
• 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>, 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.

Relevant Regulation or Law	Compliance Activity
• 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 REDD+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) ¹¹

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	539,593
QA/QC procedures to be applied	See Module M-ARR
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-ARR

Comments	
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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	9,194
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 in year t
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 at year t
Equations	PD Section 3.2.2.4 Equation 27
Source of data	IPCC default factors
Description of measurements methods	See Module M-PEAT

and procedures to be applied	
Frequency of monitoring/recording	At each monitoring period
Value monitored	5,320
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	3,874
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 28
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	201
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	69.85
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-REDD)
Source of data	Remote sensing imagery
Description of measurements methods and procedures to be applied	See Module M-REDD
Frequency of monitoring/recording	See Module M-REDD
Value monitored	N/A
QA/QC procedures to be applied	See Module M-REDD
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-REDD
Comments	See Module M-REDD

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-REDD)
Source of data	Module M-REDD
Description of measurements methods and procedures to be applied	See Module M-REDD
Frequency of monitoring/recording	See Module M-REDD
Value monitored	N/A
QA/QC procedures to be applied	See Module M-REDD
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-REDD
Comments	See Module M-REDD

Data / Parameter	$A_{RRL,forest,t}$
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Data unit	ha
Description	Remaining area of forest in <i>RRL</i> at time <i>t</i>
Equations	
Source of data	Module M-REDD
Description of measurements methods and procedures to be applied	See Module M-REDD
Frequency of monitoring/recording	See Module M-REDD
Value monitored	276.98 ha
QA/QC procedures to be applied	See Module M-REDD
Purpose of data	Calculation of project emissions
Calculation Method	See Module M-REDD
Comments	See Module M-REDD

3.1.3 Monitoring Plan

3.1.4 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 2 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.

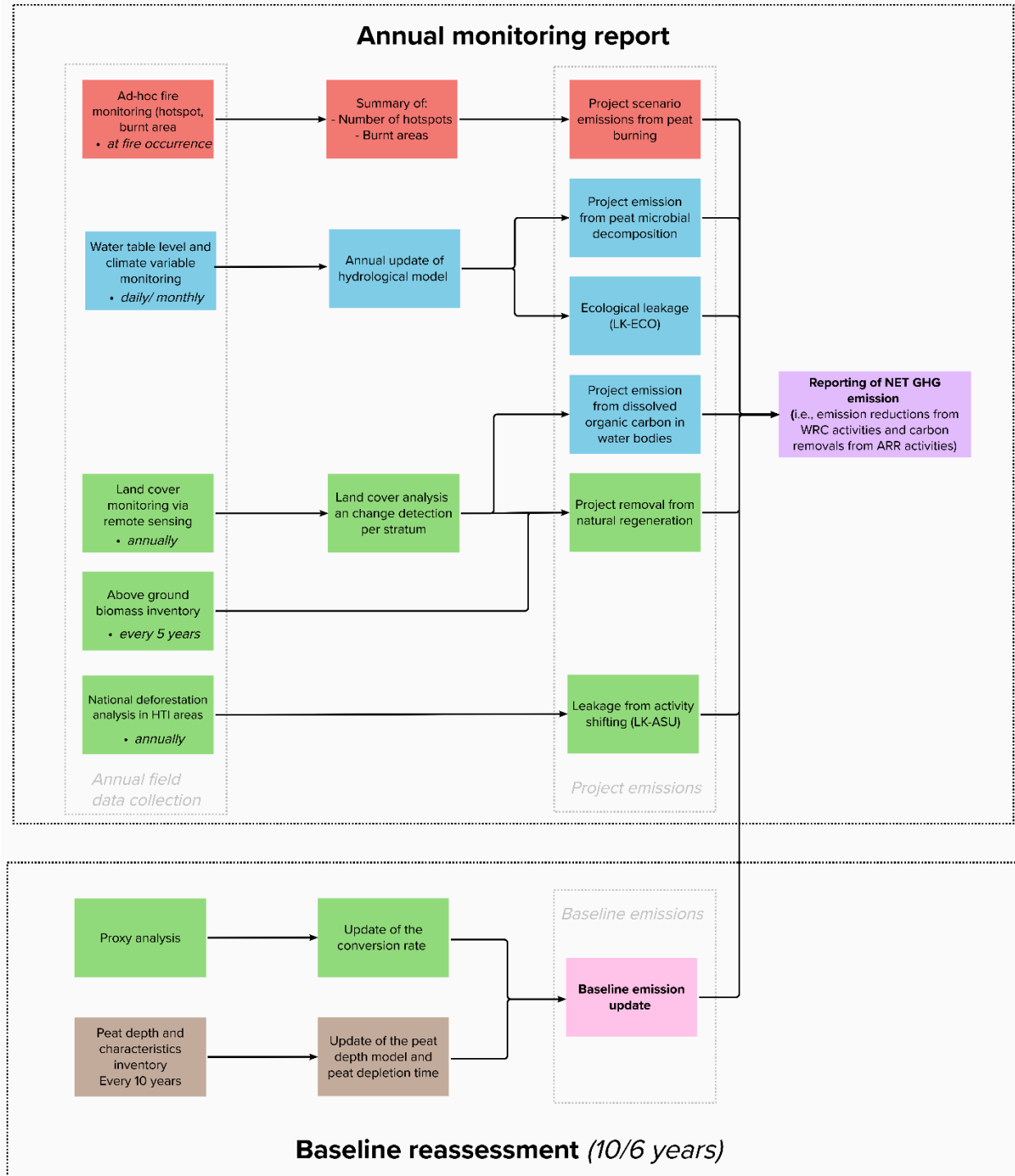


Figure 2. Schematic workflow of the GHG data collection, data management, and annual reporting.

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. 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 3). Brief, regular monitoring reports are generated to assess the quality of data received from the field and investigations into any potential outliers.

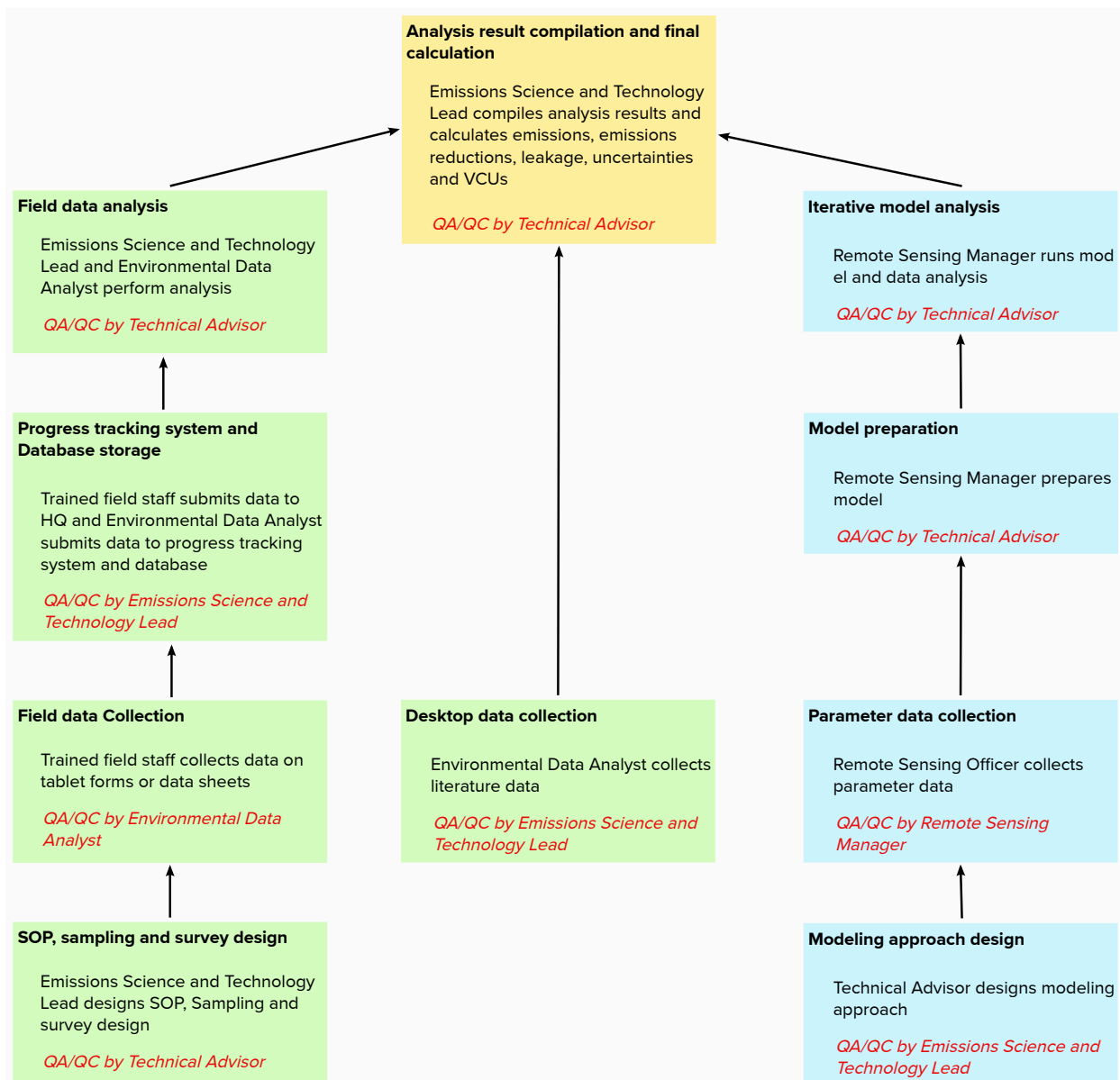


Figure 3. Data collection, QA/QC, and processing workflow.

The roles and responsibilities of each monitoring team member are listed below in Table 9.

Table 9. Roles and responsibilities of the monitoring team members.

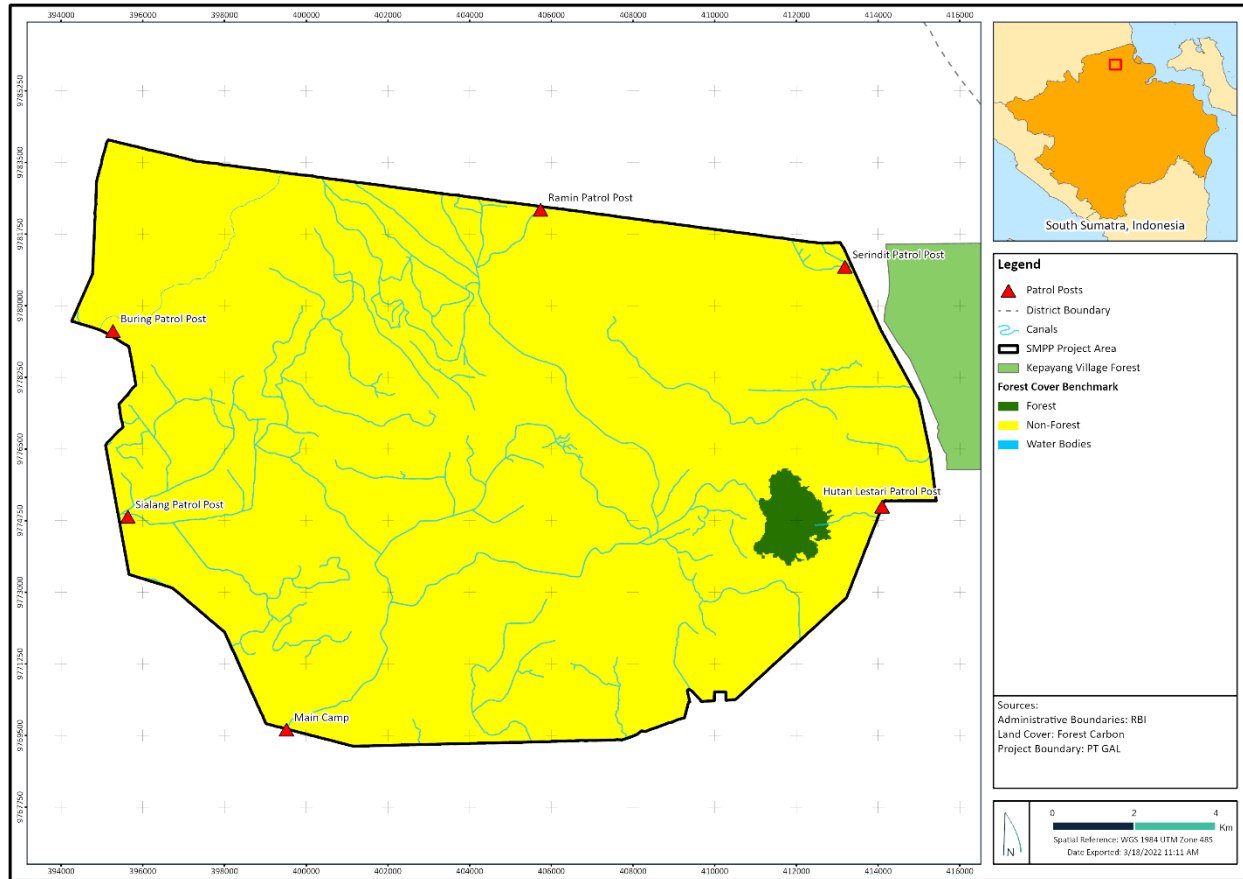
Position	Roles	Name	Short Resume
Director of Project Design and Development	Modelling approach design, QA/QC of SOP, sampling and survey design, QA/QC of field data analysis, QA/QC of model preparation, QA/QC of iterative model analysis, and QA/QC of result compilation and final calculation	Dr. Ophelia Wang	Dr. Wang holds a PhD and MSc degrees in spatial planning for conservation and brings more than 18 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.
Climate Science and MRV 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 11 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 Team Lead	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 11 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.
Monitoring and Investor Reporting Lead	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 14 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.
GIS and Remote	Parameter data collection	Rizaldy Yudhista N	Mr. Yudhista N is a GIS and Remote Sensing Specialist in Forest Carbon with 8 years of

Position	Roles	Name	Short Resume
Sensing Specialist			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	-

3.1.4.1.1 Remote Sensing

Project technical staff obtained and analyzed satellite imagery to detect land cover change over time, such as natural regeneration of vegetation. The project land cover map is updated at each monitoring period as needed.

An initial benchmark of forest/non-forest areas was created for the 2016 project start and updated annually to the current monitoring period of 2021. Map 4 below shows the map of forest/non-forest areas for this monitoring period. The emissions from deforestation will then be calculated by multiplying areas of deforestation by the actual forest carbon stock per hectare estimated for each monitoring period. The area of remaining forest will be based on subtracting non-forest area and will be recorded in a forest benchmark map, which will be updated for each monitoring period.



Map 4. Forest cover in 2021.

In addition to the above, Moderate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) hotspot data were used to provide near real-time updates on potential fire activity in the project area and alert the ground fire control and prevention team to examine the field conditions.

3.1.4.1.2 Field Measurement

3.1.4.1.2.1 Monitoring C Stock

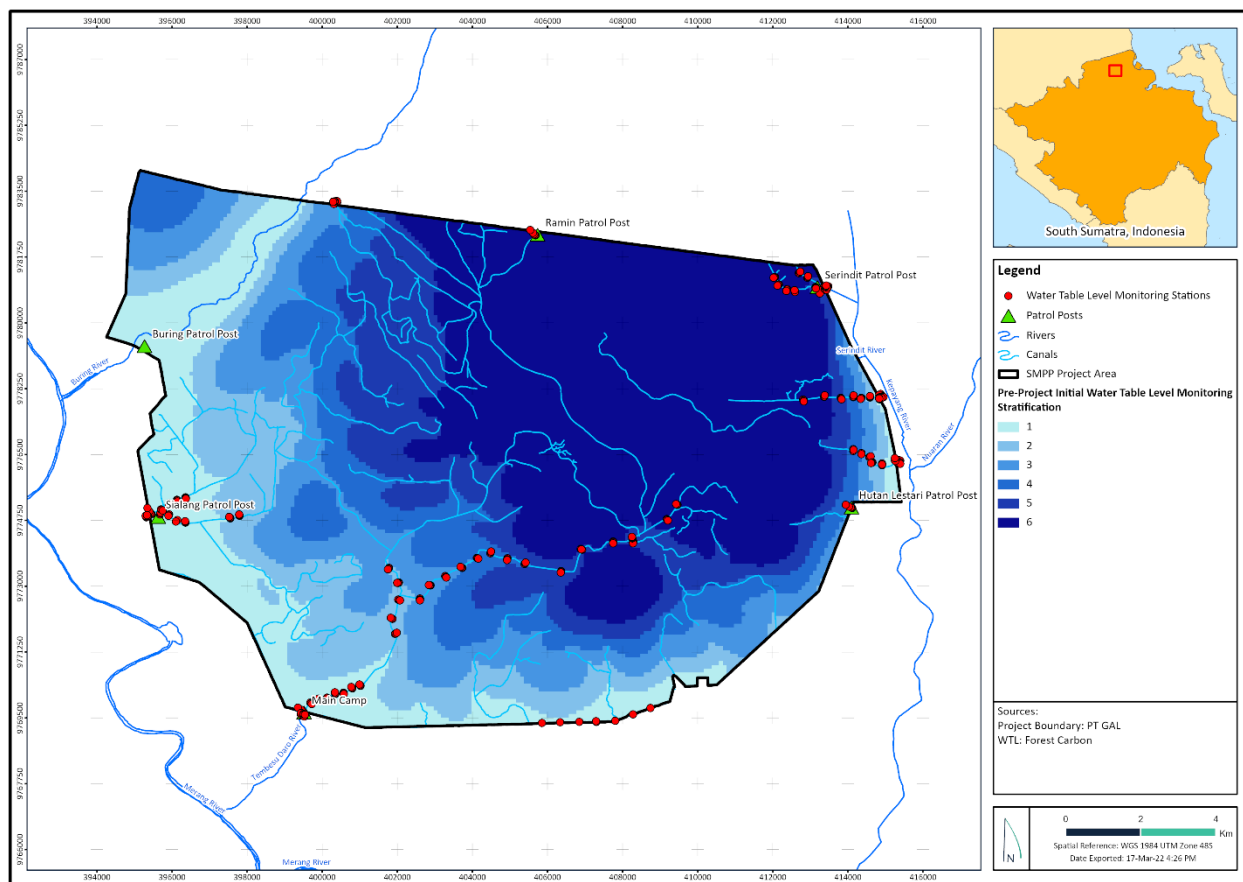
In 2020 the SMPP staff began monitoring change in tree biomass through field measurements using a point sampling method and allometric equations.¹² Per the CDM A/R Methodological Tool “Calculation of the number of sample plots for measurements within A/R CDM project activities,”¹³ the project established monitoring plots for areas representing ARR activities in 2020, with plots monitored thereafter every five years. In 2021 SMPP started to use tree biomass and height data in conjunction with spaceborne LiDAR to model a continuous C stock map of the project area at a resolution of 25m using advanced machine learning algorithms (Annex 18).

3.1.4.1.2.2 Monitoring GHG Emissions from Microbial Decomposition of Peat

In 2021 GHG emissions from microbial decomposition of peat were monitored by directly measuring proxy variables for GHG flux across all peat strata. By monitoring water table levels across peat strata and classifying landcover, the drainage status for a given area was modeled.

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 and water table levels to update annual strata cover conditions and drainage status. Remote sensing methods in Section 3.2.2.1.1. 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 265 dip wells in total within six water table level strata (Map 5). A hydrological model was developed to extrapolate dip well measurements into a continuous water table level map.



Map 5. Location of the dip wells in the project area.

The project examined changes in vegetation cover and water table levels to determine status change strata, and the efficacy of compacted peat dams for canal blocking. Annual GHG emissions from microbial decomposition of peat were summarized by using IPCC default emission factor and follow procedures in the VSC methodology VM0007 Module M-PEAT.

3.1.4.1.2.3 Monitoring GHG Emissions from Water Bodies

Values for dissolved organic carbon (DOC) were taken from Wetlands Supplement of the IPCC (2013).¹⁴ 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).

3.1.4.1.2.4 Monitoring GHG Emissions from Peat Burning

In addition to the hotspot remote sensing data listed in Section 3.2.2.2, GHG emissions from peat and biomass burning were monitored in conjunction with regular forest patrols. For future monitoring events, fire monitoring will include the integration of smoke detection cameras, soil moisture monitoring with remote sensing products and soil moisture sensors on the ground to assess fire risk. In the event of a fire, suspected fires are confirmed through a combination of ground checks and visual assessment from remote sensing imagery. GHG emissions from burning are summarized annually following Module E-BPB.

3.1.4.1.2.5 Peat Characteristics

As per the VCS Standard v4.2 (2022), the baseline reassessment period is every six years for avoided planned deforestation and degradation (APDD) projects where the deforestation agent is unknown. For projects that are registered on or before 19 January 2022, this update is effective at their subsequent baseline reassessment period. Therefore, for the SMPP project, the first baseline reassessment will be ten years after the start date, and then subsequently every six 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.

3.1.4.2 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.

3.1.5 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 using 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 1.6) 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 was 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 described here were conservative and therefore resulted in lower baseline emissions to maintain validity of calculations and estimates of a baseline scenario.

It was assumed that no rewetting would occur in the baseline scenario. Examples of natural rewetting events that we excluded in the analysis were 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. It was also assumed that regular canal maintenance activities typically carried out for drainage and transportation would continue.

As information regarding the impact, extent and frequency of canal dredging was unavailable (e.g., if dredging activities caused the peat exposure to aerobic decomposition), these emissions were omitted. This is a conservative omission as water body emissions were lower than those resulting from microbial decomposition in peat, and therefore resulted in lower emission estimates in the water body stratum than strata at the same location in the project scenario.

In the baseline scenario, the annual emissions for carbon dioxide (CO₂) and methane (CH₄) were estimated, as these emissions were impacted directly by changes in land cover 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 determine 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 conversion plan for the project area, six (the minimum) proxy areas were selected to determine the baseline rate of conversion as 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 also used subsequently in LK-ASP.

3.2.1.2.1 Data Collection and Compilation

Suitable proxy areas were selected as reference regions through an iterative process of data collection, compilation, review, and processing of national-level datasets. A description of the nationally available datasets used for performing the analyses to select appropriate proxy areas, as well as details on the methodology, is available in Annex 5.

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 ten 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 10.

Table 10. 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 of 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, 2006 MoEF forest cover was used as a proxy for 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, uncertainty resulting from mixing datasets across different time periods was avoided, 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 normalized difference vegetation index (NDVI) for 2006-2007. INCAS and MoEF datasets had a mean 78% agreement between forest/non-forest areas.¹⁵ 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,¹⁶ using INCAS data as a verification reference was viable.

The INCAS data of 2006-2007 was first compared with the MoEF 2006 percentage forest cover and one site was eliminated 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. Confirmation was carried out 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 candidate reference areas all had $> 1\%$ of forest cover difference in INCAS 2006-2007, and for these sites a change detection analysis was performed 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.¹⁷ A dNDVI map was produced in the cloud-free areas of each 2006-2007 pair, smoothed 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). Categories were 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.

Where the visual interpretation showed possibly different conclusions on forest cover or land-use change among dNDVI, Landsat-8 surface band composite, INCAS and MoEF datasets, maps were compared 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 that showed 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 5. From this iterative process it was confirmed that the remaining seven sites did not show major planned deforestation/conversion activities from 2006-2007 and therefore that the MoEF 2006 forest cover data would serve as a good proxy to represent 2007 cover.

3.2.1.2.3 Conversion/Deforestation Rate Calculation

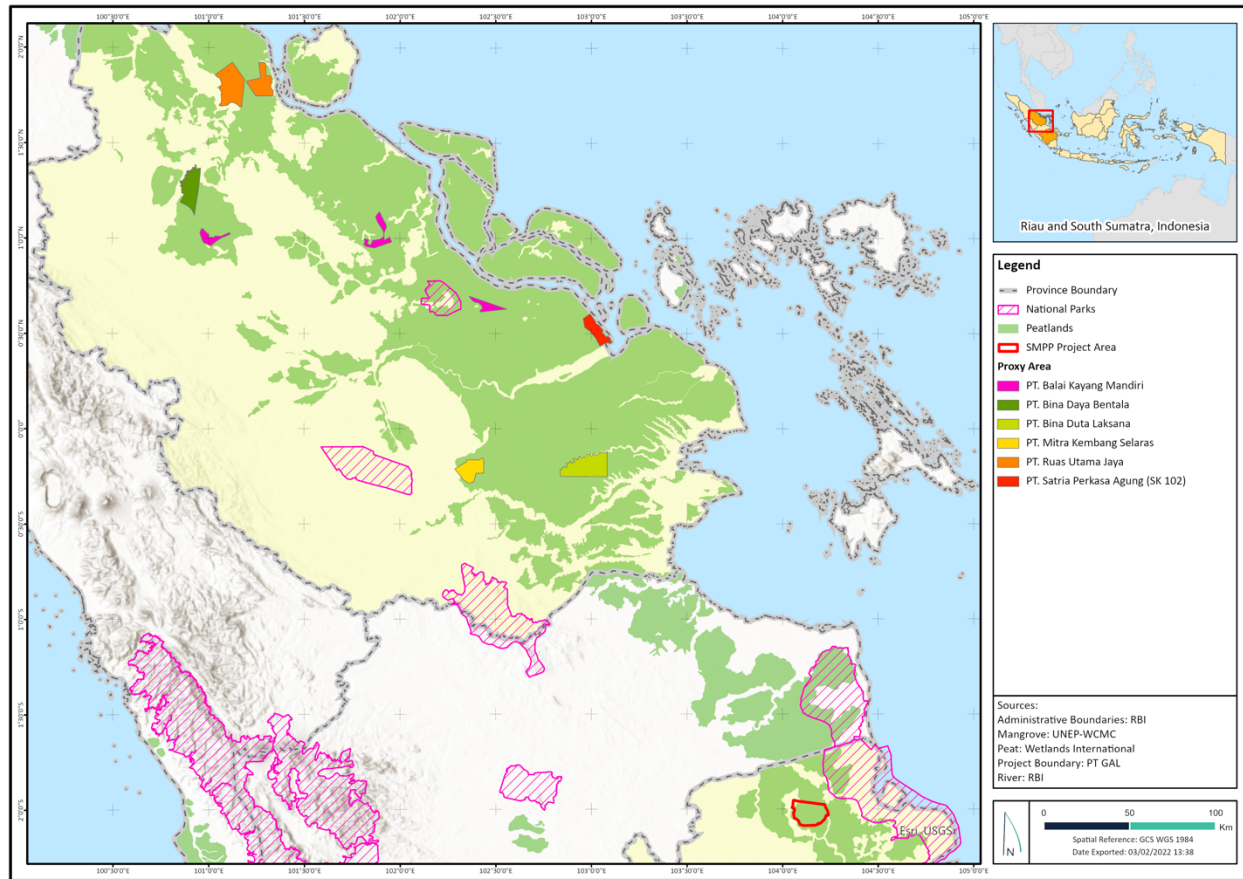
After the final elimination step using the MoEF forest cover data, seven proxy areas remained. One concession only had a 1.31% average annual forest loss rate from 2009 (the licensed year) to 2015 (prior to our project start date on 01/01/2016), which is very different from the other six sites. According 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 might not have resulted from industrial concession operations, but could be a result of smallholder practices, forest disturbance from hazards, or natural disasters. The area was eliminated, as the land conversion practices, and post-deforestation land-use did 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, these six remaining sites were selected as the proxy area for calculating the conversion/deforestation rate.

The summary comparison of sites analyzed in the visual inspection process can be found in Annex 5. The six final reference regions are summarized below in Table 11 and Map 6.

Table 11. 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	2007	95.97	14,780	9,953	32.66	4.08
Riau	PT Bina Daya Bentala	20,008	2006	88.66	8,485	0	100.00	11.11
Riau	PT Bina Duta Laksana	29,153	2006	100.00	17,837	7,084	60.28	6.70
Riau	PT Mitra Kembang Selaras	14,718	2007	100.00	10,032	2,740	72.69	9.09
Riau	PT Ruas Utama Jaya	44,795	2007	99.94	20,935	4,675	77.67	9.71
Riau	PT Satria Perkasa Agung (SK 102)	11,864	2006	100.00	5,272	2,235	57.60	6.40



Map 6. 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 (3.1) as:

$$D\%_{planned,i,t} = \left(\sum_{pn=1}^n \left(D\%_{pn} / Yrs_{pn} \right) \right) / n \quad (3.1)$$

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 (%)
Yrs_{pn}	Number of years over which conversion/deforestation occurred in land parcel pn in proxy area (yrs)
n	Total number of land parcels examined
pn	1, 2, 3, ... n * land parcels examined in proxy area
i	1, 2, 3, ... M strata

The average annual conversion/deforestation rate was estimated to be 7.85% for the six proxy areas. 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%. By taking 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, it was assumed the likelihood of deforestation ($L-D_i$) was 100%.

The risk of abandonment was assessed using the six proxy areas selected above for calculating the average annual conversion/deforestation rate. After confirming the criteria in the proxy area analysis, Landsat satellite images were assessed and visually inspected to determine if any of them experienced abandonment or 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 (3.2) is:

$$AA_{planned,i,t} = (A_{planned,i} \times D\%_{planned,i,t}) \times L - D_i \quad (3.2)$$

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

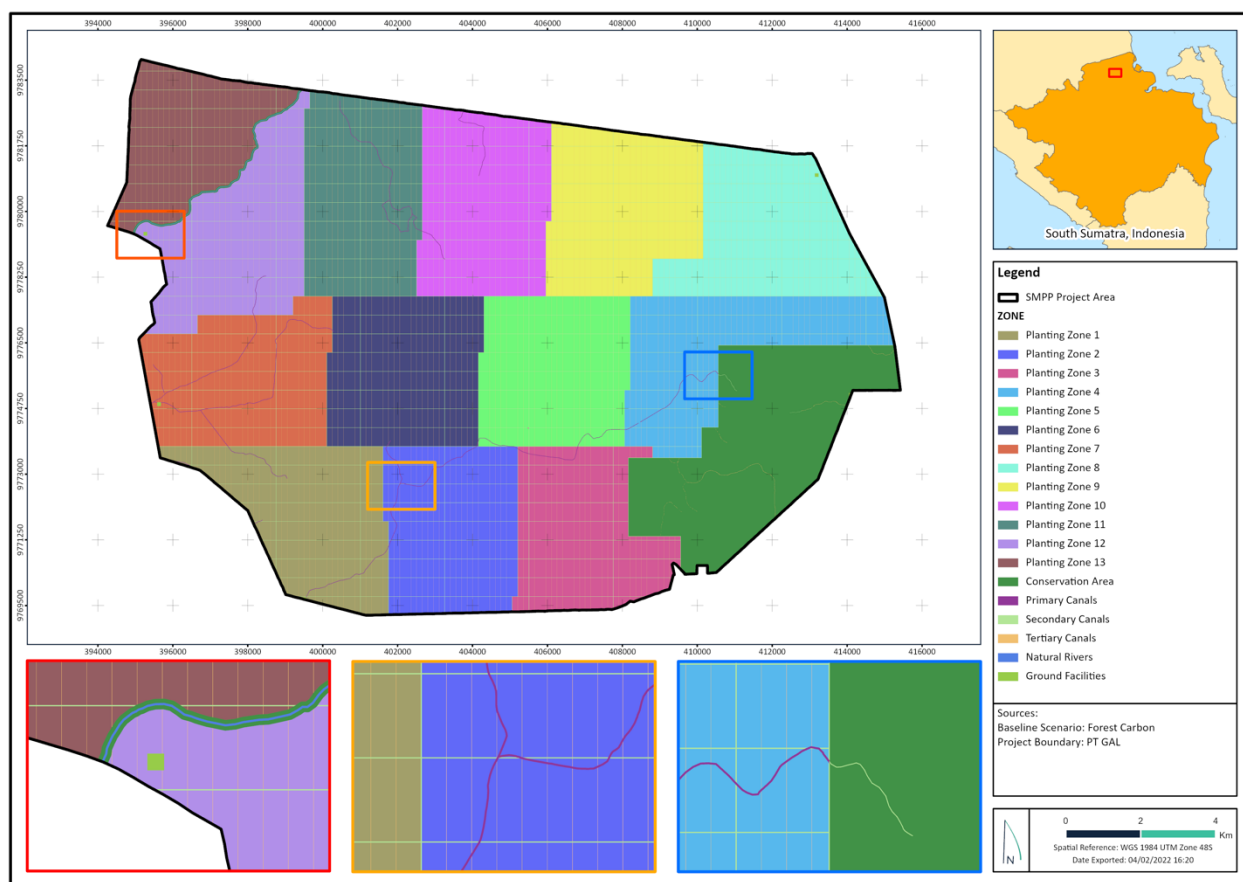
Project staff spatially allocated planting blocks to the project area to produce a map based on the total annual area converted in the baseline ($AA_{planned,i,t}$), shown in the baseline scenario in Map 7. The project area was then stratified into five strata (Table 12), using an iterative, spatially 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,^{18,19} 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 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)²⁰, 600 m (size class of primary canals)²¹, up to 1,300 m.^{21–23} 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.²⁴
 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 stratification of emission characteristics is shown in the baseline scenario designation map (Map 7) by incorporating (1) spatial coverage of land-use and drainage status; and (2) year of land-use and drainage status change.



Map 7. Baseline scenario map of the project area.

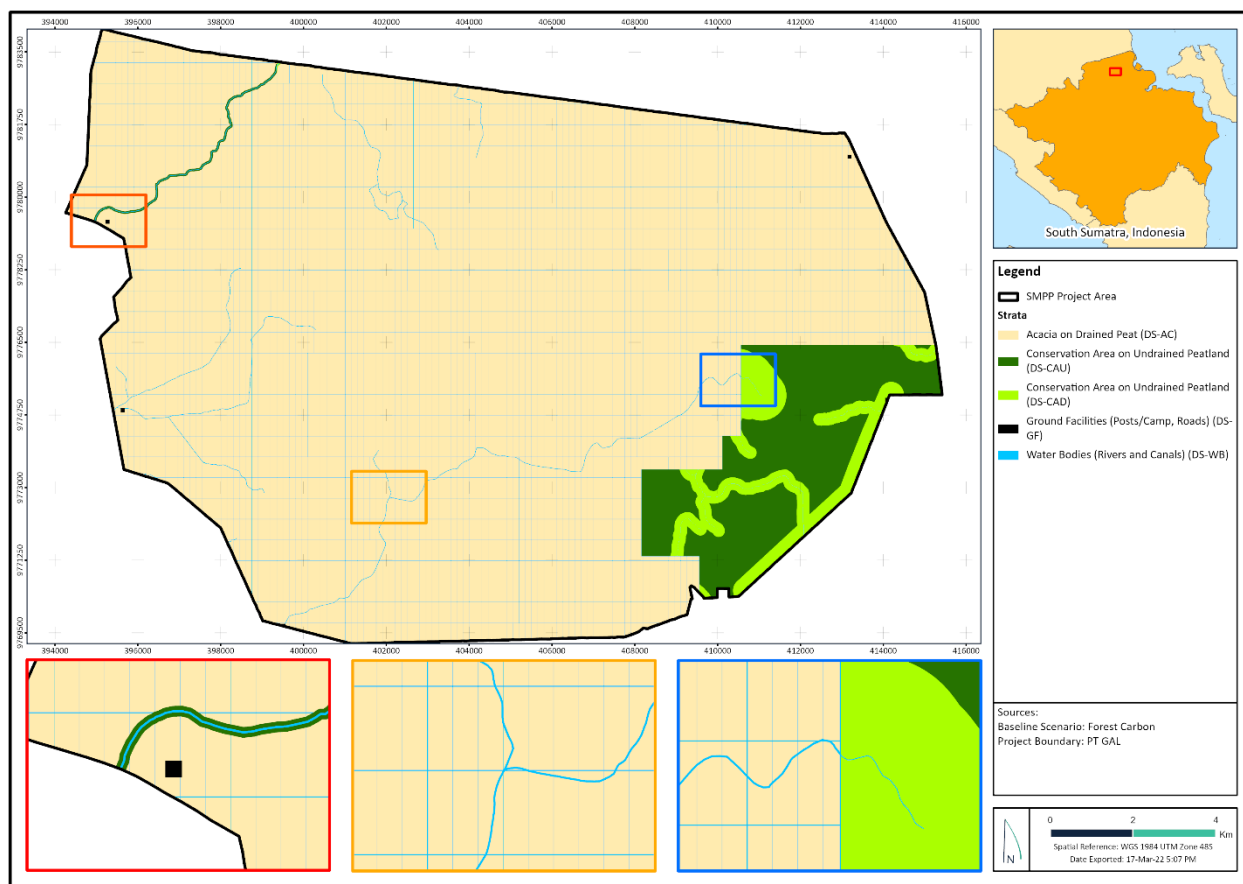
3.2.1.4 Emission Characteristics in the Baseline Scenario

3.2.1.4.1 Emission characteristics stratification for WRC activities under the baseline scenario

Table 12 and Map 8 present the baseline stratification summary based on emission characteristics. A summary of dynamics of these strata is shown in Annex 6.

Table 12. 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	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	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.	708	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	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.	19,916	86.88
Total			22,922	100.00



Map 8. 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 13). A summary of dynamics is shown in Table 13.

Table 13. 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

GHG emissions from microbial decomposition of peat, peat burning, and water bodies across spatial and temporal scales were quantified. Each baseline stratum included small units of land parcels with a combination of variables (described in Table 14 below). Annual strata changes, variability of GHG emission factors, and any restrictions to GHG emissions were calculated (Table 14) and spatial and temporal scales were also accounted for with GHG emission factors.

Table 14. 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 ≥ 50 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 burn scar depth and other related burning parameters for the corresponding parcel accordingly.

Variables	Description
(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 (3.3):

$$GHG_{BSL-WRC} = \sum_{t=1}^{t^*} \sum_{i=1}^M (E_{peatsoil-BSL,i,t} + E_{peatditch-BSL,i,t} + E_{peatburn-BSL,i,t}) \quad (3.3)$$

Where:

$GHG_{BSL-WRC}$	Net GHG emissions in the 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 (3.4) apply:

$$\begin{aligned} E_{peatsoil-BSL,i,t} &= 0 \\ E_{peatditch-BSL,i,t} &= 0 \\ E_{peatburn-BSL,i,t} &= 0 \end{aligned} \quad (3.4)$$

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 15.

Table 15. 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 2021.

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)
2021	707,391	6,041	397,247	38,008	1,692	1,150,380

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

It was 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 levels, the year of conversion, and specific subsidence rates that considered the compaction after initial drainage (Annex 6). For peat loss due to burning, the number of times the individual pixels in the fire simulation were burned in the 10-year period before project start date was first assessed and subsequently an associated burn scar depth was applied (Annex 9). 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 (3.5):

$$Rate_{peatloss-BSL,i,t} = D_{peatburn-BSL,i,t} + Sub_{i,t} \quad (3.5)$$

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 (3.6):

$$Depth_{peat-BSL,i,t^*} = Depth_{peat-BSL,i,t_0} - \sum_{t=1}^{t=t^*} Rate_{peatloss-BSL,i,t} \quad (3.6)$$

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

It was assumed that the annual rate of conversion of undrained to drained peatland in the baseline scenario was based on the conversion rate of derived from the proxy area analysis as described in Subsection 3.2.1.2 and Annex 5 (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 16 below provides details on the WRC-related baseline stratification per stratum.

Table 16. 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	0	1.02	
IN-UDP	Undrained Deforested Peatland	15,205	5.5	0.66	
IN-DPSF	Drained Dense Peatland Forest	20	19.43	0.12	
IN-DDP	Drained Deforested Peatland	7,394	19.43	0.12	
IN-WB	Water bodies (river and canals) present at project start	69			2.09
After conversion					
DS-AC	Acacia on drained peatland	19,916	73.33	0.07	
DS-CAU	Conservation area on undrained peatland	1,652	0	1.02	
DS-CAD	Conservation area on drained peatland	643	19.43	0.12	
DS-GF	Ground facilities on drained peatland	4	19.43	0.12	
DS-WB	Water bodies (river and canals)	708			3.01
Note: Annex 7 on 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 (3.7):

$$E_{peatsoil-BSL,i,t} = E_{CO2-BSL,i,t} + E_{CH4-BSL,i,t} \quad (3.7)$$

Where:

$E_{CO2-BSL,i,t}$	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)
$E_{CH4-BSL,i,t}$	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 (3.8):

$$E_{peatsoil-BSL,CO2,i,t} = A_{i,t} \times EF_{CO2,i,t} \quad (3.8)$$

Where:

$E_{peatsoil-BSL,CO2,i,t}$	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)
$EF_{CO2,i,t}$	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)

The CH₄ emissions from the peat soil for each stratum of the peat within the SMPP was calculated using the equation (3.9):

$$E_{peatsoil-BSL,CH4,i,t} = A_{i,t} \times GWP_{CH4} \times EF_{CH4,i,t} \quad (3.9)$$

Where:

$E_{peatsoil-BSL,CH4,i,t}$	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)
$EF_{CH4,i,t}$	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_{CH4}	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 17.

Table 17. GHG emissions from microbial decomposition of peat in the baseline scenario in 2021.

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)
	CUPP	RDP	CUPP	RDP	
2021	429,350	278,041	5,643	398	713,432

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.

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

To quantify GHG emissions from uncontrolled peat burnings, project staff followed procedures from the VCS methodology VM0007 Module E-BPB with the following equation (3.10):

$$E_{peatburn-BSL,i,t} = \sum_{g=1}^G \left((A_{peatburn-BSL,i,t} \times P_{BSL,i,t} \times P_{BSL,g,t}) \times 10^{-3} \right) \times GWP_g \quad (3.10)$$

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 (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 7. The average mass of peat burnt for a particular stratum was calculated using the equation (3.11):

$$P_{BSL,i,t} = D_{peatburn-BSL,i,t} \times BD_{upper} \times 10^{-4} \quad (3.11)$$

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)

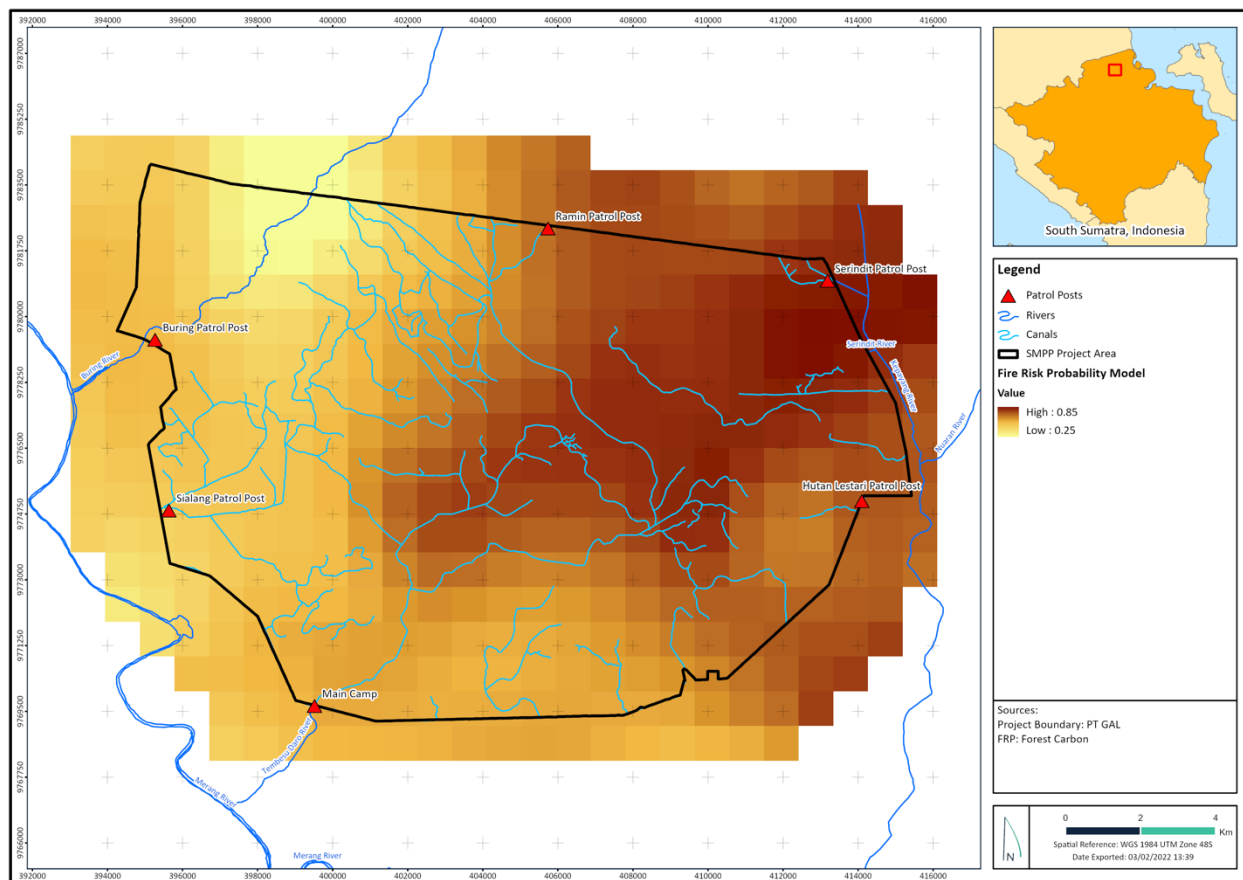
Emissions from peat burning in the baseline are derived from the mass of peat lost by combustion and emission factors from scientific literature (see Annex 7 for the default values used for the calculations of baseline carbon losses and emissions from burning).

For fire emissions, it was 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. 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), remote sensing data from a 10-year span prior to project start (2006-2015) was used.

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 MoEF 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 input preparation, iterative modeling process, model evaluation and final model result are available in Annex 8.



Map 9. Fire occurrence suitability that predicted risk probability.

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

It was 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. Parcels that had higher fire risk probability had greater chance of random selection in the simulation model.

Hotspot history based on MODIS and VIIRS data from year 2006-2015 was examined to document the number of times when a selected parcel was burnt. The 100-year fire simulation of burn frequency was 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 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 burn area and 100-year fire simulations can be found in Annex 9.

The peat burning baseline will be re-assessed in 2026 and then every 6 years thereafter 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 18 below, and annual emissions and total emission per stratum are shown in Table 19.

Table 18. Total GHG emissions from uncontrolled peat burning in the baseline scenario per stratum in 2021.

Strata	Description	Total Area burnt in 2021 (ha)	GHG Emissions from peat burning in 2021 (t CO ₂ -e)
IN-UPSF/DS-CAU	Dense Forest (undrained)	97	38,645
IN-UDP	Deforested peatland (undrained)	331	136,254
IN-DPSF	Dense Forest (drained)	61	22,415
IN-DDP	Deforested peatland (drained)	145	49,963
DS-AC	Acacia (drained peatland)	559	180,144
DS-GF	Ground facilities (drained peatland)	-	-
WB	Water bodies (river and canals)	23	7,837
Total		1,217	435,257

Table 19. Annual GHG emissions from peat burning in the baseline scenario in 2021.

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)
2021	397,247	38,008	435,255

3.2.1.5.1.5 Emissions from water bodies 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. The IPCC does not provide default emission factors for CO₂ and CH₄ emissions from water bodies, therefore default values for dissolved organic carbon (ΔDOC) were used (for detail see Annex 7).

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 value for drained peatland (0.82 t C ha⁻¹ yr⁻¹) was applied.

The approach as set out in the VCS methodology VM0007 Module BL-PEAT (equation 3.12) was used, and replaced $E_{peatditch-CO_2,i,t} + E_{peatditch-CH_4,i,t}$ with IPCC DOC emission default factors converted into CO₂-equivalents:

$$E_{peatditch-BSL,i,t} = A_{ditch-BSL,i,t} \times EF_{DOC-BSL,i} \quad (3.12)$$

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 20.

Table 20. GHG emissions from Dissolved Organic Carbon in water bodies in the baseline scenario in 2021.

Year	CO ₂ from DOC (t CO ₂ -e ha ⁻¹ yr ⁻¹)
2021	1,692

3.2.1.6 Baseline net GHG removals 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 to industrial timber plantation and the 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 21 below.

Table 21. Baseline planting and harvesting areas for ARR activities accounted for in the 2021 monitoring period.

Year	Planting (ha)	Harvesting (ha)
2021	3,035	1,465

Net GHG emissions and removals in the baseline ARR scenario were estimated using the procedure provided in AR-ACM0003 Afforestation and reforestation lands except wetlands and associated pool,²⁵ as outlined in Module BL-ARR, using the equation (3.13):

$$\Delta C_{BSL-ARR} = \sum_{t=1}^{t^*} (\Delta C_{BSL,t,ACM003}) \quad (3.13)$$

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

Net GHG removals from Acacia growth in the ARR baseline scenario during the monitoring period amounted to 60,867 t CO₂-e. Net GHG baseline removals for 2021 are presented in Table 22 below. Details on calculations are provided in Annex 19.

Table 22. Baseline net GHG removals for ARR activities accounted for in the 2021 monitoring period.

Year	NET GHG removal from ARR (t CO ₂ -e yr ⁻¹)
2021	60,867

3.2.1.7 Significant sources of Baseline Emissions

It was determined that all sources of carbon not included in the baseline or project scenarios could be conservatively excluded. Significance tests were not necessary, as all the required carbon pools and other GHG emissions within the SMPP are 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 data, proxy analyses, and the application of default emissions factors from the IPCC.¹⁴

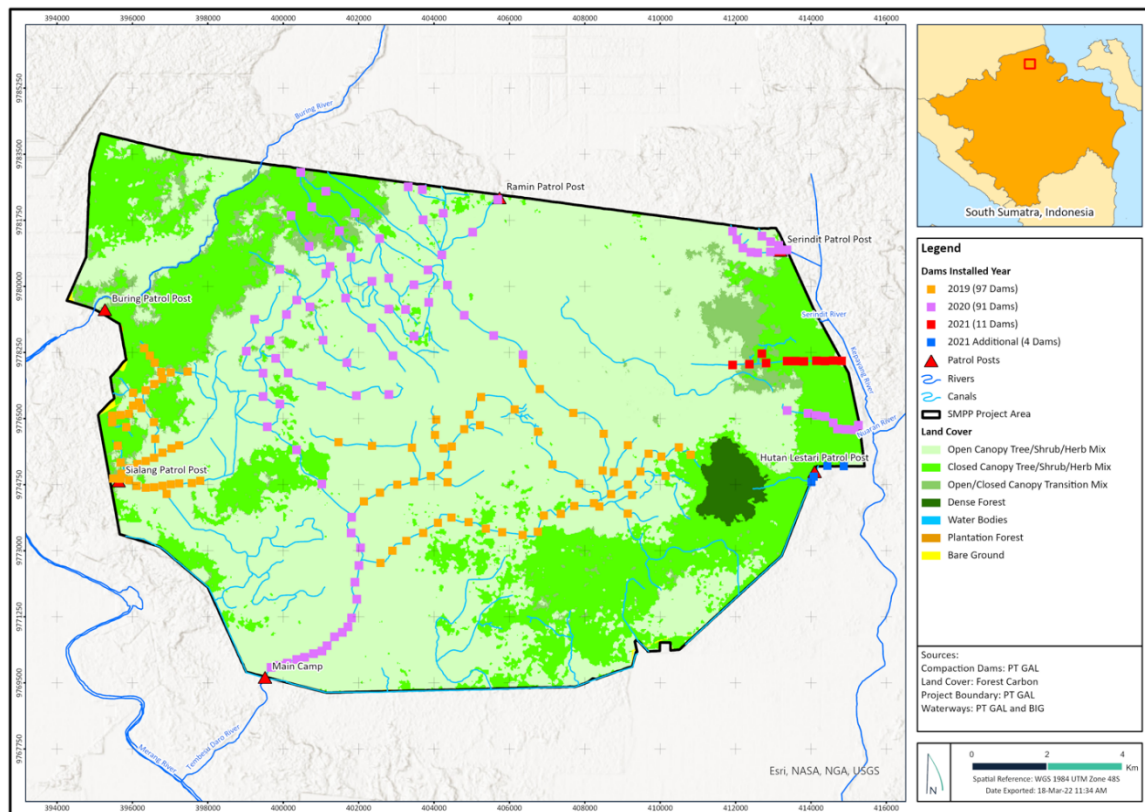
Emissions accounted for in the project scenario included:

1. Peat microbial decomposition;
2. Peat burning;

3. Dissolved organic carbon from bodies of water; and
4. AGB stock changes due to ARR activities.

Project activities 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.

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 also include active patrolling, border protection and training. The existence of the project has generally caused a reduction in human activities in the project area. If any uncontrolled burning occurs in the SMPP, an extensive fire monitoring plan is in place to ensure emissions from fire are accounted for and deducted from emissions reductions estimates. Compacted peat dams were also constructed over existing canals throughout the project area starting in late 2019 (Map 10).



Map 10. Completed canal blocks in 2019, 2020, and 2021.

3.2.2.1 Emission Characteristics Stratification Monitoring

3.2.2.1.1 Land Cover Classification

In PD Section 3.1.3.1 the project area was stratified into land cover classes based on the vegetation classes used to derive aboveground carbon stocks. The classification informed the emission characterization and emission factors. This land cover classification updates the existing land cover for 2021. Annex 11 provides details on the employed methodology and results.

3.2.2.1.1.1 Data Acquisition

A land cover classification for the project area in 2021 was performed based on cloud-free satellite data mosaics using optical data from Sentinel-2, and Synthetic Aperture Radar (SAR) from Sentinel-1 and ALOS-2/PALSAR-2 (all for 2021, see Figure 4).

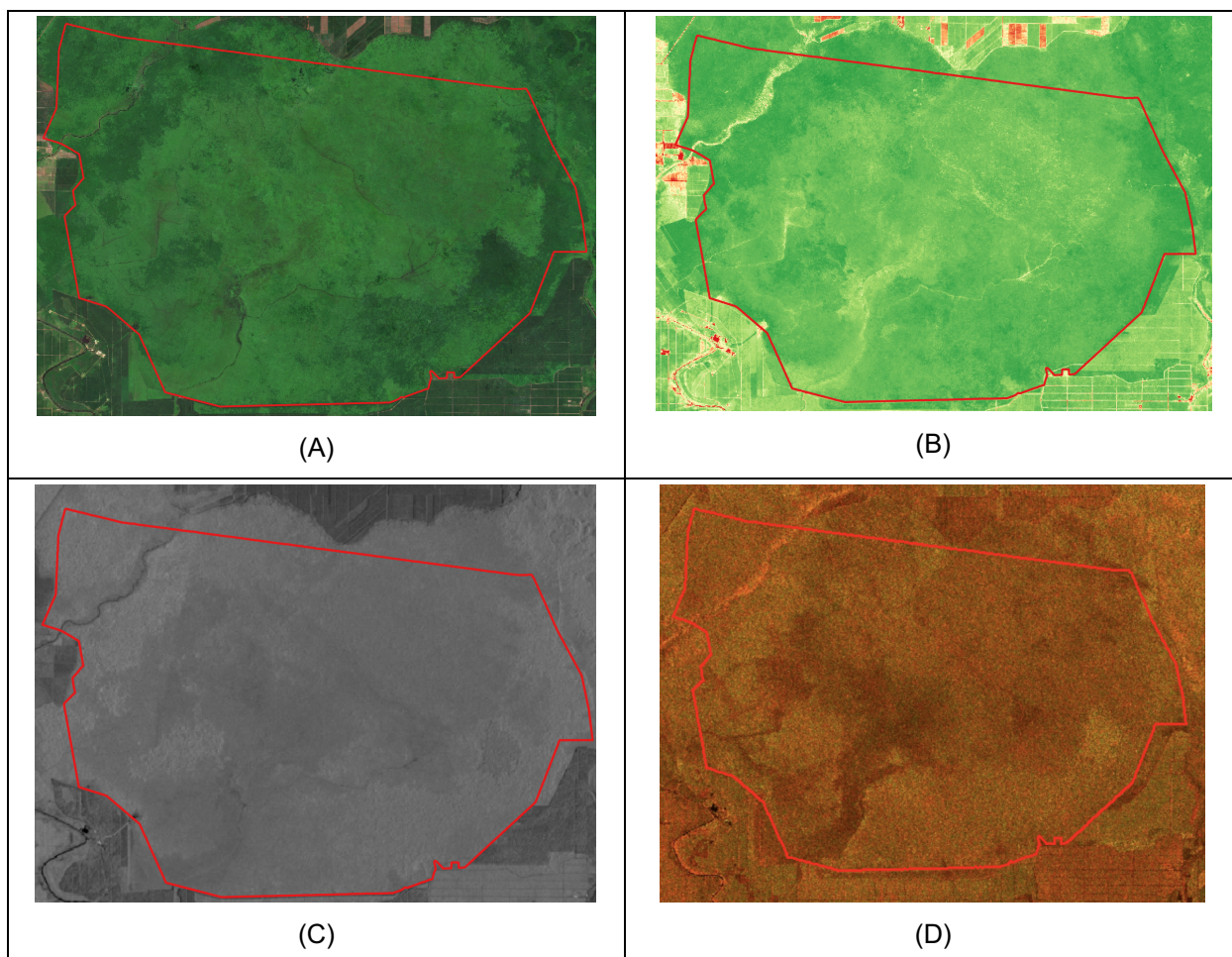


Figure 4. Source satellite images, Sentinel-2 Composite (A), Sentinel-2 NDVI (B), Sentinel-1 HH (C), ALOS/PALSAR-2 False Color (D)

Sentinel-1 and 2 are Copernicus Program satellite constellations, operated by the European Space Agency and launched in 2014 and 2015, respectively. Sentinel-1 satellite constellation carries a C-band synthetic aperture radar (SAR) instrument which provides all-weather, day and night data collection capabilities with a spatial resolution up to 5 m and a swath up to 400 km. Sentinel-2 satellite constellation carries an optical sensor that captures a wide spectrum of wavelengths up to 10 m spatial resolution.²⁶ The PALSAR-2 is an L-Band microwave SAR instrument launched the ALOS-2 satellite in 2014, operated by EORC/JAXA and is less affected by clouds and rain.²⁷

Sentinel-2 Level-2A Bottom of Atmospheric consists of corrected and normalized surface reflectance for thirteen spectral bands (ultra-blue, blue, green, red, five visible and near-infrared (VNIR) bands, and four shortwave infrared (SWIR) bands), as well as additional NDVI band.

3.2.2.1.1.2 Reference Data Acquisition

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

3.2.2.1.1.3 Classification Training Sample Development

To collect model training samples, small polygons were created within each homogeneous landcover type through expert analysis by visualizing high-resolution optical satellite data (3-m pixel size or finer, including Planet, Worldview and SPOT images). The high-resolution optical satellite data used for training were collected within the 2021 monitoring period. In cases where the high-resolution data predated 2021, a separate assessment was undertaken using 2021 data to ensure that no landcover change had occurred between dates. The training data polygons were taken from in and around the SMPP, with areas outside used where necessary to ensure sufficient samples for each landcover type, including those that are rare.

These covered six classes: open canopy tree/shrub mix, closed canopy tree/shrub mix, dense forest, water bodies, plantation forest, and bare ground. Plantation forest and bare ground appeared because of incidental encroachment by the project boundary (see details in Annex 17). These classes were chosen as being discernible by eye based on the high-resolution optical satellite data available, and separately seen in the coarser resolution images used for the classification. Table 23 below lists the total number of sample polygons within each class.

Table 23. Number of training samples use for the classification.

Class	Number of samples
Open Canopy Tree/Shrub/Herb Mix	100
Closed Canopy Tree/Shrub/Herb Mix	94
Secondary Forest	95
Water Bodies	80
Plantation Forest	30
Bare Ground	50

3.2.2.1.1.4 Classification Modeling

A combination of bands and derived indices from Sentinel-2 (optical) and Sentinel-1 (Synthetic Aperture Radar; SAR) from 2021 were used to create the classification model, based on different satellite datasets for assessing tropical forest landscapes. The datasets were combined using an established commercial classifier, HabitatMapper™ technical stack^{28–30} (owned by Space Intelligence). This technical stack included Space Intelligence's internal machine learning classifier, developed to maximize accuracy, and produce robust, consistent, and accurate land cover classifications, while minimizing model overfitting. The classifier is largely insensitive to bands that do not contain useful spectral information and is ideally suited to classification involving multiple types of satellite data (e.g., combining the strengths of optical and SAR data) without producing artefacts or displaying noises.

3.2.2.1.1.5 Accuracy Assessment

An independent accuracy assessment was conducted by the project technical team to verify the validity of the HabitatMapper technical stack following best practices. A stratified random sample of units in the map were created and interpreted by two different analysts, with a third analyst finalizing agreed/disagreed observations. The units were interpreted using Planet Norwegian International Climate and Forest Initiative (NICFI) data and Sentinel-2 10-m RGB images with very high-resolution drone data available in some regions. Analysts were also instructed to include time-series information to collect more robust reference data. SMPP technical staff collected a total of 450 samples to reach a target standard deviation on overall accuracy of 1.5%. SMPP technical used equal allocation of samples to better estimate per-class user's accuracies, except for bare ground and plantation, which have very few pixels in the area, for these a maximum of 25% of pixels in the area were used.

3.2.2.1.1.6 Error Matrices

During the model training, the water class showed a lower producer's accuracy, caused by the inclusion of sub-pixel features to generalize, and detect more canals. The closed canopy mix was mostly confused with

open canopy mix and dense forest, as expected being the middle of the canopy cover continuum. Figure 5 shows the normalized confusion matrix over the training sample set.

Table 24 shows the error matrix for the independent validation set. Also as shown in Table 25 and Figure 5, the classification model performed well outside the training samples and was able to predict the target classes accurately.

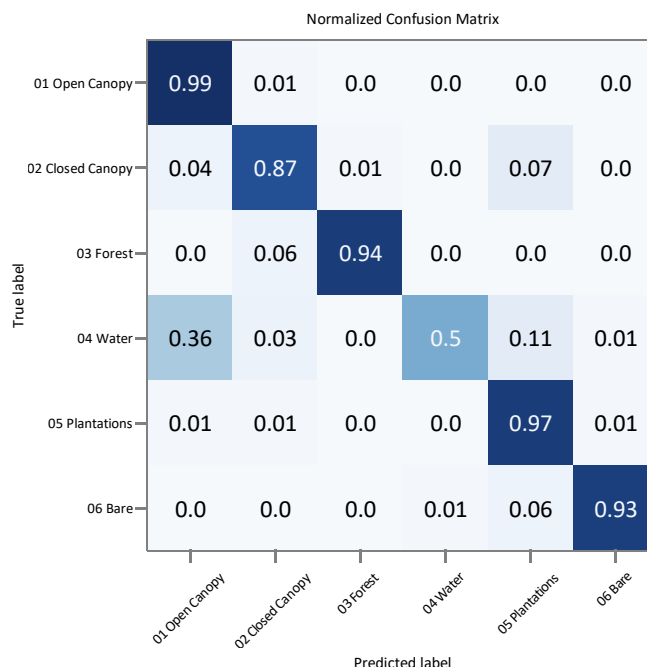


Figure 5. Validation normalized confusion matrix with user's accuracy as the diagonal cells.

Table 24. Error matrix as percentage of classified pixels in the map.

		Actual land cover class					
		Open Canopy Tree/Shrub/Herb Mix	Closed Canopy Tree/Shrub/Herb Mix	Secondary Forest	Water Bodies	Plantation Forest	Bare Ground
Classified land cover class	Open Canopy Tree/Shrub/Herb Mix	69.6	2.9	0	0	0	0
	Closed Canopy Tree/Shrub/Herb Mix	2.2	23.4	0.08	0	0	0
	Secondary Forest	0.01	0.03	1.2	0	0	0
	Open/Closed Canopy Transition Mix	0.01	0.03	0	0.4	0	0
	Water Bodies	0	0	0	0	0.02	0
	Bare Ground	0	0	0	0	0	0.1

3.2.2.1.1.7 Accuracy Assessment Results

The overall accuracy for the land cover map was $94.5 \pm 1.5\%$. The user's accuracy, a measure of how likely a pixel of a particular class in the map is the actual class, ranged from 75% for water, to 97% for forest

(Table 25). Producer's accuracy, a measure of how well the reference data are classified, was close to 90% for all classes except plantation forest (82%). Another class worth noting is water, where most features were considerably smaller than the minimum mapping unit (25 m). This also means that many canals were difficult to detect, since they contributed little to the pixel values compared to the surrounding areas.

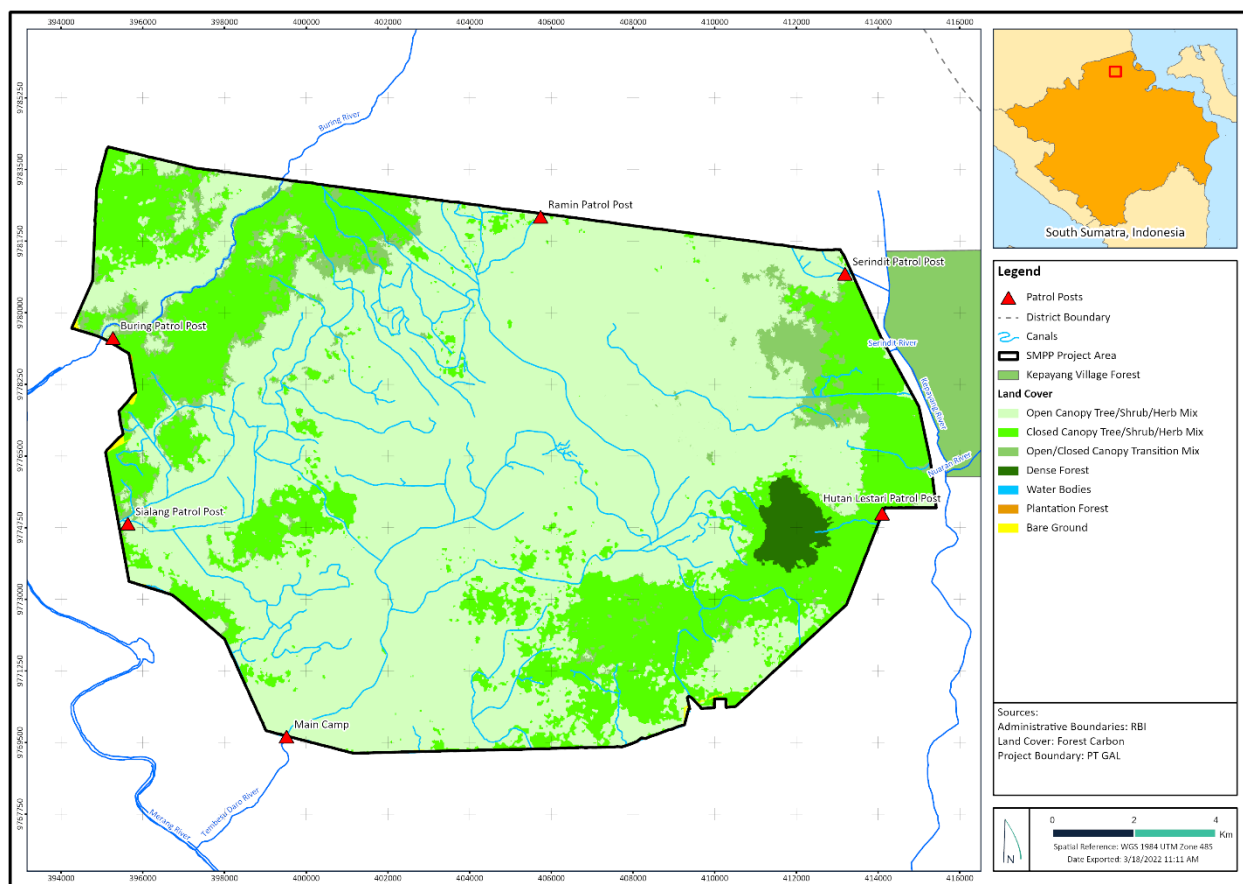
Table 25. Summary of classification accuracy in the error matrix.

Land cover class	User's accuracy	Producer's accuracy
Open Canopy Tree/Shrub/Herb Mix	96	97
Closed Canopy Tree/Shrub/Herb Mix	90	89
Secondary Forest	97	93
Water Bodies	75	100
Plantation Forest	95	82
Bare Ground	92	99

The known canals and rivers that did not appear in the image due to the image resolution were added to the final map by overlaying a GIS canal/river network layer with a buffer distance derived from field and remote sensing observations (updated in 2021). A comparison analysis was performed against the previous monitoring period land cover classification and some polygons were further reclassified as Open/Closed Canopy Transition Mix to capture the seasonality of leaf on/leaf off, water level dynamics, and vegetation growth in the open and closed canopy vegetation classes. The resulting final land cover classes are shown below (Table 26 and Map 11).

Table 26. 2021 land cover classes.

Class	Area (Ha)	Area (%)
Open Canopy Tree/Shrub/Herb Mix	15,755	69
Closed Canopy Tree/Shrub/Herb Mix	5,872	26
Secondary forest	277	1
Open/Closed Canopy Transition Mix	909	4
Water bodies	70	> 1
Plantation forest	5	> 1
Bare ground	35	> 1
Total	22,922	100



Map 11. Land cover classification in the project area for 2021

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. MODIS Collection 6 (MCD14DL) at 1-km resolution (hotspots with confidence $\geq 80\%$) and VIIRS at 375-m resolution (hotspots with confidence = High) (VNP14IMGTDL_NRT, available starting in 2012), a joint NASA/NOAA Suomi National Polar-orbiting Partnership data (Suomi NPP; available starting in 2020) and NOAA-20 satellites at 375 m resolution (VJ114IMGTDL_NRT) were used to determine the presence of potential fires.³¹ No hotspots were detected in this monitoring period for all confidence levels in any fire hotspot datasets (Table 27).

Table 27. MODIS and VIIRS hotspots (high confidence, i.e., $\geq 80\%$) with records detection in the project area showing no detected hotspots in 2021.

Year/month of MODIS hotspots detected	1	2	3	4	5	6	7	8	9	10	11	12	Total
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

Year/month of VIIRS hotspots detected	1	2	3	4	5	6	7	8	9	10	11	12	Total
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

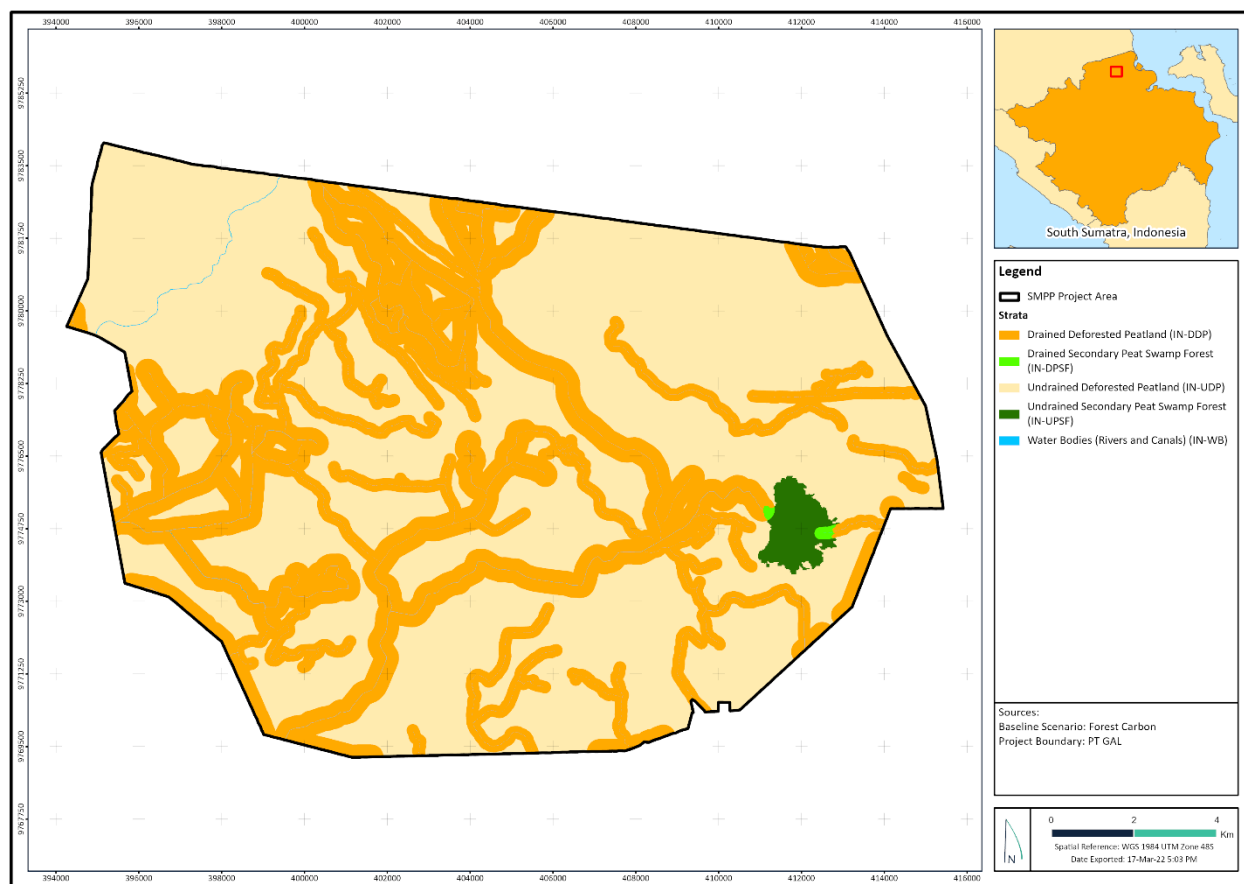
3.2.2.3 Emission Characteristics Stratification for WRC Activities Under the Project Scenario

For the project scenario, the project area was stratified 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 28 and Map 12 below show the stratification of the project area based on the types and origins of source emissions. 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. 300-m and 150-m buffers were created 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 considered when calculating project emissions.
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 11.

Table 28. Stratification of project area based on the emission characteristics of peat and water bodies in 2021.

Strata	Type	Description	Area (ha)	Percentage of project area (%)
PS-UPSF	Undrained Dense Forest	Intact dense forest on undrained peatland	257	1
PS-DPSF	Drained Dense Forest	Intact dense forest on drained peatland	8,277	36
PS-DDP	Drained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on drained peatland	20	> 1
PS-UDP	Undrained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on undrained peatland	14,299	62
PS-WB	Water Bodies	River and secondary or tertiary canals that existed before project start date.	70	> 1
Total			22,922	100



Map 12. Stratification based on emission characteristics for WRC in 2021.

Site-specific hydrological monitoring data was regularly collected 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 areas, if any changes occur.

3.2.2.4 Emission Characteristics Stratification for ARR Activities in the Project Scenario

Although project activities include active reforestation (nursery development and replanting, see PD Section 2.1.11), technical analysis only accounted for natural regeneration of vegetation when delineating ARR emissions characteristics. The eligible area for ARR crediting is all the non-forest areas where the project would carry out activities to facilitate natural regeneration, including rewetting, fire avoidance, etc. Based on spatial analysis, the total 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 land cover classification (detailed in Annex 11) served as a basis for developing strata for WRC activities (see Table 28).

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.

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

3.2.2.5.1 Emission Calculations

The net CO₂-equivalent emissions from the peat microbial decomposition and water bodies for each parcel was spatially explicit estimated as detailed in Table 28. Using the procedures provided in Module BL-PEAT and Module M-PEAT, the equation was established (3.14):

$$GHG_{WPS-WRC} = \sum_{t=1}^{t^*} \sum_{i=1}^M (E_{peatsoil-WPS,i,t} + E_{peatburn-WPS,i,t} + E_{peatditch-WPS,i,t}) \quad (3.14)$$

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 were in the 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 29.

Table 29. A summary of the annual GHG emissions from peat and water bodies under the project scenario in 2021.

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)
2021	5,320	3,874	-	201	9,395

3.2.2.6 Emissions from Microbial Decomposition of Peat

The projects GHG emissions for different emission strata were calculated using the conservative and scientifically robust (TIER 1) IPCC default emission factors for each stratum i (Annex 7 on Emission Factors), following the equations defined by the VCS methodology VM0007 Module M-PEAT (3.15):

$$E_{peatsoil-WPS,i,t} = E_{CO2-WPS,i,t} + E_{CH4-WPS,i,t} \quad (3.15)$$

Where:

$E_{CO2-WPS,i,t}$	CO ₂ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$E_{CH4-WPS,i,t}$	CH ₄ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO ₂ -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 (3.16):

$$E_{peatsoil-WPS,CO2,i,t} = A_{i,t} \times EF_{CO2,i,t} \quad (3.16)$$

Where:

$E_{peatsoil-WPS,CO2,i,t}$	CO ₂ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$EF_{CO2,i,t}$	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_{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 (3.17):

$$E_{peatsoil-WPS,CH4,i,t} = A_{i,t} \times GWP_{CH4} \times EF_{CH4,i,t} \quad (3.17)$$

Where:

$E_{peatsoil-WPS,CH4,i,t}$	CH ₄ emissions from the peat soil within the project boundary in the project scenario in stratum i at year t (t CO ₂ -e yr ⁻¹)
$EF_{CH4,i,t}$	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_{CH4}	Global Warming Potential for CH ₄
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 30 below provides details on the WRC related project emission factors and stratification.

Table 30. 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	257	1
PS-DPSF	Drained Dense Forest	Intact dense forest on drained peatland	20	> 1
PS-DDP	Drained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on drained peatland	8,277	36
PS-UDP	Undrained Deforested Peatland	Mostly open canopy tree/shrub/herb mix and closed canopy tree/shrub/herb mix on undrained peatland	14,299	62
PS-WB	Water Bodies	River and secondary or tertiary canals that existed before project start date.	70	> 1
Total			22,922	100

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

With sufficient long-term, field measurements of peat-related emissions available for estimating the overall emissions in the monitoring period of 2021, a combination of GHG emission factors provided in Annex 7 and efficacy factors derived from the hydrological models were used as a conservative approach. Detailed explanations on the hydrological models and their results can be found in Annex 14. The effect of rewetting was considered by multiplying the emission factor for each stratum by an efficacy factor. The efficacy was derived from the annual water table changes predicted by the hydrological models that compared the pre-project WTL by stratum with the WTL in undrained peat forests (for details see Annex 15). Projected annual GHG emissions from microbial decomposition of peat are shown in Table 31.

Table 31. GHG emissions from microbial decomposition of peat in the project scenario in 2021.

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)
	CUPP	RDP	CUPP	RDP	
2021	578	4,743	2,636	1,238	9,194

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).¹⁴ Throughout project implementation, the project will take 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.¹⁴

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 16).

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 32. 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 (3.18):

$$E_{\text{peatditch-WPS},t} = A_{\text{ditch-WPS},t} \times EF_{\text{DOC-WPS}} \quad (3.18)$$

Where:

$E_{\text{peatditch-WPS},i,t}$	GHG emissions from canals and other open water at year t in the project scenario (t CO ₂ -e ha ⁻¹ yr ⁻¹)
$A_{\text{ditch-WPS},i,t}$	Total area of canals and other open water at year t in the project scenario (ha)
$EF_{\text{DOC-WPS},i}$	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 32. GHG emissions from Dissolved Organic Carbon in water bodies in the project scenario in 2021.

Year	CO ₂ -e from DOC (t CO ₂ -e y ⁻¹)
2021	201

3.2.2.7.2 Future approaches for calculating project emissions

Values for DOC will 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 avoid burning, such as peatland rewetting and best-practice fire management, with goals of zero burning, effective fire control, and active fire prevention (PD Section 2.1.11).

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. If uncontrolled burning occurs in the SMPP during the project period, staff will 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 potential for repeated 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 13).

In cases of repeated burning 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 used to quantify GHG emissions from uncontrolled burning are given in Annex 7.

To quantify GHG emissions from uncontrolled peat burnings, project staff followed procedures in the VCS methodology VM0007 Module E-BPB using the following equation (3.19):

$$E_{peatburn-WPS,i,t} = \sum_{g=1}^G \left((A_{peatburn-WPS,i,t} \times P_{WPS,i,t} \times P_{WPS,g,i}) \times 10^{-3} \right) \times GWP_g \quad (3.19)$$

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 (3.20):

$$P_{WPS,i,t} = D_{peatburn-WPS,i,t} \times BD_{upper} \times 10^{-4} \quad (3.20)$$

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 from all fire hotspot datasets, thus no emissions from uncontrolled peat burning were considered (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 were installed in 2021 to improve on the existing fire monitoring system and increase detection time and accuracy.

3.2.2.9 Project Removals from ARR Activities

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

All ex-ante GHG emissions and removals followed Module M-ARR in the AR-ACM0003 procedures for afforestation and reforestation lands. In AR-ACM0003, 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). It was assumed 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 project scenario WRC activities in ARR area ($GHG_{WPS-WRC}$) are presented separately in the peat Section 5.3.1. Net GHG removals in the ARR project scenario are calculated using the equation (3.21):

$$\Delta C_{WPS-ARR} = \sum_{t=1}^{t^*} (\Delta C_{ACTUAL,i,ACM0003}) = \sum_{t=1}^{t^*} (\Delta C_{TREE,PROJ,t}) \quad (3.21)$$

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

The calculations of the actual (ex-post) Net GHG removals in the project scenario are detailed in Annex 19, where the $\Delta C_{ACTUAL,t,ACM0003}$ was calculated using a combined remote sensing/ field inventory approach following in principle the VCS tool VT0005 to estimate the AGB in 2016 and 2021. Table 33 shows the project scenario net GHG removals accounted for in 2021.

Table 33. Project scenario net GHG removals by ARR activity accounted for in the 2021 monitoring period.

Year	Change in carbon stocks in the ARR areas (tCO ₂ -e)
2021	539,593

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 34 below.

Table 34. 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 VCS methodology and steps defined in the PD, “areas deforested by the baseline class of agents through the years in which planned deforestation was forecasted to occur”, ($A_{defLK,i,t}$) was monitored and compared to the baseline leakage scenario (Step 3 of the PD Section 3.2.3.1).

In the PD Section 3.2.3.1, based on a historical trend of licensed HTI concessions in Indonesia between 2006-2015, we estimated an additional 489,073 ha of land per year that would be licensed for HTI concessions. However, the published data 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)³². In 2018 licensed HTI concessions increased by 836 ha (from 11,178,601 ha in 2017 to 11,180,437 ha in 2018)³³. In 2019 licensed HTI concessions increased by 125,753 ha (from 11,180,437 ha in 2018 to 11,306,190 ha in 2019)³⁴. 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. In 2021 licensed HTI concessions increased by 16,796 ha (from 11,207,025 ha in 2020 to 11,223,821 ha in 2021)³⁶. 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 data were lower than the baseline estimates shown in the PD (Table 35 below).

Table 35. 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
2021	14,006,164	989,536	987,916
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
2021	11,223,821	792,963	791,279

The above non-spatial comparison suggested that the actual deforestation caused by the baseline class of agents in this monitoring period would be lower than the PD estimate. To provide continuous and spatially explicit quantification for this monitoring period as summarized below, we 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 2021, including the MoEF HTI boundary dataset updated in December 2021.³⁷ The datasets contained 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, it was 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, we examined all the boundaries to remove topology errors and spatial overlap between neighboring parcels.

The annual area deforested throughout all HTI-wood fiber and HTI concessions during the monitoring period was quantified by using remote sensing data. Official land use land cover data from the MoEF is not yet made available for year 2021. Therefore, we used the most recent and commonly recognized annual global datasets from the Global Forest Change derived by the University of Maryland (available for year 2021).^{38,39} This dataset is a proxy as it quantifies tree cover loss and does not differentiate 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 the global dataset, we 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.

We determined areas of deforestation and leakage using Equation 24 below, as per module LK-ASP. The actual area of deforestation in peatland and non-peatland areas in HTI-wood fiber and HTI concessions was based on spatial analysis using the 2008 national peatland distribution data.⁴⁰ 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. We used Equation

(3.22) for calculating the difference between deforestation occurred in HTIs and estimated as $NewR_{i,t}$, and summarized results in Table 36.

$$LKA_{planned,i,t} = A_{defLK,i,t} - NewR_{i,t} \quad (3.22)$$

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 36. Deforested areas and leakage calculations 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
2020	45,311 (2,904)	138,508 (8,876)	235,403	719,579	-190,092	-581,071
2021	49,561 (9,871)	151,498 (30,173)	243,921	745,615	-194,360	-594,117

Since this analysis confirmed there was no leakage throughout the monitoring period (shown as all values of $LKA_{planned,i,t}$ in Table 36 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 within and outside the project area within a 1 km buffer were $8.43 \text{ cm} \pm 0.68$ and $8.64 \text{ cm} \pm 0.65$ (annual average $\pm$ S.E.), respectively. The water table levels inside and outside the project area were not statistically different (paired t-test: $df = 364$, $p = 1$), and showed that the WRC project activities did not influence the water table levels in the surrounding area. 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 14).

3.2.4 Net GHG Emission Reductions and Removals

This section provides an overview of total net emission reductions and detailed activity-specific calculations in the subsections. Project staff calculated Net GHG emission reductions as the sum of total net GHG emission reductions from WRC and total net GHG removals from the ARR project activities (3.23).

$$NER_{REDD+} = NGR_{ARR} + NER_{WRC} \quad (3.23)$$

Where:

NER_{REDD+} Total net GHG emission reductions of the REDD+ project activity up to year t^* (t CO₂-e)

NGR_{ARR} Total net GHG removals of the ARR project activity up to year t^* (t CO₂-e)

NER_{WRC} Total net GHG emission reductions of the WRC project activity up to year t^* (t CO₂-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 (3.24):

$$NER_{REDD+ERROR} = \frac{\sqrt{(Uncertainty_{WRC_{BSL},t^*} \times GHG_{BSL-WRC,t^*})^2 + (Uncertainty_{WRC_{WPS},t^*} \times GHG_{WPS-WRC,t^*})^2}}{(GHG_{BSL-WRC,t^*} + GHG_{WPS-WRC,t^*})} \quad (3.24)$$

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 7).¹⁴ Project staff established that CH₄ emission uncertainty was zero, as it was conservatively excluded from emission calculations. We also established that uncertainty from GHG emissions from peat burning was also zero in the project scenario and assumed fully effective fire prevention in the project area. 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.

We calculated the uncertainty for WRC in 2021 as 10.28%, and 0.95%, for the baseline and project scenario, respectively. This resulted in a total error of 8.73% for WRC. Assuming a threshold of 15% uncertainty, no deduction of VCUs was necessary. Further details on all calculations are provided in Annex 16.

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 (zero for 2021) (see Table 37).

Table 37. 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)
2021	1,150,380	9,395	-	1,140,985

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 (zero for 2021) from the project removals (see Table 38).

Table 38. Total net GHG removals for ARR project activities accounted for in the 2021 monitoring period.

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)
2021	60,867	539,593	-	478,726

3.2.4.4 Total net GHG emissions 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 39).

Table 39. Total net GHG emissions from WRC and ARR project activities accounted for in the 2021 monitoring period.

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)
2021	1,089,512	(530,198)	-	1,619,710

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 40). 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 40. 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%)
2021	1,140,984	478,726	226,759

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 41).

Table 41. Calculation of estimated verified carbon units.

Year	NER_{WRC}	NGR_{ARR}	$Adjusted_NER_{WRC} + NGR_{ARR}$	Non-Permanence Risk Buffer (14%)	Estimated VCUs
2021	1,140,985	478,726	1,619,710	226,759	1,392,951

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 2021 monitoring period relevant to climate change adaptation and their respective benefits have been provided in Table 42 below.

The hydrological restoration activities within the SMPP directly reduce fire occurrence and improve water retention and watershed health. Consequently, this 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 in response 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 42. 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. • Monitoring completed to 66% (133 out of 203 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 planting and operation is ongoing. • ANR trials continue in 2021 with 2,950 seedlings planted on 8.5 ha (see Annex 21) • Monitoring conducted in 2021.	• 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 • Co-financing rainwater catchment system • Community health center supported	• Supported students to attend <i>Universitas Terbuka</i> who will become future teachers. • Expansion of training activities including literacy training for librarians and parents, antigen sampling training for health workers, anti-stunting for health workers and cadres, as well as training for community members to construct household rainwater catchment systems. • 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. • Construction of household rainwater catchment systems in a new location. • Three community health centers supported with medicine supplies, PPE, and antigen kits, as well as facilitating three separate events of COVID-19 vaccination totaling 843 shots of vaccines administered to residents of the surrounding villages.	• 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 continued in 2021 and the results of the second 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 led to better project development and operations. - Recruited a new field coordination manager to execute and oversee field 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 several 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 14 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 4.2 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 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 43 below. Due to the lack of individuals living near or within the SMPP, the majority of community development programming 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 43. 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 2021 monitoring period, the project has continued to directly engage with the community small-scale farmers, including socialization of the canal blocking construction which started at the end of 2019. The project maintains consistent communication with the active 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 2021 monitoring period. As part of the socialization for the project's canal blocking construction which began in December 2019, the project discussed options with the fishermen as access to fishing grounds in the Tembesu Daro canal were going to become more difficult. The project representative supports the fishermen to continue fishing and suggested other areas within the project area for fishing along the Buring river in the Northwest portion of the SMPP, or the Lalan or Kepyayang rivers that are easier to access.

All the above potential negative impacts have to date not eventuated, with no human wildlife conflicts reported or loss of livelihoods from canal blocking documented. As of 2021 there remains a low risk that negative impacts on communities will be caused by project activities. Irrespective of the low risk to communities, ongoing monitoring and the development and dissemination of mitigation strategies in anticipation of potential future risk can be considered precautionary and is in line with the application of the precautionary principle.

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 0) 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 individuals' livelihoods and provides sustenance for project staff. The project also offers employment opportunities to this community to those that are interested.

Better hydrology management through canal blocking completed 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 facilitated its members in fire prevention training together with the SMPP team and Manggala Agni fire brigade under the MoEF during this 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 the 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 as a result 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 functions. 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 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 contributing to an improvement in health and livelihood outcomes. Furthermore, wildfire prevention contributes to increased biodiversity and ecosystem services within forest and intact peatland that local communities are partially dependent upon.

4.1.4 Protection of High Conservation Values (CM2.4)

No HCVs related to community well-being were negatively affected by the SMPP during this 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 thus, no predicted negative impacts on these HCVs were identified 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, 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 Merang, and 2,628 people in 574 households reside in Kepayang.⁴¹ It is important to emphasize that these stakeholders are still fairly

removed from the project site residing 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 of 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 on this group as a result of project activities, 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, generating 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:

- 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. In early 2021 the project launched a new program in collaboration with *Taman Bacaan Pelangi*, a non-profit organization working to establish children's libraries in remote areas to increase students' engagement with libraries and reading interests in general.
- Health support through COVID-19 vaccination events with a total of 843 doses administered to residents of the surrounding villages on 3 separate events during 2021. The anti-stunting socialization and training programs continued in both Muara Merang and Kepayang villages in a collaboration with 1000 Days Fund, an NGO with a mission to end stunting by 2030. The program expanded to a new location, Tebing Harapan, a hamlet under the Muara Merang village by starting a mobile vaccination program for babies. In addition, as a wider COVID-19 pandemic response, the project continues to support local health facilities by distributing Personal Protective Equipment (PPE), basic medical equipment, medicines, and 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, as well as investments in women's groups in both Muara Merang and Kepayang villages through community health programs.
- Youth and local employment opportunities continued through locally recruited SMPP field staff. Educational development and capacity building opportunities for employees also continued throughout this reporting period.
- Expanding access to clean water through the installation of 25 household rainwater catchment systems in Tebing Harapan, a hamlet under the Muara Merang village. The system provides clean water to at least 77 households in the hamlet and brings the total number of rainwater catchment systems installed by the project to 77 units.

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" are principally the residents of the settlements and villages closest to the SMPP who 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 2021 monitoring period.

However, it is possible that as biodiversity returns to the SMPP area, communities in the project zone may be impacted by large wildlife such as sun bears or tigers, but this risk was assessed as low. To deal with this potential negative impact, SMPP has been developing a wildlife human conflict reduction strategy and has trained stakeholders of the communities 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 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. Similar training is planned to be held again in 2022.

Project staff will also continue to maintain direct lines of communication with local stakeholders of the communities, 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, the SMPP has no current negative impacts to other stakeholders during the 2021 monitoring period. As the other stakeholders in the project zone are benefiting significantly from the SMPP community development programs there the net impacts are positive. 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 44). This plan considers these 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 can be found in Section 4.1.4.

Evaluation of the monitoring results by the community are conducted through engagements and stakeholder consultations as summarized in Section 2.3.7. This method of evaluation is considered important to the project as it provides continuous feedback 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 2021 monitoring period are outlined below in Table 44.

Table 44. Details of the SMPP's community monitoring plan with results from the 2021 monitoring period.

Focal issue	Key results	Indicator/ variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2021 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	14 fishermen identified and supported; two 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	One active farmer, one non-active.
	Community income improved	Gains achieved from the sale of fish	Community survey	Community fishermen	Protection of and access to fishing grounds	Every three months	Local fishermen had access to fishing grounds in and around the concession area. During 2021, estimated average weekly catch is 30 kg. In the dry season, peak weekly catch could reach up

Focal issue	Key results	Indicator/ variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2021 monitoring period)
							to ~50 kg. Fresh fish are sold at ~25,000-40,000 IDR (\$1.7-2.5 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 2021, food supplies for basecamp and guard posts were purchased from local shops in both Muara Merang and Kepayang Village to support the rural economy. Chicken and fish eaten by SMPP staff are provided by a village community member, providing them with a stable income
	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	63 employees as of December 2021, of which 43 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 26 (out of 43) SMPP field staff members from nearby villages and settlements (including four women) as of December 2021.
		# of investments and agreements with other stakeholders	Internal report & contracts	Other stakeholders-residents of settlements and	Employment opportunities within the SMPP	Every 12 months	As part of the new literacy program launch, the project supported two librarians from the two elementary schools

Focal issue	Key results	Indicator/ variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2021 monitoring period)
		signed by the SMPP		villages near SMPP			with a monthly salary since March 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 settlements and villages near SMPP	Employment opportunities within the SMPP	Every 12 months	19% - Given the remoteness of the project site and the fact that it is an unaccompanied post (not appropriate for families) target 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	In early 2021, SMPP launched a new program in collaboration with <i>Taman Bacaan Pelangi</i> , a non-profit organization working to establish children's libraries in remote areas, to increase students' engagement with libraries and reading interests in general. The program was launched in two elementary schools in Muara Merang and Kepayang villages which consisted of multiple stages of activities such as teacher training, library renovation,

Focal issue	Key results	Indicator/ variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2021 monitoring period)
							supplying children's books, and a parents' engagement workshop.
		# 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 nine students to attend <i>Universitas Terbuka</i> , of which are eight women.
		# 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 (48 in Kepayang and 87 in Merang as of December 2021)
		# 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 82 students (20 women and 32 men in Class C; eight women and 20 men in Class B; One woman and one man 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	Total of 2,620 books (1,310 books for each school)
	Access to clean water improved	# of individuals attending trainings in household rainwater catchment	Internal report	Other stakeholders-residents of settlements and	Improved access to clean water	Every 12 months	Two individuals from Tebing Harapan were given training to construct household

Focal issue	Key results	Indicator/ variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2021 monitoring period)
		systems construction		villages near SMPP			rainwater catchment systems as a livelihoods opportunity.
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	25 units of household rainwater catchment system were installed in Tebing Harapan, a hamlet in the Muara Merang village. The project plans to expand the rollout 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	In 2021, three community health facilities continue to receive support from the project with staff salaries, supplies of medicines, antigen kits, PPE, and facilitated staff to attend antigen sampling training.
	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 maintained in Kepayang elementary school. Two similar systems are also maintained in community health facilities in Muara Merang & Kepayang villages.
		# 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	Six individuals have been registered into Indonesia's national healthcare system with SMPP support at the end of 2021, bringing the total number supported to 38 individuals.

Focal issue	Key results	Indicator/ variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2021 monitoring period)
		# 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 were supported by the project in collaboration with 1000 Days Fund, an NGO with a mission to end stunting by 2030. The program includes raising awareness of the 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 to avoid crowd gathering, the focus shifted to provide 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, frying oil, sugar, condensed milk, coffee, and instant noodles. The project donated 200 packages and each village received 100 packages, distributing them in coordination with local government representatives
	Waste management improved	# of plastic recycling and trash collection programs implemented	Internal report	Other stakeholders-residents of settlements and	Improved waste management	Every 12 months	Temporarily paused due to COVID-19 pandemic. The project aims to start these programs in 2022.

Focal issue	Key results	Indicator/ variable	Data collection method	Targeted community	Monitored impacts	Monitoring frequency	Current results (during 2021 monitoring period)
				villages near SMPP			
		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. The project aims to start these programs in 2022.
	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	The project held a 4-day firefighting training with Manggala Agni fire brigade under the Indonesian MoEF. The project also facilitated the Village Fire Prevention Community (KMPA) from both Muara Merang & Kepayang villages to attend the training. The project also facilitated fire safety training for each SMPP field staff member upon their induction into the project.

4.3.2 Monitoring Plan Dissemination (CM4.3)

The project 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 PD and MR 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 do not fall below the national poverty line.⁴² 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 has maintained and enhanced 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.⁴³ The terrestrial biomes of Southeast Asia have been identified as some of the most at risk biomes on the planet,⁴³ and Indonesia has suffered significant forest and biodiversity loss over the last 40 years.⁴⁴

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%.⁴⁵

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 has 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. Evidence is mounting for net positive biodiversity impacts for both flora and fauna in the project area and will be detailed in sections that follow.

5.1.1 Biodiversity Changes (B2.1)

Assessing changes in biodiversity over time requires standardized repeatable surveys of conducted over two or more comparable time periods. During the current monitoring period, the second annual, standardized, repeatable biodiversity monitoring was undertaken, allowing for the first reliable analysis of biodiversity trends over time (see section 5.3.1 for more details).

While this is only the second year of standardized biodiversity monitoring, 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 45 and Table 46 outline the changes to biodiversity observed during the current monitoring period.

Table 45. Direct changes to biodiversity during the 2021 monitoring period.

Changes in Biodiversity	Cumulative number of floral and faunal species identified in the SMPP project area
Monitored Change	This monitoring period saw an increase in the cumulative number of both floral and faunal species identified in the SMPP project area. The species inventory was updated with new survey data from this monitoring period. A full list of all species recorded in the SMPP can be seen in Annex 20. The species inventory now includes:

	• 34 mammals (increase of seven species from last monitoring period) • 127 birds (increase of 25 species from last monitoring period) • 23 reptiles (increase of two species from last monitoring period, not actively surveyed) • 16 amphibians (increase of five species from 2020, not actively surveyed) • 28 fish (increase of 26 species from last monitoring period, due to additional survey, not actively surveyed) • 39 arthropods (dragonflies and damselflies) (no increase from last monitoring period; not actively surveyed) • 128 plant species (88 of which are trees, an increase of 27 species from last monitoring period)
Justification of Change	New surveying methodologies were developed in 2019 to support long term monitoring of the project biodiversity baselines. The surveys conducted in the 2020 monitoring period were designed to capture a wider range of species at SMPP through increased sampling effort and the rollout of several standardized and repeatable biodiversity monitoring methods (see Table 48 for more details). The surveys conducted in 2021 recorded a considerable number of new floral and faunal species in the project area. The rate at which new species will be detected in the SMPP will likely slow over time as species accumulation curves predict that additional sampling effort will have diminishing returns as the more common, abundant, and conspicuous species are identified at higher rates during early sampling efforts and rarer, less conspicuous, or newly arrived species are identified at a much slower rate. The dynamics of tropical peatland forest restoration are often sporadic, and it may be that regenerating areas will see spikes in species diversity due to an increase in the diversity of ecological niches in the project area as it becomes more heterogenous. It may also result in the contrary, where a few species of generalists outcompete other species in a challenging environment, leading to a decrease in species richness. The increased number of species identified and inventoried in this monitoring period is partly attributable to an increased sampling effort in 2021. It is also likely that the positive impacts of hydrological restoration from dams constructed in 2018 – 2021, ongoing fire management in and around the project area, ongoing patrols in the project area, and small-scale enrichment planting have increased the habitability of the project area for both flora and fauna to the extent that some species are returning to the project area or are increasing in abundance to the extent that they are now being detected in surveys.
Changes in Biodiversity	Bird species diversity
Monitored Change	Likely increase in bird species diversity

Justification of Change	The point count transect survey data, updated with this year's monitoring data, suggest that bird species diversity is being enhanced by project interventions. Bird species are benefitting from ongoing project activities, including fire management, canal blocking, enrichment planting, and patrolling activities, which enhances the quality of secondary forest and increases closed canopy cover, while likely reducing illegal activity pressures. See section 5.3.1 and section 5.4.1 for more details.
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Changes in Biodiversity	Plant species diversity
Monitored Change	Likely increase in plant species diversity
Justification of Change	The vegetation plot survey data, updated with this year's monitoring data, suggest that plant species diversity is being enhanced by the project. Plant species are likely benefitting from ongoing project activities. Fire management, canal blocking, enrichment planting, and patrolling activities are resulting in maintenance of secondary forest and increases in closed canopy cover, while likely reducing illegal activity pressures. See section 5.3.1 and section 5.4.1 for more details.

Change in Biodiversity	Mammal diversity
Monitored Change	Likely maintenance of mammal diversity
Justification of Change	The camera trap survey data, updated with this year's monitoring data, suggest that mammal species diversity and population trends are being maintained under the with-project scenario, with early data signals indicating that ecological generalists are faring better than ecological specialists in the project area (see section 5.3.1 for more details). At least several years more data is required to ascertain what may truly be occurring naturally in this regenerating tropical peatland. Mammal species are likely benefitting from ongoing project activities. Fire management, canal blocking, enrichment planting, and patrolling activities are resulting in maintenance of secondary forest and increases in closed canopy cover, while likely reducing illegal activity pressures (see section 5.4.1 for more details).

Change in Biodiversity	Apex predator population trends
Monitored Change	Likely maintenance of apex predator population trends.

Justification of Change	After the first photographic evidence of the Sumatran tiger (<i>Panthera tigris sumatrae</i>) in the project area in 2020 in which two distinct individuals were identified using their unique striping patterns through camera trap survey images. The Critically Endangered (CR) subspecies Sumatran tiger subspecies 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 prey species in the project area supports this hypothesis. Given their rarity and their large home ranges of 60-100 km², it is not unexpected that camera trap surveys did not detect any Sumatran tiger individuals this year. However, several tiger spoors (footprints) were recorded just outside the project area during this monitoring period, meaning that tigers are likely still using the project area but were just not detected by camera traps in this monitoring period. Protecting and regenerating the project area for these individuals to survive and thrive 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. These apex predators are likely benefitting from ongoing project activities. Fire management, canal blocking, enrichment planting, and patrolling activities are resulting in maintenance of secondary forest and increases in 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.
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Table 46. Indirect changes to biodiversity during the 2021 monitoring period.

Changes in Biodiversity	Maintenance of secondary forest cover and enhancement of closed canopy land cover
Monitored Change	The land cover classification for the monitoring period of 2021 was performed in March 2022 to assess changes in land cover between this and previous monitoring periods. This analysis showed an emerging trend of: - Enhanced secondary forest cover (2016 = 260 ha; 2019 = 260 ha; 2020 = 288 ha; 2021 = 277 ha) - Increased closed canopy cover (2016 = 330 ha; 2019 = 330 ha; 2020 = 5,392 ha; 2021 = 5,872 ha) - Decreased open canopy cover from regrowth into closed canopy (2016 = 21,987 ha; 2019 = 21,987 ha; 2020 = 17,173 ha; 2021 = 15,756 ha) - Open/Closed Canopy Transition Mix (2021 = 910 ha) This suggests that natural regeneration of vegetation in SMPP is already underway, which should benefit the many floral and faunal species by improving habitat quality and further diversifying niches.
Justification of Change	The data sources for the land cover classification in this monitoring period were cloud-free satellite data mosaics over the AOI using optical data from

	Sentinel-1 and 2, Synthetic Aperture Radar (SAR), and ALOS-2/PALSAR-2. The decision to change the source datasets was due to the different implementation of machine learning algorithms used for classification. The implementation for this monitoring period yielded a more precise classification. An accuracy assessment was done against higher resolution reference images (see Section 3.2.2.1.1). For example, both the user's and producer's accuracy for Secondary Forest were high at 97% and 93% respectively, suggesting that the classification was accurate and reflected field conditions as observed during the monitoring period. An additional open/closed canopy transition mix class was added to capture the seasonality of leaf on/leaf off, seasonal water level dynamics and vegetation growth in the open and closed canopy vegetation classes. This positive trend in natural vegetation regrowth is attributable to the extensive canal dam constructions, fire management activities, and forest patrols. In this monitoring period there was a major reduction in fire hotspots, down to zero peat fires in the project area. Fire incidence is 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). A pair of high-definition cameras with night vision capability were installed in the main camp which monitors the possible occurrence of forest fire by detecting the presence of fire and smoke. Cameras have a 90° field of view and 5km maximum detection range. The two cameras were installed to cover approximately 180° field of view East to West of the main camp. 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.
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Change in Biodiversity	Aquatic species diversity
Monitored Change	Likely increase in aquatic species diversity.
Justification of Change	While aquatic species in the project area were surveyed for the species inventory (see Annex 20) in previous monitoring periods, ongoing monitoring of aquatic species will be done indirectly by monitoring several factors that are likely to influence aquatic species populations. However, an additional survey conducted during this monitoring period by a local student recorded 26 additional fish species, bringing the total number of fish species recorded in the project area to 28 species. 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 maintained secondary forest and increased closed canopy cover are actively contributing to positive trends in aquatic species populations in the long-term. This monitoring period saw the maintenance of secondary forest cover and increases in closed canopy cover, no fire hotspots in the project area, the construction of an additional 15 canal dams (to make a total of 203 dams), and roughly 850 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	Invertebrate diversity
Monitored Change	Likely increase in invertebrate diversity
Justification of Change	While some invertebrate species in the project area were surveyed for the species inventory (see Annex 20) in previous monitoring periods, ongoing monitoring of changes in invertebrate species will be done 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 maintained secondary forest cover and increased closed canopy cover will all contribute to positive trends in invertebrate species populations in the long-term. This monitoring period saw the maintenance of secondary forest cover and increases in closed canopy cover, no fire hotspots in the project area, the construction of an additional 15 canal dams (to make a total of 203 dams),

	and roughly 850 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.
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5.1.2 Mitigation Actions (B2.3)

There were no negative impacts on biodiversity directly resulting from project activities recorded during this monitoring period. The only potentially negative impact on biodiversity recorded during this monitoring period was the degradation of several hectares in the west of the project area by the accidental expansion of an adjacent Acacia plantation into the project area (see Annex 17). Once the mistake was highlighted by the project field team, the expansion was halted, and the affected area was replanted with native tree species.

The other small number of potential negative impacts to biodiversity in the SMPP project area and their relevant mitigation actions are outlined in section 5.1.3 and section 5.2.1 of this report. The potential negative impacts to biodiversity in the SMPP area are considered low in the with-project scenario, but the project continues to monitor potential negative impacts through active patrol activities, remote sensing, and field surveys. To ensure the maintenance and enhancement of HCV attributes in the SMPP project area (see section 5.1.4 for an overview of HVCs identified in the project area), the project will continue the activities outlined in Figure 6.

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 habitats in which they live.

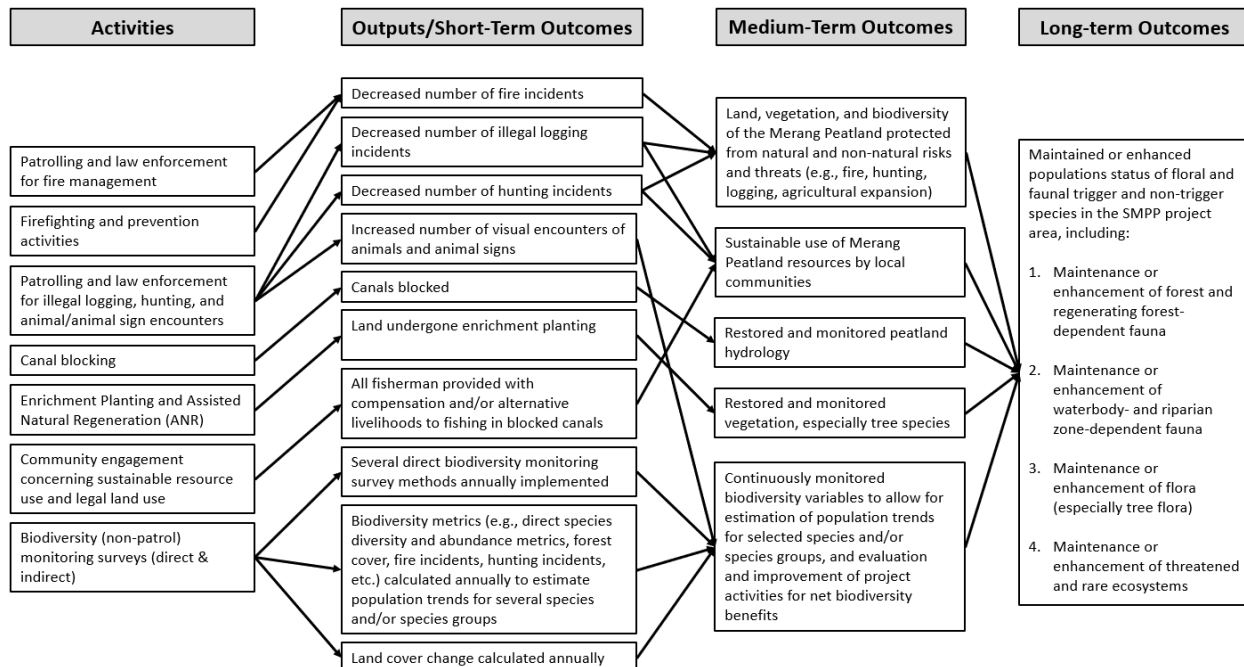


Figure 6. SMPP Causal model for SMPP biodiversity program.

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 2021, the ecological integrity of the peatland in the project area was gradually restored through activities including:

- Canal blocking with canal dams and existing canal dam monitoring
- Enrichment planting and assisted natural regeneration
- Ongoing fire management
- Ongoing project area monitoring and enforcement (see Figure 6).

In 2021, the project team:

- Constructed 15 canal dams (to make a total of 203 canal dams) and monitored existing dams where accessible (see Map 10).
- Consistently monitored and managed fires, with no fires occurring within the project area during this monitoring period.
- Continued enrichment planting, with 2,950 nursery seedlings planted in the project area during this monitoring period (see Annex 21 for details).
- Conducted standardized and systematic biodiversity monitoring (see Table 48)
- Continued daily patrols of the project area from each guard post.

The impacts of the above activities can already be seen through the maintenance of secondary forest cover and positive changes in closed canopy cover in the project area. 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.

While this monitoring period only encompasses the second annual period of systematic biodiversity monitoring, the data suggests that positive biodiversity trends are being maintained or enhanced in the project area (see sections 5.1.1, 5.3.1, and 5.4.1). 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 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 several fire hotspots nearby the project area but none in the project area.

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, but restoring the hydrology of the peatland in the project area should still result in net positive biodiversity impacts onsite and offsite for both aquatic and terrestrial species (see section 5.2.1 for more detail).
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 during this monitoring period. Some accidental illegal logging was recorded during this monitoring period and is discussed in section 5.1.2.
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 human-wildlife conflict training for project staff. No human wildlife conflicts were reported within the project area during this monitoring period.

Predicted increases in species diversity across all ecosystem types within the SMPP project area driven through ongoing habitat restoration and protection means that any potential negative impacts can be deemed to be negligible. Any decreases in species diversity are more likely to be attributable to natural ecological succession dynamics.

5.1.4 High Conservation Values Protected (B2.4)

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

- 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 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), species diversity is being maintained or enhanced in the project area (see section 5.3.1 and 5.4.1 of this report for more details). The 2021 land cover classification revealed that vegetation cover has been improved, with secondary forest cover being maintained and closed canopy cover increasing. 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 several biotic interactions. There has been a marked increase in the accumulated number of species recorded in the SMPP project area over the current monitoring period, and species diversity metrics for all surveyed floral and faunal groups are being maintained or enhanced when compared to last year's monitoring period (see section 5.1.1).

For HCV 3 (ecosystems and habitats), the remaining fragment of secondary forest within the SMPP has been maintained during this monitoring period. 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 maintenance of secondary forest and regrowth in closed canopy cover in 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 2021 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 the species used in enrichment planting activities are already found naturally growing in the project area. In 2021, 2,950 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 21).

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 5.1.2 and 5.1.3.

Potential negative impacts on biodiversity occurring offsite because of project activities that may have indirectly occurred during this monitoring period are outlined in Table 47 below:

Table 47. 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 and maintenance.	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 canal dams constructed in the project area have the potential to fragment the artificial canal ecosystem during dryer months and impact both on-site and offsite fish species. However, the canals were man-made and are not a natural ecosystem. Anecdotal evidence from researchers in Kalimantan

Negative Offsite Impact	Mitigation Measure(s)
	suggests that fish species may be using peatland with more natural, high water-table levels (WTL) as nurseries and ecological corridors (S. Thornton, 2023, pers. comm.). Hydrological restoration of the project area, i.e., raising the WTL to its natural state means that the project will increasingly better resemble a natural peatland which should improve habitat quality and quantity for native fish species. 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 to persist in the short- to medium-term. Informal interviews with fishermen in the project area revealed that fishermen often approve of canal dams because they effectively create transient fishponds between dams where fish are easy to catch. This suggests that fish species in canals survive well in degraded peatland after canal damming. Anecdotal evidence from degraded peatlands in Kalimantan also found fishermen approved of canal dams for the same reason (S. Thornton, 2023, pers. comm.). The return of riparian vegetation to canals should gradually improve the health of the wetland ecosystem. Furthermore, the dams are constructed to create natural spillways that allow for fish passage between dams when water levels are high. Any potential net negative off site impacts on the canal-living fish species should be more than offset by the benefits of blocking the canals for the wider peatland ecosystem (particularly terrestrial species), meaning that project activities should continue unmitigated to result in clear net biodiversity benefits, both onsite and offsite. The increased risk of canal and river drainage, pollution, and water pH changes in the without-project scenario due to fires and industrial forestry activities also suggests that onsite and offsite net positive benefits for fish species are being achieved in the with-project scenario.

5.2.2 Net Offsite Biodiversity Benefits (B3.3)

See section 5.1.3 and 5.2.1 for an overview of the net biodiversity benefits from project activities. In the current 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 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 continued to implement the biodiversity monitoring plan based on the causal model for maintained or enhanced biodiversity in the project area (see Figure 6). This targeted causal model for biodiversity supports the implementation of the biodiversity monitoring plan described in

the Project Document with no deviation from the validated monitoring plan. Key activities conducted during this monitoring period on biodiversity monitoring, include:

- Camera trap surveys conducted to monitoring mammal species
- Point transect surveys to monitor bird species
- Vegetation plot surveys conducted at multiple project locations
- An additional fish survey conducted by a local student
- Management of all data collected across all methods

Table 48 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 2021 monitoring period used standardized, repeatable survey methods. This allowed the project to derive early estimates of species diversity and abundance for some species. The ability of longitudinal data to detect change for other species will improve with time when important long-term patterns may become detectable. It is also important to note that ecological succession patterns in tropical peatlands undergoing assisted natural regeneration are often sporadic, particularly with regards to fauna.

Table 48. Summary of biodiversity monitoring in 2021.

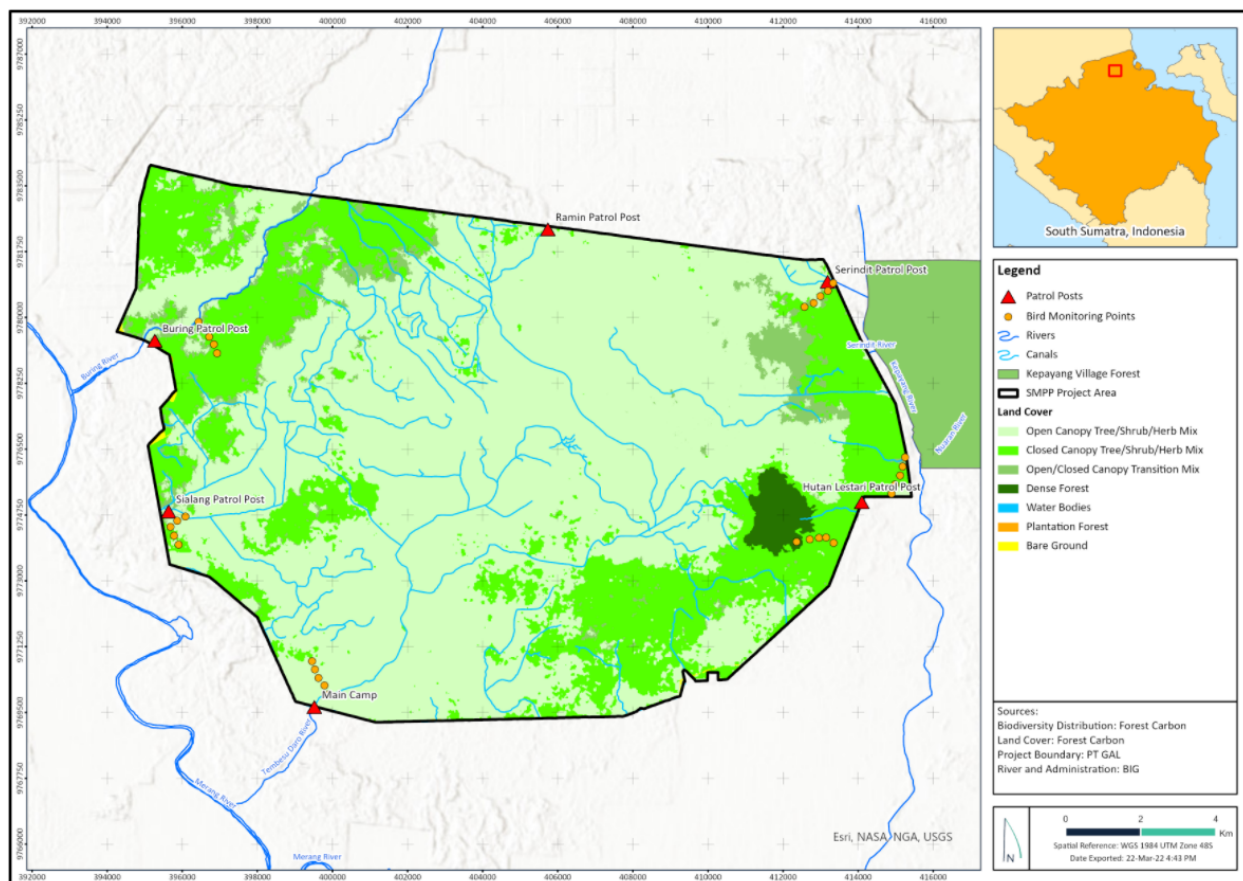
No.	Monitoring Type	Potential Target Species	Sampling Method & Frequency	Sampling Date(s)	Analysis Type	Biodiversity Variable(s) Measured	2021 Result
1	Point Count Transect Surveys	Birds	- Six 1-km-long point transects were surveyed. - Each point transect had five point transect counting stations/points 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 2021, 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 season and dry season)	February to March, and July to August 2021	Species richness-evenness; Distance Sampling	Bird species diversity metrics	see Table 47
						Bird trigger species densities	See Table 48 & Section 5.4
2	Vegetation Plot Surveys	Plants (especially tree flora)	24 permanent, nested vegetation plots along 6 transects (i.e., 4 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, all poles in the 16 m x 16 m sub plot, all saplings in the 8 m x 8 m sub plot, and all seedlings in the 2 m x 2 m sub plot were counted and identified to species level where possible.	July to September 2021	Species richness-evenness; Nested Plot Sampling	Plant species diversity metrics	see Table 49
						Density of trees by tree maturity category	see Table 50
						Average fern cover & average shrub cover	see Table 50

No.	Monitoring Type	Potential Target Species	Sampling Method & Frequency	Sampling Date(s)	Analysis Type	Biodiversity Variable(s) Measured	2021 Result
			% fern cover and % shrub cover was estimated for each 8 m x 8 m sub plot, and verified with an aerial photograph taken from a drone where possible.			Density of tree trigger species by tree maturity category	see Table 51 & Section 5.4
3	Camera Trap Surveys	Mostly medium-to-large sized mammals	30 camera trap stations were surveyed during the wet season and 29 during the dry season (due to the loss of one camera trap unit). - Camera trap stations were chosen for accessibility from project area guard posts, potential suitability as mammal walkways, and proximity to focal species spoors, e.g., sun bear/tiger tracks. - Each camera station was surveyed for an average of 69 days during the wet season and an average of 63 days during the dry season (target was 60 days each).	March to June, and September to December 2021	Species richness-evenness; Relative abundance; Species presence	Mammal species diversity metrics	see Table 52
						Mammal trigger species Relative Abundance Index (RAI)	see Table 53 & Section 5.4
						Mammal trigger species Naïve Occupancy	see Table 53 & Section 5.4

5.3.1.1 Point Transect Surveys

Point transect surveys were designed following Sutherland (2006)⁴⁶ and Buckland et al. (2008).⁴⁷ Across six point transects (Map 13), 1,948 individuals and 80 bird species were recorded during this monitoring period, 17 species of which were recorded for the first time in the project area and 22 of which were trigger species (see Table 49). One observation of particular note was the second record of a wrinkled hornbill (*Rhabdotorrhinus corrugatus*) in the project area, a species listed as Endangered (EN) on the IUCN RED List⁴⁸ and endemic to the Sundaland Bioregion.

An additional 16 bird species, eight of which were first records for the project area, were recorded opportunistically outside of point transect surveys and not included in the analyses outlined in Table 49 and Table 50. This brings the total number of bird species identified during this monitoring period to 96 and brings the total number of bird species identified in the project area up to 127 (see Annex 20 for the full species inventory).



Map 13. Map of SMPP area showing the location of point count transects during this monitoring period.

Table 49. Summary of biodiversity metrics assessed for bird species surveyed in point transect surveys in 2020 – 2021.

No.	Biodiversity Metric	Metric Type	Year	
			2020	2021
1	Total no. of species recorded in the project area (<i>S</i>)	Species Richness	70	80
2	Number of new species detected	Species Richness	29	17
3	Number of new trigger species detected	Species Richness	22	22
4	Total no. of individuals across all species recorded in the project area (<i>N</i>)	Species Abundance	1396	1948
5	Margalef's Species Richness Index (<i>D_{Mg}</i>)	Species Richness Index	9.53	10.43
6	Shannon-Wiener Diversity Index (<i>H'</i>)	Species Richness-Evenness Index	3.06	3.12
7	Shannon's Equitability (or Species Evenness) (<i>E</i>)	Species Evenness Index	0.72	0.71
8	Effective Number of Species (<i>ENS</i>)	Species Richness-Evenness Index	21.24	22.69
7	Simpson's Index of Diversity (<i>1-D</i> or <i>D_s</i>)	Species Richness-Evenness Index	0.91	0.92

All the metrics included in Table 49 are metrics of biodiversity adapted from Magurran (2004).⁴⁹ Some of these metrics use species richness to measure diversity, while other use evenness, and some use both (see Annex 22 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. An increase from 70 bird species recorded in 2020 to 80 species recorded this year and an increase from 9.53 to 10.43 for Margalef's Species Richness Index (*D_{Mg}*), indicates that species richness aspects of diversity in the project are at a moderate level and are likely being enhanced by 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 is being maintained across bird species in the area despite some notably higher 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 0.92 recorded for this monitoring period suggests low dominance, high evenness, and high diversity in the project area, despite the high relative abundances for some species mentioned above. A *H'* of 3.12 and an *ENS* of 22.69 for this monitoring period suggests that bird species diversity in the project area has improved since the 2020 monitoring period.

Of the 22 trigger species identified in this monitoring period, 19 were recorded within 25 meters of the observer conducting the point transect surveys. This brings the total number of trigger species recorded within 25 meters of the observer during point transect surveys—since systematic annual monitoring began—to 23 species. Using the 'Point Count Fixed-Radius Formula',⁴⁷ density of individuals per ha was estimated for each of these species (see Table 50).

Table 50. Density of bird trigger species in individuals per ha for 2020 – 2021.

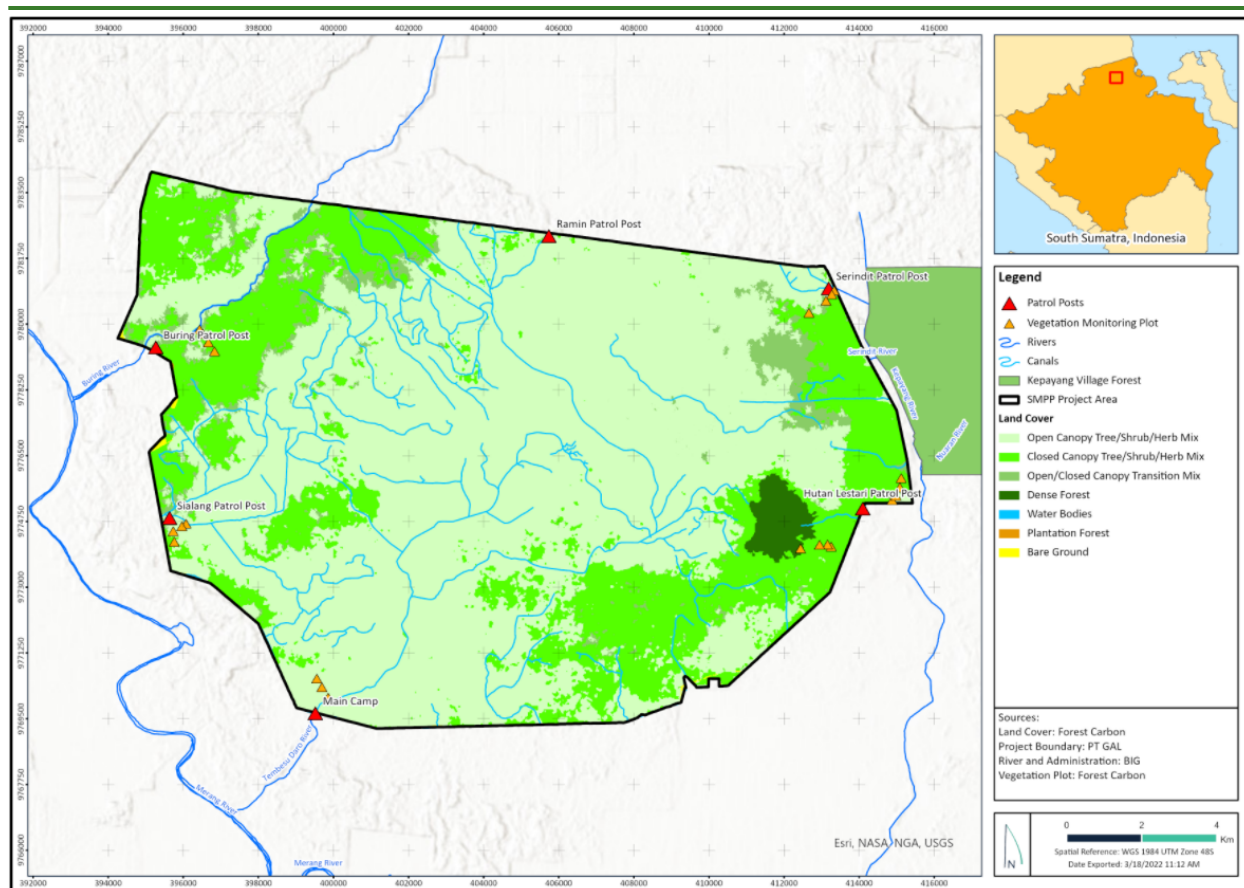
No.	Bird Trigger Species (Scientific Name (Common Name))	Density of individuals per ha	
		2020	2021
1	<i>Acridotheres javanicus</i> (Javan Myna)		0.51
2	<i>Chloropsis cyanopogon</i> (Lesser Green Leafbird)		0.34
3	<i>Chrysophlegma miniaceum</i> (Banded Woodpecker)	0.34	
4	<i>Collocalia linchi</i> (Cave Swiftlet)	25.99	6.96
5	<i>Cyanoderma erythropterum</i> (Chestnut-winged Babbler)	1.53	4.76
6	<i>Cyornis umbratilis</i> (Grey-Chested Jungle-Flycatcher)	0.17	
7	<i>Dendrocopos moluccensis</i> (Sunda Pygmy Woodpecker)	1.36	0.68
8	<i>Hemicircus concretus</i> (Grey-And-Buff Woodpecker)	0.17	0.00
9	<i>Macronus ptilosus</i> (Fluffy-Backed Tit-Babbler)		0.85
10	<i>Malacocincla sepiaria tardinata</i> (Horsfield's Babbler)	0.68	2.04
11	<i>Malacopteron magnum</i> (Rufous-Crowned Babbler)	0.17	
12	<i>Microhierax fringillarius</i> (Black-Thighed Falconet)	3.57	0.85
13	<i>Orthotomus sericeus</i> (Rufous-tailed tailorbird)		0.51
14	<i>Pellorneum capistratum</i> (Rufous-browed Babbler)		1.70
15	<i>Phaenicophaeus curvirostris</i> (Chestnut-breasted Malkoha)		1.19
16	<i>Phaenicophaeus diardi</i> (Black-Bellied Malkoha)	1.87	1.53
17	<i>Picus puniceus</i> (Crimson-Winged Woodpecker)	0.34	0.34
18	<i>Prinia familiaris</i> (Bar-Winged Prinia)	1.53	6.11
19	<i>Psittacula longicauda</i> (Long-Tailed Parakeet)	0.17	0.17
20	<i>Pycnonotus brunneus</i> (Red-Eyed Bulbul)	3.57	1.19
21	<i>Pycnonotus simplex</i> (Cream-Vented Bulbul)	0.34	0.85
22	<i>Rhabdotorrhinus corrugatus</i> (Wrinkled Hornbill)	0.68	0.34
23	<i>Zanclostomus javanicus</i> (Red-billed Malkoha)	0.17	0.85

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 56 in section 5.4.1 of this report.

5.3.1.2 Vegetation Plot Surveys

Vegetation plot survey design was adapted from Graham et al. (2014).⁵⁰ Across 24 nested vegetation plots on six transects (see Map 14), there were 2,003 individuals (479 of which were trees) recorded across 61 plant species (50 of which were tree species) during this monitoring period. Of these 61 plant species, 23 were recorded for the first time in the project area, and 16 were trigger species (see Table 51). Some observations of note include *Gonstylus bancanus* (Ramin) which is listed as Critically Endangered (CR) on the IUCN Red List⁴⁸ and *Shorea uliginosa* (Meranti Kelungkum) which is listed as Vulnerable (VU) on the IUCN Red List,⁴⁸ with both species being endemic to the Sundaland Bioregion.

The total number of plant species now identified in the project area since the first vegetation survey is now up to 128, of which 88 are tree species and 32 of which are trigger species (see Annex 20 for the full species inventory).



Map 14. Map of SMPP area showing the location of transects with nested vegetation plots during this monitoring period.

Table 51. Summary of biodiversity metrics assessed for tree and non-tree plant species surveyed in nested vegetation plot surveys in 2020 – 2021.

No.	Biodiversity Metric	Metric Type	Species	Year	
				2020	2021
1	Total no. of species recorded in the project area (S)	Species Richness	All	58	61
			Trees	45	50
			Non-Trees	13	11
2	Number of new species detected	Species Richness	All	48	23
			Trees	39	21
			Non-Trees	9	2
3	Number of new trigger species detected	Species Richness	All	18	16
			Trees	18	16
			Non-Trees	0	0
4	Total no. of individuals across all species recorded in the project area (N)	Species Abundance	All	1666	2003
			Trees	284	479
			Non-Trees	1382	1524

No.	Biodiversity Metric	Metric Type	Species	Year	
				2020	2021
5	Margalef's Species Richness Index (D_{Mg})	Species Richness Index	All	7.68	7.89
			Trees	7.79	7.94
			Non-Trees	1.66	1.36
6	Shannon-Wiener Diversity Index (H')	Species Richness-Evenness Index	All	2.06	2.24
			Trees	2.57	2.67
			Non-Trees	1.40	1.38
7	Shannon's Equitability (or Species Evenness) (E)	Species Evenness Index	All	0.51	0.55
			Trees	0.67	0.68
			Non-Trees	0.55	0.58
8	Effective Number of Species (ENS)	Species Richness-Evenness Index	All	7.83	9.40
			Trees	13.04	14.41
			Non-Trees	4.07	3.99
9	Simpson's Index of Diversity ($1-D$ or D_s)	Species Richness-Evenness Index	All	0.78	0.81
			Trees	0.84	0.85
			Non-Trees	0.68	0.68

Plant species diversity marginally increased in this monitoring period compared to the previous monitoring period but still appears to be relatively low in the SMPP project area (see Table 51 for a range of plant species diversity metrics). Tree species in the project area account for most of the plant species diversity, 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 non-tree species, namely ferns, dominating much of the project area. Most tree species are only represented by a handful of individuals, with a small number of species, e.g., *Macaranga pruinosa* and *Melicope lunu-ankenda*, being notably more abundant during this and previous monitoring periods.

All species richness-evenness metrics from Table 51 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 14.41 for tree species in this monitoring period is likely indicating an increased but still low level of diversity, which is reduced to an ENS of 9.40 when non-tree species are included in the ENS calculations.

Fern cover and shrub cover were 67% and 13% respectively in this monitoring period (see Table 50). Trends in fern and shrub cover will only become measurable from next year's monitoring period onward.

There was an increase in the density of trees across all tree age classes during this monitoring. Similarly, to the previous monitoring period, individuals from younger tree age classes (i.e., saplings and seedlings) were present at a much higher density than those from older tree age classes (i.e., poles and trees; see Table 52), indicative of expected early ecological succession and regeneration processes. However, the markers used to delineate the permanent vegetation plots established in the previous monitoring period were lost, and the exact boundaries of the permanent vegetation plots were not easily determined. This potentially led to an inflated number of individuals recorded across all age classes. More robust permanent markers structures are now in place to ensure accuracy for future monitoring periods.

Data collected in subsequent monitoring periods may more clearly support this early evidence of ecological succession leading to increased diversity in the project area.

Table 52. Density of individuals per ha of each tree age class, and average fern cover (%) and average shrub cover (%) in 2020 – 2021.

No.	Year	Tree age class density / ha				Avg. Fern Cover %	Avg. Shrub Cover %
		Trees	Poles	Saplings	Seedlings		
1	2020	24	171	599	2813	75%	24%
2	2021	41	184	1354	5938	67%	13%

Table 53 shows abundance and density data for each tree age class for each of the 22 trigger species identified in the project area, 16 of which were recorded for the first time during this monitoring period. The actions taken to maintain or enhance their populations and mitigate threats are described in more detail in Table 56 in section 5.4.1 of this report.

Table 53. Tree trigger species abundance and density per hectare (ha) for each tree age class for all trigger species observed during vegetation plots in 2020 – 2021.

No.	Tree Trigger Species	Tree age class	Abundance		Density/ha	
			2020	2021	2020	2021
1	<i>Actinodaphne macrophylla</i>	Tree	0	0	0	0
		Pole	0	0	0	0
		Sapling	0	0	0	0
		Seedling	1	0	104	0
2	<i>Archidendron borneense</i>	Tree	1	1	<1	<1
		Pole	11	7	18	11
		Sapling	3	1	20	7
		Seedling	0	29	0	3,021
3	<i>Dillenia excelsa</i>	Tree	0	0	0	0
		Pole	2	0	3	0
		Sapling	0	0	0	0
		Seedling	0	0	0	0
4	<i>Diospyros maingayi</i>	Tree	1	1	<1	<1
		Pole	4	4	7	7
		Sapling	0	5	0	33
		Seedling	0	0	0	0
5	<i>Dyera costulata</i>	Tree	2	0	<1	0
		Pole	0	0	0	0
		Sapling	0	0	0	0
		Seedling	0	0	0	0
6	<i>Dyera polyphylla</i>	Tree	0	2	0	<1
		Pole	0	0	0	0
		Sapling	0	0	0	0
		Seedling	0	0	0	0
7	<i>Endospermum diadenum</i>	Tree	2	2	<1	<1
		Pole	1	2	2	3
		Sapling	0	7	0	46
		Seedling	0	2	0	208

No.	Tree Trigger Species	Tree age class	Abundance		Density/ha	
			2020	2021	2020	2021
8	<i>Gluta wallichii</i>	Tree	0	0	0	0
		Pole	1	0	2	0
		Sapling	0	0	0	0
		Seedling	0	0	0	0
9	<i>Gonystylus bancanus</i>	Tree	0	0	0	0
		Pole	0	0	0	0
		Sapling	1	1	7	7
		Seedling	0	0	0	0
10	<i>Ilex cymosa</i>	Tree	1	4	<1	2
		Pole	0	2	0	3
		Sapling	0	0	0	0
		Seedling	0	0	0	0
11	<i>Lithocarpus lucidus</i>	Tree	0	0	0	0
		Pole	1	0	2	0
		Sapling	0	0	0	0
		Seedling	0	0	0	0
12	<i>Litsea machilifolia</i>	Tree	0	0	0	0
		Pole	0	0	0	0
		Sapling	1	0	7	0
		Seedling	0	0	0	0
13	<i>Lophopetalum beccarianum</i>	Tree	0	0	0	0
		Pole	0	0	0	0
		Sapling	0	1	0	7
		Seedling	0	0	0	0
14	<i>Macaranga pruinosa</i>	Tree	12	43	5	18
		Pole	51	47	83	77
		Sapling	12	21	78	137
		Seedling	7	1	729	104
15	<i>Melicope glabra</i>	Tree	0	0	0	0
		Pole	2	9	3	15
		Sapling	4	5	26	33
		Seedling	0	0	0	0
16	<i>Palaquium dasyphyllum</i>	Tree	0	0	0	0
		Pole	0	1	0	2
		Sapling	0	0	0	0
		Seedling	0	0	0	0
17	<i>Payena acuminata</i>	Tree	2	2	<1	<1
		Pole	0	0	0	0
		Sapling	0	0	0	0
		Seedling	0	0	0	0

No.	Tree Trigger Species	Tree age class	Abundance		Density/ha	
			2020	2021	2020	2021
18	<i>Quassia borneensis</i>	Tree	0	0	0	0
		Pole	0	2	0	3
		Sapling	1	10	7	65
		Seedling	0	0	0	0
19	<i>Sindora bruggemanii</i>	Tree	0	0	0	0
		Pole	0	1	0	2
		Sapling	0	4	0	26
		Seedling	0	0	0	0
20	<i>Shorea uliginosa</i>	Tree	1	2	<1	<1
		Pole	0	0	0	0
		Sapling	0	0	0	0
		Seedling	0	0	0	0
21	<i>Stemonurus secundiflorus</i>	Tree	1	3	<1	1
		Pole	0	2	0	3
		Sapling	1	0	7	0
		Seedling	0	13	0	1,354
22	<i>Tetramerista glabra</i>	Tree	1	2	<1	<1
		Pole	0	0	0	0
		Sapling	1	1	7	7
		Seedling	0	0	0	0

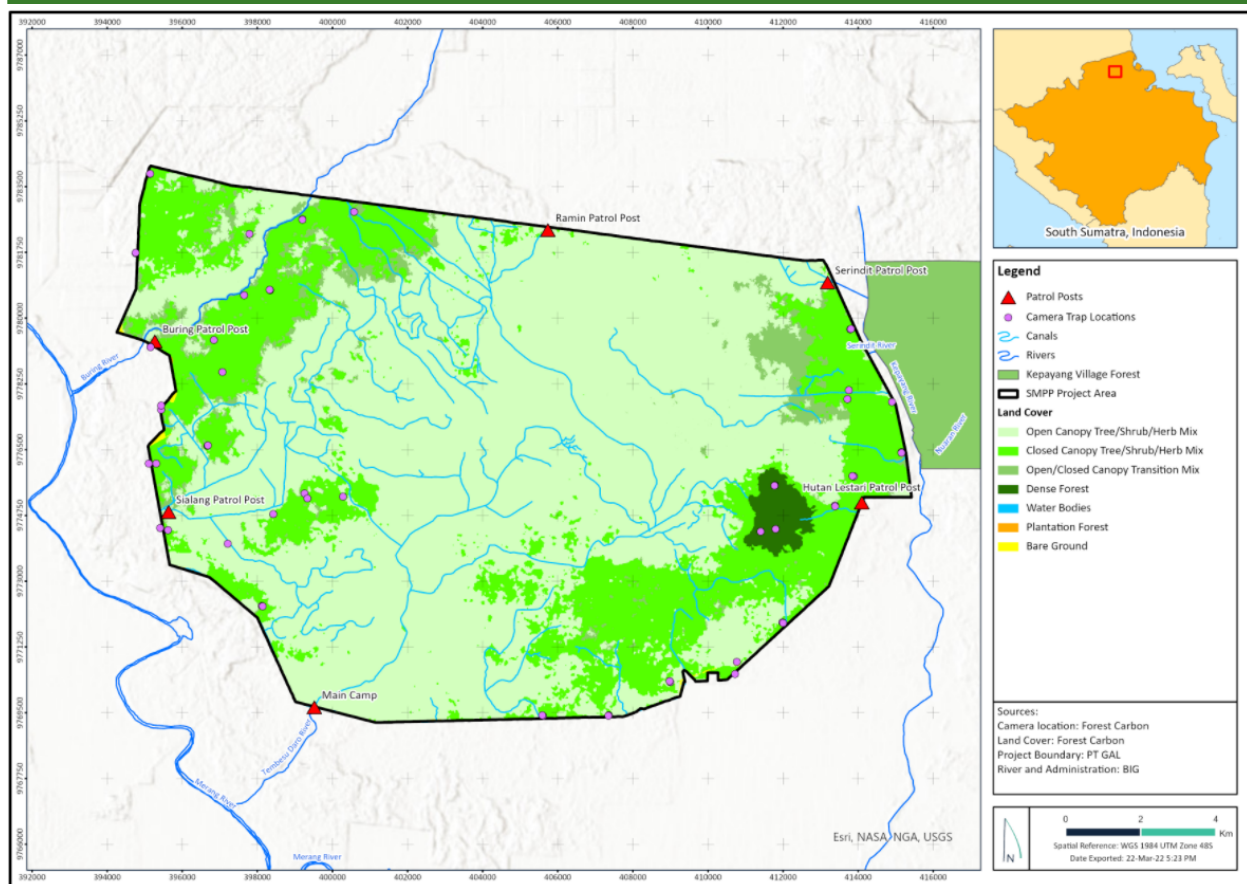
5.3.1.3 Camera Trap Surveys

Camera trap surveys were conducted to assess mammal diversity and population trends in the project area. There was an increase in camera trap survey sampling effort in this monitoring period compared to the previous period which is representative of the planned sampling effort going forward.

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-sized mammals that are likely to use game trails. 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 the potential for increased species diversity as predators keep prey species abundances relatively even.

Using 30 camera trap units across 59 camera trap stations (30 stations surveyed in the wet season and 29 of the same stations surveyed in the dry season; see Map 15), 1,191 individuals across 18 mammal species were captured in camera trap images across 3,927 active camera trap days. One species was detected for the first time in the project area and an additional six species were detected for the first time but outside of standard camera trap surveys, this brings the total number of mammal species observed in the project area to 34 (see Annex 20 for the full species inventory). An additional 22 bird species and one reptile species were captured in camera trap images, but these species have not been included in the analyses that follow (see Annex 20).



Map 15. Map of SMPP area showing camera traps surveyed during this monitoring period.

With a D_{Mg} of 2.40 and an E of 0.67, a marginal decrease on the last monitoring period, mammal species in the SMPP appear to have a relatively low species richness and a moderate species evenness (see Table 54). These results are supported by a relatively low and marginally decreased H' of 1.94 and ENS of 6.98 but a moderate to high D_s of 0.80, 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 SMPP, low mammal species richness is expected. Moderate to low mammal species evenness is also expected with some hardy, generalist, omnivorous mammal species, such as, macaques (*Macaca fascicularis* and *Macaca nemestrina*) and wild boar (*Sus scrofa*) being 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. The marginal decreases seen in mammal species richness, evenness, and richness-evenness diversity metrics are negligible and suggest that mammal species diversity is still being maintained in the project area. Most of these decreases can be accounted for by the derivation of similar richness estimates despite increased sampling effort, and the higher abundance of ecological generalist species recorded with increased sampling effort. Long term trends are only likely to become detectable with several more years of monitoring data.

Table 54. Summary of biodiversity metrics assessed for mammal species surveyed in camera trap surveys in 2020 – 2021.

No.	Biodiversity Metric	Metric Type	Year	
			2020	2021
1	Total no. of species recorded in the project area (<i>S</i>)	Species Richness	18	18
2	Number of new species detected	Species Richness	9	1
3	Number of new Trigger species detected	Species Richness	12	9
4	Total no. of individuals across all species recorded in the project area (<i>N</i>)	Species Abundance	323	1191
5	Margalef's Species Richness Index (<i>D_{Mg}</i>)	Species Richness Index	2.94	2.40
6	Shannon-Wiener Diversity Index (<i>H'</i>)	Species Richness-Evenness Index	2.04	1.94
7	Shannon's Equitability (or Species Evenness) (<i>E</i>)	Species Evenness Index	0.71	0.67
8	Effective Number of Species (<i>ENS</i>)	Species Richness-Evenness Index	7.69	6.98
7	Simpson's Index of Diversity (<i>1-D</i> or <i>D_s</i>)	Species Richness-Evenness Index	0.81	0.80

Camera trap surveys are a powerful tool for assessing mammal diversity and population trends in a way that is non-invasive. They can cover large areas with relatively little effort and detect species that are likely to actively avoid human observers. Despite these obvious benefits, camera traps do suffer from unpredictable detection rates and analyses that can be used to account for imperfect detection and derive accurate estimates of species abundance is somewhat limited. The two species abundance estimates presented here for mammal trigger species (see Table 55) use the Relative Abundances Index (RAI, equation 27)⁵¹ and Naïve Occupancy.⁵² 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 abundance 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.⁵³

$$RAI = \frac{n_i}{\sum TN} \times 100 \quad (5.1)$$

Where:

RAI Relative Abundance Index per 100 trap days

n_i Number of independent images the species *i*

$\sum TN$ Number of active camera trap days

Occupancy is defined as the proportion of sampling units (i.e., camera trap stations) that are occupied by a particular species, on a scale of 0 to 1. It measures species presence 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 55 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 56 in section 5.4.1 of this report.

Table 55. Relative Abundance Index (RAI) and Naïve Occupancy by year for each of the mammal trigger species recorded in the project area for the period 2020 – 2021.

No.	Order	Mammal Trigger Species Name (Scientific (Common))	Trigger Status	Year			
				RAI		Naïve Occupancy	
				2020	2021	2020	2021
1	Rodentia	<i>Callosciurus notatus</i> (Plantain Squirrel)	Trigger	1.06	0.59	0.18	0.22
2	Carnivora	<i>Helarctos malayanus</i> (Sun Bear)	Trigger	3.91	3.74	0.59	0.68
3	Carnivora	<i>Herpestes brachyurus</i> (Short-Tailed Mongoose)	Trigger	0.08	0.18	0.05	0.10
4	Rodentia	<i>Hystrix sumatrae</i> (Sumatran Porcupine)	Trigger	0.08	-	0.05	-
5	Primata	<i>Macaca nemestrina</i> (Southern Pig-Tailed Macaque)	Trigger	8.88	11.10	0.73	0.63
6	Carnivora	<i>Mustela nudipes</i> (Malay Weasel)	Trigger	0.08	-	0.05	-
7	Carnivora	<i>Panthera tigris sumatrae</i> (Sumatran Tiger)	Trigger	0.49	-	0.23	-
8	Primata	<i>Presbytis mitrata</i> (Mitered Langur)	Trigger	-	0.41	-	0.10
9	Artiodactyla	<i>Rusa unicolor</i> (Sambar Deer)	Trigger	0.65	1.38	0.18	0.39
10	Rodentia	<i>Sundasciurus lowii</i> (Low's Squirrel)	Trigger	0.24	0.03	0.09	0.02
11	Artiodactyla	<i>Sus barbatus</i> (Bearded Pig)	Trigger	0.49	0.05	0.23	0.02
12	Artiodactyla	<i>Tragulus napu</i> (Greater Mouse-Deer)	Trigger	0.08	-	0.05	-
13	Scandentia	<i>Tupaia tana</i> (Large Treeshrew)	Trigger	2.36	1.22	0.32	0.17

5.3.2 Biodiversity Monitoring Plan Dissemination (B4.3)

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

Both 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,⁴⁸ and species distribution (as proxies for species vulnerability and irreplaceability). This definition follows IUCN

definitions as prescribed by the CCB Standards.⁵⁴ 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/>)
- World Flora Online (<http://www.worldfloraonline.org/>)
- Kew Science Plants of the World Online (<https://powo.science.kew.org/>)
- The Plant List (<http://www.theplantlist.org/>)

By the end of this monitoring period, the project had recorded a total of 127 trigger species (an increase of 32 trigger species, including 95 faunal species, and 32 floral species), which are summarized by taxonomic class below (see Table 56, and see Annex 20 for a full list of trigger and non-trigger species):

- 21 mammals (increase of three species from previous monitoring period)
- 39 birds (increase of four species)
- Seven reptiles (no increase; not actively surveyed)
- Five amphibians (increase of three species; not actively surveyed)
- 18 fishes (increase of 17 species; not actively surveyed by project but an additional survey was conducted in the project during this monitoring period)
- Five arthropods (dragonflies and damselflies) (no increase; not actively surveyed)
- 32 plant species (31 of which are tree species; increase of four species)

While not all species groups are actively surveyed or directly assessed as part of the biodiversity monitoring plan, data on all species is updated in the species inventory each year whether the species is actively or opportunistically detected in the project area. Newly detected species which are recorded on patrols, as bycatch during other survey methods, or during additional surveys 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 yet enough data to determine any clear trends, it is likely that trigger species have experienced net positive benefits during this monitoring period from recent project activities.

Table 56. Trigger species in the SMPP.

Trigger Species	Mammals (21 species): 1. <i>Callosciurus notatus</i> (Plantain Squirrel) 2. <i>Callosciurus prevostii</i> (Prevost's Squirrel) 3. <i>Helarctos malayanus</i> (Sun Bear) 4. <i>Herpestes brachyurus</i> (Short-Tailed Mongoose) 5. <i>Hylobates agilis</i> (Agile Gibbon) 6. <i>Hystrix sumatrae</i> (Sumatran Porcupine) 7. <i>Lutrogale perspicillata</i> (Smooth-Coated Otter) 8. <i>Macaca nemestrina</i> (Southern Pig-Tailed Macaque) 9. <i>Manis javanica</i> (Sunda Pangolin) 10. <i>Muntiacus muntjak</i> (Southern Red Muntjac) 11. <i>Mustela nudipes</i> (Malay Weasel) 12. <i>Mydaus javanensis</i> (Sunda Stink-Badger) 13. <i>Panthera tigris sumatrae</i> (Sumatran Tiger) 14. <i>Presbytis mitrata</i> (Mitered Langur) 15. <i>Rhinosciurus laticaudatus</i> (Shrew-Faced Squirrel) 16. <i>Rusa unicolor</i> (Sambar Deer) 17. <i>Sundasciurus lowii</i> (Low's Squirrel) 18. <i>Sus barbatus</i> (Bearded Pig) 19. <i>Trachypithecus cristatus</i> (Silvery Lutung) 20. <i>Tragulus napu</i> (Greater Mouse-Deer) 21. <i>Tupaia tana</i> (Large Treeshrew)
Population Trend at Start of Project	Two of these species are listed as Critically Endangered (CR) on the IUCN Red List (i.e., <i>Manis javanica</i> (Sunda pangolin) and <i>Panthera tigris sumatrae</i> (Sumatran tiger)), one species is listed as Endangered (EN) (i.e., <i>Hylobates agilis</i> (agile gibbon)), and six species are listed as Vulnerable (VU). The remaining species are listed as Near Threatened (NT) or Least Concern (LC) but have been designated as trigger species because they are endemic to the region. All trigger species identified are vulnerable to ongoing habitat loss and degradation, and many were threatened by hunting, and experiencing decreasing population trends across their range at the start of the project.
Without-project Scenario	Without the presence of the project, it is likely that these species would continue to be impacted by hunting, and habitat loss/degradation from land use change (planned conversion to Acacia plantation) and fires, resulting in further pressures on population persistence.
With-project Scenario	As primarily forest-dependent and regenerating forest-dependent mammal species, all the 21 mammal trigger species listed above stand to benefit from key project activities undertaken during this and previous monitoring periods. Activities include new canal blocking and existing canal dam monitoring to restore the natural peatland water table level, fire management in and around the project area (bolstered by new agreements signed in 2019, 2020, and 2021 with adjacent

	concessions), and enrichment planting and assisted natural regeneration. Many of these species are at risk from hunting for the illegal wildlife trade, particularly <i>Panthera tigris sumatrae</i> (Sumatran Tiger), <i>Manis javanica</i> (Sunda pangolin), <i>Helarctos malayanus</i> (Sun Bear), and <i>Rusa unicolor</i> (Sambar Deer). The project field team conducted roughly 850 individual patrols during this monitoring period and observed no evidence of illegal hunting, with active patrols acting as a deterrent to hunting activities in the area. During this monitoring period, 14 mammal trigger species were recorded, nine of which were recorded during camera trap surveys, making it possible to estimate Relative Species Abundance (RAI) and Naïve Occupancy for these nine species (see Table 52). See section 5.3.1.3 of this report 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 <i>Helarctos malayanus</i> (Sun Bear) (RAI = 3.74; Naïve Occupancy = 0.68), <i>Sus scrofa</i> (Wild Boar) (RAI = 5.07; Naïve Occupancy = 0.51), <i>Macaca nemestrina</i> (Southern Pig-Tailed Macaque) (RAI = 11.10; Naïve Occupancy = 0.63), <i>Macaca fascicularis</i> (Long-Tailed Macaque) (RAI = 4.53; Naïve Occupancy = 0.41). The latter two species saw an increase in RAI, but a decrease in Naïve Occupancy, suggesting that most of this increase in relative abundance is concentrated in a few camera trap locations. Perhaps the most notable new species recorded this year is <i>Manis javanica</i> (Sunda Pangolin), which was recorded outside of camera trap surveys. The Sunda pangolin is listed as Critically Endangered (CR) on the IUCN Red List due to severe population declines, primarily because of its extensive use as a delicacy and for traditional medicine. Southern pig-tailed macaques are listed as Vulnerable (VU) on the IUCN Red List, are endemic to the Sundaland Bioregion, and are threatened by habitat loss and hunting as pests and for the illegal wildlife trade. Sun bears, the world's smallest bears, 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. Several species with a low RAI and Naïve Occupancy in the last monitoring period were not recorded in this year's monitoring period, including <i>Hystrix sumatrae</i> (Sumatran Porcupine), <i>Mustela nudipes</i> (Malay Weasel), <i>Panthera tigris sumatrae</i> (Sumatran Tiger), and <i>Tragulus napu</i> (Greater Mouse-Deer). After the first photographic evidence of the Sumatran tiger (<i>Panthera tigris sumatrae</i>) in the project area in 2020, it would have been another significant result if the same evidence had emerged in the 2021 monitoring, but that has not been the case. The Sumatran tiger is a Critically Endangered (CR) 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
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	potential prey species, such as, bearded pigs (<i>Sus barbatus</i>) and sambar deer (<i>Rusa unicolor</i>) seem to support this hypothesis. Given their rarity and their large home ranges 60-100 km², it is anticipated that camera trap surveys will not detect Sumatran tiger individuals every year. However, several tiger spoor (footprints) were documented just outside the project area during this monitoring period, meaning that tigers are likely still using the project area. Protecting and restoring the project area 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. The camera trap survey data suggest that mammal trigger species diversity and population trends are being maintained under the with-project scenario, with early data indicating that ecological generalists are faring better than specialists in the project area, leading to marginal reductions in overall diversity and in the population trends of some species. At least several more years of monitoring is required to determine the long-term impacts of project activities and ecological succession on the mammal populations in the project area.
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Trigger Species	Birds (39 species): 1. <i>Acridotheres javanicus</i> (Javan Myna) 2. <i>Alophoixus finschii</i> (Finsch's Bulbul) 3. <i>Anas gibberifrons</i> (Sunda Teal) 4. <i>Anorrhinus galeritus</i> (Bushy-Crested Hornbill) 5. <i>Buceros rhinoceros</i> (Rhinoceros Hornbill) 6. <i>Chloropsis cyanopogon</i> (Lesser Green Leafbird) 7. <i>Chrysophlegma miniaceum</i> (Banded Woodpecker) 8. <i>Collocalia linchi</i> (Cave Swiftlet) 9. <i>Copsychus pyrropygus</i> (Rufous-Tailed Shama) 10. <i>Chrysocolaptes validus</i> (Orange-backed Woodpecker) 11. <i>Cyanoderma erythropterum</i> (Chestnut-winged Babbler) 12. <i>Cyornis umbratilis</i> (Grey-Chested Jungle-Flycatcher) 13. <i>Dendrocopos moluccensis</i> (Sunda Pygmy Woodpecker) 14. <i>Hemicircus concretus</i> (Grey-And-Buff Woodpecker) 15. <i>Leptoptilos javanicus</i> (Lesser Adjutant) 16. <i>Lophura erythrophthalma</i> (Malay Crestless Fireback) 17. <i>Loriculus galgulus</i> (Blue-Crowned Hanging-Parrot) 18. <i>Macronus ptilosus</i> (Fluffy-Backed Tit-Babbler) 19. <i>Malacocincla malacense</i> (Short-Tailed Babbler) 20. <i>Malacocincla sepiaria tardinata</i> (Horsfield's Babbler) 21. <i>Malacopteron affine</i> (Sooty-Capped Babbler) 22. <i>Malacopteron magnum</i> (Rufous-Crowned Babbler) 23. <i>Microhierax fringillarius</i> (Black-Thighed Falconet) 24. <i>Nisaetus nanus</i> (Wallace's Hawk-Eagle) 25. <i>Orthotomus sericeus</i> (Rufous-tailed tailorbird) 26. <i>Pellorneum capistratum</i> (Rufous-browed Babbler) 27. <i>Phaenicophaeus curvirostris</i> (Chestnut-breasted Malkoha)
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	28. <i>Phaenicophaeus diardi</i> (Black-Bellied Malkoha) 29. <i>Phaenicophaeus sumatranus</i> (Chestnut-Bellied Malkoha) 30. <i>Picus dedemi</i> (Sumatran woodpecker) 31. <i>Picus puniceus</i> (Crimson-Winged Woodpecker) 32. <i>Prinia familiaris</i> (Bar-Winged Prinia) 33. <i>Psittacula longicauda</i> (Long-Tailed Parakeet) 34. <i>Psittinus cyanurus</i> (Blue-Rumped Parrot) 35. <i>Pycnonotus brunneus</i> (Red-Eyed Bulbul) 36. <i>Pycnonotus simplex</i> (Cream-Vented Bulbul) 37. <i>Rhabdotorrhinus corrugatus</i> (Wrinkled Hornbill) 38. <i>Setornis criniger</i> (Hook-Billed Bulbul) 39. <i>Zanclostomus javanicus</i> (Red-billed Malkoha)
Population Trend at Start of Project	One of these species is listed as Endangered on the IUCN Red List, while an additional 7 species are listed as Vulnerable. The remaining species are listed as Near Threatened (NT) or Least Concern (LC) but have been designated as trigger species because they are endemic to the region. All the trigger species identified were vulnerable to ongoing habitat loss and degradation, and many were threatened by hunting, and seeing decreasing population trends across their ranges at the start of the project.
Without-project Scenario	Without the presence of the project, it is likely that these species would continue to be impacted by hunting, and habitat loss/degradation from land use change (planned conversion to Acacia plantation) and fires, resulting in further pressures on population persistence
With-project Scenario	As forest-dependent, regenerating forest-dependent, waterbody-dependent, and riparian zone-dependent bird species, all 39 bird trigger species listed above stand to benefit from key project activities undertaken during this and previous monitoring periods. These activities include new canal blocking and existing canal dam monitoring to restore the natural peatland water table, fire management in and around the project area (bolstered by new agreements signed in 2019, 2020, and 2021 with adjacent concessions), and enrichment planting and assisted natural regeneration. Many of these species are at risk from hunting for the illegal wildlife trade, for example, <i>Psittacula longicauda</i> (Long-Tailed Parakeet), <i>Lophura erythrophthalma</i> (Malay Crestless Fireback), <i>Buceros rhinoceros</i> (Rhinoceros Hornbill), <i>Rhabdotorrhinus corrugatus</i> (Wrinkled Hornbill), and <i>Nisaetus nanus</i> (Wallace's Hawk-Eagle). The project field team conducted roughly 850 individual patrols during this monitoring period and observed no evidence of illegal hunting. Conducting regular patrols is likely acting as a deterrent to hunting activities in the area. During this monitoring period, 26 of these trigger species were observed, 22 of which were observed during point transect surveys, with 19 of these being observed within 25 meters of the observer, allowing for an estimate of species population density to be calculated for these species (see Table 52).

	For trigger species recorded within 25 m of the observer for the first time this year, their population trends over longer time periods are not yet clear. However, for species that were recorded in both the current and previous monitoring periods, it is possible to infer some potential population trends. Some of the trigger species recorded at low densities in the last monitoring period were not recorded in this monitoring period, e.g., <i>Cyornis umbratilis</i> (Grey-Chested Jungle-Flycatcher), while others saw an increase in density, e.g., <i>Malacocincla sepiaria tardinata</i> (Horsfield's Babbler). Several species were documented at high densities, such as, <i>Collocalia linchi</i> (Cave Swiftlet), <i>Cyanoderma erythropterum</i> (Chestnut-winged Babbler), and <i>Prinia familiaris</i> (Bar-Winged Prinia), with 6.96, 4.76, and 6.11 individuals/ha respectively. It's worth noting that several of the trigger species were recorded outside the 25-meter radius necessary for accurate density estimates. Overall, it appears that the populations trends of these trigger species are being maintained or enhanced. It will take several years before reliable population trends may become detectable.
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Trigger Species	Plant Species (32 species): 1. <i>Actinodaphne macrophylla</i> 2. <i>Anisoptera marginata</i> 3. <i>Aquilaria microcarpa</i> 4. <i>Archidendron borneense</i> 5. <i>Cantleya corniculata</i> 6. <i>Combretocarpus rotundatus</i> 7. <i>Dillenia excelsa</i> 8. <i>Diospyros maingayi</i> 9. <i>Dyera costulata</i> 10. <i>Dyera polyphylla</i> 11. <i>Endospermum diadenum</i> 12. <i>Gluta wallichii</i> 13. <i>Gonystylus bancanus</i> 14. <i>Ilex cymosa</i> 15. <i>Lithocarpus lucidus</i> 16. <i>Litsea machilifolia</i> 17. <i>Lophopetalum beccarianum</i> 18. <i>Macaranga pruinosa</i> 19. <i>Melicope glabra</i> 20. <i>Nepenthes rafflesiana</i> 21. <i>Palaquium dasyphyllum</i> 22. <i>Payena acuminata</i> 23. <i>Peronema canescens</i> 24. <i>Quassia borneensis</i> 25. <i>Shorea balangeran</i> 26. <i>Shorea dasyphylla</i> 27. <i>Shorea platycarpa</i>
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	28. <i>Shorea teysmanniana</i> 29. <i>Shorea uliginosa</i> 30. <i>Sindora bruggemanii</i> 31. <i>Stemonurus secundiflorus</i> 32. <i>Tetramerista glabra</i>
Population Trend at Start of Project	Of the 32 plant trigger species now identified in the project area, 31 are tree species. Two of these species are listed as Critically Endangered (CR) on the IUCN Red List (i.e., <i>Gonystylus bancanus</i> and <i>Shorea platycarpa</i>), four species are listed as Endangered (EN) (i.e., <i>Anisoptera marginata</i>, <i>Aquilaria macrocarpa</i>, <i>Shorea dasyphylla</i>, and <i>Shorea teysmanniana</i>), seven are listed as Vulnerable (VU). The remaining species are listed as Near Threatened (NT), Least Concern (LC), or Not Evaluated (NE) but have been designated as trigger species because they are endemic to the region. The majority of the trigger species identified here were vulnerable to ongoing logging for timber and land use change and seeing decreasing population trends across their ranges at the start of the project.
Without-project Scenario	Without the presence of the project, it is likely that these species would continue to face the negative impacts of habitat loss and degradation due land use change (due to planned conversion to Acacia plantations in the case of the project area) and fires, resulting in a further decreasing population trend.
With-project Scenario	All 32 plant trigger species have likely benefitted from key project activities undertaken during this and previous monitoring periods. These activities include new canal blocking and existing canal dam monitoring to restore the natural peatland water table depth, fire management in and around the project area (bolstered by new agreements signed in 2019, 2020, and 2021 with adjacent concessions), and enrichment planting and assisted natural regeneration. Most of these tree species are at risk of illegal logging. The project field team conducted roughly 850 individual patrols during this monitoring period and observed no evidence of intentional illegal logging. However, several hectares in the west of the project area were degraded by the accidental expansion of an adjacent Acacia plantation into the project area. Once discovered by the field team, the expansion was halted, and the affected area was replanted with native tree species. Conducting regular patrols is likely acting as a deterrent to illegal logging activities in the area. During this monitoring period 16 of these trigger species were recorded in vegetation plot surveys, allowing for estimates of density of individuals per hectare (ha) to be calculated for each tree age class (see Table 53). Similar to the previous monitoring period, most of these 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 trigger species were notably abundant, such as <i>Macaranga pruinosa</i>, <i>Endospermum diadenum</i> (previously named under the alternative taxonomic name of <i>Endospermum malaccense</i>), <i>Archidendron borneense</i> (previously

	identified as <i>Leucaena leucocephala</i>, which is not a trigger species), and <i>Stemonurus secundiflorus</i>, particularly for younger tree age classes. Other observations of note include a Critically Endangered (CR) <i>Gonstylus bancanus</i> (Ramin) sapling, two Vulnerable (VU) <i>Shorea uliginosa</i> (Meranti Kelungkum) trees, and three Vulnerable (VU) <i>Tetramerista glabra</i> (Punah) trees and saplings, all of which are endemic to the Sundaland Bioregion. Most plant trigger species saw an increase in density when comparing this monitoring period to the previous monitoring period. Four of these trigger species were included in enrichment planting activities during this monitoring period, including three trigger species that were not recorded in vegetation plots during this monitoring period. Sufficient long-term data is not yet available to establish trigger species population trends. However, early vegetation plot survey data combined with positive land cover change detection analysis suggests that trigger species are likely being maintained and enhanced under the with-project scenario.
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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.

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