



RIAU ECOSYSTEM RESTORATION CARBON PROJECT MONITORING REPORT



**RESTORASI
EKOSISTEM
RIAU**



Himpanzee

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LIST OF ACRONYMS

Acronym	Explanation
A/R	Afforestation/ Reforestation
AFOLU	Agriculture, Forestry, and Other Land Use
AGB	Above Ground Biomass
ANOVA	Analysis of Variance
APD	Avoiding Planned Deforestation
APRIL	Asia Pacific Resources International Limited
APWD	Avoiding Planned Wetlands Degradation
ARR	Afforestation, Reforestation and Revegetation
BAU	Business As Usual
BGB	Below Ground Biomass
BL-DFW	VMD0008 Estimation of baseline emissions from forest degradation caused by extraction of wood for fuel (BL-DFW), v1.0
BL-PEAT	VMD0042 Estimation of baseline soil carbon stock changes and greenhouse gas emissions in peatland rewetting and conservation project activities (BL-PEAT), v1.1
BL-PL	VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL), v1.3
BL-UP	VMD0007 Estimation of baseline carbon stock changes and greenhouse gas emissions from unplanned deforestation and unplanned wetland degradation (BL-UP), v3.3
BSL	Baseline
C	Carbon
CDM	Clean Development Mechanism
CH ₄	Methane
CIW	Conservation of Intact Wetlands
cm	Centimetre
CO ₂	Carbon dioxide
CO ₂ e or CO ₂ -e	Carbon dioxide equivalent
COP	Conference of the Parties
CP-AB	VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB), v1.1
CP-W	VMD0005 Estimation of carbon stocks in the long-term wood products pool (CP-W), v1.1
CUPP	Conservation of Undrained and Partially Drained Peatland
dbh	Diameter at Breast Height
DEM	Digital Elevation Map
df	Degrees of Freedom
DOC	Dissolved Organic Carbon
EB	Executive Board of the Clean Development Mechanism (CDM)
E-BPB	VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning

	(E-BPB), v1.2
E-FFC	VMD0014 Estimation of emissions from fossil fuel combustion (E-FFC), v1.0
ETM+	Landsat 5 Enhanced TM Plus
EVI	Enhanced Vegetation Index
FSC	Forest Stewardship Council
GAN	PT. Global Alam Nusantara
GCN	PT. Gemilang Cipta Nusantara
GHG	Greenhouse Gas
GOFC-GOLD	Global Observations of Forest Cover and Land-use Dynamics
H ₂ O	Water Vapour
ha	Hectares
HD	<i>Hutan Desa</i> or Village Forests
HCVF	High Conservation Value Forest
HTI	<i>Hutan Tanaman Industri</i> or Industrial Plantation Forestry
ISO	International Organization for Standardization
km	Kilometre
km ²	Kilometre Square
Landsat	Land Remote-Sensing Satellite
LiDAR	Light Detection and Ranging
LK-ARR	VMD0043 Estimation of emissions from displacement of pre-project agricultural activities (LK-ARR), v1.0
LK-ASP	VMD0009 Estimation of emissions from activity shifting for avoided planned deforestation/forest degradation and avoided planned wetland degradation (LK-ASP), v1.3
LK-DFW	VMD0012 Estimation of emissions from displacement of fuelwood extraction (LK-DFW), v1.0
LK-ECO	VMD0044 Estimation of emissions from ecological leakage (LK-ECO), v1.1
LUC	Land Use Change
LULUCF	Land Use, Land-Use Change, and Forestry
m	Metre
m ³	Cubic Metre
M-ARR	VMD0045 Methods for monitoring greenhouse gas emissions and removals in ARR project activities (M-ARR), v1.1
mm	Millimetre
M-REDD	VMD0015 Methods for monitoring of greenhouse gas emissions and removals (M-REDD), v2.2
MODIS	Moderate Resolution Imaging Spectroradiometer
MoEF	Ministry of Environment & Forestry
MONEV	Laporan Kegiatan Monitoring Dan Evaluasi
M-PEAT	VMD0046 Methods for monitoring of soil carbon stock changes and greenhouse gas emissions and removals in peatland rewetting and conservation project activities (M-PEAT), v1.1
MRV	Monitoring Reporting and Verification
MS	Mean Squares

N ₂ O	Nitrous Oxide
NDCs	Nationally Determined Contributions
NGO	Non-Governmental Organisation
NTFP	Non-Timber Forest Products
OLI	Landsat 8 Operational Land Imager
PA	Project Area
PD	Project Description
PDT	Peat Depletion Timeline
PEFC	Programme for the Endorsement of Forest Certification
Ph.D.	Doctor of Philosophy
PSP	Permanent Sample Plot
PT	Perseroan Terbatas
P-value	Calculated Probability
Q&A	Questions & Answers
QA	Quality Assurance
QC	Quality Control
R ²	Coefficient of Determination
RAPP	PT. Riau Andalan Pulp & Paper
REDD+MF	VM0007 REDD+ Methodology Framework (REDD+MF), v1.6
RDP	Rewetting Drained Peatland
REDD	Reducing Emissions from Deforestation and Degradation
REDD+	Reducing Emissions from Deforestation and Degradation and Foster Conservation, Sustainable Management of Forests, and Enhancement of Forest Carbon Stocks
REDD-MF	REDD+ Methodology Framework
RER	Riau Ecosystem Restoration
RER-CP	Riau Ecosystem Restoration Carbon Project
RKT	<i>Rencana Kerja Tahunan</i> or Annual Work Permit
RKU	<i>Rencana Kerja Usaha</i> or long-term work plan
RWE	Restoring Wetland Ecosystems
SDG	Sustainable Development Goals
SFM	Sustainable Forest Management
SINTAS	Save The Indonesian Nature and Threatened Species
SMN	PT. Sinar Mutiara Nusantara
SOP	Standard Operating Procedure
SRTM	Shuttle Radar Topography Mission
t	Tonne or Metric Ton
T-ADD	CDM Combined tool to identify the baseline scenario and demonstrate additionality
T-BAR	VCS AFOLU Non-Permanence Risk Tool
TBOT	PT. The Best One Unitimber
t.CO ₂ -e or t CO ₂ -e	Tonnes of Carbon Dioxide Equivalent
TM	Landsat Thematic Mapper
T-SIG	CDM Tool for testing significance of GHG emissions in A/R CDM project activities

UNFCC	United Nations Framework Convention on Climate Change
USGS	United States Geological Survey
VCS	Voluntary Carbon Standard
VCU	Voluntary Carbon Unit
VT0001	Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities
WRC	Wetland Restoration and Conservation
X-STR	VMD0016 Methods for stratification of the project area (X-STR), v1.2
X-UNC	VMD0017 Estimation of uncertainty for REDD project activities (X-UNC), v2.2

1. PROJECT DETAILS

1.1. Summary Description of The Implementation Status Of The Project

The Riau Ecosystem Restoration Carbon Project (the "Project", "RER-Project" or "RER-CP") is protecting and restoring 130,090 ha of peatland ecosystem located in the Republic of Indonesia while at the same time preserving biodiversity and enhancing local livelihoods. The Project avoids 78,425 ha of forest clearing and conversion to industrial forestry plantation. The Project is on the island of Sumatra and in the Province of Riau. Specifically, it is located on the Kampar Peninsula; a rain-fed domed peatland forest made up of four former logging concessions.

The Project at its heart is tasked with demonstrating how peat landscapes can be responsibly managed to protect biodiversity and enhance local communities. Forest preservation is augmented by the ring of *Acacia* plantations surrounding the Project and acts as a natural buffer to the Project Area.

The four original concessions that make up the Project area are PT. Gemilang Cipta Nusantara (20,123 ha), PT. The Best One Unitimber (40,666 ha), PT. Sinar Mutiara Nusantra (32,776 ha) and PT. Global Alam Nusantara (36,525 ha). All have long been gazetted as part of the Forest Production Estate (*Hutan Produksi*) by the Indonesian Ministry of Environment and Forestry but now have each acquired Ecosystem Restoration licenses.

Through the REDD+ process of avoided planned deforestation (APD) and wetlands restoration and conservation (WRC), the Project is preserving the peat swamp forests from the baseline scenario of conversion to a forestry plantation landscape which is what happened to all of the area directly surrounding the Project. Under the business-as-usual baseline scenario, the landscape would have been converted to an industrial *Acacia* plantation, complete with extensive water table management systems that would effectively drain the peatlands and allow the release of substantial carbon into the atmosphere.

The Project has undertaken and implemented the following emission reduction activities:

Table 1 - Activity Implemented

Activity	Activity Implemented	Activity Start Date
WRC RWE	and blocked 23 of 36 canals with 63 hand-built dams to rewet the peatland where legacy canals existed that would have otherwise continued to drain the landscape.	06 August 2016
APD & CIW	Conserved large areas of very deep peatlands and prevented the conversion of the Project Area to an industrial acacia plantation that would have included substantial water table drainage construction that would have allowed the oxidation and loss of substantial amounts of peatlands.	1 January 2017

In the timeframe from the project start to the end of the monitoring period (specifically 06/08/2016 - 31/07/2020 for RWE and 01/01/2017 – 31/07/2020 for APD and CIW), the Project estimates to have created 15,264,400 t.CO₂-e of GHG emission reductions and removals. The Project applies a 10% Non-Permanence Risk buffer factor to determine the number of emission reductions and removals set aside for the VCS pooled buffer account, which equals 1,526,440 t.CO₂-e. The net amount of VCUs generated by the Project under this Monitoring Report (that is emission reductions and removals less 10% for the pooled risk buffer) is **13,737,960 t.CO₂-e**.

Table 2 - Summary of Emission Reduction & Removals

Summary of Emission Reduction & Removals	t CO ₂ -e
Total GHG Emission Reductions and Removals for APD & WRC	15,264,400
10% allocation to VCS Pooled Buffer Account	1,526,440
Total VCUs generated in the Monitoring Period	13,737,960

The Project during the Monitoring Period additionally implemented monitoring of the peatlands, conservation and habitat management, on-the-ground forest protection with a team of Rangers, limited replanting and revegetation of degraded areas, and substantial community engagement activities.

1.2. Sectoral Scope and Project Type

Sectoral Scope: Agriculture, Forestry and Other Land Use (AFOLU).

Project Category: Reducing Emissions from Deforestation and Degradation (REDD) and Wetlands Restoration and Conservation (WRC).

Type of Activity: Avoided Planned Deforestation (APD), Restoring Wetland Ecosystems (RWE), and Conservation of Intact Wetlands (CIW) through Avoiding Planned Wetland Degradation (APWD).

The Project is not a grouped project.

1.3. Project Proponent

Table 3 - Project proponent information. ASIA PACIFIC RESOURCES INTERNATIONAL LTD (APRIL)

Organisation name	ASIA PACIFIC RESOURCES INTERNATIONAL LTD (APRIL) ¹
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Table 4 - Project proponent information. APRIL - RIAU ECOSYSTEM RESTORATION

Organisation name	RIAU ECOSYSTEM RESTORATION ²
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Table 5 - Project proponent information. PT. GEMILANG CIPTA NUSANTARA

Organisation name	PT. GEMILANG CIPTA NUSANTARA ³
Contact person	Dian Novarina
Title	Current PT. Director
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Table 6 - Project proponent information. PT. THE BEST ONE UNITIMBER

Organisation name	PT. THE BEST ONE UNITIMBER
Contact person	Bambang Prayitno
Title	Current PT. Director
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Email	Bambang_Prayitno@aprilasia.com

Table 7 - Project proponent information. PT. GLOBAL ALAM NUSANTARA

Organisation name	PT. GLOBAL ALAM NUSANTARA
Contact person	Ikhsan
Title	Current PT. Director
Address	Jalan Lintas Timur Rukon Akasia, Blok III No. 1 RT 01 / RW 09 Pangkalan Kerinci, Riau 28300 Indonesia
Telephone	+62 8117524224
Email	Ikhsan@aprilasia.com

Table 8 - Project proponent information. PT. SINAR MUTIARA NUSANTARA

Organisation name	PT. SINAR MUTIARA NUSANTARA
Contact person	Rudi Hartono
Title	Current PT. Director
Address	Jalan Lintas Timur Rukon Akasia, Blok III No. 1 RT 01 / RW 09 Pangkalan Kerinci, Riau 28300 Indonesia
Telephone	+62 82388597688
Email	Rudi_Hartono1@aprilasia.com

1.4. Other Entities Involved in the Project

Table 9 - Entities involved in the Project. - Himpanzee Pte Ltd

Organisation name	Himpanzee Pte Ltd
Role in the project	Project Developer
Contact person	Ralph J. Strebel
Title	Head of Carbon
Address	100 Peck Seah Street #08-14, PS 100 Singapore 079903
Telephone	+65 9772 6138
Email	ralph@himpanzee.com

Table 10 - Entities involved in the Project. - Ata Marie Group Ltd

Organisation name	Ata Marie Group Ltd.
Role in the project	Assistant Project Developers
Contact person	George Kuru
Title	Director
Address	Ruko Darmawangsa Square No. 5, 4th Floor, Jln Darmawangsa 6, Kebayoran Baru, Jakarta Selatan 12160 Indonesia
Telephone	+62 21 72789411
Email	george.kuru@ata-marie.co.id

Table 11 - Entities involved in the Project – BIDARA

Organisation name	BIDARA
Role in the project	Community Engagements
Contact person	Ahmad Fachrudin
Title	Executive Director
Address	Jl Perjuangan No 24 Kebun Jeruk Jakarta Barat, 11530 021-535-5995
Telephone	+62 8111630179
Email	Ahmad Fachrudin@gmail.com

1.5. Project Start Date

As the Project has three emission reduction activities, two WRC activities, RWE and CIW and one REDD+ activity, the Project has three activity crediting start dates.

The Project has denoted **6 August 2016** as the Project Start Date for WRC-RWE activities. This date corresponds to when actual activities that would lead to emission reduction credits began. 5 August 2016 was when the implementation of the RWE activity (blocking of canals) took place and saw the completion of the first dam as part of the canal blocking activity.

The APD and CIW crediting start date is date is **1 January 2017**. The APD and CIW activity crediting start date is directly linked to the implementing of management and protection plans as outlined in each of the concession's long-term management plan or RKU. All of the RKU's require security and protection of the forest landscape. Generally, this includes things such as retention of security personnel (i.e., forest rangers), conducting patrols and securing the concession from encroachment, illegal logging, illegal draining and fire.

The APD and CIW activity crediting start date of 1 January 2017 is the date of the 2017 forest security contract, which required that all of RER be secured by *PT Satria Elang Nusantara* (PT SEN), the designated security company. This date is after all of the ten-year management plans have been approved by the MoEF, the last two were approved for PT TBOT and PT GAN on 29 December 2016. It was at this point when security for the entire concession was undertaken, as part of four separate concessions acting in unison after formal approval of the management plans.

1.6. Project Crediting Period

The Project Crediting Period will be over 57 years⁴. The Project Crediting Period starts on 06 August 2016 for WRC-RWE and 1 January 2017 for REDD+ APD and WRC-CIW, and for all three activities, ends on 23 July 2072.

1.7. Project Location

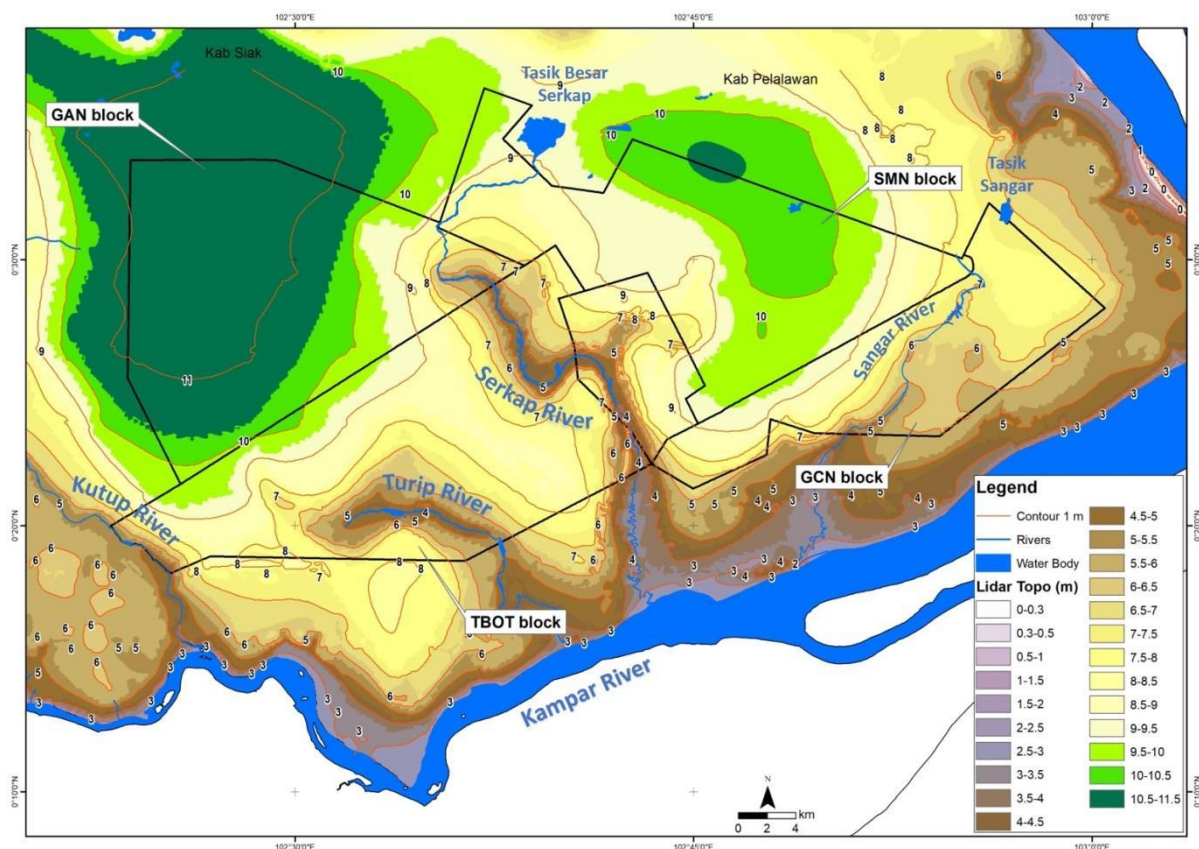
The Riau Ecosystem Restoration Carbon Project is located in the Republic of Indonesia, on the central, eastern side of Sumatra. It is located in the Province of Riau in the *Kabupaten* or "Regency" of Pelalawan located adjacent to the Strait of Malacca. (See Map 1).



Map 1 - RER Carbon Project located in Indonesia



The Project itself is located on the Kampar Peninsula, which has an area of roughly 670,000 ha and is on the eastern coast of Sumatra and the eastern edge of the Pelalawan Regency. It is roughly wedge-shaped, defined by the Selat Panjang Strait to its north and east and the Kampar River, which forms its southern boundary (see Map 2). The Kampar's western boundary is partly the Siak River and is roughly composed of a broad swath of land where the mineral soils of the foothills merge into the peat soils of the coastal plain that stretches eastward to the Strait of Malacca.



Map 3 - Project Area Location

The Kampar Peninsula itself is comprised almost entirely of tropical peat swamp forests. Its central core, where the Project is located, has two peat domes, the western dome being more prominent in size than the eastern dome. The edges of the Kampar are all converted lands, made up of industrial tree plantations, oil palm plantations, some communal farmlands, and degraded environments.

1.7.2. Project Area

The Project Areas itself is 130,090 ha and is made up of four individual former industrial selective logging concessions. PT. Global Alam Nusantara (GAN) with 36,525 ha is located in the northwest, PT. Sinar Mutiara Nusantara (SMN) with 32,776 ha lies in the northeast, PT. Gemilang Cipta Nusantara (GCN), the smallest of the four concessions with 20,123 ha, is situated in the southeast and the largest, PT. The Best One Unitimber (TBOT) with 40,666 ha is located in the southwest (see Map 3 above).

The projects geographical coordinates are as indicated below:

Northernmost point: 0° 36' 26.95" N 102° 37' 07.98" E
Easternmost point: 0° 28' 11.24" N 103° 00' 29.10" E
Southernmost point: 0° 18' 12.28" N 102° 25' 17.42" E
Westernmost point: 0° 19' 59.92" N 102° 23' 03.75" E

1.8. Title and Reference of Methodology

The RER Project applies the latest version of VM0007 (version 1.6), including all applicable modules. The below table lists all methodology components and tools used.

Table 12 - Title and Reference of Methodology

No.	Doc ID	Version	Issue Date	Documents Name	Abbreviation
1	VM0007	1.6	8-Sep-20	REDD+ Methodology Framework	REDD+ MF
2	VMD0015	2.0	8-Sep-20	Methods for monitoring of GHG emissions and removals in REDD and CIW projects	M-REDD
3	VMD0016	1.2	8-Sep-20	Methods for Stratification of the Project Area	X-STR
4	VMD0017	2.2	8-Sep-20	Estimation of Uncertainty for REDD+ Project Activities	X-UNC
5	VMD0046	1.1	8-Sep-20	Methods for monitoring of soil carbon stock changes and greenhouse gas emissions and removals in peatland rewetting and conservation project activities	M-PEAT
6	EB 31 Annex 16	1.0	4-May-07	CDM Tool for testing significance of GHG emissions in A/R CDM project activities	T-SIG
7	EB 35 Annex 19	1.0	19-Oct-07	CDM Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities	T-ADD
8		4.0	19-Sep-19	VCS AFOLU Non-Permanence Risk Tool	T-BAR
BASELINE					
9	VMD0006	1.3	8-Sep-20	Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation	BL-PL
10	VMD0042	1.1	8-Sep-20	Estimation of baseline soil carbon stock changes and greenhouse gas emissions in peatland rewetting and conservation project activities	BL-PEAT
LEAKAGE					
11	VMD0009	1.3	8-Sep-20	Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation	LK-ASP
12	VMD0044	1.1	8-Sep-20	Estimation of emissions from ecological leakage	LK-ECO
CARBON POOLS					
13	VMD0001	1.1	11-Oct-13	Estimation of carbon stocks in the above- and belowground biomass in live trees and non-tree pools	CP-AB
EMISSIONS					
14	EB 33 Annex 16	1.0	27-Jul-07	Estimation of direct nitrous oxide emission from nitrogen fertilization	E-NA
15	VMD0013	1.2	8-Sep-20	Estimation of greenhouse gas emissions from biomass and peat burning	E-BPB

1.9. Participation under other GHG Programs

1.9.1. Projects Registered (or Seeking Registration) under Other GHG Programme(s)

The RER-Carbon Project is not involved in any other GHG programmes, nor do the activities of the Project fall under any other emissions trading scheme or other binding limits in relation to any GHG emissions programmes.

UNDERTAKING REGARDING PARTICIPATION UNDER OTHER GHG PROGRAMMES

We, the undersigned, hereby certify that for and on behalf of the Riau Ecosystem Restoration Project (the Project) and PT Gemilang Cipta Nusantara have not undertaken the following:

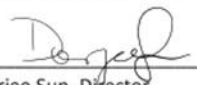
- Participate in any other approved or unapproved GHG Program contemplated by §3.7 and §§3.19.5 - 3.19.6 of the VCS Standard v4.0, including but not limited to the Clean Development Mechanism, Joint Implementation, Climate Action reserve or any other approved or unapproved GHG programme.
- Apply to nor been rejected by any other GHG Programme as contemplated by §§3.19.7(1- 3) of the VCS Standard v4.0.
- Seek to generate any other form of GHG-related environmental credit as contemplated by §3.20.2 of the VCS Standard v4.0.

We also confirm that the project is intended to be part of the Government of Indonesia's Nationally Determined Contributions (NDC) and overall climate mitigation initiative in the country. The Project undertakes to ensure that any emission reductions or removals (ERs) that will contribute to such NDCs will be accounted for appropriately such that they will not be double counted.

We further certify that to the best of our knowledge to date, we are not aware of any potential emission allowances or GHG credits from the Project having been used, cancelled or purchased in relation to the NDC programme or any other mechanism for GHG trade.

The Project, exclusive of the above referenced NDC programme, is not part of or included in any other emissions trading programme or other mechanism that includes GHG trading.

We also undertake to inform the VCS Secretariat of any changes to the above position that may affect the status of the Project.

Signed: 
Dorjee Sun, Director
Himpanzee Pte Ltd – Project Developer

Date: 26/01/2021

Signed: 
Dian Novarina, Director
PT. GEMILANG CIPTA NUSANTARA – Lead Project Proponent

Date: 13.01.2021

Figure 1 -Project Undertaking Re: Other GHG Programmes

Additionally, the Project has not sought to generate any other type of GHG emission reductions other than VCUs and has never received any other form of GHG-related environmental credit.

However, as per recent (2021) requirements under Indonesian law, the RER Carbon Project has completed Step I of the registry process of the **Indonesian National Registry System (SRN PPI)** and has been issued registration number: 005-IX-2021-2358 under PT. GCN. Upon information and belief, this is a project tracking registry to assist with NDC contributions and is not issuing any type of carbon credits separate to those originated in this VCS project.

1.10. Other Forms of Credit

1.10.1. Emissions Trading Programs and Other Binding Limits

RER-CP is in compliance with the requirements regarding participation in other GHG programs as mandated by § 3.20.1 of the VCS Standards (v4.3) in regard to application and rejection by other GHG programs.

The RER-Carbon Project is not generating emission reduction credits in a country or region with any type of compliance mechanism.

1.10.2. Other Forms of Environmental Credit

The Project has not sought any other type of environmental credit and does not anticipate doing so in the future.

1.11. Sustainable Development

The Government of Indonesia (GOI) has made a number of international commitments to sustainable development and reduction of GHG emissions.

1.11.1. 2015 UN Sustainable Development Goals

GOI has made commitments under the UN's Sustainable Development Goal (SDG) program to address climate change issues by reducing GHG emissions in forest landscapes against a 2015 business as usual (BAU) scenario. This includes decreasing deforestation and protection of peatlands⁵ under Goal 13 and Goal 15. More specifically, **GOI SDG Goal 13 -Climate Action** notes that deforestation contributed to 30% of GOI emissions and indicates a desire to reduce BAU emissions⁶. GOI indicates a Policy Direction for 2020-2030 in regard to Forest, Land and Peat that would see a "returning the function of the ecosystem and environmental services of forestry, maintaining and increasing land cover."⁷

This is coupled with:

SDG Goal 15 – Life on Land – Forest Protection which has as its goal of

- a. preventing a higher rate of forest degradation and

- b. incorporating private and public participation in conservation programmes.

The GOI indicated two policy directions in SDG Goal 15 for 2020-2024 and 2025-2030. Both included a goal of “decreasing Deforestation” and “continuing the peat protection policy.”

The RER-CP is not a formal part of the Indonesian SDGs in the sense that the Project is not directly incorporated into the SDG programme and that none of the results from the Project will be reported in relation to the hopeful success of the GOI goals. Nonetheless, in an informal way, the RER Project in its own actions is supportive of the two related SDGs. The Project Activity of avoiding planned deforestation and of wetlands restoration are well aligned with the GOI SDGs.

The Project supports Goal 13 in its Project Activity by the blocking of the canals that assist with rewetting the peat landscape. Further, the overall act of avoiding planned deforestation supports the goal of increasing forest cover as the Project’s Activity allows the *in situ* forest to naturally regrow. The limited reforestation and revegetation by the Project also assists with maintaining and increasing forest cover.

The Project also informally supports Goal 15 through avoiding deforestation that would have otherwise occurred in the Project’s baseline scenario while at the same time protecting a large peatland area from the loss of much of the peatland landscape that would have happened under the same baseline scenario.

Although the RER Project does undertake monitoring of its activities, none of the Project’s monitoring is directly linked to the GOI SDG programme, and there are neither any requirements to monitor and report to the SDG programme, nor are there any plans to report the activity to the GOI SDG programme.

The GOI and the RER Project have not had any direct discussions or consultations regarding the SDGs, and the Project’s contribution to them is only informal

1.11.1.1. 2015 Nationally Determined Contributions under Paris Agreement

The GOI adheres to the Paris agreement, and it has been ratified by Act No. 16/2016. The GOI Submitted its first NDCs in November of 2016. Further, and pursuant to Decision 1/CP.23 paragraph 10-11 and Annex II on Talanoa Dialogue and the Guidance for Parties by COP Presidencies (27 March 2018), the Government of the Republic of Indonesia committed to a 29% reduction of national GHG emission by 2030, with 17.2% coming from the Forestry sector⁸. The only aspect included as part of the Private Sector implementation in the Talanoa Dialogue that was specifically mentioned was the “Fire-Free Village Program,” which has been implemented in the Kampar Peninsula.

1.11.1.2. RER-CP’s Contributions

The RER Carbon Project activities support the GOI’s-NDCs. Informally at this stage, the RER Project may contribute a portion of the Project’s GHG reductions and removals to the NDC goals of Indonesia, that is GHG emission reduction of 17.2% from the forestry sector. The details of that contribution are continuing to be developed. No formal agreement has been reached to date; however, discussions are ongoing. The Project is committed to avoiding any double counting so that

any emission reductions that the Project achieves, and would be claimed by the GOI, would not result in tradeable VCU credits. Further, any GHG reductions or removals that were issued as VCUs would be potentially subject to corresponding adjustments as contemplated by Article 6 of the Paris Agreement. As Art. 6 rules continue to be developed in the ongoing SBSTA and COP negotiations, it remains unclear as to precisely how the accounting will be conducted. Irrespective of the outcomes, RER will adhere to any agreed-upon rules and will not engage in any double counting.

The Project's monitoring, reporting and verification program provides accurate science-based information's systems that can be used to assess contributions to GOI NDCs. Currently, there are no formal requirements that establish how the Project will monitor or report its emission reductions to the GOI. It is anticipated that the VCS Verification Reports of the Project will be provided to the relevant divisions within the Ministry of Forestry (i.e., Director General of Climate change and the senior minister in MoEF). Details regarding this exchange of information will be developed, and the Project will adhere to any legal requirements and will avoid any double counting.

The GOI and the RER Project have had one formal consultation regarding the NDC issues, on 14 January 2021. Additional meetings are anticipated in the future.

2. SAFEGUARDS

2.1. No Net Harm

The RER-Carbon Project does not expect any negative environmental impacts. Because the Project Activity prevents the conversion of degraded natural forest to industrial *Acacia* plantation and assists with some rewetting of the landscape, there are no changes to the environment other than naturally occurring forest growth and the limited rehydration of approximately seven per cent of the landscape by the blocking of legacy canals. The Project will have positive outcomes for both climate change mitigation through carbon storage and the prevention of oxidation of the peat soils that would have otherwise occurred in the baseline scenario. Further, there will be positive impacts on biodiversity conservation through the preservation of critical habitats of the endemic and endangered flora and fauna. The Project is unable to identify any potential negative environment and socio-economic impacts.

The Project aims to provide positive environmental, social, and biodiversity benefits. The Project Proponents do not expect any negative socio-economic impacts. Community-focused non-carbon Project Activities are aimed at increasing economic growth in the area surrounding the Project Area. In place. Importantly the Project has a robust Grievance Resolution Procedure that is part of a third-party certified grievance redress mechanism under the Programme for the Endorsement of Forest Certification (PEFC) that can assist and resolve any complaints or comments from the community. Preservation of the forest in the Project Area will not only improve local communities by the preservation of local ecosystem services, but it will also help strengthen the biodiversity and the health of forest-dwelling species-in and around the Kampar Peninsula.

Further, the Project has been open with communities during community meetings that there is no restriction on access to the Project Area's forests, and that the communities are free to collect non-timber forest products.

However, during the original community consultations process, there were concerns raised by some communities of loss of access to the forests for fish and timber, as well as a dispute over forested land in or near PT GCN. During the monitoring period, this dispute was resolved. RER does not prohibit access to the forest, but Security Rangers do inform local villagers that enter RER what activities are prohibited by law (include logging, wildlife poaching, fire use, etc). In addition, in 2017 the Ministry of Environment & Forestry allocated approximately 4,000 ha of forest adjacent to PT GCN as Village Forest (*Hutan Desa*) for two villages (Segamai and Serapung). There is a technical overlap with the Segamai HD and PT GCN. Both parties need to complete their legal documentation requirements (RKU/RKT, Tatas Batas, etc) for the matter to be fully resolved through MoEF. RER has completed this process during the monitoring period but the Segamai HD has not. RER is supportive of their efforts to do so.

Potential negative socio-economic impacts have been mitigated during the first monitoring period by the following:

- GCN has been cooperative and supportive of the Segamai Hutan Desa. It has also undertaken from its side the required legal activities to clarify and resolve the technical overlap by conducting the required field surveys, completing its RKU/RKTs and completing its own formal boundary process with MoEF, the Tatas Batas.
- GCN/RER is working with Segamai to assist them with their Hutan Desa (HD) (Village Forest) application and confirm their legal boundaries and develop an HD operation plan, to resolve the technical overlap issue and so it will have its own Village Forest it can manage.
- RER does not prohibit access to the forest, but Security Rangers do inform local villagers that enter RER what activities are prohibited by law (including logging, wildlife poaching, fire use, etc). This is supported by the Riau Natural Resources Conservation Agency (BBKSDA) through socialization meetings with fishermen and in the villages.
- The 6 October 2018A Fisherman's agreement has allowed continued access for the primary users of the forest on the Serkap River

RER also has a dedicated ongoing community development program which assists with a number of initiatives in the community including the development of livelihoods such as sustainable fishing and no burn vegetable farming. This is reported annually and publicly. (See 2016-2020 RER Annual Report, usually Section 4 - Community.)

The only other potential negative impact that the Project has identified is concerning the objective risks to worker's safety while they work in the RER Project area. This would include encountering occupational and safety hazards during ranger patrols, during fire suppression related activities and any field-based conservation activity (i.e., canal maintenance and dam construction, restoration and replanting activity, etc.). These activities include a variety of occupational hazards and risks to the workers as the tropical peat forest field environment presents a variety of natural hazards that could lead to physical injuries. These are mitigated by implementation of rigorous safety protocols, SOPs and regular safety briefings and training.

2.2. Local Stakeholder Consultation

RER Carbon Project has throughout the Monitoring Period had regular interactions with the local communities. The Project does have an SOP in place that addresses how community meetings are to be organized, conducted, monitored and reported on. As a general rule the relevant SOP indicates that notices and invitations for meetings must be made at least 5 days in advance of any meetings. The RER regional community coordinator will prepare an agenda for the meeting in coordination with the village head or village officials. Any equipment needed to conduct meetings are provided by RER. An attendance sheet is circulated at the meeting to capture who attended and participated. The Community Development officer who oversees a meeting is obligated to report on the implementation of such meeting and submit the report to the regional coordinator and estate manager. The regional coordinator then submits its report to the Community Development Program Coordinator who in turn submits monthly reports to the Community Development Manager. In addition to any meetings organized for a special purpose, there are regular "town hall" style meetings that are held every month. This allows an ongoing connection to be maintained with community members, village leaders, religious leaders, local NGOs, women's groups, school groups etc. Company representatives are in each village and are contactable as part of WhatsApp groups.

Additional social media accounts that are established to allow engagement with local communities exist on Facebook, twitter, Instagram and YouTube.

Regarding the local community consultations held with the communities prior to and during the validation and verification of the current monitoring period, the five relevant communities all had announcements for the first meeting made on 09 February 2021. The following table sets forth the date and location of each meeting:

Table 13 - Community Consultations Pre-Validation and Verification

Village	Date of 1 st Meeting	Location of 1 st Meeting	Date of 2 nd Meeting	Location of 2 nd Meeting
Desa Segamai	17 Feb 2021	Desa Segamai Office	24 Feb 2021	Desa Segamai Office
Pulau Muda	18 Feb 2021	Pulau Muda Office	25 Feb 2021	Pulau Muda Meeting Hall
Kuala Panduk	18 Feb 2021	Kuala Panduk Office	24 Feb 2021	Kuala Panduk Office
Teluk Binjai	17 Feb 2021	Teluk Binjai Office	25 Feb 2021	Teluk Binjai Meeting Hall
Teluk Meranti	16 Feb 2021	Teluk Meranti District Hall	26 Feb 2021	Teluk Meranti Meeting Hall

The date of the follow-up second meeting was provided at the first meeting. Participants at the initial meetings were provided with a written summary of the Project that included information related to the overview of the Project, that participants, the estimated amounts of the emission reductions, an overview of the projects design related to the REDD+ crediting activities: avoiding planned deforestation and wetlands restoration and conservation. Information was provided about community communications and where information about the Project was located. The summary also included information about technical aspects of the property such as above ground and below ground biomass sampling, peat depth issues, baseline scenarios, how the project area was developed, carbon pools, emissions from the baseline and project scenario and some details about monitoring.

The meetings in addition to presenting the summary of the Projects implementation and outcome of monitoring (i.e., emission reductions and removals) also presented a power point presentation that provided some general background information about the risk and impact of climate change.

The Project did not receive any input from the local communities during these meetings that impacted the design of the Project or that warranted a change in the future implementation of the on-site REDD activities. However, one clear takeaway was that the communities were keen to receive more information about the science and impacts to their own communities from climate change.

No updates to the project design were made as a result of the feedback received from the local stakeholder consultation. This was because:

1. Stakeholders at the consultations did not raise concerns about the design or implementation of the carbon project;
2. The Project area has no permanent inhabitants, only a small number of local fishermen are part-time inhabitants, and they are supportive of the Project as it has conserved the last wild fishing areas for them;
3. Except the local fisherman, there are few community users of the Project Area;
4. The Project's carbon generating activities have low social and financial impacts on their lives. Most of the local communities are in fact geographically separated from the project area by the Kampar River, a major tidal estuary; and regardless,
5. There is no restriction on access to the Project Area for local communities.

In addition to the above, the Project is conserving a difficult to access forest that is surrounded by existing industrial plantations.

2.2.1. Communicating Relevant Laws and Regulations Covering Workers' Rights

Labour law and the associated rights of workers are governed by Indonesian laws and regulations at the national or federal level. The following laws and regulations apply specifically to workers' rights in Indonesia.

Table 14 - Relevant laws & regulations covering workers' rights

No.	Name of Labour Law (i.e., Agreement/Treaty, Law & Regulation)
1	Law No. 80/1957 on Ratification of International Labour Organisation Convention of Equal Remuneration for Men and Women Workers for Work of Equal Value
2	Law No. 21/1999 on Ratification of International Labour Organisation Convention on Discrimination in Respect of Employment and Occupation
3	Law No. 1/1970 on Work Safety
4	Law No. 3/1992 on Labour Social Security
5	Law No. 21/2000 on Labour Union
6	Law No. 13/2003 on Manpower
7	Law No. 2/2004 on Industrial Relations Dispute
8	Law No. 40/2004 on National Social Security System
9	Government Regulation 8/1981 on Wage Protection
10	Government Regulation 14/1993 on Worker Social Security Program
11	Government Regulation No. 50/2012 on Occupational Safety and Health Management System Application

The RER Project and APRIL, as noted above, adheres to a broad range of Indonesian legal requirements, including relating to the labour sector. APRIL's Human Resources teams, in hiring all employees on the Kampar peninsula, follow a variety of Indonesian labour laws that relate to workers' rights. These laws are outlined above and cover issues ranging from occupational & worker safety, labour unions, social security, discrimination and equal rights issues, wage protection, etc.

Each employee at the RER Project is hired through APRIL's human resource team and has a written contract that clearly and in writing sets forth the parties' contractual arrangements. Upon being hired, each new employee is provided orientation as to expectations, requirements, and workers' rights in the APRIL group. Each individual is provided with a copy of the company Employee manual that outlines all major issues regarding employment. This includes communicating information about employee rights, anti-discrimination, timeliness of pay, HR procedures, insurance benefits, etc. As noted in the employee handbook, individual workers have the contact details for Human resources. They can contact them directly with any questions related to employment issues and the rights of employees.

Additionally, RER employees can freely associate and join the local labour union known as [SP Kahut RAPP Fiber (Forestry and Wood Labor Union RAPP Fiber). This union operates in Kerinci and is available to all employees hired under the APRIL FiberOne group, of which RER is a part of.

Occupational health and safety issues are communicated to all employees via work training programs and safety training. This is especially true of employees that operate not in an office setting but the field. APRIL/RER has regular training that includes reviewing safety issues while in the field, including first aid, use of safety equipment (i.e., life jackets, hard hats, etc.) and safety procedures. Occupational Safety and worker safety training is regularly reviewed and is certified as part of the PEFC and IFCC certification process (see also §2.5.3 of the PD). Pre-operation safety briefings are also regularly used before employee's undertaking field operations.

2.2.2. Communications Regarding Validation & Verification

The RER-Project prior to the validation and verification of the project undertook several steps to communicate the process of the VCS audit to the local communities.

Pre-Validation Meetings

Upon completing the PD's drafting, the RER Project initiated a socialisation campaign in the 5 neighbouring villages and sub-districts. These meetings took place in January and February of 2021. An initial meeting was held that presented a slide show about climate change and the RER Project. The RER community relations teams also briefed the villages and sub-districts about the upcoming validation and verification process. It was explained that the VCS project was required to undergo third-party certification and that an auditor or group of auditors would be visiting the area and the project to ensure that the project described in the PD was reflected on the ground. For each of the villages and sub-districts, a follow-up meeting was held three to four weeks later so that the communities would have an opportunity to consider the presentation and raise any concerns and questions at the follow-up meetings.

One week before initiating the validation and verification field site visit, in March of 2021, a further meeting was held in Telok Meranti with representatives from the surrounding villages and subdistricts to inform them of the upcoming audit further. The meetings specifically addressed the validation and verification audit. A discussion about the audit process was held so that it was clear that the carbon credits had to be certified by a third party to make sure that they were "real."

including what aspects the RER Project the auditor and or audit team would review operations in Kerinci and the field (i.e., nursery, eco-camp, forest, etc.) and the communities.

2.2.1.1. Meetings During Validation & Verification

During the filed-site visit by the auditor in March 2021, two meetings were held in Telok Meranti with community representatives, the RER team and the auditor. One meeting was with the local Sub-District leader (the equivalent of a mayor), and the other was with about 20 plus community members made up of both men and women. At both meetings, the auditor described his role and then discussed various aspects of the Project, including but not limited to knowledge of the RER Project, the relationship between the communities and APRIL, Project Activities, and how the audit process worked. At each meeting, the auditor invited and responded to questions and comments posed by the community members.

2.3. AFOLU-Specific Safeguards

Not Applicable⁹. The RER Carbon Project notes that it is not subject to the AFOLU Specific safeguards Nonetheless, the Project is able to briefly summarize about issues relevant to AFOLU safeguards.

The Project Area does not contain any communities. All local communities exist only outside of the boundaries of the Project Area, as a result there are direct risks or direct impacts to the communities, nor are there any property disputes in the Project Area with the communities as no villages border the Project Area.

Further, the Project explicitly allows local communities access to the forest within the Project Area to undertake sustainable collection of non-timber forest products (NTFPs). There are currently (as well as during the entire monitoring period) no conflicts with local communities regarding land use issues. The Project has not impacted any community's ability to access and collect NTFPs without first undertaking free prior informed consent of the parties affected. For example, in regard to both fishing and collection of songbirds in the Project Area, the Project acquired the consent and agreement before entering into written agreements to maintain sustainable fishing practices (2017) and the agreement to cease the collection of songbirds (2019). In regard to the fisherman's agreements, the fishermen were provided a number of outboard boat motors for their cooperation with agreement. However, as the collection of songbirds is actually poaching and illegal under Indonesian law, i.e., there was no actual right that the communities had to conduct the activity, no specific reciprocal benefit was provided. However, the local environment agency (BBKSDA) did tacitly agree not to pursue any legal action over any of the past activities.

The communication process and procedures with the communities is described above and the grievance redress mechanisms are described in the VCS PD. There were no property conflicts or other conflicts impacting the rights of the communities during the monitoring period.

The Project did identify the potential for some net-harm as a result of the risks that workers face while undertaking field activity in RER (i.e., dam building, travel on waterways, cross-country travel

on foot, etc.); the Project has mitigated this risk by ensuring worker safety is recognised and prioritised. Appropriate training and SOPs are in place to mitigate harm.

3. IMPLEMENTATION STATUS

3.1. Implementation Status of the Project Activity

3.1.1. Project Milestones in the Monitoring Period

The Current Monitoring Period is from 06 August 2016 (specifically 06 August 2016 for WRC-RWE and 1 January 2017 for APD and CIW) through 31 July 2020. The below tables (one for each year) outline a summary of key milestones that took place during each year of the Monitoring Period.

The following milestones were achieved in 2016:

Table 15 - Project Milestones 2016

No	Date	Summary of Milestone(s) in Project Development for 2016
1	06 August 2016	Project Start Date: 06 August 2016
2	2016	Avoiding Planned Deforestation and Conservation of Intact Wetlands: The Project maintained its Ecosystem Restoration licenses, including but not limited to acquiring approval for the long-term management plans (RKU) for PT TBOT, PT SMN and PT GAN.
3	2016	Peatland Rewetting: The Project received its first shipment of dam construction materials. This allowed the implementation of the canal blocking activity. The first dam was completed 05 August 2016. 14 of dams were constructed in 4 canals. 5 sandbag dams were constructed and 9 felt dams were constructed
4	2016	Peatland Monitoring: The Project began to implement the monitoring programme by establishing 39 new monitoring points. 39 subsidence poles with an integrated dipwell were established. The Project began to collect weather data.
5	2016	Planting and Revegetation (Non-Credit Generating): RER produced over 40,0068 seedlings in their 4 nurseries, which contain over 70 different native species. Of these, 6,389 seedlings were utilised on 8.9 ha of degraded land for planting and assisted natural regeneration
6	2016	Community Development: RER and MoEF authorities met with 7 villages on Kampar Peninsula to inform of the rights and obligations of ER license holders and discuss community needs and collaboration opportunities. APRIL's Fire Free Village Program was implemented in all nine communities adjacent to the Project Area on the Kampar Peninsula, which incentivizes the community over a two-year period to avoid the use of fire in land preparation (i.e., no burn agriculture). Written agreements are entered into with the communities. 17 "no-burn" vegetable gardening trainings were conducted in Sangar and Segamai villages with BIDARA. 40 families received ownership of Goats by passing on offspring to neighbours; the goat manure is used as organic compost.

7	2016	Forest Protection: RER monitored access to the Project Area, conducted on-the-ground patrols and assisted with support for all on site conservation and habitat management activity. No forest loss or illegal logging was observed.
8	2016	Fire Prevention & Suppression: APRIL monitored hotspots in Kampar Peninsula, and none were detected in the Project Area. Fire suppression related to land clearing activity was conducted in 6 villages outside of the Project Area. Fire training activity was also conducted.
9	2016	Conservation & Habitat Management: Independent consultants produced a biodiversity report which will establish a baseline for future conservation initiatives in the Project Area.
11	2016	Adaptive Management: RER began developing a Quality Management System (based on ISO 14000) to establish SOPs, documentation and auditing of logical framework to ensure continuous improvement.

The following milestones were achieved in 2017:

Table 16 - Project Milestones 2017

No	Date	Summary of Milestone(s) in Project Development for 2017
1	2017	Avoiding Planned Deforestation and Conservation of Intact Wetlands: The Project maintained its Ecosystem Restoration licenses, including but not limited to acquiring approval for the first annual work permits (RKT) for PT TBOT, PT SMN and PT GAN. The Project began implementation of all RKUs including ensuring the security of the RER concessions from illegal logging, fire and other threats.
2	2017	Peatland Rewetting: The Project continued implementation of the canal blocking activity. 2 of dams were constructed in 1 canal. All the dams constructed were felt dams.
3	2017	Peatland Monitoring: The Project continued the monitoring programme by establishing 15 new monitoring points. The project established 15 subsidence poles, each integrated with a dipwells. The Project continued to monitor weather data as well.
4	2017	Planting and Revegetation (Non-Credit Generating): RER produced 22,270 seedlings in their 4 nurseries, which contain over 70 different species. Of these, 1,978 seedlings were utilised on 12.5 ha of degraded land for planting and assisted natural regeneration.
5	2017	Community Development: RER enters into a written agreement with Community Fisherman's Association which includes provisions agreeing not to use fire to clear land, refrain from destructive fishing techniques and reporting their catches to RER rangers. 80% of RER's contracted rangers and team members that work to protect and restore the forest are drawn from the two regencies in Riau where the Project is located RER begins its Forest Honey Programme by contracting to purchase sustainably and traditionally harvested local honey from Sialang trees. The honey is marketed and sold on to third parties and profits are

		returned to the community in the form of projects or infrastructure that all can share and benefit from. No burn vegetable gardening continues in Sangar sub-village and Segamai, including the establishment of a field school for regular learning. Continuation with written agreements with communities to not undertake burning for land clearing purposes
6	2017	Forest Protection: RER monitored access to the Project Area, conducted on-the-ground patrols and assisted with support for all on site conservation and habitat management activity. No forest loss or illegal logging was observed. Forest rangers were trained to monitor and collect data on songbird collection in the RER Project Area.
7	2017	Fire Prevention & Suppression: APRIL monitored hotspots in Kampar Peninsula, and none were detected in the Project Area. Fire training activity was also conducted. The RER forest protection team was the overall winner at the APRIL firefighter competition.
8	2017	Conservation & Habitat Management: Participation in the Asian Waterbird Census surveyed 200 water birds and 64 non-water birds Publication of the RER Report – Birds of the Kampar Peninsula listing 299 rare and endangered bird species Installation and monitoring of 88 new wildlife camera traps that produced 6,310 snapshots and videos which led to the identification of 52 species of animals.
9	2017	Research: Establishment in PT GCN of a 48m high GHG Flux monitoring tower that automatically measures GHG flux data using the eddy covariance technique every 30 minutes.

The following milestones were achieved in 2018:

Table 17 - Project Milestones 2018

No	Date	Summary of Milestone(s) in Project Development for 2018
1	2018	Avoiding Planned Deforestation and Conservation of Intact Wetlands: The Project maintained its Ecosystem Restoration licenses.
2	2018	Peatland Rewetting: The Project continued implementation of the canal blocking activity. 26 of dams were constructed in 12 canals. 4 sandbag dams were constructed and 22 felt dams were constructed
3	2018	Peatland Monitoring: The Project continued to monitor subsidence poles, dipwells and automatic level loggers. The Project also continued to collect weather data.
4	2018	Planting and Revegetation (Non-Credit Generating): In 2018, for the first time in RER's history there was a substantial dipterocarp flowering. Special efforts were made to acquire such seeds for the nurseries, and over 10,000 seeds were collected from March to May 2018. These endangered species were a favourite of past commercial logging activities. The efforts established over 6,000 seedlings of these endangered species, which are now available for planting at different locations.

		RER also produced 9,595 seedlings in their 8 nurseries. Of these, 6,713 seedlings were utilised on 58.2 ha of degraded land for planting and assisted natural regeneration.
5	2018	Community Development: Continuation with written agreements with communities to not undertake burning for land clearing purposes. The non-burn vegetable farming programme continued. RER invested in the fishing community through the donation of three boat engines. These engines are new and will help the fishermen to maintain their catch rates without resorting to unsustainable practices
6	2018	Forest Protection: RER monitored access to the Project Area, conducted on-the-ground patrols and assisted with support for all on site conservation and habitat management activity. No forest loss or illegal logging was observed. Forest rangers begin the monitoring of songbird collection in the RER Project Area.
7	2018	Fire Prevention & Suppression: APRIL monitored hotspots in Kampar Peninsula, and none were detected in the Project Area. Fire training activity was also conducted.
8	2018	Conservation & Habitat Management: Wildlife monitoring continued in RER, with a maximum of 57 camera traps active during the year. RER again participated in the Asian Waterbird Census, a semi-annual monitoring of migratory birds RER by the end of 2018 had positively identified that there are 759 species in RER of which 71 were mammals, 107 amphibians and reptiles, 304 birds, 189 plants and 89 fish. In February 2018, RER published a new report - Mammals of the Kampar Peninsula: An Annotated Checklist - which detailed the presence of 73 mammals, including 17 globally threatened species.
9	2018	Research: The GHG Flux Tower research study continues.

The following milestones were achieved in 2019:

Table 18 - Project Milestones 2019

No	Date	Summary of Milestone(s) in Project Development for 2019
1	2019	Avoiding Planned Deforestation and Conservation of Intact Wetlands:: The Project maintained its Ecosystem Restoration licenses, including but not limited to receiving MoEF approval for all four concessions (PT GCN, PT SMN, PT TBOT and PT GAN) formal boundaries (Tata Batas) and issuance of MONEV certificates.
2	2019	Peatland Rewetting: The Project continued implementation of the canal blocking activity. 13 of dams were constructed in 7 canals. All of the dams that were constructed were felt dams.
3	2019	Peatland Monitoring: The Project began to implement the monitoring programme by establishing 27 new monitoring points. 15 subsidence poles were established, along with 7 dipwells. 5 level loggers were put into the Project Area as well. The Project continued to collect weather data.
4	2019	Planting and Revegetation (Non Credit Generating): RER produced 9,620 seedlings throughout 5 different nurseries. Of these, 8,658 seedlings were utilised on 24.1 ha of degraded land for planting and assisted natural regeneration.

5	2019	Community Development: During 2019, RER teams conducted a number of community development activities in Kampar Peninsula, including employee volunteering and eco-education. RER established a written agreement with communities to cease the collection of songbirds in the RER Project area, which has led to a cessation of known songbird collection. Continuation with written agreements with communities to not undertake burning for land clearing purposes
6	2019	Forest Protection: RER monitored access to the Project Area, conducted on-the-ground patrols and assisted with support for all on site conservation and habitat management activity. No forest loss or illegal logging was observed.
7	2019	Fire Prevention & Suppression: APRIL monitored hotspots in Kampar Peninsula and none were detected in the Project Area. Fire training activity was also conducted.
8	2019	Conservation & Habitat Management: RER began work with "Save the Indonesian Nature and Threatened Species Foundation" to assist with a Sumatra wide tiger survey. RER undertook the first insect survey focusing on the order Odonata (i.e., dragonflies and damselflies) RER by the end of 2019 had positively identified that there are 797 species in RER of which 76 were mammals, 107 amphibians and reptiles, 307 birds, 190 plants, 89 fish and 28 Odanta. Migratory raptor monitoring in 2019 resulted in 2,243 raptor sightings during a 13 day period. A pilot study was carried out to investigate how mammal species respond to the interface between acacia plantation and peat swamp forest. The pilot investigated the presence of mammal species across the plantation-natural forest edge and observed whether there were changes in these faunal communities across this environmental gradient. This included a further introduction of numerous camera traps.
9	2019	Research: The GHG Flux Tower research study continues.

The following milestones were achieved in 2020:

Table 19 - Project Milestones 2020

No	Date	Summary of Milestone(s) in Project Development for 2020
1	1 Jan 2020 through 31 July 2020	Avoiding Planned Deforestation and Conservation of Intact Wetlands: The Project maintained its Ecosystem Restoration licenses, including but not limited to acquiring approval for the long-term management plans (RKT) for PT TBOT, PT SMN and PT GAN.
2	1 Jan 2020 through 31 July 2020	Peatland Rewetting: The Project continued implementation of the canal blocking activity. 10 of dams were constructed in 5 canals. All of the dams that were constructed were felt dams.
3	1 Jan 2020 through 31 July 2020	Peatland Monitoring: The Project continued to monitor subsidence poles, dipwells and automatic level loggers. The Project also continued to collect weather data.
4	1 Jan 2020 through 31 July 2020	Community Development: Continuation with written agreements with communities to not undertake burning for land clearing purposes.

	July 2020	The Forest Honey programme continues and receives certification as Halal RER begins to the process to engage and socialise communities with the validation and verification of the RER-Carbon Project
5	1 Jan 2020 through 31 July 2020	Forest Protection: RER monitored access to the Project Area, conducted on-the-ground patrols and assisted with support for all on site conservation and habitat management activity. No forest loss or illegal logging was observed.
6	1 Jan 2020 through 31 July 2020	Fire Prevention & Suppression: APRIL monitored hotspots in Kampar Peninsula, and none were detected in the Project Area. Fire training activity was also conducted.
7	1 Jan 2020 through 31 July 2020	Conservation & Habitat Management: RER continues its efforts of wildlife monitoring using camera traps and data collection RER in conjunction with the Riau Govt. release a Sumatran tiger that had been found trapped in a poacher's snare outside of the Project Area into the RER concession. The tiger is collared with a radio GPS transmitter and is being tracked.
8	1 Jan 2020 through 31 July 2020	Research: RER begins to develop a Dragonfly Biotic Index which is used to assess the environmental health of aquatic ecosystems The GHG Flux tower study continues.
9	1 Jan 2020 through 31 July 2020	Other: RER is in the final stages of producing its VCS PD to formalize the project into one of the world's largest VCS REDD+ projects RER-CP begins the VCS validation and verification process in December 2020. Opening of the Eco-Camp just outside of the RER boundaries to serve as a research base and as a field HQ for RER operations

3.1.2. Implementation and Monitoring Status of Project Activity

The RER-CP undertakes two main activities that impact GHG emission reductions and removals, avoiding planned deforestation and wetlands restoration and conservation. Each is dealt with in turn below regarding the implementation and monitoring of the activity.

3.1.2.1. Avoided Planned Deforestation (APD)

The implementation and monitoring status of the avoided planned deforestation component of the Project in the Monitoring Period is set forth below.

Table 20 - APD Implementation & Monitoring Status

Avoided Planned Deforestation (APD) Implementation & Monitoring Status		
A.	Monitoring Period	1 January 2017 through 31 July 2020
B.	Operation of the project activity(s) during this monitoring period	The granting to APRIL of the four individual 60 year Ecosystem Restoration (ER) licenses beginning in July of 2012 through September 2014 (see RER-CP VCS PD § 1.7.2) and assist in preventing the 130,090 ha Project Area from reverting to the same type of industrial Acacia plantation forestry that surrounds the site. The four ER licenses form the backbone of protection against any future planned deforestation.

		The Project uses remote sensing imagery to determine land use/land use change in the project area (see § 5.1 below) in line with the Project's Monitoring Plan to determine if there is any forest cover loss in the Project Area. During this monitoring period no forest cover loss was detected. If anything, when comparing remotely sensed images from 2016 with 2020, the forest appears to be denser. The Project also uses remotely sensed Hot Spot data (MODIS and NASA) to regularly monitor fire activity on an ongoing basis. No fires were detected in the project area during the monitoring period and no forest loss due to fire occurred. The Project has monitored forest growth in the areas that would have been deforested in baseline scenario by collecting field data from Permanent Sample Plots (PSPs) located in the Project Area. 40 PSPs were established to represent the different land use cover types in the Project Area. For verification, sampling is conducted on 50% of the plots, ensuring adequate representative samples from each of the relevant forest classes. The Project was able to measure significant growth of the forest (see 3.1.2.3 below) Additionally, the forest protection efforts (as noted above) which include regular foot patrols assist with ensuring that no illegal forest loss through illegal logging or clearing of the forest area through burning occur. No legal or illegal logging has been observed or detected. None of the Ranger patrols observed any land clearing (with or without fire) as having taken place in the Project Area during the monitoring period.
C.	Impact on GHG Reductions or Removals	The Project has been able to generate GHG emission removals as a result of avoiding planned deforestation (APD) and the forest growth that has occurred in the absence of the APD baseline scenario. 5,747,443 t.CO₂-e of emission reductions and removals were generated in the first monitoring period that are attributable to the APD activity, and 9,897,693 t.CO₂-e of emission reductions and removals due to the WRC activity.
	Supporting Monitoring Documents	Remotely Sensed Images from 2016, 2019 and 2020 Hot Spot data from 2016,2017,2018,2019 & 2020 PSP growth Data
D.	Monitoring of factors related to leakage and non-permanence risk	The Project has monitored activity shifting leakage by analysing Indonesian HTI forestry concessions for any increase evidence of industrial Acacia plantation activity that would be in excess of the observed historical deforestation trends. No increase has been observed as a result of the displaced baseline activities on forested peatlands. Market Leakage is not applicable. Non-Permanence risks have been monitored and reported on in the latest Non-Permanence Risk Assessment Report. Non-Permanence Fire Risk Mitigation: The Project has <i>in situ</i> continual hot spot and fire monitoring systems in place that reduce the risk of forest and peat loss due to anthropogenic fires; this system is coupled with the active fire suppression teams. No forest cover has been lost during the monitoring period due to fire as no fires have occurred in the Project area.
E.	Any other notable changes	None at this time.

Avoiding Planned Deforestation has two main monitoring activities, land use/land use change monitoring and forest growth monitoring and. Additional relevant details as to each of these monitoring activities undertaken during the monitoring period is described below.

3.1.2.2. Land Use / Land Use Change – Forest Cover Assessments

A comparison of the Landsat 8 satellite images from June 2016 and October 2020, show land cover to be virtually identical with no obvious evidence of deforestation, degradation, or new canal development. This supports RER claims that there has been forest loss or obvious forest degradation during the project monitoring period. Further, there is no evidence of burn scars that would indicate any fire activity during the monitoring period.

Landsat monitoring is shown below in Figures 2 through 4. The Landsat references are set forth in the table below.

Table 21 - Landsat 8 References

No	Year	Month	Day	File Name	Source
1	2016	June	26	LC08_L2SP_126060_20160626_20200906_02_T1	USGS
2	2019	May	18	LC08_L1TP_126060_20190518_20190522_01	USGS
3	2020	October	27	LC08_L1TP_126060_20201027_20201106_01	USGS

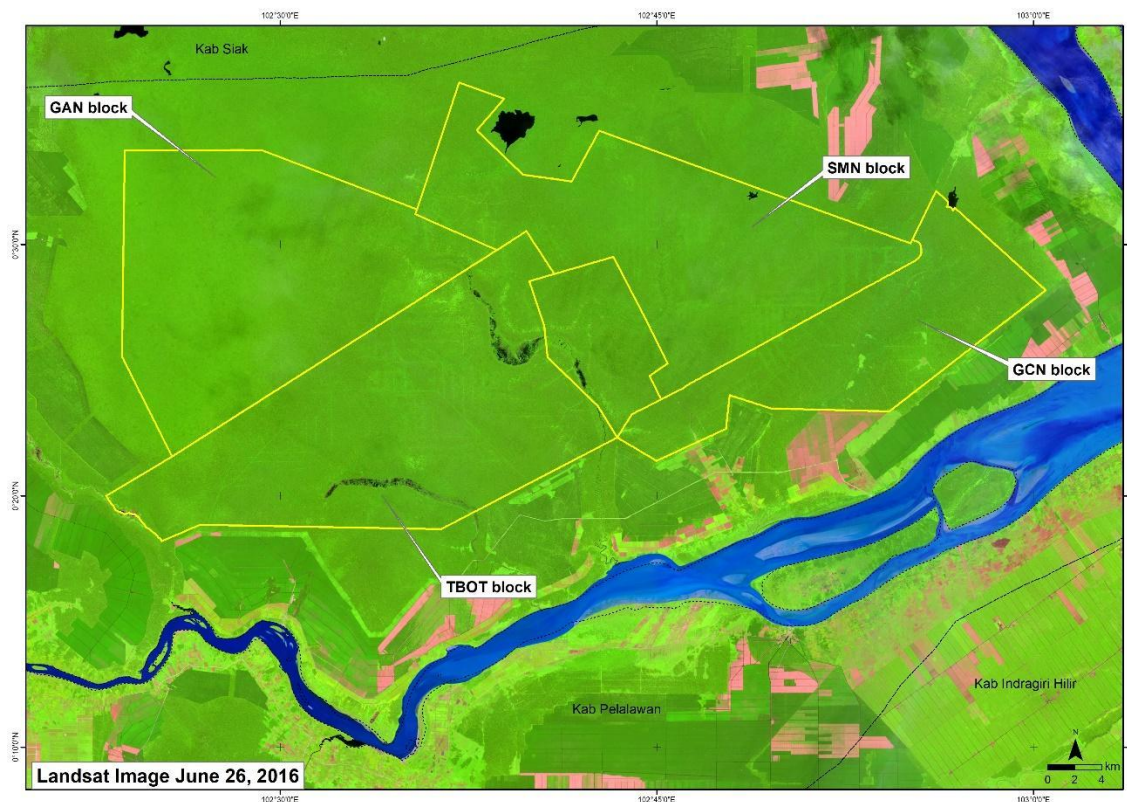


Figure 2- Landsat 08 Images: 26 June 2016

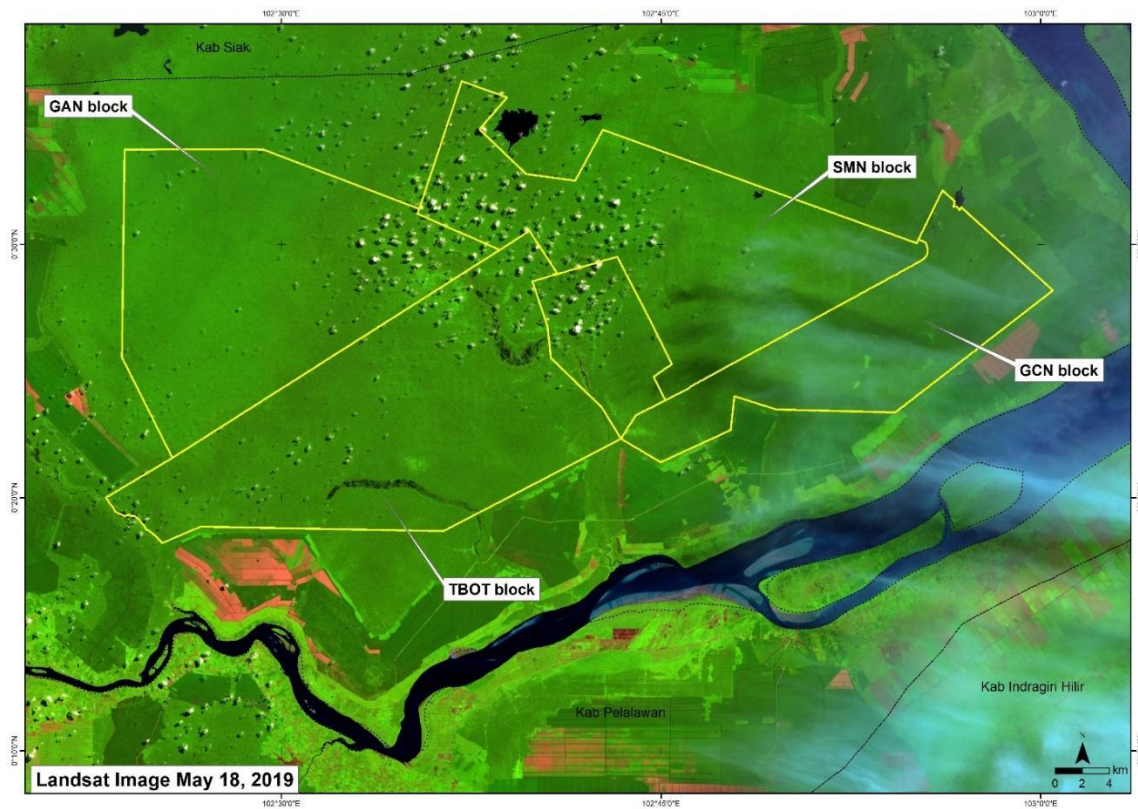


Figure 3 - Landsat 08 Image: 18 May 2019



Figure 4 - Landsat 08 Image: 27 October 2020

Additional monitoring data from the on the ground foot patrols of the forest guards and RER staff, further indicate that there has been no evidence of deforestation or forest degradation within the project boundaries since the start of the project.

The Project Monitoring Report show that there is no deforestation, forest degradation, fires impacting AGB. The Monitoring Report provides its estimates of GHG emission reductions and removals as set forth in §5.7 below.

3.1.2.3. Forest regrowth monitoring

During the original baseline assessment, the Project surveyed 159 Above Ground Biomass (AGB) inventory plots. In 2020, a further 10 AGB inventory plots were measured in peat dome forest by RER to support the original AGB baseline assessment. It is assumed that these plots will be completely remeasured for the baseline reassessment sometime prior to 2026.

In 2020, RER selected 40 of the original AGB plots (from the original 159) within the area where project is avoiding deforestation as compared to the baseline scenario for assessment of natural forest growth. These plots are known are established across the various forest cover types and have been designates as the Project's PSPs (as discussed above). They are set forth in the below map and 50% of them will be monitored every monitoring period. The PSP sampling during this (and all monitoring periods) was done to ensure that each forest class was appropriately represented. No PSP sampling is undertaken in the "Peat Dome Forest" because no avoided deforestation (i.e., no REDD project activity) takes place there; under the baseline scenario, this area would have remained as forest.

The first measurement of the PSP's indicates that there is vigorous regrowth in the forest stratum, well above the assumed IPCC allometric estimates of growth. The PP have taken the position that further growth plot measurements are required before the estimates of emissions reductions from growth of avoided deforestation forests.

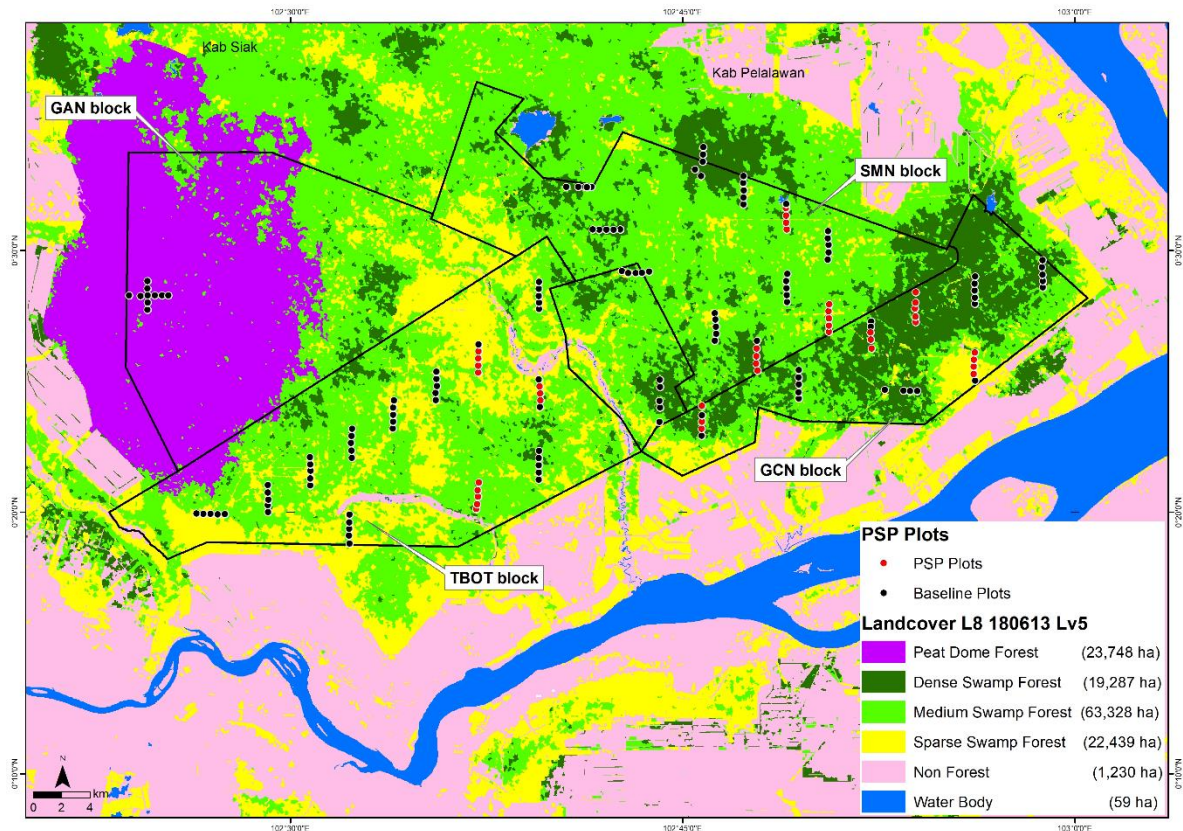


Figure 5 - Location of Permanent Sample Plots and Baseline Plots

The Project was able to estimate the growth rate of the forest in the baseline area of the Project by comparing the AGB of the inventory data from the 2015 data, and then with the remeasured data from the same plots (now established as PSPs) in July of 2020. A summary of the results is shown in the table below.

Table 22 - AGB Growth Rates (2015-2020)

LC_Landsat 2013	Concession	Transect	Plot Name	AGB 2015	AGB 2020	AGB Growth	AGB 2015	AGB 2020	Carbon 2015	Carbon 2020
Units				(t/ha)			(t.CO2E/ha)		(t.CO2E/ha)	
Dense Forest	GCN	RK-GC01	RK-GC01.2	255.7	225.6	-6.0 ¹⁰	440.8	388.8	575.4	507.6
	GCN	RK-GC03	RK-GC03.3	170.0	180.6	2.1	293.0	311.3	382.5	406.4
	GCN	RK-GC05	RK-GC05.1	165.8	280.8	23.0	285.7	484.0	372.9	631.8
	GCN	RK-GC05	RK-GC05.2	146.1	117.3	-5.8	251.8	202.2	328.6	263.9
	GCN	RK-GC05	RK-GC05.3	89.6	125.7	7.2	154.5	216.7	201.7	282.8
	GCN	RK-GC05	RK-GC05.4	179.5	257.3	15.6	309.3	443.5	403.8	579.0
	GCN	RK-GC05	RK-GC05.5	157.2	211.5	10.9	270.9	364.4	353.6	475.7
	SMN	RK-SM01	RK-SM01.2	161.5	167.0	1.1	278.3	287.8	363.3	375.7
	SMN	RK-SM01	RK-SM01.3	134.8	206.1	14.3	232.3	355.3	303.2	463.8
	SMN	RK-SM01	RK-SM01.4	179.3	196.4	3.4	309.0	338.5	403.3	441.8
	SMN	RK-SM01	RK-SM01.5	185.6	244.5	11.8	319.9	421.3	417.5	550.0
	SMN	RK-SM04	RK-SM04.2	98.2	259.9	32.3	169.3	447.9	221.0	584.7
	SMN	RK-SM04	RK-SM04.3	105.1	219.4	22.9	181.1	378.2	236.4	493.7
	SMN	RK-SM04	RK-SM04.5	73.4	186.9	22.7	126.5	322.2	165.1	420.6
	TBOT	RK-TB08	RK-TB08.4	177.5	163.8	-2.7	305.9	282.2	399.4	368.4
	TBOT	RK-TB10	RK-TB10.1	142.4	212.1	13.9	245.4	365.6	320.4	477.3
	TBOT	RK-TB10	RK-TB10.5	176.2	169.3	-1.4	303.7	291.8	396.4	380.9
Medium Forest	GCN	RK-GC01	RK-GC01.3	113.9	187.7	14.8	196.4	323.5	251.8	414.9
	GCN	RK-GC01	RK-GC01.5	144.8	231.7	17.4	249.5	399.3	319.9	512.1
	GCN	RK-GC03	RK-GC03.4	106.1	181.5	15.1	182.8	312.8	234.5	401.1
	GCN	RK-GC03	RK-GC03.5	104.1	241.1	27.4	179.4	415.4	230.0	532.8
	GCN	RK-GC06	RK-GC06.3	55.9	103.1	9.4	96.3	177.7	123.5	227.9
	SMN	RK-SM04	RK-SM04.1	64.7	186.0	24.3	111.5	320.5	143.0	411.0
	SMN	RK-SM04	RK-SM04.4	85.3	185.4	20.0	147.0	319.6	188.5	409.9
	SMN	RK-SM06	RK-SM06.1	92.3	209.6	23.5	159.1	361.3	204.0	463.4
	SMN	RK-SM06	RK-SM06.2	67.6	187.9	24.1	116.5	323.9	149.4	415.4

	SMN	RK-SM06	RK-SM06.3	70.8	154.3	16.7	122.0	265.9	156.5	340.9
	SMN	RK-SM06	RK-SM06.4	60.5	121.1	12.1	104.3	208.8	133.7	267.8
	TBOT	RK-TB07	RK-TB07.1	124.8	175.9	10.2	215.1	303.1	275.8	388.7
	TBOT	RK-TB07	RK-TB07.2	115.8	171.9	11.2	199.5	296.2	255.9	379.9
	TBOT	RK-TB07	RK-TB07.3	129.9	181.3	10.3	223.9	312.4	287.2	400.6
	TBOT	RK-TB07	RK-TB07.4	97.2	187.4	18.0	167.6	322.9	214.9	414.1
	TBOT	RK-TB08	RK-TB08.2	92.4	171.9	15.9	159.2	296.2	204.2	379.9
	TBOT	RK-TB08	RK-TB08.3	125.7	104.6	-4.2	216.6	180.2	277.8	231.1
	TBOT	RK-TB10	RK-TB10.2	213.0	204.6	-1.7	367.0	352.6	470.7	452.2
	TBOT	RK-TB10	RK-TB10.3	162.6	143.8	-3.8	280.3	247.8	359.4	317.8
	TBOT	RK-TB10	RK-TB10.4	99.1	158.6	11.9	170.8	273.3	219.1	350.5
Sparse Forest	GCN	RK-GC06	RK-GC06.2	43.3	117.7	14.9	74.5	202.8	95.6	260.1
	GCN	RK-GC06	RK-GC06.4	74.4	89.6	3.1	128.2	154.5	164.4	198.1
	GCN	RK-GC06	RK-GC06.5	60.0	110.4	10.1	103.4	190.3	132.6	244.1

The estimate of forest growth by forest type is summarized in the table below:

Table 23 - AGB Growth Rates by Forest Class (2015-2020)

Forest Classification	Number plots	Avg AGB (t/ha)		Avg AGB (t.CO2E/ha)				Avg AGB (t.CO2E/ha)		
		2015	2020	Annual Growth	2015	2020	Annual Growth	2015	2020	Annual Growth
Dense Forest	17	152.8	201.4	9.7	263.4	347.2	16.8	343.8	453.2	21.9
Medium Forest	20	106.3	174.5	13.6	183.2	300.7	23.5	235.0	385.6	30.1
Sparse Forest	3	59.2	105.9	9.3	102.0	182.5	16.1	130.8	234.1	20.6

The results of the APD monitoring are set forth in § 5 below.

3.1.2.4. Wetlands Restoration and Conservation

The implementation and monitoring status of the wetlands restoration and conservation (WRC) component of the Project in the Monitoring Period is set forth below.

Table 24 - WRC Implementation & Monitoring Status

Wetlands Restoration & Conservation		
A.	Monitoring Period	06 August 2016 through 31 July 2020
B.	Operation of the project activity(s) during this monitoring period	The RER Project formally began with the implementation of the WRC Activity that would lead to emission reduction initiated on 06 August 2016 with the completion of the first dam the day before on 05 August 2016. During the monitoring period the Project has installed 63 dams on 36 canals in the project area. All of the dams are regularly inspected, at least once per year. No dams have failed during the monitoring period. The project has continued to conserve the peatland during the monitoring period by ensuring that it is not subject to any industrial Acacia plantation activity that would see the area be subjected to intensive water table management and drainage activity that would lead to peat subsidence and oxidation of the peat. The Project has also ensured that there has been no expansion of the existing canals in the Project Area. The Project has monitored the peatland via the installation of a large number of Subsidence Poles (81) and dip wells (61). There are a smaller number of automatic level loggers (9) installed in the Project Area. These monitoring points, in conjunction with daily monitoring of rainfall and weather data help the project to understand and monitor the peatland water table dynamics. The peatland area is further monitored with remote sensing Hotspot data (MODIS & NASA) to monitor if any of the peatland in the Project area has been subject to fire. No fires have been detected or observed on the peatlands and no peatlands were lost due to fire during the monitoring period.
C.	Impact on GHG Reductions or Removals	Implementation of the Project has resulted in significant reductions of GHG emissions as compared to the baseline scenario. The Project as part of the WRC activities has reduced net GHG emissions by 9,897,693 t.CO ₂ -e in the initial monitoring period.
D.	Monitoring Data	Remotely Sensed Imagery from 2016,2019 & 2020 Remotely Sensed Imagers from 2016 through 2020 Dam Construction Records Dam Maintenance Records Dam Monitoring records The below additional data has been collected in the monitoring period but is not used for the GHG emissions calculations; IPCC default data is used instead. The Project anticipates that in-situ water table, subsidence data and weather data will be used in the future for the baseline reassessment and then also possibly as regular monitoring data after that time. The following additional data was recorded:

		Water Table Monitoring Data (from dipwells and level loggers) Subsidence Data (from subsidence poles) Weather Data (from weather monitoring stations in and around the Project Area)
E	Monitoring of factors related to leakage and non-permanence risk	The Project monitors the condition of dams and water table located near dams in the event of the failure of a dam to monitor any ecological leakage. No dam has failed during the monitoring period. Non-Permanence risks are monitored and set forth in the Non-Permanence Risk Assessment. A copy of the Non-Permanence Risk Assessment is available for review by the audit team and is updated for each monitoring period. Non-Permanence Risk Mitigation efforts related to fire are addressed above. No peatland loss was experienced in the monitoring period due to fire.
E.	Other notable changes	None.

Water Table Depth Monitoring – Inside and outside RER

The applicability conditions for all WRC activity require that project activities do not lower the water table unless the project converts open water to tidal wetlands, or improves the hydrological connection to impounded waters. Water Table Depth (WTD) and subsidence have been monitored. From the monitored WTD results, WTD both inside and outside the Project boundary remained above the WTD for August 2016 and fluctuation for both was correlated with rainfall (See Fig. 6).

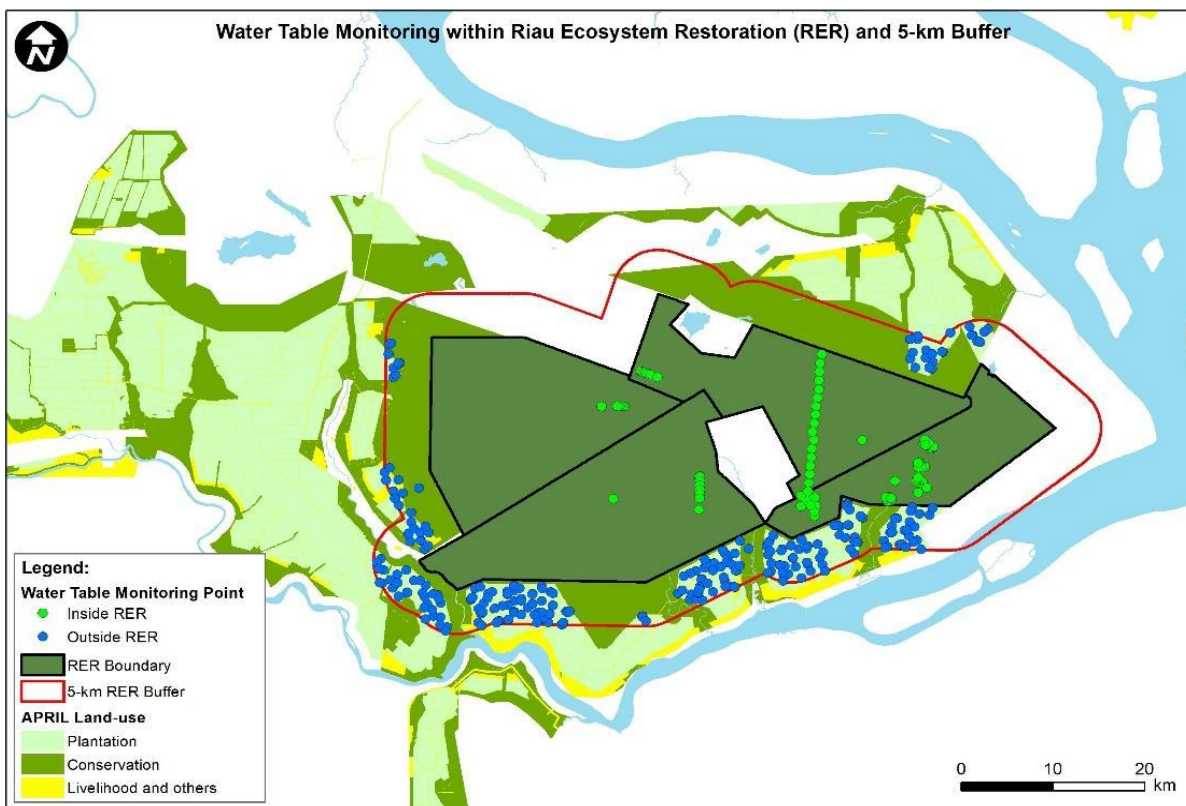


Figure 6 - Water Table Monitoring within RER and 5-km Buffer

Water table remains stable since 2016

The monitored WTD demonstrates that the Project activities have not lowered the water table, and that the Project is in continued compliance with the relevant applicability conditions. Inside the Project boundary, Water table depth in August 2020 remains above that in August 2016 and has consistently been above the WTD outside the Project Boundary (See Fig 7 below).

No adverse effects from outside activities on WTD

Based on results of the WTD monitoring, and the analysis above and figures below, it is demonstrated that any drainage activities occurring outside the project area have no adverse effect or impact on the Project GHG benefits and ecological leakage. This is demonstrated by the WTD inside the Project areas being consistently higher than outside the project areas.

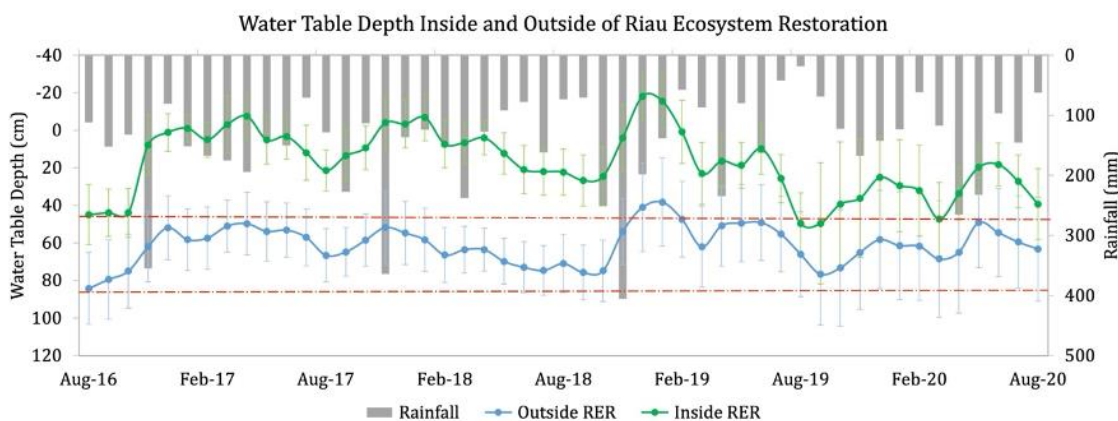


Figure 7 - Water table depth inside and outside of RER

The results of the relevant WRC monitoring activity and the estimated GHG emission reductions and removals are set forth in § 5.2.3 below. PP also notes that the project follows the requirements of VMD0007-REDD-MF v1.6 at §9.3.2 Monitoring, as all requirements of VMD0046-M-PEAT v1.1 §5.6 are complied with in the Project’s validated MRV plan, Appendix 1 of the MR and entitled the “RER-CP MRV Plan (Detailed)” including regular monitoring to comply with all methodological requirements

3.1.2.5. Additional Monitoring Activity Not Related to GHG Emission Reductions

Revegetation, fire control/prevention, conservation and habitat management and other activities are being operationally implemented in the Project Area. However, it is noted that these activities are not included in emissions reduction estimates. They are nonetheless monitored as set forth in the VCS PD §5.3. The below table is a brief description of the activity and the associated monitoring data that the Project uses.

Table 25 - Monitoring Data Related to Activity Not Leading to GHG Reductions or Removals

Monitoring Data Related to Activity Not Leading to GHG Reductions or Removals		
No.	Activity	Monitoring Data to support activity
1	<i>Planting and Revegetation:</i> RER produces seedlings in the 4 nurseries during the monitoring period from 70 different native tree species, primarily early successional species. To date, RER has replanted and revegetated 68 ha in the GCN and GAN concession areas. New seedlings come from three sources: 1) uprooted seedlings; 2) seeds that have fallen from forest trees; or 3) cuttings from mature trees. The activity also includes re-assessment of the planted areas to fill in gaps due to die off (blanking) and weeding around planted seedlings to promote growth.	Remotely Sensed Imagery from 2016,2017,2018,2019 & 2020 Drone imaging used to determine planting and revegetation data Nursery Data Pre-Planting Assessments Work Records re: assisted natural regeneration efforts, planting, blanking, and weeding, etc. Restoration Quality Assessments
2	<i>Research:</i>	GHG Flux Tower Monitoring

	GHG Flux Tower measurements began in 2017. As the data from this research program is part of a larger incomplete scientific research effort, the data has not been used for RER-CP and is still awaiting publication in a peer reviewed journal. It is anticipated that it may be available at the baseline's reassessment in 2025.	Records
3	Forest Protection: The Ranger teams have posts located at the primary access routes into the forest along rivers and conduct regular patrols to monitor the forest use by the local community members. The primary users of the forest are local fisherman, whereby Ranger's document individuals using the rivers and collect data to monitor the seasonal and annual trends in fish harvesting. Ranger's also monitor and document the collection of songbirds, the collecting of plant material for medicinal and other uses, and the extraction of other non-timber forest products	Guard Post Monitoring Data/logs
	Conservation & Habitat Management As noted above in the annual milestones, the Project undertakes substantial conservation and wildlife surveys. This data is used to expand the knowledge of the Project in relation to on site species and future habitat management issues.	Conservation Assessments/ Biodiversity Monitoring Reports from 2016 – 2020 HCVF Assessments Camera Trap Records from 2016-2020
	Community Development Community engagement is a core non-GHG emission activity. Communities use of the Project Area is documented and monitored, including the types and amounts of non-timber forest products collected in the forest. Community engagement and related activity is also tracked and monitored.	Community Agreements from 2016-2020 Community Development team reports, etc.

3.2. Deviations

3.2.1. Methodology Deviations

The Project to date has only deviated from the VM0007 REDD+ MF methodology in the peat depth mapping as part of the original baseline assessment work as set forth in the RER-CP VCS PD version 12 at § 3.6.1.

This deviation however has had no impact on the current monitoring period as it will relate only to the baseline reassessment.

Additionally, the Project has opted to exclude a number of emissions from the Baseline and the Project. These omissions might be considered deviations/alterations from the methodology. REDD+ MF and its modules allow for the exclusions, however, for transparency purposes, the Project has opted to include these exclusions in this section. All of the exclusions are conservative and only relate to the measurement of emissions, they do not relate to any other aspect of the methodology. This is set forth in additional detail in the RER-CP VCS PD version 12 at § 3.6.2.

The RER project undertook a methodology deviation regarding a minor deviation in statistical calculations in the activity shifting leakage reporting. The deviation is consistent with the requirements of VCS Standard v4.3 §3.17. The deviation is only used in relation to data that is used to monitor leakage reporting and the use of the deviation will not negatively impact the conservativeness of any calculation.

Section 5.1 of Module: Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP), under Step 1, Option 1.1, the Historical Deforestation Trend requires in its calculation the use of an annual licensed area to develop a linear regression¹¹.

The Project Proponent notes that regressions of (i) historical cumulative and (ii) historical annual will generate the same estimates of future deforestation. With the regression of cumulative deforestation, estimates of annual deforestation are calculated by deducting the cumulative deforestation rates between different years.

The reason a regression of cumulative deforestation is that these data are generated directly from the datasets with the minimum of transformation required. There is a consistent relationship between the start point and the subsequent measure of forest area and deforestation. Accurate estimation of annual deforestation requires “annual measurements” of forest area.

Furthermore, the regression of cumulative deforest has also been used in previous Project Documents and RER felt it better to stick with the accepted practice rather than try unproven innovations.

3.2.2. Project Description Deviations

There are four project description deviations in this monitoring report as compared to the project activities and monitoring described in the Project Document.

PD Deviation One - Monitoring of Permanent Sample Plots (PSPs)

The Project reports a minor change in the first monitoring period in regard to the monitoring of Permanent Sample Plots (PSPs) established by the Project. The PSPs are to be used to sample above-ground biomass for the Project and were originally established in 2015. Some of the Boundary markers were lost between 2015 and 2020. Boundaries were established using the same GPS coordinates. However, because of GPS variability (+/- 10m), the change in the location can result in the measurement of different individual trees, this is a deviation from the project description document and is reported below.

Per Project VCS-PD, section 5.3.2.1 of the PD document states that “The Project has established a network of 40 Permanent Sample Plots that will be monitored upon verification but at least every 5 years. In practice, at least 50% of the plots will be measured at each monitoring event.”

The 40 plots established in 2020 to create the PSPs were taken from the original 2015 baseline assessment. However, given the time frame from 2015 to 2020, some boundary markers were lost. Plot markers are often lost or destroyed over time in tropical forest settings.

GPS was used by the 2020 monitoring teams to locate any missing boundary marker location in the PSPs being established. Therefore, the PSPs were measured as close to the original location as possible; but when boundary markers were missing, the boundary marker location would be fixed by GPS. Because GPS accuracy is +/- 10 meters they were not always in “exactly” the same location, there could be minor variability of +/- 10m, but this would be enough to include or exclude some trees and create minor variability from the original biomass estimates that could result in negative growth (as reported in Table 22 and footnote 10 above and in section 4.3.2.2 below). This is a project description deviation from the PD which inferred that the plots would be in the exact same location.

To rectify the potential for loss of PSP locations, during the establishment of the PSPs, great care was taken to ensure that boundary markers would survive. Further, all trees are now permanently “tagged” with aluminum markers permanently affixed to the tree.

Identification of Impacts and explanation of same:

- a. **Applicability of the methodology:** There is no impact to the “applicability of the methodology.” All of the relevant applicability conditions continue to be applicable.
- b. **Additionality:** There is no impact to the “additionality.” All of the additionality arguments and positions therein remain unchanged.
- c. **Appropriateness of the baseline scenario:** There is no impact to the “appropriateness of the baseline scenario.” It remains unchanged, as the PD Deviation only impacts in a minor way the monitoring of the Project.

PD Deviation Two – VMD0006-BL-PL - §5. Part 1 - Agent of Planned Deforestation & Rate of Deforestation

PP notes that VMD0006-BL-PL, v1.3 requires the application §5, Part 1., Step 1.1 to identify the Agent of Planned deforestation in each baseline stratum. The PP has identified a class of deforestation agents for the baseline as the most likely deforesting agents following the methodological requirements.

1. Justification of the most likely “Class of Deforestation Agents”

In the Province of Riau, the PP identified the strata of all (54 in 2019, see PD Table 60) Plantation Forestry (i.e. HTI) concessions in the province in order to stratify for a similar type of baseline activity. This was done based on historical records from the Ministry of Forestry and Environment (<https://sigap.menlhk.go.id/sigap/> and <https://sigap.menlhk.go.id/sigap/peta-interaktif>). The area was further stratified to only include plantation forestry concessions that included peatlands as a soil type. Further biophysical parameters of the concessions were also similar, such as elevation, temperature and precipitation regime and tree species. Activity-related parameters were also similar, as all were located close to transportation networks that included, canals, roads and natural waterways leading to pulping facilities on the coast.

This resulted in a class of deforestation agents that were made up of industrial-scale agribusiness that were practicing plantation forestry under legal license from the MoEF. The 4 distinct types of concession owners in the strata containing forest plantation development on peatlands are:

1. Sinar Mas Group with 653,730 ha or 46% of the strata
2. APRIL Group with 338,909 ha or 24% of the strata
3. Long Term Supply Partner contracted with APRIL with 317,343 ha or 22% of the strata
4. Unidentified Other with 103,854 ha or 7% of the strata

The Long Term Supply Partners contracted with APRIL are each distinct legal entities that are not owned by APRIL. They are individual entities that have agreed by contract to undertake operations in line with APRIL requirements and have fixed delivery rates for forest plantation stock to be provided to the APRIL pulping facilities. The APRIL group does not undertake their licencing or community activity, this is done by the individual entity itself including long-term and short-term operational planning. However, the entities follow APRIL requirements by virtue of their supply contract.

In addition to the above, the PP undertook an analysis to ensure that the applicability criteria set out in Section 5, Part 1, point 1.3, page 10 of the Module VMD0006-BL-PL v1.3 correctly applied to the proxy areas and that the class of deforestation agents was representative of the proxy choices. As the class of deforestation agents is one that is converting secondary forested land to industrial forest plantations using acacia in drained peatlands, this can only legally be done with an Industrial forestry license or *Hutan Tanaman Industri* (HTI) licence issued and regulated by the MoEF. Because this conversion practice is highly regulated, the conversion and management practices are very similar from one concession to another. All HTI concessions in the province of Riau, and in the country were regulated by MoEF General Regulation 6/2007 Article 38, 71 and per Article 73(1)(a) and (b), were required to produce a 10-year management plan (RKU) and annual work plans (RKT) that are approved by the MoEF. These work plans are required among other things, to outline biophysical characteristics of the concession, conduct a socio-economic assessment for community programmes, undertake an inventory and produce conversion and planting management plans that comply with all Indonesian MoEF government regulations.

The three largest group groups therefore make up 93% of all forest plantation development concessions in Riau Province and make up the most likely class of deforestation agents. It was from this class of deforestation agents, the 6 proxy concessions were chosen for the baseline deforestation rate.

2. Rate of Deforestation:

PP in the PD indicated that it had used what was termed the “RER Deforestation Rate” instead of the “Proxy Deforestation Rate” as required by VMD0006 (BL-PL) PP’s “Proxy Deforestation Rate” was not derived using the exact proscribed method of BL-PL, but by applying an approach supported by domestic Indonesian forestry planning regulations. The deforestation rate used in the RER-CP VCS PD was 8.2% (i.e., the RER Project Area deforestation rate on p.187 of the RER-CP VCS PD version 12.3g) and has now been updated as the Proxy Deforestation Rate to 7.82% based on the exact requirements of BL-PL. In order to comply exactly with the methodology, the MR now uses the Proxy Deforestation Rate identified below in the MR at §5.1.1, step 1.3. With the application

of the Proxy Deforestation Rate, the methodology also required the use of a specific process to determine the baseline area of deforestation, the issue of deforestation rate and area to be deforested which are intricately linked in BL-PL.

As such the MR has updated text and tables related to: the deforestation rate, the baseline area of deforestation, and baseline & project emission reduction and removals.

The MR now indicates and refers only to the Proxy Deforestation Rate.

Identification of Impacts and explanation of same:

- a. **Applicability of the methodology:** There is no impact to the “applicability of the methodology.” All of the relevant applicability conditions continue to be applicable.
- b. **Additionality:** There is no impact to the “additionality” of the Project. All of the additionality arguments and positions therein remain unchanged.
- c. **Appropriateness of the baseline scenario:** The impact on the “appropriateness of the baseline scenario” is that 1.) the steps required in VMD0006-BL-PL, v1.3, section 5, Part 1.1 have been clarified and 2.) part 1.3 of the same section has also been updated. The Project’s deforestation rate now reflects the actual result of the Proxy Deforestation Analysis from VMD006, v1.3, §5 Procedures (Part1, §1.2); the Project’s use of the Proxy Deforestation Rate has altered the flow of emission reductions and removals of the Project and has made them more conservative; the emission reductions and removals for this monitoring period are reported in this Monitoring Report.

PD Deviation Three – Crediting Start Dates:

The PP has updated all of the three Project Activity Start dates in §1.5 of the MR in order to clarify the activity crediting start date for each activity. The three crediting start dates have been updated throughout the MR in order to clarify the different crediting start dates for APD, RWE and CIW.

Identification of Impacts and explanation of same:

- a. **Applicability of the methodology:** There is no impact to the “applicability of the methodology.” All of the relevant applicability conditions continue to be applicable.
- b. **Additionality:** There is no impact to the “additionality” of the Project. All of the additionality arguments and positions therein remain unchanged.
- c. **Appropriateness of the baseline scenario:** There is no impact on the “appropriateness of the baseline scenario” as the baseline itself has not changed. For this PD Deviation, the only change in relation to the baseline is when Project Emission Reductions and Removals can begin to be accounted for against the baseline for the project activities. The MR has been updated with the changes in emission reductions and removals in relation to APD, CIW and RWE.

PD Deviation Four – Clarifications made to Section 5.1 & 5.2 – Baseline & Project Emissions

PP has updated the MR section 5.1 in order to clarify:

1. How Soil Organic Carbon (SOC) is treated in the project and accounted for;
2. How baseline accounting is done, including enhancing the references necessary to ensure a third party is able to recreate the project calculations; and
3. How in the WRC baseline, the rate of peat loss and the GHG baseline emissions due to drainage are accounted for.

For section 5.1 & 5.2, the overall approach in the sections were re-grouped and edited to ensure greater comprehension and ability by any given reader to recreate the Project's calculations and equations.

Identification of Impacts and explanation of same:

- a. **Applicability of the methodology:** There is no impact to the “applicability of the methodology.” All of the relevant applicability conditions continue to be applicable.
- b. **Additionality:** There is no impact to the “additionality” of the Project. All of the additionality arguments and positions therein remain unchanged.
- c. **Appropriateness of the baseline scenario:** There is no apparent impact on the “appropriateness of the baseline scenario” as the changes implemented only serve to enhance comprehension of the section; no substantive changes to the baseline were made.

3.3. Grouped Projects

Not applicable as RER-CP is not a grouped project.

4. DATA AND PARAMETERS

4.1. Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,planned}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions in the baseline from planned deforestation
Source of data	Module BL-PL
Value applied	42,354,649 (CAB_tree + CBG_tree)
Justification of choice of data or description of measurement methods and procedures applied (Justification)	Derived and justified in §4.1 of the PD in which the baseline is set and calculated as required by BL-PL.
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is from REDD-MF and can be found in the RER Carbon Model at [NER].[F65].

Data / Parameter	GHG _{BSL-WRC}
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions in the WRC baseline scenario up to year t*
Source of data	Module BL-PL
Value applied	321,327,127
Justification	See Module BL-PL.
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is from REDD-MF and can be found in the RER Carbon Model at [NER].[M65].

Data / Parameter	Project Forest Cover Monitoring Map
Data unit	Dimensionless
Description	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event
Source of data	Remote sensing in combination with GPS data collected during ground truthing
Value applied	0
Justification	The minimum map accuracy must be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data

	and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy. Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Purpose of Data	Calculation of forest cover
Comments	Where forest land contains more than one forest class, the map must be stratified into forest classes using module X-STR. Parameter is from M-REDD

Data / Parameter	CF
Data unit	t C t d.m. ⁻¹
Description	Carbon fraction of dry matter in t C t ⁻¹ d.m.
Source of data	Values from the literature (e.g., IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.3) shall be used if available, otherwise default value of 0.47 t C t ⁻¹ d.m. can be used
Value applied	0.47
Justification	Globally accepted default value derived from IPCC 2006GL
Purpose of Data	Calculation of carbon stock
Comments	Parameter is found in modules M-REDD and CB-AB

Data / Parameter	CF _j
Data unit	t C t d.m. ⁻¹
Description	Carbon fraction of biomass for tree species j
Source of data	Values from the literature (e.g., IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.3) shall be used if available, otherwise default value of 0.47 t C t ⁻¹ d.m. can be used
Value applied	0.47 or species specific value.
Justification	IPCC 2006GL
Purpose of Data	Calculation of carbon stock
Comments	Where new species are encountered in the course of monitoring, new carbon fraction values must be sourced from the literature or otherwise use the default value. Parameter is from M-REDD

Data / Parameter	D _j
Data unit	t d.m. m ⁻³
Description	Density of wood by species from World Wood Database
Source of data	See wood density allometrics attached
Value applied	The species density assumptions are recorded in the appendices.
Justification	Derived from World Wood Database. See also Module CP-AB
Purpose of Data	Calculation of wood density
Comments	Parameter is from M-REDD

Data / Parameter	D_{MN}
Data unit	t d.m. m ⁻³
Description	Mean wood density of commercially harvested species.
Source of data	See wood density allometrics attached
Value applied	The species density assumptions are recorded in the appendices.
Justification	Derived from World Wood Database. See also Module CP-AB
Purpose of Data	Calculation of wood density of commercially harvested species.
Comments	Parameter is from M-REDD

Data / Parameter	$f_j(X,Y)$
Data unit	t d.m. tree ⁻¹
Description	Allometric equation for species j linking measured tree variable(s) to aboveground biomass of living trees, expressed as t d.m. tree ⁻¹
Source of data	Chave, J., C. Andalo, S. Brown, M. A. Cairns, J. Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.-P. Lescure, B. W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. <i>Oecologia</i> 145: 87-99. The formula is: $AGB = 0.0776 * (WOOD\ DENSITY) * (DBH) * (DBH) * (Estimated\ Height)^{0.94}$ Diameter at breast height (DBH) and Estimated Height are generated from forest inventory. Wood density uses the World Wood Database
Value applied	Module CP-AB – see also the reference
Justification	Derived from Chave, J., C. Andalo, S. Brown, M. A. Cairns, J. Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.-P. Lescure, B. W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. <i>Oecologia</i> 145: 87-99.
Purpose of Data	Calculation of aboveground biomass
Comments	It is necessary to validate the applicability of equations used. Source data from which equation was derived should be reviewed and confirmed to be representative of the forest type/species and conditions in the project and covering the range of potential independent variable values. Parameter is found in modules M-REDD and CB-AB

Data / Parameter	$A_{planned,i}$
Data unit	ha
Description	Total area of planned deforestation over the fixed baseline period for stratum i
Source of data	GPS coordinates and/or Remote Sensing data and/or legal parcel records
Value applied	See table 90 of the RER-CP VCS-PD ver11
Justification	Derived and justified in §4.1 of the PD in which the baseline is set and calculated as required by BL-PL.
Purpose of Data	Calculation of baseline planned deforestation
Comments	Parameter from module M-REDD

Data / Parameter	$C_{BSL,i,t100}$
Data unit	t C ha ⁻¹
Description	Peat carbon stock in the baseline scenario in peat depth stratum i at t=100
Source of data	Module X-STR
Value applied	395,176,037
Justification	Derived and justified in §4.1 of the PD in which the project emissions are described.
Purpose of Data	Calculation of peat carbon stock
Comments	Parameter from module M-REDD and can be found in the RER Carbon Model at [Model - Peat Depth and Drained] [EO27].

Data / Parameter	$C_{AB_tree,peatdome}$
Data unit	t CO ₂ e ha ⁻¹
Description	Mean aboveground tree biomass carbon stock of trees in peat dome forest.
Source of data	Module CP-AB
Value applied	343.47
Justification	Derived from and justified in §3.3 of the PD.
Purpose of Data	Calculation of carbon stock
Comments	Parameter from module M-REDD and can be found in the RER Carbon Model at [AGB Inventory].[AF20].

Data / Parameter	$C_{AB_tree,dense\ swamp\ forest}$
Data unit	t CO ₂ e ha ⁻¹
Description	Mean aboveground tree biomass carbon stock of trees in dense swamp forest
Source of data	Module CP-AB
Value applied	258.96

Justification	Derived from and justified in §3.3 of the PD.
Purpose of Data	Calculation of carbon stock
Comments	Parameter from module M-REDD and can be found in the RER Carbon Model at [AGB Inventory].[AF17].

Data / Parameter	$C_{AB_tree,medium\ swamp\ forest}$
Data unit	t CO ₂ e ha ⁻¹
Description	Mean aboveground tree biomass carbon stock of trees in medium swamp forest
Source of data	Module CP-AB
Value applied	194.22
Justification	Derived from and justified in §3.3 of the PD.
Purpose of Data	Calculation of carbon stock
Comments	Parameter from module M-REDD and can be found in the RER Carbon Model at [AGB Inventory].[AF18].

Data / Parameter	$C_{AB_tree,sparse\ swamp\ forest}$
Data unit	t CO ₂ e ha ⁻¹
Description	Mean aboveground tree biomass carbon stock of trees in sparse swamp forest
Source of data	Module CP-AB
Value applied	135.07
Justification	Derived from and justified in §3.3 of the PD.
Purpose of Data	Calculation of carbon stock
Comments	Parameter from module M-REDD and can be found in the RER Carbon Model at [AGB Inventory].[AF19].

Data / Parameter	$D\%_{planned,i,t}$
Data unit	% year ⁻¹
Description	Projected annual proportion of land that will be deforested in stratum <i>i</i> at year <i>t</i>
Source of data	Module BL-PL
Value applied	7.82%
Justification	It justified in §4.1 of the PD in which the baseline is set and calculated as required by BL-PL.
Purpose of Data	Calculation of projected deforestation
Comments	Must be revisited at the time of baseline revision Parameter from module M-REDD & BL-PL and can be found in the RER Carbon Model file at Sheet/cell [REDD – Area avoid deforested.B10]

Data / Parameter	$N_{2Odirect-N,i,t}$
Data unit	t CO ₂ e

Description	Direct N ₂ O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum i in year t
Source of data	Module E-NA
Value applied	N/A
Justification	Justified in § 4.2 of the PD. See also Module E-NA
Purpose of Data	Calculation of N ₂ O emissions on the alternative land use
Comments	Parameter from module M-REDD

Data / Parameter	R																																																			
Data unit	t root d.m. t ⁻¹ shoot d.m.																																																			
Description	Root to shoot ratio appropriate to species or forest type / biome; note that as defined here, root to shoot ratio is applied as belowground biomass per unit area:above ground biomass per unit area (not on a per stem basis)																																																			
Source of data	<table><tr><th colspan="7">Emissions factors for calculation of biomass for non-tree pools in natural forest and scrub</th></tr><tr><th rowspan="2">Forest type</th><th rowspan="2">AGB_{DBH≥5cm}</th><th>AGB_{DBH< 5cm}</th><th>AGB_{understorey}</th><th>BGB (root)</th><th>Litter</th><th>Woody debris</th></tr><tr><th>Ratio to (2)</th><th>Ratio to (2+3)</th><th>Ratio to (2+3+4)</th><th>Ratio to (2+3)</th><th>Ratio to (2+3)</th></tr><tr><th>-1</th><th>-2</th><th>-3</th><th>-4</th><th>-5</th><th>-6</th><th>-7</th></tr><tr><td>Dense swamp forest</td><td rowspan="4">From carbon stock estimate report</td><td>16.83%</td><td>3.30%</td><td>30.54%</td><td>2.22%</td><td>25.91%</td></tr><tr><td>Medium swamp forest</td><td>15.00%</td><td>4.94%</td><td>28.24%</td><td>3.01%</td><td>31.02%</td></tr><tr><td>Sparse swamp forest</td><td>15.00%</td><td>4.94%</td><td>28.24%</td><td>3.01%</td><td>31.02%</td></tr><tr><td>Peat dome forest</td><td>16.83%</td><td>3.30%</td><td>30.54%</td><td>2.22%</td><td>25.91%</td></tr></table> Source: Krisnawati et al. (2015). Standard Methods for Estimating Greenhouse Gas Emissions from Forests and Peatlands in Indonesia (Version 2). Table 2-3. Indonesian National Carbon Accounting System.	Emissions factors for calculation of biomass for non-tree pools in natural forest and scrub							Forest type	AGB _{DBH≥5cm}	AGB _{DBH< 5cm}	AGB _{understorey}	BGB (root)	Litter	Woody debris	Ratio to (2)	Ratio to (2+3)	Ratio to (2+3+4)	Ratio to (2+3)	Ratio to (2+3)	-1	-2	-3	-4	-5	-6	-7	Dense swamp forest	From carbon stock estimate report	16.83%	3.30%	30.54%	2.22%	25.91%	Medium swamp forest	15.00%	4.94%	28.24%	3.01%	31.02%	Sparse swamp forest	15.00%	4.94%	28.24%	3.01%	31.02%	Peat dome forest	16.83%	3.30%	30.54%	2.22%	25.91%
Emissions factors for calculation of biomass for non-tree pools in natural forest and scrub																																																				
Forest type	AGB _{DBH≥5cm}	AGB _{DBH< 5cm}	AGB _{understorey}	BGB (root)	Litter	Woody debris																																														
		Ratio to (2)	Ratio to (2+3)	Ratio to (2+3+4)	Ratio to (2+3)	Ratio to (2+3)																																														
-1	-2	-3	-4	-5	-6	-7																																														
Dense swamp forest	From carbon stock estimate report	16.83%	3.30%	30.54%	2.22%	25.91%																																														
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Peat dome forest		16.83%	3.30%	30.54%	2.22%	25.91%																																														
Value applied	30.54% peat dome and dense swamp forest 28.24 for medium and sparse swamp forest																																																			
Justification	Derived from Table 2-3 of the Indonesian National Carbon Accounting System, Krisnasati, <i>et al.</i> 2015. <i>Standard methods for estimating greenhouse gas emissions from forests and peatlands in Indonesia</i> (version2). See also Module CP-AB																																																			
Purpose of Data	Calculation of carbon stock																																																			
Comments	See Module CP-AB Parameter is found in modules M-REDD and CB-AB																																																			

Data / Parameter	A _{BSL,i,t} or A _{i,t}
Data unit	ha
Description	Area of baseline stratum i in year t
Source of data	Own assessment

Value applied	See table 51 - REDD and Non-REDD Areas within Plantation Development Area of the RER_CP VCS-PD ver 12
Justification	Delineation of strata is preferably done using a Geographical Information System (GIS), which allows for integrating data from different sources (including GPS coordinates and remote sensing data). Applied techniques must follow international standards of application or local standards as laid out in pertinent scientific literature or handbooks. The area of peat burnt (Apeatburn-WPS,i,t for the project scenario from Module M-PEAT and Apeatburn-BSL,i,t for the baseline scenario from Module BL-PEAT) and area of peatland (not open water, not burnt) (Apeatsoil-WPS,i,t for the project scenario from Module M-PEAT and Apeatsoil-BSL,i,t for the baseline scenario from Module BL-PEAT) determine the difference between the remaining carbon stock in the project scenario and baseline scenarios after 100 years. In the procedures in Section 5.4 these areas are together referred to as AWPS,i,t and ABSL,i,t.
Purpose of Data	Calculation of peat carbon stock
Comments	Parameter from module X-STR

Data / Parameter	Depth _{peat-BSL,i,t0}
Data unit	m
Description	Average peat depth in the baseline scenario and the project scenario in stratum <i>i</i> at project start
Source of data	Existing peat depth maps and/or field assessment and/or in combination with remote sensing data.
Value applied	See table 46 of the VCS PD
Justification	Procedures for monitoring peat depth are given in Module <i>M-PEAT</i> and in this module. Peat depths can be derived from - Existing peat depth maps - Literature datasets involving the project or similar areas. - Field measurements, e.g., using a peat corer - Remote sensing to derive height of the peat surface above datum. For the purpose of determining the PDT, where relevant, peat depth may be determined as the depth of the peat layer down to a level where no further oxidation or other losses occur (e.g., the average water table depth).
Purpose of Data	Calculation of baseline emissions
Comments	In the absence of peer-reviewed data sources, the project proponent must justify that the data used are representative

	and that standard methods have been used. Parameter from module X-STR
Data / Parameter	Depth _{peat-WPS,i,t0}
Data unit	m
Description	Average peat depth in the baseline scenario and the project scenario in stratum <i>i</i> at project start
Source of data	Existing peat depth maps and/or field assessment and/or in combination with remote sensing data.
Value applied	See table 46 of the RER-CP VCS-PD ver10
Justification	Procedures for monitoring peat depth are given in Module <i>M-PEAT</i> and in this module. Peat depths can be derived from Existing peat depth maps Literature datasets involving the project or similar areas. Field measurements, e.g., using a peat corer Remote sensing to derive height of the peat surface above datum. For the purpose of determining the PDT, where relevant, peat depth may be determined as the depth of the peat layer down to a level where no further oxidation or other losses occur (e.g., the average water table depth).
Purpose of Data	Calculation of baseline emissions
Comments	In the absence of peer-reviewed data sources, the project proponent must justify that the data used are representative and that standard methods have been used. Parameter from module X-STR
Data / Parameter	Sub _{initial-BSL,i}
Data unit	m yr ⁻¹
Description	Subsidence in the initial years after drainage in stratum <i>i</i>
Source of data	Default factor from scientific literature or field assessments in peatland areas in the same region that underwent equal land use development as projected for the baseline scenario.
Value applied	0.04
Justification	Deemed 0 for RDP projects. Procedures for measuring soil subsidence are described in Module <i>M-PEAT</i>
Purpose of Data	Calculation of baseline GHG emissions
Comments	Parameter from module X-STR
Data / Parameter	Rate _{peatloss-BSL,i,t} ; Rate _{peatloss-BSL,i}
Data unit	m yr ⁻¹
Description	Rate of peat loss due to subsidence and fire in the baseline scenario in stratum <i>i</i> in year <i>t</i> ; a conservative (low) value may

	be applied that remains constant over time; Subsidence in the initial years after drainage is not included in this rate; Rate of peat loss due to subsidence and fire in the baseline scenario in stratum i ; a conservative (high) value must be applied that remains constant over the time from $t = 0$ to PDT
Source of data	Default factor from scientific literature or field assessments in peatland areas that are similar to the project area (proxy area)
Value applied	0.0397m yr ⁻¹
Justification	See VMD0016 X-STR Section 5.4. Subsidence in the initial years after drainage is not included in this rate. Also there is no fire modelled in the baseline and the fire losses are estimated as 0.
Purpose of Data	Calculation of baseline emissions
Comments	Parameter from module X-STR

Data / Parameter	$C_{vol_lower,BSL,i,t}$; $C_{vol_lower,WPS,i,t}$
Data unit	kg C m ⁻³
Description	Volumetric carbon content of the peat below the water table in the project scenario in stratum i in year t
Source of data	Module M-PEAT
Value applied	50.4 kg C m ⁻³ based on bulk density (0.09 g cm ⁻³), carbon content 56% (Anshari et al., 2010; Page et al., 2011; Hooijer et al., 2012).
Justification	Anshari et al., 2010, Drainage and land use impacts on changes in selected peat properties and peat degradation in West Kalimantan Province, Indonesia, Biogeosciences, 7, 3403-3419; Page et al., 2011. Global and regional importance of the tropical peatland carbon pool, Global change Biology. 17:2, 798-818; Hooijer et al., 2012. Subsidence and carbon loss in drained tropical peatlands. Biogeosciences 9, 1053-1071. See also Module M-PEAT
Purpose of Data	Calculation of project emissions
Comments	See Module M-PEAT Parameter from module X-STR

Data / Parameter	$GHG_{peatsoil,CO_2,i,t}$
Data unit	t CO ₂ e yr ⁻¹
Description	CO ₂ emissions from microbial decomposition of the peat soil in stratum i in year t
Source of data	Module BL-PEAT
Value applied	317,291,188
Justification	Justified in §4.1 of the PD. See also module BL-PEAT
Purpose of Data	Calculation of baseline emissions
Comments	Parameter from module X-STR and can be found in the RER Carbon Model at sheet [WRC - Emissions Peat Soils /(G2)].

Data / Parameter	VC
Data unit	kg C m ⁻³
Description	Volumetric organic carbon content
Source of data	Direct measurements and/or literature involving the project area or similar areas
Value applied	50.4 kg C m ⁻³ based on bulk density (0.09 g cm ⁻³), carbon content 56% (Anshari et al., 2010; Page et al., 2011; Hooijer et al., 2012).
Justification	Anshari et al., 2010, Drainage and land use impacts on changes in selected peat properties and peat degradation in West Kalimantan Province, Indonesia, Biogeosciences, 7, 3403-3419; Page et al., 2011. Global and regional importance of the tropical peatland carbon pool, Global change Biology. 17:2, 798-818; Hooijer et al., 2012. Subsidence and carbon loss in drained tropical peatlands. Biogeosciences 9, 1053-1071. See also Module M-PEAT & Module E-NA. Justified in § 4.1 of the PD.
Purpose of Data	Calculation of baseline emissions Calculation of the maximum quantity of GHG emission reductions that may be claimed by the project
Comments	Parameter from module M-PEAT

Data / Parameter	E _{REDD_BSL,SS,I,Pool#}
Data unit	t CO ₂ e
Description	Carbon stock or GHG sources (eg, trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the REDD baseline scenario
Source of data	The terms denoting significant carbon stocks, GHG sources or leakage emissions used in calculating net emission reductions from the following relevant modules: CP-AB, E-NA.
Value applied	540.6
Justification	See relevant modules noted above in Source of Data.
Purpose of Data	Calculation of uncertainty
Comments	The ex-ante estimation must be derived directly from the estimations originating in the relevant modules: CP-AB, E-NA. Parameter from module X-UNC and can be found in the RER Carbon Model at [AGB Inventory].[P19].

Data / Parameter	U _{REDD_BSL,SS,I,Pool#}
Data unit	%
Description	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the REDD baseline scenario (1, 2...n represent different carbon pools and/or GHG

	sources)
Source of data	Calculations arising from field measurement data
Value applied	0.09
Justification	Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level. For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest. For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero.
Purpose of Data	Calculation of uncertainty
Comments	Baseline stocks and sources are estimated ex ante for each baseline period Parameter from module X-UNC

Data / Parameter	$U_{*,i,t}$
Data unit	t CO ₂ e ha ⁻¹ yr ⁻¹
Description	Uncertainty in parameter * in stratum i in year t * = parameters Eprox- CO _{2,t} , Eprox-CH _{4,t} , Epeatditch- CO _{2,t} , Epeatditch-CH _{4,t} and Epeatburn-BSL,
Source of data	Module X-UNC
Value applied	0.09
Justification	Where regression models are used to estimate emissions from oxidation of peat from proxy parameters, uncertainty is calculated by referencing the 95% confidence limits of the regression model, calculated using standard regression analysis techniques. For the value of the referenced proxy in year t, the half-width of the 95% confidence interval for the dependent variable (emissions) is calculated to produce parameters $U_{*,t}$. Where emissions are estimated applying a discrete default factor, uncertainty, $U_{*,t}$, is simply calculated by referencing the 95% confidence limit of the default factor estimate, or assigned as zero if an indisputably conservative factor is used.
Purpose of Data	Calculation of uncertainty
Comments	Parameter from module X-UNC

Data / Parameter	D% _{pn}
Data unit	%
Description	Percent of deforestation in land parcel pn etc of a proxy area as a result of planned deforestation as defined in this module
Source of data	Module X-UNC & Module BL-PL
Value applied	42%
Justification	Justified in §4.1 of the PD. See also Module BL-PL

Purpose of Data	Calculation of uncertainty
Comments	Parameter from module X-UNC and can be found in the RER Carbon Model sheet/cell [Proxy Analysis / B15]

Data / Parameter	Yrs _{pn}
Data unit	years
Description	Number of years over which deforestation occurred in land parcel pn in proxy area
Source of data	Module BL-PL
Value applied	N/A
Justification	Justified in §4.1 of the PD. See also Module BL-PL
Purpose of Data	Calculation of uncertainty
Comments	Parameter from module X-UNC

Data / Parameter	Cvol_upper,i,t and Cvol_lower,i,t
Data unit	g C cm ⁻³
Description	Average volumetric carbon content of the peat above and below the water table in stratum i at year t
Source of data	Own measurements
Value applied	0.05
Justification	Justified in §4.2 of the PD. Estimated conservatively from literature or determined from field sampling using standard laboratory techniques
Purpose of Data	Calculation of project emissions.
Comments	M-PEAT Section 5.6.5 - if subsidence is chosen as proxy Parameter from module M-PEAT

Data / Parameter	D _{peatburn,i,t}
Data unit	m yr ⁻¹
Description	The peat fire depth, or fire scar depth per year
Source of data	Data sources or own measurements
Value applied	0
Justification	Field measurements or remote sensing, expert judgment, literature (e.g., Ballhorn <i>et al.</i> 2009; Couwenberg <i>et al.</i> 2010; Van der Werf <i>et al.</i> 2010; IPCC) and/or datasets of historic burn depths involving the project or similar areas
Purpose of Data	Calculation of project emissions.
Comments	See M-PEAT Section 5.6.8 Parameter from module M-PEAT

Data / Parameter	CC
Data unit	%
Description	Carbon concentration of the peat
Source of data	Anshari <i>et al.</i> , 2010; Page <i>et al.</i> , 2011; Hooijer <i>et al.</i> , 2012

Value applied	Default factor (if employed): 56
Justification	Sampling using national default factors
Purpose of Data	Calculation of project emissions
Comments	See M-PEAT Section 5.6.5 - if subsidence is chosen as proxy Parameter from module M-PEAT and can be found in the RER Carbon Model sheet/cell [Model - Peat Depth and Drained].[B10]

Data / Parameter	A_p
Data unit	ha
Description	Total area of peat in the project area (in case of rewetting projects) or proxy area (in case of conservation projects)
Source of data	Module X-STR
Value applied	130,090.00
Justification	Justified in §4.2 of the PD. See also Module X-STR
Purpose of Data	Calculation of project emissions
Comments	Parameter from module M-PEAT

Data / Parameter	$A_{\text{peatburn-BSL},i,t}$
Data unit	ha
Description	Area of peat burnt in stratum i in year t in the project scenario
Source of data	Module X-STR
Value applied	N/A
Justification	Justified in §4.1 of the PD. See also Module X-STR. Also the area of peat burnt can be assessed using field observations and/or remote sensing using best-practice methods (see e.g., Congalton 1991; Congalton et al., 2008). Remote sensing-based data on burnt peat areas must be validated by field observations or other, higher resolution remote sensing data. When using remote sensing, data must be georeferenced into a common geodetic system, for example using the UTM system using best-practice methods in remote sensing (see e.g., Congalton 1991; Congalton et al., 2008). Semi-automated image classification approaches may be applied. Strata must be validated by reference data collected in the field, other official documentation or from recent independent higher resolution remote sensing imagery. See Module X-STR for procedures to delineate all peat strata
Purpose of Data	Calculation of baseline emissions
Comments	Parameter from module M-PEAT & BL-PEAT

Data / Parameter	$GHG_{\text{peatsoil,BSL},i,t}$
Data unit	t CO ₂ e y ⁻¹

Description	CO ₂ emissions from microbial decomposition of the peat soil within the project boundary in the baseline scenario in stratum <i>i</i> in year <i>t</i>
Source of data	Module BL-PEAT
Value applied	317,291,188 t CO ₂ e
Justification	See Module BL-PEAT
Purpose of data	Calculation of baseline emissions
Comments	Parameter used in module M-PEAT, equation 1 and can be found in the RER Carbon Model at sheet/cell: WRC - Emissions Peat Soils / G2]

Data / Parameter	L-D _i
Data unit	%
Description	Likelihood of deforestation in stratum <i>i</i>
Source of data	Module BL-PL
Value applied	1
Justification	For all areas not both under Government control and zoned for deforestation, <i>L-D_i</i> must be equal to 1 For areas under Government control and zoned for deforestation <i>L-D_i</i> must be calculated as the summed proxy areas in the appropriate stratum divided by the areas within these proxy areas that has been deforested within the previous five years.
Purpose of Data	Calculation of projected deforestation
Comments	Alternatively, BCEF, where not directly available, can be calculated as wood density (t dry mass m ⁻³ green volume) * BEF (Biomass Expansion Factor = ratio of aboveground biomass to biomass of the commercial volume). If using BCEFs developed outside the project country (cases (c) and (d) above under Source of data), it is necessary to validate the applicability of BCEFs used. Parameter is found in BL-PL

Data / Parameter	GHG _{BSL-PEAT}
Data unit	t CO ₂ e
Description	Net GHG emissions in the WRC baseline scenario up to year <i>t</i> *
Source of data	Module BL-PEAT
Value applied	321,327,127
Justification	Derived and justified in §4.1 of the PD in which the baseline is set and calculated as required by BL-PEAT
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is found in module BL-PL and can be found in the

	RER Carbon Model at [NER].[M65].
Data / Parameter	GHG _{peatburn-BSL,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	GHG emissions from burning of peat in the baseline scenario in stratum i at year t
Source of data	(IPCC) default factors, literature values or direct measurements
Value applied	N/A
Justification	Justified in §4.1 of the PD. Procedures for assessing GHG emissions from burning of biomass and peat are provided in Module E-BPB.
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is found in module BL-PEAT
Data / Parameter	GHG _{proxy-CO2,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	Emission of CO ₂ in relation to the chosen proxy in stratum i at year t
Source of data	(IPCC) default factors, literature values or direct measurements IPCC (2013) Supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands. Methodological guidance on lands with wet and drained soils and constructed wetlands for wastewater treatment. Gyldenkaerne, S. and Lin, E. (eds). Japan: Institute for Global Environmental Strategies [IGES].
Value applied	73.34
Justification	Justified in §4.1 of the PD. See also Module M-PEAT
Purpose of Data	Calculation of baseline emissions
Comments	Proxies must comply with VCS requirements on proxies. It must be demonstrated that the proxy used is strongly correlated with CO ₂ emissions by referring to IPCC, literature or own data. When referring to own data, comparison with literature values must be made. Parameter is used in module BL-PEAT equation 6 and can be found in the RER Carbon Model at sheet/cell: Peatland Allometrics / (F4).
Data / Parameter	GHG _{proxy-CH4,i,t}
Data unit	t CH ₄ ha ⁻¹ y ⁻¹
Description	Emission of CH ₄ in relation to the chosen proxy in stratum i at year t
Source of data	IPCC (2013) Supplement to the 2006 IPCC guidelines for

	national greenhouse gas inventories: Wetlands. Methodological guidance on lands with wet and drained soils and constructed wetlands for wastewater treatment. Gyldenkaerne, S. and Lin, E. (eds). Japan: Institute for Global Environmental Strategies [IGES].
Value applied	0.0756
Justification	Justified in §4.1 of the PD. See also Module M-PEAT
Purpose of Data	Calculation of baseline emissions
Comments	Proxies must comply with VCS requirements on proxies. It must be demonstrated that the proxy used is strongly correlated with CO ₂ emissions by referring to IPCC, literature or own data. When referring to own data, comparison with literature values must be made. Parameter is used in module BL-PEAT equation 6 and can be found in the RER Carbon Model at sheet/cell: Peatland Allometrics / (F6).

Data / Parameter	GHG _{peatditch-CO₂,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	Emission of CO ₂ from ditch and open water stratum i at year t
Source of data	Project-specific values; appropriate literature sources
Value applied	3.01
Justification	Justified in §4.1 of the PD. See also Module M-PEAT
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is used in module BL-PEAT equation 7 and can be found in the RER Carbon Model at sheet/cell: Peatland Allometrics / (F11).

Data / Parameter	GHG _{peatditch-CH₄,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	Emission of CH ₄ from ditch and open water stratum i at year t
Source of data	Intergovernmental Panel on Climate Change. 2013. 2013 Supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands. Methodological guidance on lands with wet and drained soils and constructed wetlands for wastewater treatment. Gyldenkaerne, S. and Lin, E. (eds). Japan: Institute for Global Environmental Strategies [IGES].
Value applied	63.25
Justification	Justified in §4.1 of the PD. See also Module M-PEAT and IPCC 2013GL.
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is used in module BL-PEAT equation 7 and can be

	found in the RER Carbon Model at sheet/cell: Peatland Allometrics / (F10).
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Data / Parameter	$A_{\text{peatsoil-BSL},i,t}$
Data unit	ha
Description	Area of peatland (not open water, not burnt) in stratum i in year t in the project scenario
Source of data	Module X-STR
Value applied	130,090.00
Justification	Justified in §4.1 of the PD. See also Module X-STR
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is found in module BL-PEAT

Data / Parameter	$A_{\text{ditch-BSL},i,t}$
Data unit	ha
Description	Total area of ditch and other open water stratum i in year t in the baseline scenario
Source of data	Module X-STR
Value applied	169.6
Justification	Justified in §4.1 of the PD. See also Module X-STR
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is found in module BL-PEAT and can be found in the RER Carbon Model at sheet/cell: WRC - Surf Area Drainage canals / (Y73).

Data / Parameter	$t_{\text{PDT-BSL},i}$
Data unit	yr
Description	Peat depletion time (PDT) in the baseline scenario in stratum i in years elapsed since the project start
Source of data	Module X-STR
Value applied	>100 years
Justification	Justified in §4.1 of the PD. See also Module X-STR
Purpose of Data	Calculation of baseline emissions
Comments	Parameter is found in module BL-PEAT and in LK-ASP

Data / Parameter	Hist_{Hai}
Data unit	ha
Description	Average annual area of deforestation by the baseline agent of deforestation in stratum i for the 5 years prior to project implementation
Source of data	Data sources or own measurements
Value applied	0
Justification	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously

	owned or controlled by the baseline agent of deforestation.
Purpose of Data	Calculation of annual deforestation by the baseline agent
Comments	Must be re-evaluated whenever the baseline is revised Parameter is found in module LK-ASP
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
Source of data	On the ground observations, remotely sensed data and GIS.
Value applied	0
Justification	Under the applicability conditions of this methodology, ecological leakage affecting the soil (peat) carbon pool does not occur, by ensuring that the effect of hydrological connectivity with adjacent areas is insignificant, as outlined in §5 of LK-ASP.
Purpose of Data	Calculation of Leakage
Comments	All of the Project's areas where blocking canals occurs are a significant distance from any adjacent area, thus the risk of ecological is insignificant.

4.2. Data and Parameters Monitored

Data / Parameter	$\Delta C_{WPS-REDD}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions within the project area under the project scenario;
Source of data	M-REDD
Description of MM&P	See Module M-REDD
Frequency	Upon each verification event. See also Module M-REDD
Value applied	402,949 t CO ₂ e
Monitoring equipment	See Module M-REDD
QA/QC	See Module M-REDD
Purpose of data	Calculation of project emissions
Calculation method	See Module M-REDD
Comments	Parameter is found in REDD-MF and can be found in the RER Monitoring Model; at sheet/cell: Monitoring Report / (FD15].

Data / Parameter	$\Delta C_{LK-AS,planned}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation
Source of data	Public records of Indonesian HTI concessions from MoEF. See also Module LK-ASP
Description of MM&P	See Module LK-ASP
Frequency	Upon each verification event. See also Module LK-ASP
Value applied	0
Monitoring equipment	GIS and remote sensed images. See also Module LK-ASP
QA/QC	See Module LK-ASP
Purpose of data	Calculation of leakage
Calculation method	See Module LK-ASP in equation 1
Comments	n/a

Data / Parameter	$GHG_{WPS-WRC}$
Data unit	t CO ₂ e
Description	Net GHG emissions in the WRC project scenario up to year t*
Source of data	Module M-PEAT
Description of MM&P	See Module M-PEAT
Frequency	Upon each verification event. See also Module M-PEAT
Value applied	1,308,616

Monitoring equipment	See Module M-PEAT
QA/QC	See Module M-PEAT
Purpose of data	Calculation of project emissions
Calculation method	See Module M-PEAT
Comments	Parameter is found in REDD-MF and can be found in the RER Monitoring Model at sheet/cell: Monitoring Report / (ET16).

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
Source of data	Module LK-ECO
Description of MM&P	See Module LK-ECO
Frequency	See Module LK-ECO
Value applied	0
Monitoring equipment	See Module LK-ECO
QA/QC	See Module LK-ECO
Purpose of data	Calculation of leakage
Calculation method	See Module LK-ECO equation 1
Comments	n/a

Data / Parameter	Project Forest Cover Monitoring Map
Data unit	Dimensionless
Description	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event
Source of data	Remote sensing in combination with GPS data collected during ground truthing
Description of MM&P	See Module M-REDD
Frequency	See Module M-REDD
Value applied	Maps provided for 2016 to 2020. No evidence or indication of deforestation or forest degradation.
Monitoring equipment	See Module M-REDD
QA/QC	See Module M-REDD
Purpose of data	The minimum map accuracy must be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy. Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification

	event
Calculation method	See Module M-REDD
Comments	Where forest land contains more than one forest class, the map must be stratified into forest classes using module X-STR. Parameter is from module M-REDD

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
Source of data	Remote sensing imagery
Description of MM&P	See Module M-REDD
Frequency	Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	0 ha. There is no deforestation or forest degradation detected during the monitoring period.
Monitoring equipment	See Module M-REDD
QA/QC	See Module M-REDD
Purpose of data	Calculation of deforestation
Calculation method	See Module M-REDD
Comments	Ex-ante, an estimation shall be made of deforestation in the with-project case. If the belief is that zero deforestation will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent deforestation. Parameter is from module M-REDD

Data / Parameter	F_{LU}
Data unit	Dimensionless
Description	Land use factor before or after conversion
Source of data	Stock Change Factors are provided in Tables 5.5, 5.10, and 6.2 of the IPCC 2006GL Volume 4
Description of MM&P	See Module M-REDD
Frequency	See Module M-REDD
Value applied	Factor = 1. No FLU because there is no skid trail creation detected during the monitoring period.
Monitoring	See Module M-REDD

equipment	
QA/QC	See Module M-REDD
Purpose of data	"Stock Change Factors as defined in IPCC 2006GL are equal to the carbon stock in the altered condition as a proportion of the reference carbon stock. The management factor after conversion can be conservative
Calculation method	See Module M-REDD
Comments	Parameter is from module M-REDD

Data / Parameter	F_{MG}
Data unit	Dimensionless
Description	Management factor before or after conversion
Source of data	Stock Change Factors are provided in Tables 5.5, 5.10, and 6.2 of the IPCC 2006GL Volume 4
Description of MM&P	See Module M-REDD
Frequency	See Module M-REDD
Value applied	Factor = 1. No FMG because there is no skid trail creation detected during the monitoring period.
Monitoring equipment	See Module M-REDD
QA/QC	See Module M-REDD
Purpose of data	"Stock Change Factors as defined in IPCC 2006GL are equal to the carbon stock in the altered condition as a proportion of the reference carbon stock.
Calculation method	See Module M-REDD
Comments	Parameter is from module M-REDD

Data / Parameter	F_I
Data unit	Dimensionless
Description	Input factor before or after conversion
Source of data	Stock Change Factors are provided in Tables 5.5, 5.10, and 6.2 of the IPCC 2006GL Volume 4
Description of MM&P	See Module M-REDD
Frequency	See Module M-REDD
Value applied	Factor = 1.
Monitoring equipment	See Module M-REDD
QA/QC	See Module M-REDD
Purpose of data	"Stock Change Factors as defined in IPCC 2006GL are equal to the carbon stock in the altered condition as a proportion of the reference carbon stock.
Calculation method	The land use factor after conversion can be conservatively assumed to equate 1, the default value for medium input.
Comments	Parameter is from module M-REDD

Data / Parameter	$A_{planned,i}$
Data unit	Ha
Description	Total area of planned deforestation over the entire project lifetime for stratum i
Source of data	Data sources or own measurements
Description of MM&P	GPS coordinates and/or remote sensing data and/or legal parcel records. Ex ante, $A_{planned,i}$ must be determined as described in Module BL-PL
Frequency	Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	78,395.8 ha of planned deforestation
Monitoring equipment	See Module BL-PL
QA/QC	See section 9.3 of REDD+ MF or other VCS methodology that uses this module.
Purpose of data	Calculation of baseline deforestation
Calculation method	See Module BL-PL
Comments	See Module BL-PL Parameter is used in modules M-REDD, BL-PL & LK-ASP

Data / Parameter	$\Delta C_{BSL,i}$
Data unit	t CO ₂ e ha ⁻¹
Description	Net carbon stock changes from planned deforestation in all pools in the baseline stratum i
Source of data	Module BL-PL
Description of MM&P	See Module BL-PL
Frequency	See Module BL-PL
Value applied	15,667,348
Monitoring equipment	See Module BL-PL
QA/QC	See Module BL-PL
Purpose of data	Calculation of leakage emissions, analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation.
Calculation method	See Module BL-PL
Comments	Must be re-evaluated whenever the baseline is revised Parameter is found in modules BL-PL & LK-ASP and can be found in the RER Monitoring Model, at sheet/cell: Monitoring Report / (FC15)

Data / Parameter	$C_{AB_tree,Dense\ swamp\ forest}$
Data unit	t CO ₂ e / ha
Description	Carbon stock in aboveground biomass of trees in plot sp in stratum i
Source of data	APRIL forest inventories, 2015 and 2020
Description of MM&P	See Module CP-AB
Frequency	See Module CP-AB

Value applied	258.96 t CO ₂ e / ha
Monitoring equipment	See Module CP-AB and can be found in the RER Carbon Model at [AGB Inventory].[AF17]
QA/QC	See Module CP-AB
Purpose of data	Calculation of aboveground biomass
Calculation method	See Module CP-AB
Comments	Parameter is from module M-REDD and can be found in the RER Monitoring Model at sheet/cell: AGB Inventory / (AF18) and sheet/cell: Plantation Allometrics / (M6)

Data / Parameter	C _{AB_tree,Medium swamp forest}
Data unit	t CO ₂ e ha
Description	Carbon stock in aboveground biomass of trees in plot sp in stratum i
Source of data	APRIL forest inventories, 2015 and 2020
Description of MM&P	See Module CP-AB
Frequency	See Module CP-AB
Value applied	194.22 t CO ₂ e / ha
Monitoring equipment	See Module CP-AB
QA/QC	See Module CP-AB
Purpose of data	Calculation of aboveground biomass
Calculation method	See Module CP-AB
Comments	Parameter is from module M-REDD and can be found in the RER Monitoring Model at sheet/tab: AGB Inventory / (AF19) and sheet/cell: Plantation Allometrics / (M7)

Data / Parameter	C _{AB_tree,Sparse swamp forest}
Data unit	t CO ₂ e / ha
Description	Carbon stock in aboveground biomass of trees in plot sp in stratum i
Source of data	See Module CP-AB
Description of MM&P	See Module CP-AB
Frequency	See Module CP-AB
Value applied	135.07 t CO ₂ e / ha
Monitoring equipment	See Module CP-AB
QA/QC	See Module CP-AB
Purpose of data	Calculation of aboveground biomass
Calculation method	See Module CP-AB
Comments	Parameter is from module M-REDD and can be found in the RER Monitoring Model at sheet/cell: AGB Inventory / (AF20) and sheet/cell: Plantation Allometrics / (M8)

Data / Parameter	C _{AB_tree,peat dome forest}
Data unit	t CO ₂ e / ha
Description	Carbon stock in aboveground biomass of trees in plot sp in stratum i

Source of data	See Module CP-AB
Description of MM&P	See Module CP-AB
Frequency	See Module CP-AB
Value applied	343.47 t CO ₂ e / ha
Monitoring equipment	See Module CP-AB
QA/QC	See Module CP-AB
Purpose of data	Calculation of aboveground biomass
Calculation method	See Module CP-AB
Comments	See Module CP-AB Parameter is from module M-REDD and can be found in the RER Monitoring Model at sheet/cell: AGB Inventory /.(AF21) and sheet/cell: Plantation Allometrics / (M5)

Data / Parameter	$A_{WPS,i,t}$ or $A_{i,t}$
Data unit	Ha
Description	Area of project stratum i in year t
Source of data	Own assessment
Description of MM&P	GIS coverages, ground survey data and/or remote imagery (satellite or aerial photographs), as outlined in Section 5. The area of peat burnt ($A_{peatburn-WPS,i,t}$ for the project scenario from Module <i>M-PEAT</i> and $A_{peatburn-BSL,i,t}$ for the baseline scenario from Module <i>BL-PEAT</i>) and area of peatland (not open water, not burnt) ($A_{peatsoil-WPS,i,t}$ for the project scenario from Module <i>M-PEAT</i> and $A_{peatsoil-BSL,i,t}$ for the baseline scenario from Module <i>BL-PEAT</i>) determine the difference between the remaining carbon stock in the project scenario and baseline scenarios after 100 years. In the procedures in Section 5.4 these areas are together referred to as $A_{WPS,i,t}$ and $A_{BSL,i,t}$.
Frequency	At each monitoring event
Value applied	130,090 ha
Monitoring equipment	See Module M-PEAT
QA/QC	See Section 9.3 of <i>REDD+ MF</i> or other VCS methodology that uses this module.
Purpose of data	Calculation of project emissions
Calculation method	See Module M-PEAT
Comments	the area for $A_{WPS,i,t,100}$ must be used Parameter is from module X-STR

Data / Parameter	$Rate_{peatloss-WPS,i,t}$
Data unit	m yr ⁻¹
Description	Rate of peat loss due to subsidence and fire in the project scenario in stratum i in year t
Source of data	Module M-PEAT
Description of MM&P	See Module M-PEAT

Frequency	See Module M-PEAT
Value applied	The rate of peat loss due to subsidence and fire due in the project scenario is approximately 2.34 cm/year over the monitoring period.
Monitoring equipment	See Module M-PEAT
QA/QC	Calculation of baseline emissions
Purpose of data	See Module X-STR
Calculation method	See Module X-STR
Comments	Parameter is from module X-STR and can be found in the RER Carbon Model at [Model - Peat Depth and Drained].[EL32]

Data / Parameter	$GHG_{peatsoil,WPS,i,t}$
Data unit	t CO ₂ e yr ⁻¹
Description	GHG emissions from microbial decomposition of the peat soil in stratum <i>i</i> in year <i>t</i>
Source of data	Module M-PEAT
Description of MM&P	See Module M-PEAT
Frequency	See Module M-PEAT
Value applied	GHG emissions from microbial decomposition of the peat soil within the project boundary in the baseline scenario during the monitoring period is 10,803,525 t CO ₂ e.
Monitoring equipment	See Module BL-PEAT
QA/QC	See Module BL-PEAT
Purpose of data	Calculation of project emissions. See module M-PEAT
Calculation method	See Module M-PEAT – equation 2
Comments	Parameter is from module X-STR and can be found in the RER Monitoring Model at sheet/cell: WRC - Emissions Peat Soils / (B16)

Data / Parameter	$E_{REDD,WPS,SS,i, Pool\#}$
Data unit	t CO ₂ e
Description	Percentage of uncertainty of Carbon stock or GHG sources (eg, trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the project scenario
Source of data	The terms denoting significant carbon stocks, GHG sources or leakage emissions used in calculating net emission reductions from the following relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA.
Description of MM&P	See Module X-UNC
Frequency	See Module X-UNC
Value applied	8.65%
Monitoring equipment	See Module X-UNC
QA/QC	See Module X-UNC

Purpose of data	Calculation of uncertainty
Calculation method	See Module X-UNC
Comments	The ex ante estimation shall be derived directly from the estimations originating in the relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA. Parameter stems from module X-UNC and can be found in the RER Monitoring Model at sheet/cell: AGB Inventory / (P19)

Data / Parameter	U _{REDD,WPS,SS,i,pool#}
Data unit	%
Description	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the project case (1, 2...n represent different carbon pools and/or GHG sources)
Source of data	Calculations arising from field measurement data
Description of MM&P	See Module X-UNC
Frequency	See Module X-UNC
Value applied	The calculated uncertainty in the project AGB carbon stock inventory was 8.65%.
Monitoring equipment	See Module X-UNC
QA/QC	See Module X-UNC
Purpose of data	"Calculation of uncertainty. Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level.
Calculation method	For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest. For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero."
Comments	The ex ante estimation shall be derived directly from the estimations originating in the relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA. Parameter stems from module X-UNC

Data / Parameter	GHG _{peatburn-WPS,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	CO ₂ emissions from burning of peat within the project boundary in the project scenario in stratum <i>i</i> in year <i>t</i>
Source of data	IPCC default factors, literature or direct measurements
Description of MM&P	See Module M-PEAT
Frequency	At each monitoring period
Value applied	0 t CO ₂ e ha ⁻¹ y ⁻¹ . No fire or burning of peat detected during the monitoring period.
Monitoring equipment	GIS and remote sensed images; see also Module M-PEAT
QA/QC	See Module M-PEAT
Purpose of data	Calculation of project emissions

Calculation method	See Module M-PEAT
Comments	Parameter is found in M-PEAT

Data / Parameter	GHG _{proxy-CO₂,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	Soil emission of CO ₂ as per the chosen proxy in stratum <i>i</i> at year <i>t</i>
Source of data	(IPCC) default factors, literature values or direct measurements
Description of MM&P	The estimation of GHG emissions in rewetted (for RPD projects) or undrained or partially drained (for CUPP projects) peat follows similar procedures as described in Module <i>BL-PEAT</i> .
Frequency	At each monitoring period
Value applied	Soil emission of CO ₂ in rewetted peat was estimated to be 73.34 t CO ₂ e ha ⁻¹ y ⁻¹ .
Monitoring equipment	See Module BL-PEAT
QA/QC	See Section 9.3 of <i>REDD+ MF</i> or other VCS methodology that uses this module
Purpose of data	Calculation of project emissions.
Calculation method	See Module M-PEAT - equation 3 and BL-PEAT – equation 6.
Comments	Proxies must comply with VCS requirements on proxies.¹¹ It must be demonstrated that the proxy used is strongly correlated with CO₂ emissions by referring to IPCC, literature or own data. When referring to own data, comparison with literature values must be made. Parameter is found in M-PEAT and can be found in the RER Monitoring Model at sheet/cell: Peatland Allometrics / (F5).

Data / Parameter	GHG _{proxy-CH₄,i,t}
Data unit	t CH ₄ ha ⁻¹ y ⁻¹
Description	Soil emission of CH ₄ as per the chosen proxy in stratum <i>i</i> at year <i>t</i>
Source of data	(IPCC) default factors, literature values or direct measurements
Description of MM&P	The estimation of GHG emissions in rewetted (for RPD projects) or undrained or partially drained (for CUPP projects) peat follows similar procedures as described in Module <i>BL-PEAT</i> .
Frequency	At each monitoring period
Value applied	Soil emission of CH ₄ in rewetted peat was estimated to be 0.0756 t CH ₄ ha ⁻¹ y ⁻¹ .
Monitoring equipment	See Module BL-PEAT
QA/QC	See Section 9.3 of <i>REDD+ MF</i> or other VCS methodology that uses this module
Purpose of data	Calculation of project emissions
Calculation method	See Module BL-PEAT – equation 6 and M-PEAT – equation 3
Comments	Proxies must comply with VCS requirements on proxies.¹² It must be demonstrated that the proxy used is strongly correlated with CO₂ emissions by referring to IPCC, literature or own data. When referring to own data, comparison with literature values must be made. Parameter is found in M-PEAT and can be found in the RER Monitoring Model at sheet/cell: Peatland Allometrics / (F7)

Data / Parameter	$A_{\text{peatsoil-WPS},i,t}$
Data unit	ha
Description	Area of peatland (not open water, not burnt) in stratum i in year t in the project scenario
Source of data	Module X-STR
Description of MM&P	See Module X-STR
Frequency	See Module X-STR
Value applied	139,090 ha
Monitoring equipment	See Module M-PEAT
QA/QC	See Section 9.3 of <i>REDD+ MF</i> or other VCS methodology that uses this module
Purpose of data	Calculation of project emissions, Module M-PEAT – equation 1
Calculation method	See Module X-STR
Comments	Parameter is used in M-PEAT

Data / Parameter	$A_{\text{ditch-WPS},i,t}$
Data unit	ha
Description	Total area of ditch and other open water stratum i in year t in the baseline scenario
Source of data	Module X-STR
Description of MM&P	See Module X-STR
Frequency	See Module X-STR
Value applied	120.3 ha at the end of the monitoring period.
Monitoring equipment	See Module X-STR
QA/QC	See Section 9.3 of <i>REDD+ MF</i> or other VCS methodology that uses this module
Purpose of data	Calculation of project emissions. M-PEAT – equation 1
Calculation method	See Module X-STR
Comments	Parameter is found in M-PEAT and can be found in the RER Monitoring Model at sheet/cell: WRC - Surf Area Drainage canals /(Y21)

Data / Parameter	$A_{\text{peatburn-WPS},i,t}$
Data unit	ha
Description	Area of peat burnt in stratum i in year t in the project scenario
Source of data	Module X-STR
Description of MM&P	The area of peat burnt can be assessed using field observations and/or remote sensing using best-practice methods (see e.g., Congalton 1991; Congalton <i>et al.</i>, 2008). Remote sensing-based data on burnt peat areas must be validated by field observations or other, higher resolution remote sensing data. When using remote sensing, data must be georeferenced into a common geodetic system, for example using the UTM system using best-practice methods in remote sensing (see e.g., Congalton 1991; Congalton <i>et al.</i>, 2008). Semi-automated image

	classification approaches may be applied. Strata must be validated by reference data collected in the field, other official documentation or from recent independent higher resolution remote sensing imagery.
Frequency	See Module X-STR
Value applied	Area = 0 hectares. No peat burning was detected during the monitoring period.
Monitoring equipment	See Module X-STR
QA/QC	See Section 9.3 of <i>REDD+ MF</i> or other VCS methodology that uses this module
Purpose of data	Calculation of project emissions.
Calculation method	See Module M-PEAT
Comments	Parameter is found in M-PEAT

Data / Parameter	GHG _{peatditch-CO₂,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	Emission of CO ₂ from ditch and open water stratum i at year t
Source of data	Project-specific values; appropriate literature sources
Description of MM&P	See Module M-PEAT
Frequency	See Module M-PEAT
Value applied	3.01 t CO ₂ e ha ⁻¹ y ⁻¹ . Source: Intergovernmental Panel on Climate Change. 2013. 2013 Supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands. Methodological guidance on lands with wet and drained soils and constructed wetlands for wastewater treatment. Gyldenkaerne, S. and Lin, E. (eds). Japan: Institute for Global Environmental Strategies [IGES].
Monitoring equipment	See Module M-PEAT
QA/QC	See Module M-PEAT
Purpose of data	Calculation of project emissions. See Module M-PEAT
Calculation method	See Module M-PEAT – equation 4
Comments	Parameter is used in M-PEAT and can be found in the RER Monitoring Model at sheet/cell: Peatland Allometrics / (F12)

Data / Parameter	GHG _{peatditch-CH₄,i,t}
Data unit	t CO ₂ e ha ⁻¹ y ⁻¹
Description	Emission of CH ₄ from ditch and open water stratum i at year t
Source of data	Project-specific values; appropriate literature sources
Description of MM&P	See Module M-PEAT
Frequency	See Module M-PEAT
Value applied	2,259 kg CH ₄ ha ⁻¹ yr ⁻¹ equivalent to 63.2 t CO ₂ e ha ⁻¹ y ⁻¹ . Source: Intergovernmental Panel on Climate Change. 2013. 2013 Supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands.

	Methodological guidance on lands with wet and drained soils and constructed wetlands for wastewater treatment. Gyldenkaerne, S. and Lin, E. (eds). Japan: Institute for Global Environmental Strategies [IGES].
Monitoring equipment	See Module BL-PEAT
QA/QC	See Module M-PEAT
Purpose of data	Calculation of project emissions. See Module X-STR
Calculation method	See Module M-PEAT – equation 4
Comments	Parameter is found in M-PEAT and can be found in the RER Monitoring Model at sheet/cell: Peatland Allometrics / (D11)

Data / Parameter	N
Data unit	Dimensionless
Description	Number of sample points
Source of data	Recording and archiving of number of sample points
Description of measurement methods and procedures to be applied (Description of MM&P)	See Module CP-AB
Frequency of monitoring/recording (Frequency)	Monitoring must occur at least every ten years for baseline renewal. Where carbon stock enhancement is included monitoring shall occur at least every five years
Value applied	N/A
Monitoring equipment	See Module CP-AB
QA/QC procedures to be applied (QA/QC)	See Module CP-AB
Purpose of data	Monitoring
Calculation method	See Module CP-AB
Comments	Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known <i>ex-ante</i> . Where part of project monitoring, <i>ex-ante</i> the number of sample plots shall be estimated based on projected sample

Data / Parameter	DBH
Data unit	cm
Description	Diameter at breast height of a tree in cm
Source of data	Field measurements in sample plots
Description of MM&P	Typically measured 1.3m aboveground. Measure all trees above some minimum DBH in the sample plots. The minimum DBH varies depending on tree species and climate; for instance, the minimum DBH may be as small as 2.5 cm or as high as 20 cm, but for humid tropical forests 10 cm is commonly used. Minimum DBH employed in inventories is held constant for the duration of the project.
Frequency	Monitoring must occur at least every ten years for baseline renewal.

	Where carbon stock enhancement is included monitoring shall occur at least every five years
Value applied	N/A
Monitoring equipment	See Module CP-AB
QA/QC	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the IPCC GPG LULUCF 2003, is recommended.
Purpose of data	Carbon stock in AGB
Calculation method	See Module CP-AB
Comments	Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante. Where part of project monitoring, ex-ante DBH shall be estimated based on projections of growth.

Data / Parameter	H
Data unit	m
Description	Total height of tree
Source of data	Field measurements in sample plots
Description of MM&P	See Module CP-AB
Frequency	Monitoring must occur at least every ten years for baseline renewal. Where carbon stock enhancement is included monitoring shall occur at least every five years
Value applied	N/A
Monitoring equipment	See Module CP-AB
QA/QC	See Module CP-AB
Purpose of data	See Module CP-AB
Calculation method	See Module CP-AB
Comments	Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known <i>ex-ante</i> . Where part of project monitoring, <i>ex-ante</i> height shall be estimated based on projections of growth.

Data / Parameter	Ecological leakage process as described in Table 5.1
Data unit	N/A
Description	N/A
Source of data	On the ground observations, remote sensed data and GIS
Description of MM&P	See Module LK-ECO
Frequency	At each monitoring
Value applied	0
Monitoring equipment	See Module LK-ECO
QA/QC	See Module LK-ECO and REDD+ MF
Purpose of data	Assessing avoidance of leakage emissions
Calculation method	See Module LK-ECO for process – not calculations
Comments	N/A

4.3. Monitoring Plan

4.3.1. Monitoring Methods

The RER Carbon Project is required to undertake periodic monitoring of the Project and leakage area.

The RER-CP Monitoring Reporting and Verification (MRV) system uses a dynamic system that seeks to identify, assess and create a mitigation plan for potential risks that might arise concerning the Project. The system is established to ensure a process for monitoring Project progress and documenting lessons learned or corrections that may be needed and incorporating them into Project decision-making for future monitoring periods. The Project adopts the systems that are already in place and implemented for APRIL.

The company (i.e. APRIL) activity in Riau Province being PEFC certified, has *in situ*, a set of procedures and systems in place (verified annually during the PEFC verification audits) that regulate the management of documents, the procedures for verification and validation, etc. These are systems that RER and APRIL management and staff are used to working with. The quality assurance and quality control (QA/QC) systems already in place will serve as a “backbone” for the Project QA/QC system, for example, to handle complaints or non-conformities, etc.

The MRV Plan is described in detail in Appendix 1 - RER-CP MRV Plan; it is based on 10 main activities:

1. Remote Sensed Monitoring – Natural Disturbances/Anthropogenic Disturbances
2. Field Monitoring
 - a. Permanent Sample Plot (PSP) Inventory
 - b. Illegal Activities and Fire
 - c. Ground Water Table & Subsidence Monitoring
 - d. Changes of Peat Carbon Stock (i.e. bulk density and carbon contents) & Peat Depth
 - e. Dam & Canal Monitoring
 - f. Weather Monitoring
 - g. GHG Flux Measurements
3. Leakage Monitoring
4. Uncertainty Monitoring
5. Non-Permanence Risk Assessment
6. Quality Assurance/ Quality Control
7. Training
8. Big Data and Document Management

9. VCU Calculations
10. Stakeholder Access to Online Selected Documents

4.3.2. Policies for oversight and accountability of monitoring activities

4.3.2.1. General Approaches Undertaken for Monitoring

The monitoring plan incorporates the latest scientific findings and new technologies as they become available to increase effectiveness of existing practices systematically.

The monitoring plan includes monitoring changes in land cover, peat thickness and water table level, as per the latest REDD+ MF requirements.

4.3.2.2. MRV Activities

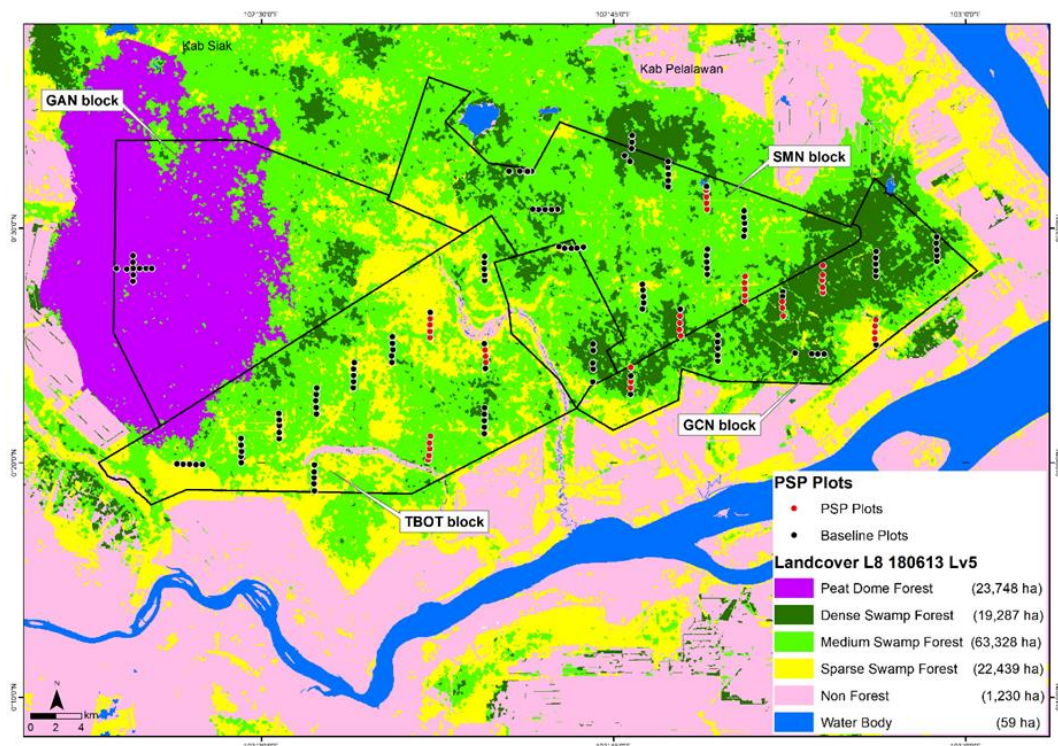
Remotely Sensed Monitoring

The Project acquired satellite images will be acquired by the Project of the Project Area. Those images will be analysed to determine any evidence of forest loss or forest changes, either from natural disturbances or from human-induced changes.

Field Monitoring

a. Permanent Sample Plot Inventory

The Project has established a network of 40 Permanent Sample Plots. All 40 plots were measured for this Monitoring Period.



Map 4 - Established Permanent Sample Plots (PSP) and AGB inventory plots.

Original inventory plots were relocated (see the textbox below for more details on the establishment of PSPs). The plots were measured, and new labels were affixed to each tree. In-growth (trees that have attained 5cm DBH since the last measurement) were identified and measured. Trees that have died since the last measurement were and measured. Trees that were declared dead in the previous measurement were confirmed “dead” – these trees were permanently removed from the live tree list for subsequent PSP measurements.

Establishment of PSPs

- During the initial carbon stock survey in 2015, 160 plots were measured for carbon stock assessment, said plots were used for the baseline.
- In 2021, 40 of these plots were remeasured for biomass growth monitoring and reporting purposes. The comparison of the measurements between 2015 and 2021 was used to estimate changes in biomass and growth.
- The 40 plots remeasured in 2021, were located by GPS only. This means that as a result of GPS variability (i.e., +/- 10 m), some of the plots are not located at “exactly” the same location, as some boundary markers had disappeared since the plots were first measured. Therefore, the remeasurement of these plots boundaries were measured as close to the original location as was possible (via GPS) in accordance with the methodology. The GPS variability will create some variability in the plot locations and will add some variation to the estimates of plot growth. In some instances, this will generate negative growth estimates at the plot level. However, this has nothing to do with deforestation.
- The 40 plots have now been permanently marked in the field and trees permanently labeled. These “permanent sample plots (PSP)” will be regularly remeasured for growth monitoring purposes biannually and in practice, half of the PSPs will be remeasured each year.
- The results of the PSP measurement program will be reported in the monitoring report.
- During the baseline reassessment, it is intended that all 160 plots from the original baseline assessment will be remeasured.

The parameters and forest dynamics were measured, analysed, and compiled to estimate the carbon stock changes for above-ground biomass and regrowth of the forest.

b. Illegal Activities and Fire

Illegal logging is not considered a viable threat of the Project as there are no communities that reside directly in the Project Area. Furthermore, the closest communities have limited means to access the Project Area (i.e. by boat or on foot without roads). Nonetheless, on-the-ground conditions can change rapidly in the Province of Riau and Indonesia.

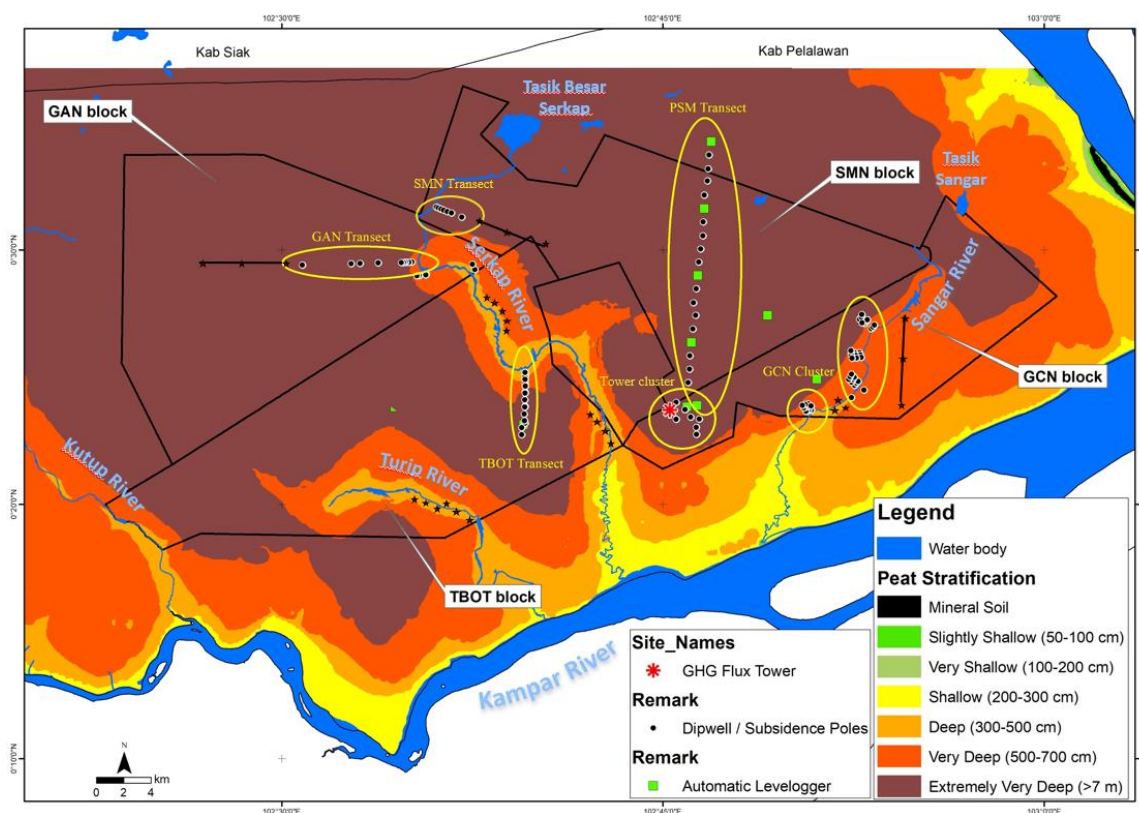
The Project maintained guard posts at the Project’s river access points along the Serkap, Turip and Sangar rivers. The guard posts recorded and monitored all river access and use conducted by boats into the Project Area (primarily local fisherman). Regular field patrols by boat and foot occurred in the Project Area to check both for unauthorised activity and for fire.

The Project, in conjunction with APRIL, monitored all fire hotspots on the Kampar Peninsula and the Project Area for fire hotspots via multiple remote sensing platforms. No hotspots were observed in the Project Area during the Monitoring Period.

c. Ground Water Table & Subsidence Monitoring

Monitoring. The Project has a number of *in situ* automatic level-loggers, dipwells and subsidence poles to monitor the peat characteristics. At present, there are 81 subsidence poles, of which 44 are integrated with a manual dipwells in the Project Area. There are a total of 61 dipwells; 17 are standalone dipwells and the remainder are (as noted above) combined with the subsidence poles. The Project also has 9 automatic level loggers, 5 of which run (every 5km) along a north-south transect known as the PSM transect, originating from the GHG Flux Tower. There are a further 4 automatic level loggers in the Project Area that pre-date the carbon project (two in TBOT, one in GCN and one in SMN). The distribution of these monitoring points is set forth in Map 5 below. Numerous automatic level-loggers are also currently *in situ* outside of the Project Area in the Project Zone and can be used to monitor for ecological leakage issues if required.

Although these monitoring stations were monitored during the Monitoring Period, the data was not used to estimate GHG emission reductions or removals in this Monitoring Period. The data will be used next for the baseline reassessment in 2025.



Map 5 - Water Table and Peat Subsidence Monitoring locations transects or Clusters

d. Changes of Peat Carbon Stock & Peat Depth (i.e. Bulk Density, Nitrogen, Carbon Contents and Depth)

No peat depth or peat carbon stock monitoring is required for this Monitoring Period pursuant to VMD0016 (X-STR), VMD0042(BL-PEAT) or VMD0046(M-PEAT). The monitoring of peat depth and of peat carbon stock will be done at the baseline review event.

e. Dam & Canal Monitoring

The Project has since 2016 been actively blocking the 146 km of canals on the project area with hand-built dams as a significant component of the WRC project activity. Foot patrols regularly monitored both the dams and canals. The dams are monitored to ensure that they remain in position and intact. If there was any degradation to their structure, this was noted, and they were scheduled for service. No dams were observed to have failed during the Monitoring Period.

f. Weather Monitoring

The Project Monitored and recorded rainfall, temperature, wind speed and humidity from a variety of locations in and around the Project Area. The data was not used for this monitoring Period and will be used to correlate water table and subsidence issues during the baseline reassessment.

g. GHG Flux Monitoring

Since 2017, the Project monitored local GHG emissions by directly monitoring proxy variables for GHG flux that are used when calculating GHG emissions. The *in situ* GHG flux tower utilises the Eddy Covariance Technique to monitor greenhouse gas emissions, ecosystem CO₂ exchange, groundwater level and subsidence rate. It measured the net balance of all vertical carbon dioxide (CO₂) source and removal pathways. It provided high-frequency measurements (every 60 min) with temporal variability and ecosystem-scale measurements, i.e., 200 ha around the tower. The data was not used to estimate GHG emissions and removals during this Monitoring Period but will be used during the baseline reassessment in 2025.

3. Leakage Monitoring

Appropriate HTI (Forest Plantation) production and concession data was acquired and analysed to determine that no activity shifting leakage occurred during the Monitoring Period. Dams were monitored to ensure no ecological leakage occurred, no dams failed, and no ecological leakage occurred during the Monitoring Period.

4. Uncertainty Monitoring

Uncertainty linked to the parameters monitored was analysed and calculated as necessary using excel models.

5. Non-Permanence Risk Assessment

The non-permanence risk tool was used to analyse Non-Permanence risk. A copy is provided to the audit team for verification purposes.

6. Procedures for internal auditing and Quality Assurance/Quality Control

The Project via APRIL, implements a rigorous QA/QC system to ensure the long-term accuracy of the data that is collected, to ensure a robust data storage system and to create a systematic data management structure. This QA/QC system is entirely integrated into the already existing APRIL QA/QC system that has been implemented for PEFC certification. This system is operational and reviewed annually during PEFC Verification audits, so as to guarantee of the quality and dynamic nature of the QA/QC system.

7. Training

All new personal participating in PSPs inventory/control, water table monitoring, etc. were trained following PSP Inventory/Control/Monitoring Procedures specifications and standard RER and APRIL practices, as much as is reasonably possible. Training was provided to ensure consistent data collection of all monitoring equipment and techniques. Training records area available upon request.

8. Data and Document Management

All data and documents were reviewed and stored in a manner that complies with standard APRIL practices, or as much as is reasonably possible. Hard copy data will continue to be stored and managed following APRIL's ISO Data Management procedures and will be kept for at least 10 years. All hardcopy data will be kept for the 10 year period as hardcopy and then will be converted to a digital format and kept for the duration of the project on hard drives or cloud-based storage systems. All other digital data will also be kept in a digital format on hard drives or cloud-based storage systems for the duration of the project.

9. VCU Calculation

For this verification event, VCU vintage is estimated based on the parameters monitoring results and are set forth in the Monitoring Models.

10. Stakeholder Access to Online Selected Documents

The Project reported to stakeholders (local communities and government officials) prior to the Validation and Verification event. Project reports, the VCS Pd and the Monitoring Report will be available online. The RER Community teams will also provide reporting directly to the local communities.

4.3.3. Data Management Methods and Structure

Data that was generated by RER-CP continues to be centrally managed in the Kerinci offices and as part of an online, user-restricted proprietary database. Hard copies of all paper-based data or data sheets are archived in field offices. Duplicate copies were stored centrally in RER's headquarter in Riau or alternatively in APRIL headquarters. Field data was uploaded directly into the RER and APRIL database from the field or head office, allowing simultaneous multi-user input through a local

server network. After the database server collated the data, it was made available to the Project and was adapted as necessary to fulfil all RER Project or APRIL monitoring and reporting needs. All hardcopy data will continue to be kept for at least 10 years. All hardcopy data that is necessary to be kept for longer, such as data required for baseline re-assessment, land ownership documents, stakeholder meeting notes, project boundary documents etc will be kept for the 10 year period as hardcopy and then will be converted to a digital format and kept for the duration of the project on hard drives or cloud-based storage systems. All other digital data will also be kept in a digital format on hard drives or cloud-based storage systems for the duration of the project.

To ensure the traceability and security of data entry and QA/QC procedures, all users are allocated unique user IDs and passwords to access any of APRIL or RER's database. Access to the databases is restricted based on an individual's role and responsibility per APRIL's standard data policies.

4.3.4. Procedures for handling non-conformances with the validated monitoring plan.

The RER-Carbon Project has a method to handle internal auditing and non-conformities that are addressed through APRIL's SOPs that incorporate multiple QA/QC measures. All QA/QC systems are based on ISO certified systems that are in place throughout all APRIL's Riau concessions. All data was collected, recorded, stored, and reported. All data was subject to review and approval by team leaders or project managers concerning specific written SOPs, which cover different levels of operations and data management. A list of SOPs which have already been or will be developed is presented in the Appendices of the VCS-PD version 10. Copies of SOPs are available to the verification audit team upon request.

4.3.5. Sampling Approach

The sampling approaches for the two Project Categories, REDD & WRC is set forth below, in general terms though, the overarching goal of monitoring was to ensure the accurate scientific description of the changes to the landscape over time. The Project therefore aimed to achieve a target precision level for its monitoring at a 95% confidence interval, +/- 10%, which is sufficient for the requirements of VCS and GHG project level monitoring. The Monitoring Models provide the calculations that show that this goal was achieved.

4.3.5.1. REDD Project Category

For this monitoring period, the Project acquired appropriate data from remote sensing platforms to determine if there were obvious changes in land cover, no such changes were detected.

Remote Sensing Monitoring

RER collected remote sensing imagery on a continuous basis in conjunction with APRIL (plantation based) planning team. Images acquired are for the entirety of the RER area and from multiple satellite sources, primarily Landsat 8 (15m resolution) and Sentinel (resolution) and others as required. The APRIL team in Kerinci were continuously monitoring land use change in the protected areas within the entire APRIL estate and in RER and immediately notify RER if any suspicious

activity occurs within the Project boundary or close to the project boundary. The remote sensed images are also accessed for changes to land cover are determined and reported.

Above ground biomass

In July 2020, RER selected 40 of the original AGB inventory plots (from the original 159) within the REDD area (where avoided deforestation would be assumed to occur as part of the baseline scenario, and also known as the “plantation development area”) for ongoing assessment of natural forest growth. These plots were established as Permanent Sample Plots (PSPs) and were the basis of the current AGB data monitored during this verification period. The Project monitored forest growth in 40 PSPs during this Monitoring Period. See Map 4 above.

Illegal Activities and Fire

RER is monitored for fire 24 hours a day, seven days a week with NASA's Fire Information for Resource Management System (FIRMS). FIRMS distributes near real time active fire data within 3 hours of satellite observation from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Aqua and Terra satellites, and the Visible Infrared Imaging Radiometer Suite (VIIRS) aboard S-NPP and NOAA 20 (formally known as JPSS-1). FIRMS identifies hotspots globally. APRIL has a dedicated fire team that will receive alerts if hotspots are detected in APRIL properties, including RER. All hotspots, i.e., suspected fires are investigated, and fire mitigation teams are dispatched in the event of fire. Additionally, security rangers maned guard-posts on the boundary of the Project area on all river access ways and roadways. All movements of people into the Project Area were recorded and reported, and suspicious activities were managed through their security SOP and protocols. No fire or illegal logging activity was detected.

APRIL has a sophisticated hotspot fire monitoring program across all their estates and RER is also covered by this programme. RER received daily reports on fire risks and fires on their boundaries and within RER. Forest protection protocols saw rangers undertake regular fire patrols.

4.3.5.2. WRC Project Category

For this monitoring period the Project assessed the effectiveness of the canal blocking program and its ability to maintain a natural water table level. This was done by regular monitoring of all canals and dams as well as the regular monitoring of water table levels (via dip wells or level-loggers) and potential increase or decrease of the peat (via subsidence poles). The project monitored rainfall on a daily basis which will be used in order to correlate water table with natural precipitation during the baseline reassessment.

Dam & Canal Monitoring

All dams were inspected visually at least once per year usually, during the dry season. A maintenance program was in place in order to correct any deficiencies of the observed condition of the dams in the canals. No dams failed during the monitoring period.

Ground Water Table & Subsidence Monitoring

RER maintained an extensive network of ground water and subsidence monitoring stations and were monitored as described below.

- **81 Subsidence poles:** monitored at least once per year;
- **61 Dip wells:** monitored regularly and at least once every two months;
- **9 Automatic level loggers:** The data was collected from the field approximately every 6 months.

Peat Carbon Stock

Peat Carbon stock will be resampled at each baseline event and was not done during this Monitoring Period.

4.3.6. Organizational structure, responsibilities, and competencies of the personnel

Table 26 - MRV Personnel: Responsibilities & Competencies

Title	Name	Responsibilities	Competencies
Project Coordinator	Bradford M. Sanders (BMS)	Remote Sensed (RS) Monitoring - Forest Disturbances Field Monitoring PSPs Monitoring Unauthorised Activities and Fire Monitoring Ground Water Table & Subsidence Monitoring Peat Carbon Stock Monitoring Dam & Canal Monitoring Weather Monitoring GHG Flux Measurements Leakage Monitoring Uncertainty Monitoring Non-Permanence Risk Assessment Quality Assurance / Quality Control Training Data & Documentation Management VCU Calculation Community & Stakeholder	Bradford M. Sanders is currently the Deputy Head of Conservation of Riau Ecosystem Restoration (RER). Bradford has tremendous experience in the forestry industry and has held multiple roles such as a fire protection specialist and fuels specialist since 1988. Bradford was the executive head of The Royal Society for the Protection of Birds / PT Restorasi Ekosistem Indonesia prior to his work in RER. Bradford provides operational management and leadership to 170 employees and staff to protect and restore 150,693 ha of Ecosystem Restoration Concessions in lowland peat tropical rainforest on the Kampar Peninsula and Padang Island, and coordinates environmental and social technical advice from collaborators. Bradford also promotes the RER program to customers, financiers, academics, and in public forums. Bradford has 21 publications on a wide range of topics regarding strategic forest management to integrated forest fire management. Education: M.S. Forestry, Clemson University, 1987 B.S. Forest Management, Clemson University, 1985

Field Work Supervisor	Nawari (NAW)	Reporting Remote Sensed (RS) Monitoring - Forest Disturbances Field Monitoring PSPs Monitoring Unauthorised Activities and Fire Monitoring Peat Carbon Stock Monitoring Quality Assurance / Quality Control Training	Nawari has held multiple roles as a forest biometrician and strategy and remote sensing and mapping manager in APRIL since 2012. Nawari is currently the Strategy and Tactical Forest Planning Manager of APRIL and established the permanent sample plots for above ground biomass in the RER project area. Nawari played an essential role in land cover and land use change monitoring and provided forestry density data through field resistograph measurement and developed the mathematical prediction model. Nawari has 6 scientific publications regarding agroforestry regimes and mortality and production of <i>Acacia</i> plantations in Indonesia. Nawari's latest publication in January 2021 is about Suitability Analysis and Environmental CBLying Capacity for Ecotourism Development in Central Lombok. Education: PhD. Environmental Science, Riau University, 2020 - Present M.S. Environmental Science, Gadjah Mada University, 2020 M.S. Computer Science, Gadjah Mada University, 2011 B.S. Forest Resources Conservation, Gadjah Mada University, 2004
Field Work Analyst	Dr. Sofyan Kurnianto (SK)	Remote Sensed (RS) Monitoring - Forest Disturbances Field Monitoring PSPs Monitoring Peat Carbon Stock Monitoring Quality Assurance / Quality Control Data & Documentation Management	Sofyan Kurnianto is currently the Manager - Biogenic Carbon Assessment and Sustainability Support, Peatland Science. Sofyan is a peatland ecologist with the research interest on the linking between biogeochemical processes with the peat hydraulic properties. He has experience on the quantifying carbon stocks and greenhouse gas emission in the tropical peatlands. He developed the framework of greenhouse gas inventory system at the corporate level to quantify the total emission along the value chain, including the land use change emission. Sofyan has developed the research on linking hydrological and biogeochemical cycle in tropical peatlands and quantified the total greenhouse gas emission from land use and land use change for all APRIL land bank.

			Education: PhD. Wetlands Hydrology, Oregon State University, 2017 M.S. Geochemical System Specialisation, University of New Hampshire, 2013 B.S. Meteorology and Geophysics, Bogor Agricultural University, 2004
Technical Partner	Ralph J. Strebel (RJS)	Remote Sensed (RS) Monitoring - Forest Disturbances Field Monitoring PSPs Monitoring Leakage Monitoring Uncertainty Monitoring Non-Permanence Risk Assessment VCU Calculation	Ralph J. Strebel has worked in the climate change sector since 2007, almost exclusively with forest carbon projects. Ralph has substantial experience in all aspects of forest carbon projects, from assessments to project development. He successfully developed the world's first REDD+ Improved Forest Management project in Africa, worked assessing and developing numerous large-scale REDD+ projects in Indonesia, and was the lead author of the Republic of Congo's successful application to join the World Bank's Forest Carbon Partnership Facility, including establishing the National Reference Emission Levels for the country. Ralph holds degrees from the University of Colorado – Boulder (International Affairs / Political Science) and Lancaster University (Hons. Law). He is a licensed attorney in the States of Colorado and Arizona as well as being a qualified solicitor in England & Wales.
Sustainability Operations	Craig R. Tribolet (CRT)	Community & Stakeholder Reporting	Craig Tribolet has more than twenty years in environmental and forest management in Asia and Australia with experience in both the public, private, and academic sectors as a forester, consultant and ecologist and has demonstrated skills and experience in developing, managing, and delivering large scale, multi-stakeholder projects. Craig has a strong customer, contractor and community focus. Ability to listen to and integrate stakeholder needs and deliver results. Craig is currently the Sustainability Operations Manager and has held the position since 2014. Craig is responsible for all facets of forest protection including sustainability, certification, fire management and conservation forest management, as well as leading audits teams to meet domestic and international audits. Education: M.S. Business Administration,

			Corporate Finance and Accounting, Leadership and Project Management. Australian National University, 2006 B.S. Ecology, Australian National University, 1996 B.S. Forestry, Australian National University, 1995
Technical Monitoring	Chandra S. Deshmukh (CSD)	Field Monitoring Weather Monitoring GHG Flux Measurements	Chandra S. Deshmukh is experienced in the design and implementation of programs aimed at Greenhouse Gas (GHG) removals and emissions monitoring and reporting in hydroelectric and forestry sector. Chandra has an excellent scientific publication record to prove science background in GHG removals and emissions monitoring and reporting. Chandra has 38 scientific publications, and 28 of them being presented at international conferences. The latest being the presentation on significant carbon loss from a natural tropical peatland under current climate at the European Geosciences Union General Assembly in May 2020. Education: PhD. Greenhouse Gas Emissions from Hydroelectric Reservoir in Subtropical South Asia, Université Paul Sabatier (Toulouse III), 2013 MS. Water Resources Engineering, Indian Institute of Technology, 2008 B.S. Agricultural Engineering, CAE, Jabalpur (JNKVV), 2006
Data Coordinator	Kuswondo (Dodo) ST (KUS)	Field Monitoring PSPs Monitoring Quality Assurance / Quality Control Data & Documentation Management	Kuswondo (Dodo) ST has a wide experience with land survey equipment such as total station, Drone Phantom 4 Pro, Water Pass and GPS and with hydrography survey such as echosounder, side scan sonar, SVP (sound velocity profile) and Veripos (GPS). Kuswondo is responsible for analytical data monitoring such as hydrology, weather, vegetation, restoration and social monitoring since 2017. Kuswondo has undergone training courses throughout Southeast Asia from training for QINSy Software with SAFA Geoscience in Kuala Lumpur, Malaysia to Prevention and Management of Human and Wildlife Conflicts in Harimau Kita, Indonesia. Kuswondo has completed topographic surveys for a double track rail line, limestone quarry, sports facility, housing complexes, water pipeline, commercial

			development, sanitation, cement and digital satellite imagery mainly in Java but also in West Timur and East and Central Kalimantan. Education: BS. Geomatic Engineering, Sepuluh Nopember Institute of Technology, 2013
Field Operations	Dibyo Kuswiyono (DK)	Field Monitoring Unauthorised Activities and Fire Monitoring Quality Assurance / Quality Control Data & Documentation Management	Dibyo Kuswiyono is currently the Estate Manager in Restoration Kampar Peninsula and has held the position since 2020. Dibyo has held multiple positions in RAPP since 2003 as a forester and plantation quality assessor. During this time, Dibyo has developed his professional career and has grown to be an exceptional forest protection executive in Restoration Pulau Padang and a restoration executive in Restoration Kampar Peninsula. Dibyo has undergone numerous training courses to further develop his skills as an estate manager in RER such as ISO training in ISO 14001 & OHSAS 18001 in 2006 and water management in 2015 to leadership & people management in 2020 and restoration techniques in peat area in 2021. Education: M.S. Environmental Science, Riau University, 2020 B.S. Silviculture in Forestry, Gadjah Mada University, 2003

5. QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1. Baseline Emissions

The Project has used VM0007 REDD+ Methodology Framework (REDD+ MF); VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL); and VMD0042 Estimation of baseline soil carbon stock changes and greenhouse gas emissions in peatland rewetting and conservation project activities (BL-PEAT) to assess the Project's baseline.

Overarching Baseline Approach

In order to determine baseline emissions for both modules, the Project must establish two baseline areas:

First, the Project must establish the Baseline Proxy Areas as per §5 Part 1 of VMD0006 (BL-PL) and §5.1.2 of VMD0042 (BL-PEAT). This needs to be done first because the Project does not have a government-approved management plan for deforestation.

Secondly, the Project must establish the Baseline Project Area which will describe the “annual area of land deforested”. This is done per §5 Part 1, Steps 1.1 through 1.6 of BL-PL; this will establish the baseline project area that will be deforested, and it will also be the area where peat related emissions will occur. It will also establish the boundaries for the four Wetlands Restoration and Conservation (WRC) Project Activities:

Table 27 - Summary of WRC Project Activities

No.	WRC Project Activity	Acronym	RER Project ER Activity
1	Restoration of Wetlands	RWE	Canal blocking in draining peatlands that would not have been developed for plantation activity
2	Restoration of Wetlands and Avoided Deforestation	RWE+REDD	Canal blocking in draining peatlands areas and avoided planned deforestation (APD) that would have occurred in the baseline
3	Conservation of Intact Wetlands	CIW	Conservation of intact peatlands in areas that would not have been developed for plantation activity
4	Conservation of Intact Wetlands and Avoided Deforestation	CIW+REDD	Conservation of intact peatlands areas and avoided planned deforestation (APD) that would have occurred in the baseline

It should be noted that CIW+REDD is the “Avoiding Planned Wetland Degradation” (APWD) activity of the Project as per Appendix 1, §A1.15(2)(a) of the VCS Standard v.4.3. APWD is the terminology employed by BL-PL, while CIW (and CIW+REDD) are the terms used by BL-PEAT. Equivalency of the terms is further supported by equation 2 of BL-PL where the module notes that on peatland:

$$GHG_{BSL-PEAT, \text{planned}} = GHG_{BSL-PEAT}$$

BL-PL uses the parameter: “ $GHG_{BSL-PEAT, \text{planned}}$ ” while BL-PEAT uses the parameter “ $GHG_{BSL-PEAT}$ ” (see equation 1 and §5.2).

No ARR activities take place in the baseline scenario. There is no requirement/ obligation for an Indonesian plantation forestry concession holder to either re-establish forests or restore degraded forest areas and these activities are not routinely conducted by plantation forestry concession holders. No ARR activities are calculated in the Project’s emission removals¹².

Only after the Project has established the two baseline areas can it begin to calculate “baseline carbon stock change” for BL-PL pursuant to §5, Part 2 of that module (i.e., for RWE+REDD & CIW+REDD) and also begin “assessing GHG emissions in the Baseline Scenario” per §5.2 of BL-PEAT (i.e., for RWE & CIW). For BL-PEAT, the Project is also required to take into consideration a set of “General Procedures and Assumptions” from §5.1.1 of BL-PEAT; these are described below.

The flowchart below describes the process used by the Project.

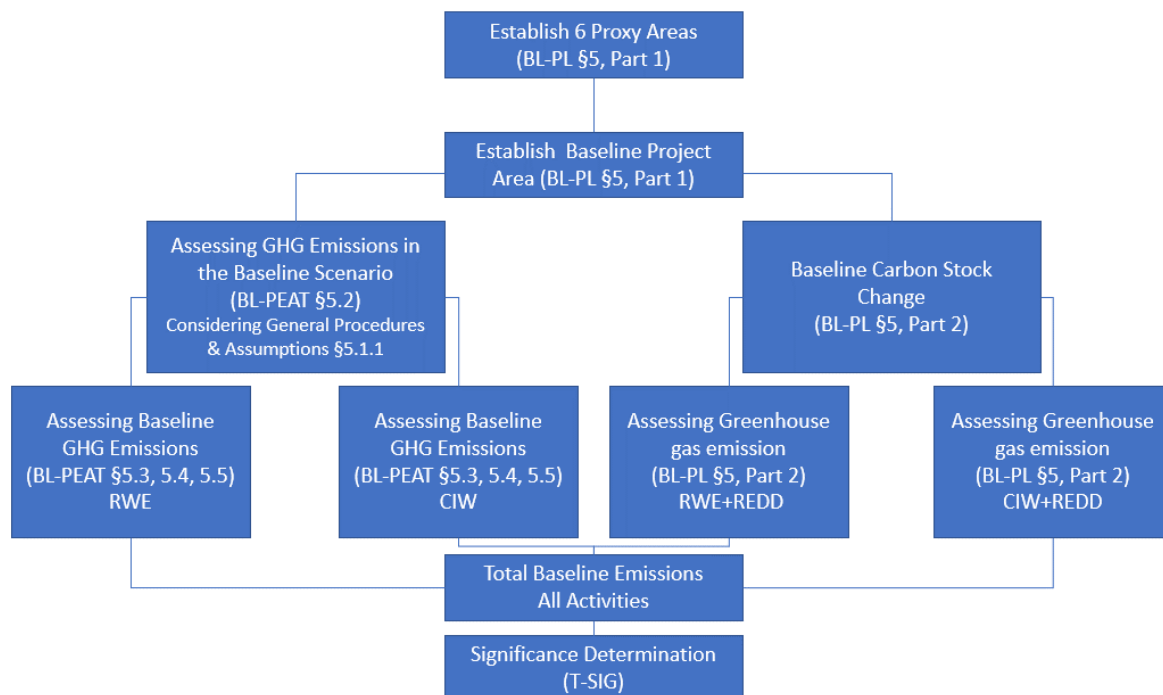


Figure 8 - Flowchart of how the Project established the two baselines

General Procedures and Assumptions

§5.1.1 of BL-PEAT requires that a set of “General Procedures and Assumptions” are followed in assessing Baseline emissions; the Project makes additional assumptions as well related to the APD component of the Project.

The Project’s baseline emissions and carbon stock assumptions were assessed based on an analysis of the likeliest baseline scenario. Accounted emissions resulted from the following:

- Avoided deforestation
- Avoided microbial peat decomposition
- Avoided organic carbon dissolved from water bodies

The Project assumes that no non-human-induced rewetting of the peatland would have occurred under the baseline scenario. Examples of such rewetting include:

- Avoided wetland degradation through avoided drainage and avoided plantation development;
- Dike or canal collapses, which would have closed naturally over time; and
- Any progressive subsidence resulting in a raising of relative depths in the water table, increasingly thinner aerobic layers, and reduced CO₂ emission rates.

All assumptions made by the Project team are based on expert assessments taking into account verifiable scientific experience for the local area and published scientific documentation available. All such assumptions were made on a conservative basis.

The Project also has assumed that the baseline deforesting agent would perform regular maintenance of canals for drainage and transportation purposes. Notwithstanding this, emissions resulting from peat exposed to aerobic decomposition via spreading caused by dredging for the establishment and maintenance of canals are omitted in line with a conservative approach in baseline modeling.

The omission of this source of GHG emissions is considered very conservative, and results in lowering GHG emission estimates in the baseline water body stratum as compared to strata at the same location in the Project scenario. This is because emissions from water bodies are lower than emissions that would have otherwise resulted from peat microbial decomposition. CO₂, CH₄ and N₂O are accounted for in the baseline.

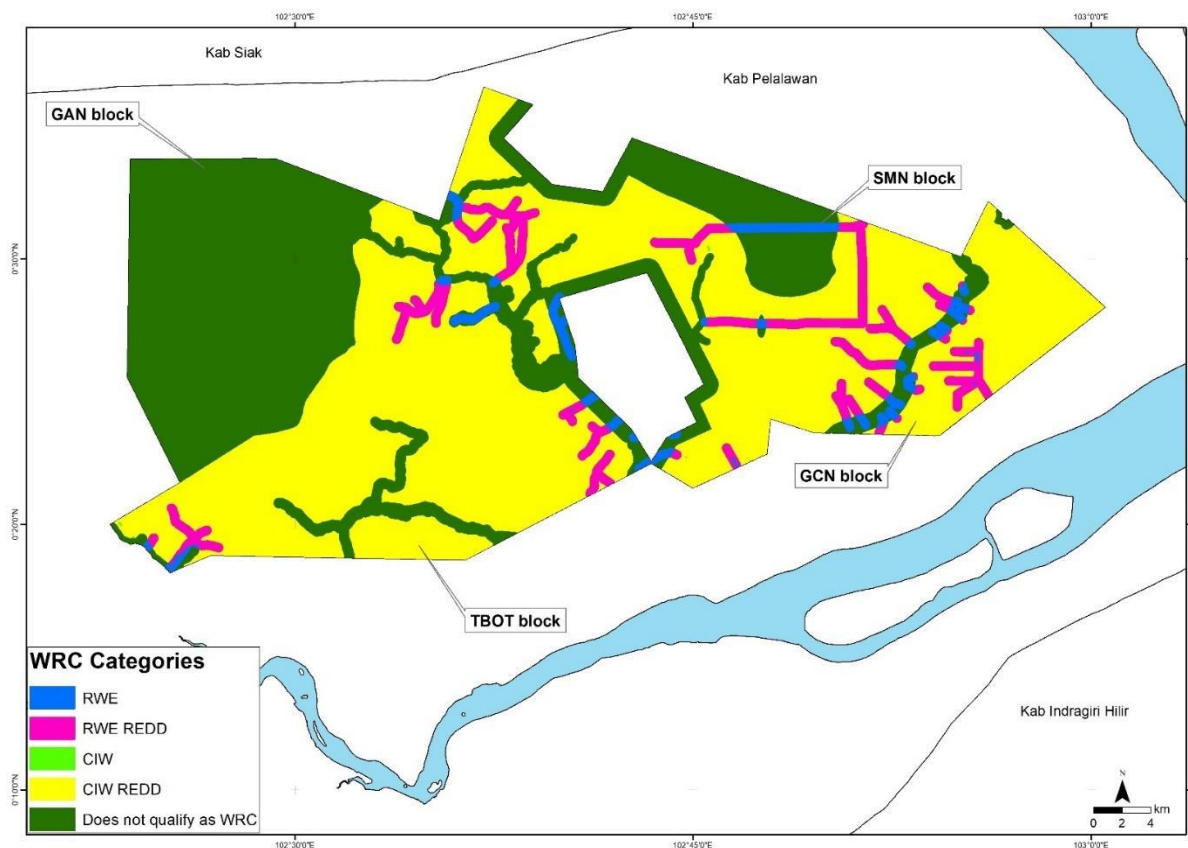
The Project assumed because of the known fire record for the Project Area that no uncontrolled burning of peat would occur in the Project Area. These emissions are not accounted for since the loss is insignificant. It was therefore considered conservative to omit GHG emissions from biomass burning in the baseline.

Baseline emissions have been calculated on an annual basis. This has been done as baseline changes in land cover classes and drainage status during the project lifetime determine (changes in) emissions of CO₂, CH₄ and N₂O.

The Project has followed the requirements of §5.4.2 of REDD+ MF and included N₂O as a carbon pool because of the potential for nitrogen fertilizer application in the baseline scenario. However, because no nitrogen fertilizer application occurs in the project scenario, it has been excluded from the GHG emission reduction accounting as suggested in Table 7 of the same section.

Description of Project Activities

As a result of the Project reporting separate Project Activities, 4 separate baseline emissions calculations have been prepared for each of the 4 separate project activities that would occur in comparison to the baseline scenario.



Map 6 - The Four Project Activities

The Project will undertake the following activities:

1. **RWE** – Restoration of drained peatland with no avoiding planned deforestation.
2. **RWE+REDD** - Restoration of drained peatland with avoiding planned deforestation.
3. **CIW** – Avoiding wetland degradation with no avoiding planned deforestation.
4. **CIW+REDD** - Avoiding wetland degradation with avoiding planned deforestation.

All the area developed into plantations under the baseline scenario in any given year is expected to be clear-felled of all forest cover, then drained (if not drained already) and converted to plantations.

Where legacy canals exist, it is assumed that these are to be replaced by the plantation drainage canals in the baseline scenario area (a.k.a. the “plantation development area”) and retained outside of the plantation development areas.

Quantification of GHG emissions from microbial decompositions of peat and water bodies in peatlands has been carried out by using a spatially and temporally explicit approach. Each baseline stratum as set out in the below table was discretized into parcels of the smallest land or water body unit with relatively uniform combinations of spatial variables as given in the below table. Temporal discretization has been used by sequencing the calculation into 1-year time-steps, while temporal variables determine the sequence of strata changes. Temporal variability of GHG emission parameters and temporal restrictions to GHG emissions are presented in the below table. The schematization assures the proper use of GHG emission parameters at the correct spatial location and the correct time.

Table 28 - Variables used in the schematization of quantification of GHG emissions from microbial decompositions of peatland dissolved organic carbon from water bodies in peatlands in the baseline scenario.

Variables	Description
(A) Spatial Variables	
(A1) Soil type	Distinction between peat or non-peat. This is used to exclude all non-peat parcels from GHG calculation. In the RER Project, there are no non-peat parcels so this requirement is redundant.
(A2) Initial peat thickness available for microbial decompositions	Derived from DEM and Peat Thickness maps. These maps are used to determine the initial condition for subsequent calculations of the remaining peat layer available for microbial decompositions. In the RER project, there are no non-peat parcels and so this requirement is redundant.
(A3) Initial stratum	Stratum of the corresponding parcel at the project start date as derived in §4.4 before conversion into baseline stratum takes effect. This is used to determine the correct emission factor for the corresponding parcel for the duration before B1 and B2 (in this table, below) take effect.
(B) Temporal Variables	
(B1) Year of drainage	Determines the onset of conversion from the initial stratum to the drained stratum and sets 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 is already drained. Together with B2, this is used to determine the correct Emission Factor for the corresponding parcel.
(B2) Year of deforestation/ planting of the baseline land cover	Determines the onset of conversion of initial stratum to deforested/planted stratum. Together with B1, this is used to determine the correct Emission Factor for the corresponding parcel.
(B3) PDT	The Peat Depletion Timeline (PDT) is the period that it takes to deplete the remaining peat layer by microbial decomposition

	(conservatively will be assumed that PDT is reached once the remaining peat layer has reached 20 cm). Once the PDT is reached in each stratum, all GHG emissions in that stratum are set to zero.
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5.1.1. Baseline Emissions Calculations

5.1.1.1. Net GHG Emissions Calculations and Stratification

The baseline net GHG emissions from terrestrial carbon pools for planned deforestation are calculated using equation 1 of BL-PL.

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

Where:

$\Delta C_{BSL,planned}$	Net greenhouse gas emissions in the baseline from planned deforestation up to year t^* ; t CO ₂ -e
$\Delta C_{BSL,i,t}$	Net carbon stock changes in all pools in the baseline stratum i in year t ; t CO ₂ -e
$GHG_{BSL-E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum i in year t ; t CO ₂ -e yr ⁻¹
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the projected start of the project activity

Soil organic carbon (SOC) for APWD-REDD project activities (i.e., wetland SOC pool) is properly accounted for with BL-PEAT; per the requirements in §5, Equation 2 of BL-PL which requires:

$$GHG_{BSL-PEAT,planned} = GHG_{BSL-PEAT}$$

Where:

$GHG_{BSL-PEAT,planned}$ Net GHG emissions in the baseline scenario from planned peatland degradation up to year t^* , t CO₂-e or stand-alone APWD baseline scenario on peatland up to year t^* , t CO_{2e}

$GHG_{BSL-PEAT}$ Net GHG emissions in the APWD-REDD or stand-alone APWD baseline scenario on peatland up to year t^* , t CO_{2e}

In this project, we do not include emissions from fossil fuel emissions or biomass burning (see below in this §5.1.1.1, Part 3. Greenhouse gas emissions)

The Project undertook stratification of the Project Area as required by the module and the following results:

Table 29 - Land-Use Change of all Stratum

Land Cover Strata	Description	Area Beginning	Area Baseline	Land-Use Change
		(ha)		
Acacia Plantation	Acacia Plantation and associated infrastructure on drained peatland. This stratum represents typical <i>Acacia</i> plantations on peatland in Indonesia. For this stratum, drainage is required, and forest covers are removed if present. <i>Acacia</i> planting starts in the same year as deforestation. The development of drainage constructions is assumed to happen just before or in the same year as the deforestation/planting.	0	78,425	78,425
Peat Dome Forest	Peatlands cover in high-density peat dome forests. Most of this forest type is allocated for conservation, but some areas will be cleared for plantation development.	23,748	22,825	-923
Dense Swamp Forest	Peatlands cover in high-density natural forests. Most of this forest type is allocated for conversion to <i>Acacia</i> plantation, but some areas will be retained for conservation in riparian zones and buffer zones.	19,287	4,151	-15,136
Medium Swamp Forest	Peatlands cover in medium-density / moderately degraded natural forests. Most of this forest type is allocated for conversion to <i>Acacia</i> plantation, but some areas will be retained for conservation in riparian zones and buffer zones.	63,328	18,955	-44,373
Sparse Swamp Forest	Peatlands cover in low density / highly degraded natural forests. Most of this forest type is allocated for conversion to <i>Acacia</i> plantation, but some areas will be retained for conservation in riparian zones and buffer zones.	22,439	4,474	-17,965
Non-Forest	Non-Forest. This stratum represents peatlands where forest covers have been removed, i.e. bare land. It is assumed that this stratum remains largely unchanged since the project start date, although it is likely to naturally regenerate itself.	1,230	1,200	-30
Water Body	Water bodies. This stratum represents lakes and rivers. Rivers and lakes remain unchanged during the project period.	59	59	0
Total		130,090	130,090	0

1. We calculate the quantity of the average per hectare above ground biomass (AGB) and its CO₂ equivalent GHG emissions from the cleared forest using the forest inventory data. This is reported separately and summarised below. The conversion factor for biomass weight to molecular carbon weight is 0.47¹³ and the conversion factor for molecular carbon to CO₂-e is 3.667¹⁴. The total above ground biomass emissions in CO₂-e from deforestation is calculated by multiplying the area of each land cover stratum deforested each year by the average AGB for the stratum.

Table 30 - Average AGB of all Stratum

Land Cover Strata	Average AGB		
	(t.ha ⁻¹)	(t.C.ha ⁻¹)	(t.CO ₂ -e.ha ⁻¹)
Peat Dome Forest	199.3	93.7	343.5
Dense Swamp Forest	150.3	70.6	259.0
Medium Swamp Forest	112.7	53.0	194.2
Sparse Swamp Forest	78.4	36.8	135.1
Non-Forest and Water Bodies	0	0.0	0.0

2. The below ground biomass emissions in t.CO₂-e are calculated by multiplying the above ground biomass estimate for each of each land cover stratum deforested by the appropriate root to shoot ratio. This is described in the table below. The total below ground biomass emissions in t.CO₂-e from deforestation is calculated by multiplying the area of each land cover stratum deforested by the average AGB for the stratum.

Table 31 - Root to shoot ratio of different forest types

Forest type	Root to shoot ratio
Dense Swamp Forest	30.54%
Medium Swamp Forest	28.24%
Sparse Swamp Forest	28.24%
Peat Dome Forest	30.54%
Source: Krisnawati et al. (2015). Standard Methods for Estimating Greenhouse Gas Emissions from Forests and Peatlands in Indonesia (Version 2). Table 2-3. Indonesian National Carbon Accounting System.	

Table 32 - Average BGB of all Stratum

Land Cover Strata	Average BGB		
	(t.ha ⁻¹)	(t.C.ha ⁻¹)	(t.CO ₂ -e.ha ⁻¹)
Peat Dome Forest	60.9	28.6	104.9
Dense Swamp Forest	45.9	21.6	79.1
Medium Swamp Forest	31.8	15.0	54.9
Sparse Swamp Forest	22.1	10.4	38.2
Non-Forest and Water Bodies	0.0	0.0	0.0

5.1.1.2. Area of Land Deforested, Carbon Stock Change and GHG Emissions

The methods for estimating net carbon stock changes and GHG emissions from planned deforestation (i.e., REDD-APD) under the baseline scenario are described in module §5, Part 1 of BL-PL; (Note: soil organic carbon is calculated per BL-PEAT).

Baseline Project Area

Part 1 - Calculating annual area of planned deforestation.

Step 1.1 - Identification of agent of planned deforestation

PP has followed the requirements of VMD0006-BL-PL,v1.3 in §5 Procedures, Part 1, 1.1 – Identify the agent of planned deforestation.

The Project notes that the project baseline scenario does not have a single identifiable agent of deforestation, therefore the Project was required to identify the most likely “class of deforestation agents”.

The most likely class of deforestation agents identified by the Project are the forest plantation companies with operational concessions in Indonesia who manage IUPHHK-HT licenses and undertake plantation forestry to provide feedstock for the pulp and paper industry. These are all entities that practice similar deforestation and planting practices. There are numerous entities of this type in Sumatra, Kalimantan and Papua. In Riau Province alone there are 54 companies operating IUPHHK-HT licenses and two major pulp and paper processing facilities¹⁵. In the baseline stratum of the Project, HTI concessions on peatland in Ria Province, there are 42 companies that meet those criteria.

Most of them are industrial-scale agribusiness that were practicing plantation forestry under legal license from the MoEF. The 4 distinct types of concession owners in the Strata containing forest plantation development on peatlands:

1. Sinar Mas Group with 653,730 ha or 46% of the stratum
2. APRIL Group with 338,909 ha or 24% of the stratum
3. Long Term Supply Partner contracted with APRIL with 317,343 ha or 22% of the stratum
4. Unidentified Other with 103,854 ha or 7% of the stratum

Long-term supply partners are separate legal entities from APRIL, that is, they are not owned by the April group. They independently own and manage their licensing activity with MoEF, as well as develop their own community activities.

The largest of the three concessions comprise 93% of all stratified landcover in question, they are all engaged in plantation development on peatland; hence a class-based approach is appropriate.

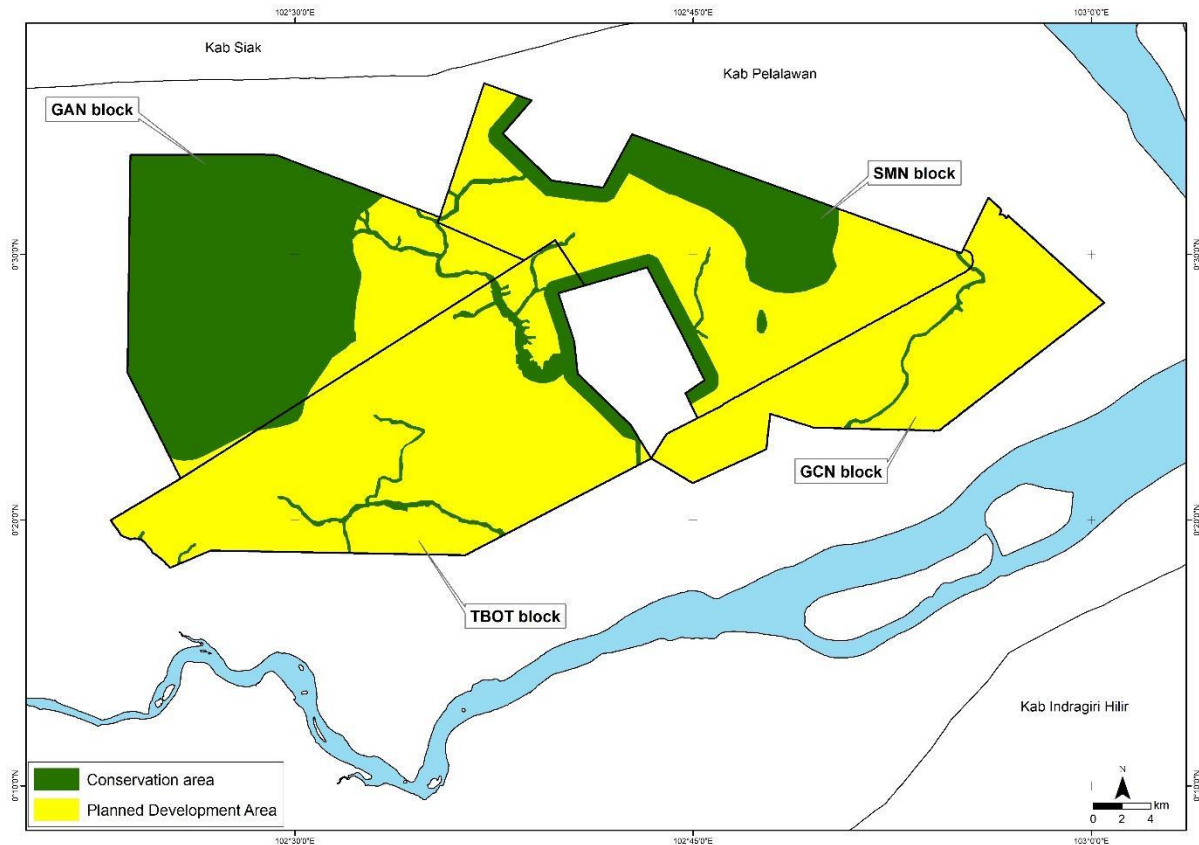
The class of deforestation agents chosen is further justified by spatial similarities in biophysical parameters when compared to the Project Area.

Table 33 - Similarities of biophysical and activity-related to parameters used for the justification of the selection of the class of deforestation agents

Biophysical Parameters	Project Area	Proxy Area
Forest cover	89.8% forest cover	At least 79.1% forest cover
Soil type	100% peat	At least 80% peat
Elevation	100% of area in the 0-500m class	At least 80% of the area falls in the 0-500m class
Slope	100% of area has "gentle" (slope<15%) slopes	At least 80% of the area has "gentle" slopes
Temperature	Tropical	Tropical
Precipitation Regime	Wet equatorial	Wet equatorial
Activity Related Parameters	Project Area	Proxy Areas
Distance to Transport Networks	Direct road access to project area and less then 20km to river transportation system	Direct road access to all proxy areas. Contiguous water access (i.e. canals) to river transportation systems
Distance to Pulp Processing Facility	60km-120 km, dependent on location in the Project area	45km-120km, dependent on which Proxy Area concession

Step 1.2 - Area of deforestation

The area of planned deforestation is described in section 3.3.4 of the RER-CP VCS-PD titled "REDD and WRC Boundaries". This area applies to all forested land within the plantation development area situated in the geographical boundaries of the project. The APD boundaries are generated by intersecting the forest area stratification boundaries with the planned plantation development boundaries and identifying all areas of forest subject to planned deforestation. The specific areas for planned deforestation RWE+REDD and CIW+REDD activities are described below in Sections 5.1.1.3.2 and 5.1.1.3.4 respectively.



Map 7 - Plantation Development Area

Step 1.3 - Rate of deforestation

Baseline Proxy Areas

Per the module BL-PL, A minimum of 6 proxy areas is required to determine the baseline rate of deforestation. A total of 6 suitable proxy areas were identified (see Table 34 and Map 8). This is required for both BL-PL and BL-PEAT as there is no fixed management plan to determine the rate of deforestation, thus a process set forth in §5, Part 1 of BL-PL is used to do this. §5.1.2 of BL-PEAT also requires the use of a proxy analysis.

Pursuant to part 1.3, all proxy areas must meet the following criteria:

- Land conversion practices shall be the same as those used by the baseline agent or class of agent;
- The post-deforestation land use shall be the same in the proxy areas as expected in the Project Area under business as usual;
- The proxy areas shall have the same management and land use rights type as the proposed Project Area under business as usual;

- 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 neighbouring countries;
- Agents of deforestation in proxy areas must have deforested their land under the same criteria that the project lands must follow (legally permissible and suitable for conversion);
- Deforestation in the proxy area shall have occurred within the 10 years prior to the baseline period; and
- Additionally, the three following conditions were met:
 - The forest types surrounding the proxy area or in the proxy area prior to deforestation shall be in the same proportion as in the Project Area ($\pm 20\%$).
 - 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 proxy area 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 proxy areas shall be ($\pm 20\%$) the same as the ratio in the Project Area.
 - Elevation classes (500m classes) in the proxy area shall be in the same proportion as in the Project Area ($\pm 20\%$).

The proxy areas selected were all concessions operated by APRIL Group, which were located on the Kampar Peninsula immediately adjacent to and surrounding the RER Project Area. They were all pulp and paper concessions in Indonesia whose licenses were granted between 2000 and 2010. Using the peat depth map for Kampar Peninsula¹⁶, the pulp and paper concessions with similar peat proportions as the Project Area were identified (see tables 33 and 34). APRIL has also prepared a LiDAR-based DEM for the Kampar Peninsula and this has been analysed to confirm that the concessions have met the biophysical parameter (i.e., slope, elevation, etc.) requirements. To determine which of the remaining concessions met the forest type and forest cover percentage criteria, medium-resolution satellite imagery was used.

Table 34 - Summary of selected Proxy Areas

Proxy Area	Area in Ha	Province	Concession Grant Date	Peat %
PT. RAPP (Tasik Belat)	11,339	Riau	2009	100%
PT. Peranap Timber (Serapung)	32,527		2002	
PT. Essa Indah Timber (Serapung)	10,023		2003	
PT. Madukoro Lestari (Tasik)	14,903		2003	
PT. Harapan Jaya (Tasik)	5,084		2003	
PT. RAPP (Meranti East and West)	44,170		2009	

Table 35 - Summary of RER Project concession areas

Concession	Area in Ha	Province	Concession Grant Date	Peat %
PT. Gemilang Cipta Nusantara	20,123	Riau	2012	100%
PT. Sinar Mutiara Nusantara	32,776		2014	
PT. The Best One Unitimber	40,666		2014	
PT. Global Alam Nusantara	36,525		2014	
Total	130,090			

In addition, the proxy areas were representative of the “class of deforestation agents” as identified in the previous step 1.1 and per the applicability conditions, including having similar management practices and conversion practices as other concession holders.

In that respect, the “class of deforestation agents” is one that is legally converting secondary forested land to industrial forest plantations using acacia in drained peatlands. This can only legally be done with an Industrial forestry license or Hutan Tanaman Industri (HTI) licence, issued and regulated by the MoEF. Other conversion practices such as, oil palm conversion, other agricultural conversion, etc are regulated and managed with different licenses and business utilization permits. Because this conversion practice is highly regulated, the conversion and management practices are very similar from one concession to another. All HTI concessions in the province of Riau, and in the country, were regulated by MoEF General Regulation 6/2007 Article 38, 71 and per Article 73(1)(a) and (b) and were required to produce a 10-year management plan (RKU) and annual work plans (RKT) that in turn are approved by the MoEF. These work plans are required among other things, to outline biophysical characteristics of the concession, conduct a socio-economic assessment for community programmes, undertake inventory, produce conversion and management plans that complied with Indonesian all Indonesian MoEF government regulations, etc. In short, all licensed and regulated HTI concessions in Indonesia have similar management practices and undertake the same conversion practice, as it is mandated by law which sets out a standardised process which is well enforced by the MoEF

Process to Select the Proxy Areas

The initial selection of proxy locations was conducted by using proprietary APRIL information regarding its plantation concessions and APRIL supply partner plantation concessions. This proprietary data included actual deforestation records, management plans (RKUs RKTs, and other proprietary plantation management documentation), plantation area registers, forest inventory data, plantation and infrastructure survey maps, and plantation survey records. The harvesting plans of all of these concessions (and subsequent harvesting rates) have been verified by data from the Indonesian Ministry of Environment and Forestry and ensure that in addition to the below satellite imagery analysis that the deforestation rates of the proxy areas are accurate.

A) Data acquisition

For each concession, Landsat Thematic Mapper (TM), Landsat Data was downloaded from the US Geological Survey (USGS) online database¹³, including Landsat Thematic Mapper (TM), Landsat 5 Enhanced TM Plus (ETM+) or Landsat 8 Operational Land Imager (OLI). Geometric corrections and ortho rectification were applied to all Level 1 Landsat data sourced from USGS applying SRTM DEM

data and precision ground control points, in accordance with all standards provided by the GOFC-GOLD (2013) Sourcebook.

B) Landsat pre-processing

Multi-year satellite data were analysed using Google Earth Engine to get nearly cloud-free data. For time-step 1, imagery from the concession grant date was downloaded. For time-step 2, imagery from the last year of forest development was downloaded. Multi-year satellite data were analysed using Google Earth Engine to identify cloud-free image coverage for the start year. Due to Landsat's long revisit time and the high level of cloud cover in Indonesia, a compromise had to be made between cloud cover and the imagery acquisition date's proximity to the concession grant and development completion dates.

C) Landsat classification

To increase the accuracy of the classification, the Project Area boundaries were overlaid on the Landsat imagery, and all spectral data outside the relevant area of interest was removed from further analysis.

To determine the land cover types using Landsat data the algorithm was developed following a decision tree logic¹⁷ of two land cover types which were generated by using: i) canopy cover percentage¹⁸, and ii) supervised classification using a support vector machine. The canopy cover percentage was calculated as a function of the Enhanced Vegetation Index¹⁹, an 'optimized' vegetation index designed to enhance the vegetation signal with improved sensitivity in high biomass regions and improved vegetation monitoring through a de-coupling of the canopy background signal and a reduction in atmosphere influences. Finally, the noises due to the cloud effect were corrected by taking the output from the analysis using the satellite imagery from the previous time step.

Two path/row Landsat scenes were used, 1) Path/row 126/60 for Madukoro Lestari, Harapan Jaya, and Meranti; 2) Path/row 126/60 and 126/59 for Peranap Timber, Essa Indah Timber, and Tasik Belat. All Landsat details are set forth in Tables 36-41 below.

All images for the proxy analysis were used to get nearly 100% cloud-free images. The satellite images shown are for both pre- and post-plantation to represent the median values within the historical reference period (1 Jan 2006 to 31 Dec 2015).

The mosaic Landsat images used were cloud-free. Finally, an accuracy assessment was run on each of the maps to ensure that the overall classification accuracy (i.e., forest vs non-forest) was at least 90%. The overall classification accuracy was then calculated using the below equation. This was obtained by comparing the unprocessed Landsat data and high-resolution imagery from Google Earth (when available).

$$\text{Overall Classification Accuracy} = \frac{\text{Number of Pixels Classified Correctly}}{\text{Total Number of Classified Pixels}}$$

All accuracy estimates for the maps were satisfactory with the average accuracy being 94.8%.

Further, the concession boundaries were overlaid onto the satellite images, and images outside of the boundaries were masked to improve the classification of land cover. The canopy cover map and training data (forest classifications from plots assessed in the field) were then analysed using supervised classification machine learning algorithms to classify into forests, degraded forests, and non-forest. The information was further classified against the company spatial database (Python Base) to verify land cover classifications. It should be noted here that actual planted areas have been ground surveyed in the field to a high level of accuracy, so the deforestation estimates are of a high level of accuracy (sub-meter level). The process used to prepare the satellite imagery is also set forth in Figure 9 below. This process is consistent for all 6 proxy area maps.

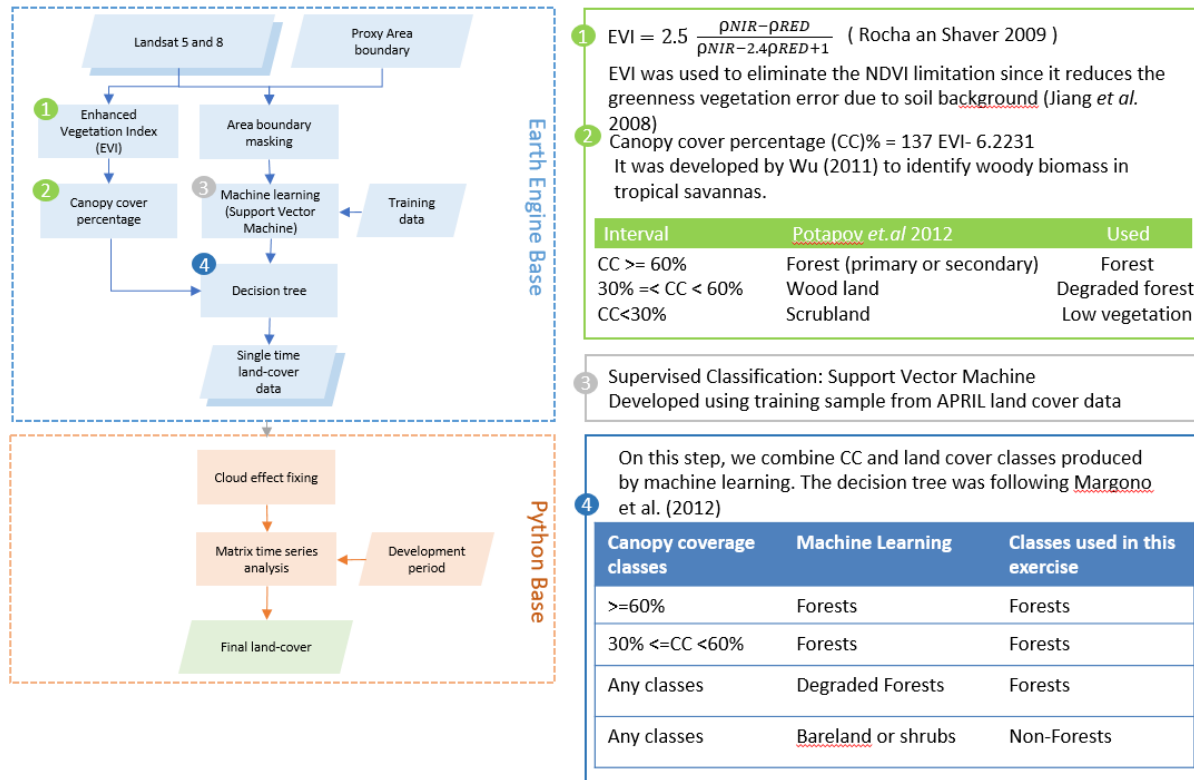
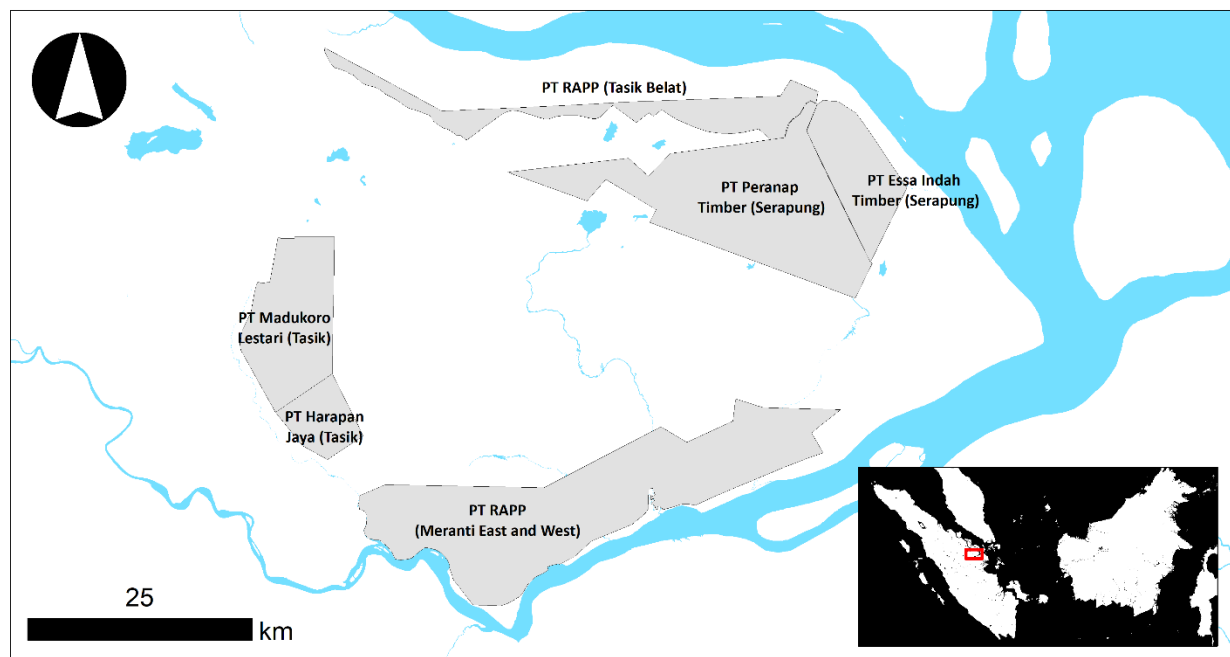


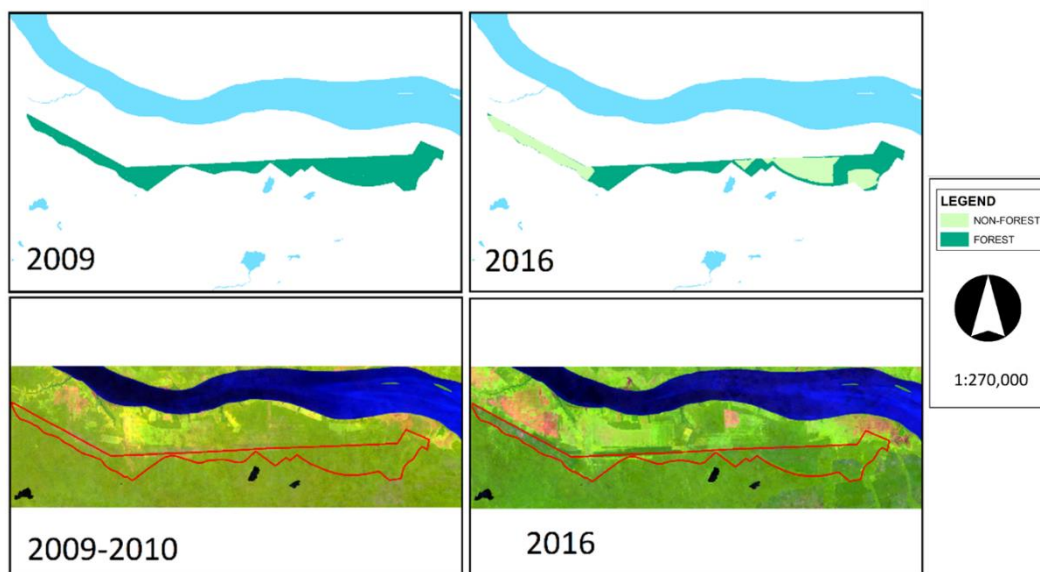
Figure 9 - The process flow used to prepare satellite imagery for proxy area analysis



Map 8 - Geographic location of the 6 Proxy Areas for the baseline deforestation rate calculation

All 6 proxy areas share the same landscape as RER Project Area, located on the geological landscape, share the same soil types (100% peatland), have similar topography (flat and low altitude) and are all within the same range of land areas as the 4 RER concessions.

- A) **Proxy Area 1. PT. RAPP** (Tasik Belat) is located to the north of the RER project area and is a long thin strip of land that runs from east to west. The concession was granted in 2009 and is 11,339 hectares. In 2011 the concession contained 11,323 hectares of natural or secondary forest and by 2016 this had been reduced to 6,233 hectares through planned deforestation.



Map 9 - Land cover maps (top) and satellite data (bottom) for PT. RAPP (Tasik Belat)

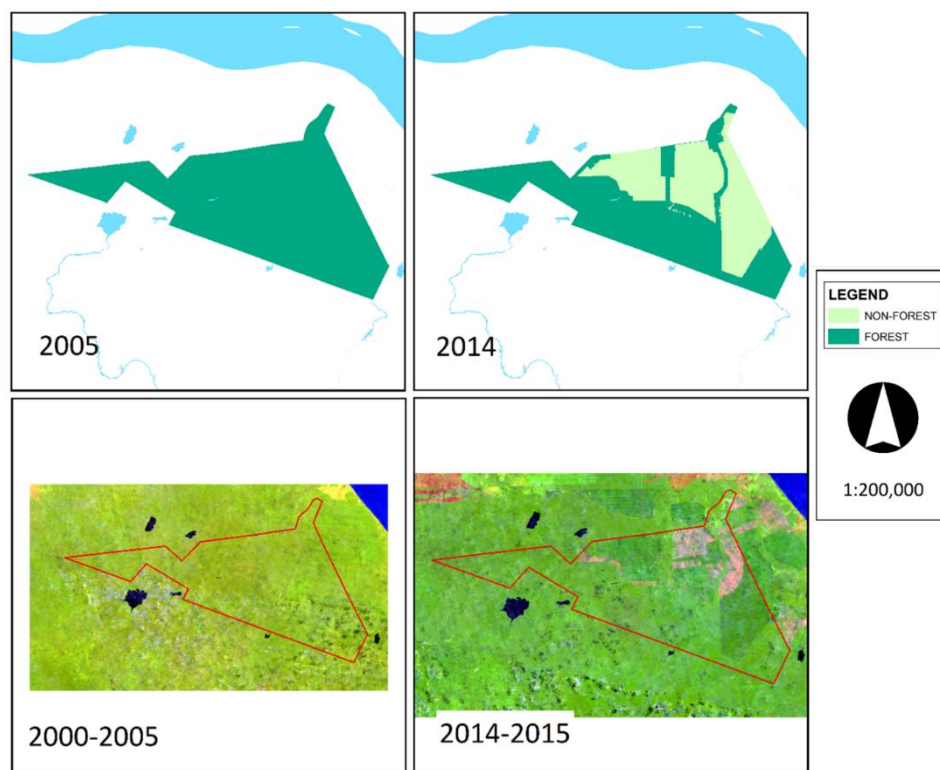
Mosaic satellite data used for the above land use classification is listed below.

Table 36 - Satellite Imagery Details for PT. RAPP (Tasik Belat)

Concession	PT. RAPP			
Sector	Tasik Belat			
Time	Before plantation establishment			
Year	2009-2010			
Satellite	Landsat 5			
Path/ Row	126/60 & 126/59			
	Image ID	Date	Image ID	Date
Image ID/ Date	LT05_126059_20090130	30/01/2009	LT05_126059_20090911	11/09/2009
	LT05_126060_20090215	15/02/2009	LT05_126059_20090927	27/09/2009
	LT05_126059_20090215	15/02/2009	LT05_126060_20091013	13/10/2009
	LT05_126059_20090404	04/04/2009	LT05_126059_20091013	13/10/2009
	LT05_126059_20090522	22/05/2009	LT05_126059_20091029	29/10/2009
	LT05_126059_20090607	07/06/2009	LT05_126059_20091216	16/12/2009
	LT05_126059_20090623	23/06/2009	LT05_126059_20100117	17/01/2010

	LT05_126060_20090709	09/07/2009	LT05_126059_20100202	02/02/2010
	LT05_126059_20090709	09/07/2009	LT05_126059_20100914	14/09/2010
	LT05_126060_20090725	25/07/2009	LT05_126060_20101016	16/10/2010
	LT05_126060_20090826	26/08/2009	LT05_126059_20101016	16/10/2010
	After plantation establishment			
	2016			
	Landsat 8			
	126/60 & 126/59			
	Image ID	Date	Image ID	Date
	LC08_126059_20160118	18/01/2016	LC08_126059_20160712	12/07/2016
	LC08_126060_20160203	03/02/2016	LC08_126060_20160813	13/08/2016
	LC08_126059_20160306	06/03/2016	LC08_126059_20160813	13/08/2016
	LC08_126060_20160407	07/04/2016	LC08_126059_20160829	29/08/2016
	LC08_126059_20160407	07/04/2016	LC08_126059_20160914	14/09/2016
	LC08_126059_20160423	23/04/2016	LC08_126060_20160930	30/09/2016
	LC08_126060_20160509	09/05/2016	LC08_126059_20160930	30/09/2016
	LC08_126059_20160509	09/05/2016	LC08_126060_20161016	16/10/2016
	LC08_126059_20160525	25/05/2016	LC08_126060_20161117	17/11/2016
	LC08_126059_20160610	10/06/2016	LC08_126059_20161117	17/11/2016
	LC08_126060_20160626	26/06/2016	LC08_126060_20161203	03/12/2016
	LC08_126059_20160626	26/06/2016	LC08_126060_20161219	19/12/2016
	LC08_126060_20160712	12/07/2016	LC08_126059_20161219	19/12/2016

B) **Proxy Area 2. PT. Peranap Timber** (Serapung) is located to the north east of the RER project area and is a triangular block of land. The concession was granted in 2002 and is 32,527 hectares. In 2006 the concession contained 32,526 hectares of natural forest and by 2014 this had been reduced to 19,515 hectares through planned deforestation.



Map 10 - Land cover maps (top) and satellite data (bottom) for PT. Peranap Timber (Serapung)

Mosaic satellite data used for the above land use classification is listed below.

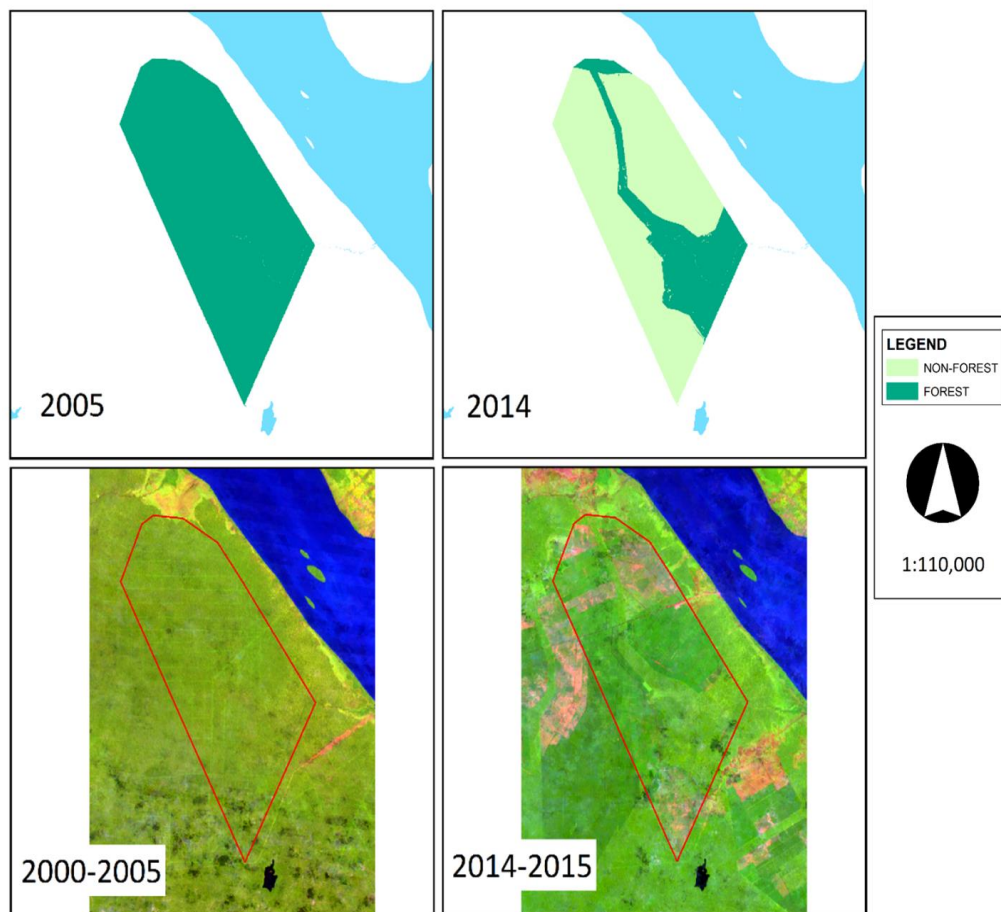
Table 37 - Satellite Imagery Details for PT. Peranap Timber (Serapung)

Concession	PT. Peranap Timber			
Sector	Serapung			
Time	Before plantation establishment			
Year	2000-2005			
Satellite	Landsat 5			
Path/ Row	126/60 & 126/59			
	Image ID	Date	Image ID	Date
Image ID/ Date	LT05_126060_20000122	22/01/2000	LT05_126060_20010719	19/07/2001
	LT05_126059_20000122	22/01/2000	LT05_126059_20010719	19/07/2001
	LT05_126059_20000207	07/02/2000	LT05_126059_20010804	04/08/2001
	LT05_126060_20000223	23/02/2000	LT05_126060_20010905	05/09/2001
	LT05_126059_20000223	23/02/2000	LT05_126059_20010905	05/09/2001
	LT05_126059_20000310	10/03/2000	LT05_126060_20010921	21/09/2001
	LT05_126059_20000411	01/04/2000	LT05_126059_20010921	21/09/2001
	LT05_126060_20000427	27/04/2000	LT05_126059_20031130	30/11/2003
	LT05_126059_20000427	27/04/2000	LT05_126059_20040218	18/02/2004
	LT05_126060_20000513	13/05/2000	LT05_126060_20040321	21/03/2004
	LT05_126059_20000513	13/05/2000	LT05_126059_20040321	21/03/2004

	LT05_126060_20000529	29/05/2000	LT05_126059_20040406	06/04/2004
	LT05_126059_20000529	29/05/2000	LT05_126059_20040422	22/04/2004
	LT05_126060_20000614	14/06/2000	LT05_126060_20040508	08/05/2004
	LT05_126059_20000614	14/06/2000	LT05_126059_20040508	08/05/2004
	LT05_126060_20000630	30/06/2000	LT05_126060_20040625	25/06/2004
	LT05_126059_20000630	30/06/2000	LT05_126059_20040625	25/06/2004
	LT05_126060_20000716	16/07/2000	LT05_126059_20040727	27/07/2004
	LT05_126059_20000716	16/07/2000	LT05_126059_20040812	12/08/2004
	LT05_126060_20000817	17/08/2000	LT05_126059_20041015	15/10/2004
	LT05_126059_20000817	17/08/2000	LT05_126059_20041218	18/12/2004
	LT05_126059_20000902	02/09/2000	LT05_126060_20050220	20/02/2005
	LT05_126060_20001004	04/10/2000	LT05_126059_20050220	20/02/2005
	LT05_126059_20001004	04/10/2000	LT05_126059_20050308	08/03/2005
	LT05_126060_20001020	20/10/2000	LT05_126059_20050324	24/03/2005
	LT05_126059_20001020	20/10/2000	LT05_126059_20050409	09/04/2005
	LT05_126059_20001105	05/11/2000	LT05_126059_20050425	25/04/2005
	LT05_126059_20001207	07/12/2000	LT05_126059_20050511	11/05/2005
	LT05_126059_20010108	08/01/2001	LT05_126060_20050612	12/06/2005
	LT05_126059_20010124	24/01/2001	LT05_126059_20050612	12/06/2005
	LT05_126059_20010313	13/03/2001	LT05_126059_20050628	28/06/2005
	LT05_126060_20010329	29/03/2001	LT05_126059_20050714	14/07/2005
	LT05_126059_20010329	29/03/2001	LT05_126059_20050730	30/07/2005
	LT05_126059_20010414	14/04/2001	LT05_126059_20050815	15/08/2005
	LT05_126059_20010516	16/05/2001	LT05_126059_20050831	31/08/2005
	LT05_126060_20010601	01/06/2001	LT05_126059_20050916	16/09/2005
	LT05_126059_20010601	01/06/2001	LT05_126059_20051002	02/10/2005
	LT05_126060_20010703	03/07/2001	LT05_126059_20051018	18/10/2005
	LT05_126059_20010703	03/07/2001		
	After plantation establishment			
	2014-2015			
	Landsat 8			
	126/60 & 126/59			
	Image ID	Date	Image ID	Date
	LC08_126059_20140112	12/01/2014	LC08_126059_20141214	14/12/2014
	LC08_126059_20140128	28/01/2014	LC08_126059_20150115	15/01/2015
	LC08_126059_20140213	13/02/2014	LC08_126059_20150131	31/01/2015
	LC08_126059_20140301	01/03/2014	LC08_126059_20150216	16/02/2015
	LC08_126060_20140402	02/04/2014	LC08_126060_20150320	20/03/2015
	LC08_126059_20140402	02/04/2014	LC08_126059_20150405	05/04/2015
	LC08_126059_20140504	04/05/2014	LC08_126060_20150421	21/04/2015
	LC08_126059_20140520	20/05/2014	LC08_126059_20150421	21/04/2015
	LC08_126060_20140621	21/06/2014	LC08_126059_20150507	07/05/2015
	LC08_126059_20140621	21/06/2014	LC08_126060_20150608	08/06/2015
	LC08_126060_20140707	07/07/2014	LC08_126059_20150624	24/06/2015

	LC08_126059_20140707	07/07/2014	LC08_126060_20150710	10/07/2015
	LC08_126060_20140723	23/07/2014	LC08_126059_20150710	10/07/2015
	LC08_126059_20140723	23/07/2014	LC08_126059_20150726	26/07/2015
	LC08_126060_20140808	08/08/2014	LC08_126059_20150827	27/08/2015
	LC08_126059_20140808	08/08/2014	LC08_126060_20150912	12/09/2015
	LC08_126059_20140824	24/08/2014	LC08_126059_20150912	12/09/2015
	LC08_126060_20141011	11/10/2014	LC08_126059_20151014	14/10/2015
	LC08_126059_20141011	11/10/2014	LC08_126059_20151030	30/10/2015
	LC08_126059_20141112	12/11/2014	LC08_126059_20151201	01/12/2015
	LC08_126059_20141128	28/11/2014	LC08_126059_20151217	17/12/2015
	LC08_126060_20141214	14/12/2014		

- C) **Proxy Area 3. PT. Essa Indah Timber** (Serapung) is located to the north east of the RER project area and is an oblong block of land that is oriented north to south. The concession was granted in 2003 and is 10,023 hectares. In 2006 the concession contained 10,023 hectares of natural forest and by 2014 this had been reduced to 2,753 hectares through planned deforestation.



Map 11 - Land cover maps (top) and satellite data (bottom) for PT. Essa Indah Timber (Serapung)

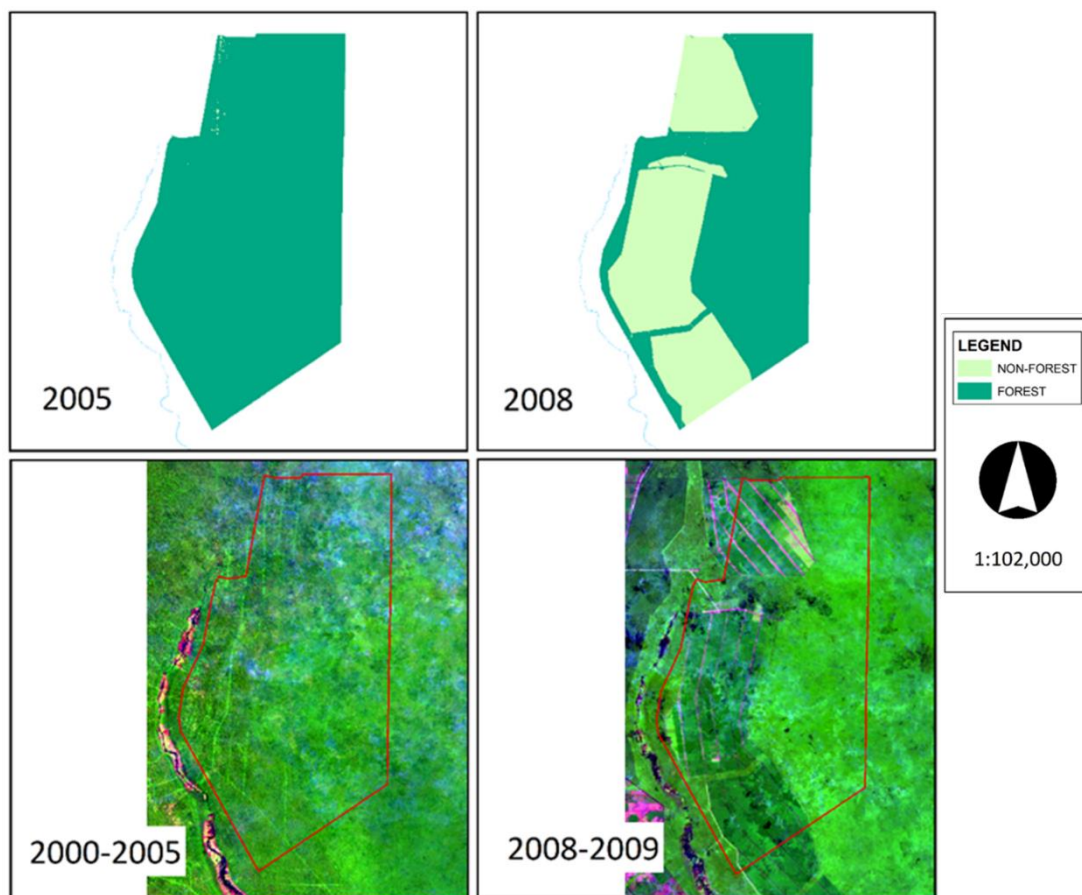
Mosaic satellite data used for the above land use classification is listed below.

Table 38 - Satellite Imagery Details for PT. Essa Indah Timber (Serapung)

Concession	PT. Essa Indah Timber			
Sector	Serapung			
Time	Before plantation establishment			
Year	2000-2005			
Satellite	Landsat 5			
Path/ Row	126/60 & 126/59			
Image ID/ Date	Image ID	Date	Image ID	Date
	LT05_126060_20000122	22/01/2000	LT05_126060_20010719	19/07/2001
	LT05_126059_20000122	22/01/2000	LT05_126059_20010719	19/07/2001
	LT05_126059_20000207	07/02/2000	LT05_126059_20010804	04/08/2001
	LT05_126060_20000223	23/02/2000	LT05_126060_20010905	05/09/2001
	LT05_126059_20000223	23/02/2000	LT05_126059_20010905	05/09/2001
	LT05_126059_20000310	10/03/2000	LT05_126060_20010921	21/09/2001
	LT05_126059_20000411	01/04/2000	LT05_126059_20010921	21/09/2001
	LT05_126060_20000427	27/04/2000	LT05_126059_20031130	30/11/2003
	LT05_126059_20000427	27/04/2000	LT05_126059_20040218	18/02/2004
	LT05_126060_20000513	13/05/2000	LT05_126060_20040321	21/03/2004
	LT05_126059_20000513	13/05/2000	LT05_126059_20040321	21/03/2004
	LT05_126060_20000529	29/05/2000	LT05_126059_20040406	06/04/2004
	LT05_126059_20000529	29/05/2000	LT05_126059_20040422	22/04/2004
	LT05_126060_20000614	14/06/2000	LT05_126060_20040508	08/05/2004
	LT05_126059_20000614	14/06/2000	LT05_126059_20040508	08/05/2004
	LT05_126060_20000630	30/06/2000	LT05_126060_20040625	25/06/2004
	LT05_126059_20000630	30/06/2000	LT05_126059_20040625	25/06/2004
	LT05_126060_20000716	16/07/2000	LT05_126059_20040727	27/07/2004
	LT05_126059_20000716	16/07/2000	LT05_126059_20040812	12/08/2004
	LT05_126060_20000817	17/08/2000	LT05_126059_20041015	15/10/2004
	LT05_126059_20000817	17/08/2000	LT05_126059_20041218	18/12/2004
	LT05_126059_20000902	02/09/2000	LT05_126060_20050220	20/02/2005
	LT05_126060_20001004	04/10/2000	LT05_126059_20050220	20/02/2005
	LT05_126059_20001004	04/10/2000	LT05_126059_20050308	08/03/2005
	LT05_126060_20001020	20/10/2000	LT05_126059_20050324	24/03/2005
	LT05_126059_20001020	20/10/2000	LT05_126059_20050409	09/04/2005
	LT05_126059_20001105	05/11/2000	LT05_126059_20050425	25/04/2005
	LT05_126059_20001207	07/12/2000	LT05_126059_20050511	11/05/2005
	LT05_126059_20010108	08/01/2001	LT05_126060_20050612	12/06/2005
	LT05_126059_20010124	24/01/2001	LT05_126059_20050612	12/06/2005
	LT05_126059_20010313	13/03/2001	LT05_126059_20050628	28/06/2005
	LT05_126060_20010329	29/03/2001	LT05_126059_20050714	14/07/2005
	LT05_126059_20010329	29/03/2001	LT05_126059_20050730	30/07/2005
	LT05_126059_20010414	14/04/2001	LT05_126059_20050815	15/08/2005

	LT05_126059_20010516	16/05/2001	LT05_126059_20050831	31/08/2005
	LT05_126060_20010601	01/06/2001	LT05_126059_20050916	16/09/2005
	LT05_126059_20010601	01/06/2001	LT05_126059_20051002	02/10/2005
	LT05_126060_20010703	03/07/2001	LT05_126059_20051018	18/10/2005
	LT05_126059_20010703	03/07/2001		
	After plantation establishment			
	2014-2015			
	Landsat 8			
	126/60 & 126/59			
	Image ID	Date	Image ID	Date
	LC08_126059_20140112	12/01/2014	LC08_126059_20141214	14/12/2014
	LC08_126059_20140128	28/01/2014	LC08_126059_20150115	15/01/2015
	LC08_126059_20140213	13/02/2014	LC08_126059_20150131	31/01/2015
	LC08_126059_20140301	01/03/2014	LC08_126059_20150216	16/02/2015
	LC08_126060_20140402	02/04/2014	LC08_126060_20150320	20/03/2015
	LC08_126059_20140402	02/04/2014	LC08_126059_20150405	05/04/2015
	LC08_126059_20140504	04/05/2014	LC08_126060_20150421	21/04/2015
	LC08_126059_20140520	20/05/2014	LC08_126059_20150421	21/04/2015
	LC08_126060_20140621	21/06/2014	LC08_126059_20150507	07/05/2015
	LC08_126059_20140621	21/06/2014	LC08_126060_20150608	08/06/2015
	LC08_126060_20140707	07/07/2014	LC08_126059_20150624	24/06/2015
	LC08_126059_20140707	07/07/2014	LC08_126060_20150710	10/07/2015
	LC08_126060_20140723	23/07/2014	LC08_126059_20150710	10/07/2015
	LC08_126059_20140723	23/07/2014	LC08_126059_20150726	26/07/2015
	LC08_126060_20140808	08/08/2014	LC08_126059_20150827	27/08/2015
	LC08_126059_20140808	08/08/2014	LC08_126060_20150912	12/09/2015
	LC08_126059_20140824	24/08/2014	LC08_126059_20150912	12/09/2015
	LC08_126060_20141011	11/10/2014	LC08_126059_20151014	14/10/2015
	LC08_126059_20141011	11/10/2014	LC08_126059_20151030	30/10/2015
	LC08_126059_20141112	12/11/2014	LC08_126059_20151201	01/12/2015
	LC08_126059_20141128	28/11/2014	LC08_126059_20151217	17/12/2015
	LC08_126060_20141214	14/12/2014		

D) **Proxy Area 4. PT. Madukoro Lestari** (Tasik) is located to the west of the RER project area and is an oblong block of land-oriented east to west. The concession was granted in 2003 and was 14,903 hectares. In 2006, the concession contained 14,889 hectares of natural forest and by 2008 this had been reduced to 8,642 hectares through planned deforestation.



Map 12 - Land cover maps (top) and satellite data (bottom) for PT. Madukoro Lestari (Tasik)

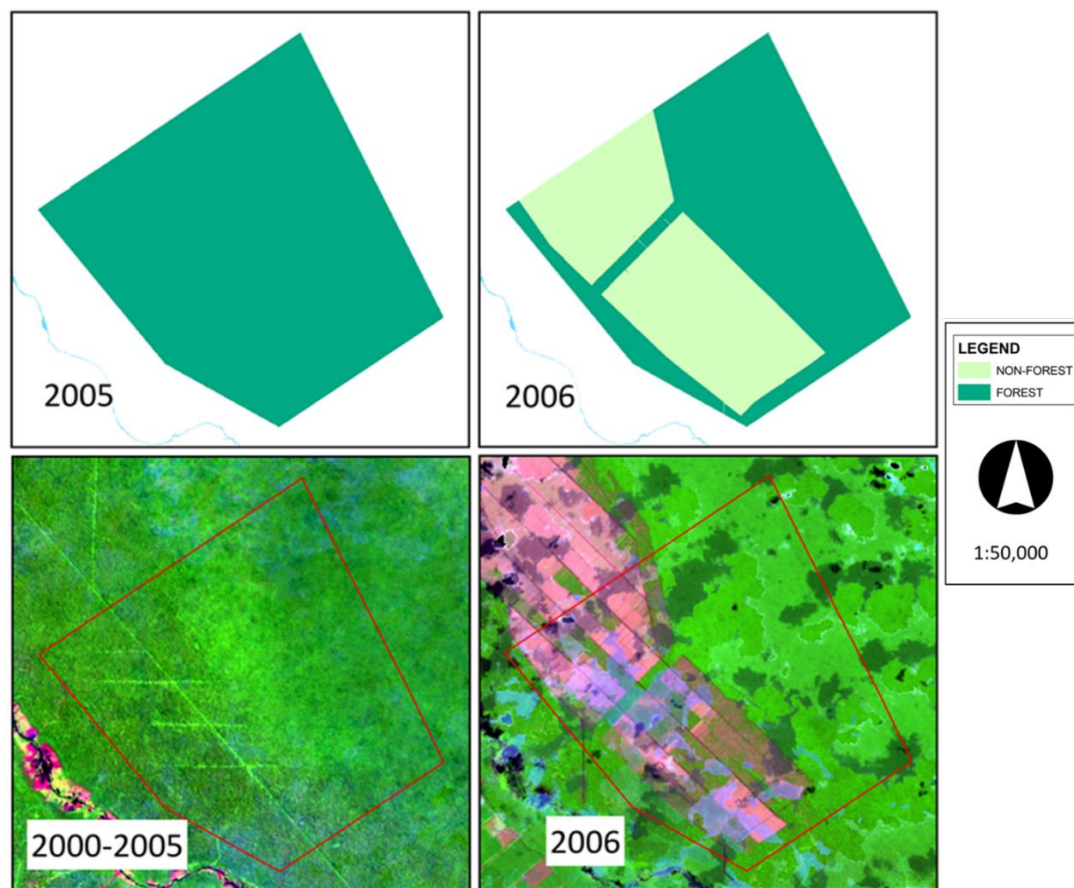
Mosaic satellite data used for the above land use classification is listed below.

Table 39 - Satellite Imagery Details for PT. Madukoro Lestari (Tasik)

Concession	PT. Madukoro Lestari			
Sector	Tasik			
Time	Before plantation establishment			
Year	2000-2005			
Satellite	Landsat 5			
Path/ Row	126/60			
Image ID/ Date	Image ID	Date	Image ID	Date
	LT05_126060_20000122	22/01/2000	LT05_126060_20010329	29/03/2001
	LT05_126060_20000223	23/02/2000	LT05_126060_20010601	01/06/2001
	LT05_126060_20000427	27/04/2000	LT05_126060_20010703	03/07/2001
	LT05_126060_20000513	13/05/2000	LT05_126060_20010719	19/07/2001
	LT05_126060_20000529	29/05/2000	LT05_126060_20010905	05/09/2001
	LT05_126060_20000614	14/06/2000	LT05_126060_20010921	21/09/2001
	LT05_126060_20000630	30/06/2000	LT05_126060_20040321	21/03/2004
	LT05_126060_20000716	16/07/2000	LT05_126060_20040508	08/05/2004

	LT05_126060_20000817	17/08/2000	LT05_126060_20040625	25/06/2004
	LT05_126060_20001004	04/10/2000	LT05_126060_20050220	20/02/2005
	LT05_126060_20001020	20/10/2000	LT05_126060_20050612	12/06/2005
	After plantation establishment			
	2008-2009			
	Landsat 5			
	126/60			
	Image ID	Date	Image ID	Date
	LT05_126060_20080503	03/05/2008	LT05_126060_20090709	09/07/2009
	LT05_126060_20080519	19/05/2008	LT05_126060_20090725	25/07/2009
	LT05_126060_20080722	22/07/2008	LT05_126060_20090826	26/08/2009
	LT05_126060_20081127	27/11/2008	LT05_126060_20091013	13/10/2009
	LT05_126060_20090215	15/02/2009		

- E) **Proxy Area 5. PT. Harapan Jaya** (Tasik) is located to the west of the RER project area and is a diamond shaped block of land. The concession was granted in 2003 and is 5,084 hectares. In 2006 the concession contained 5,084 hectares of natural forest and in one year this had been reduced to 2,980 hectares through planned deforestation.



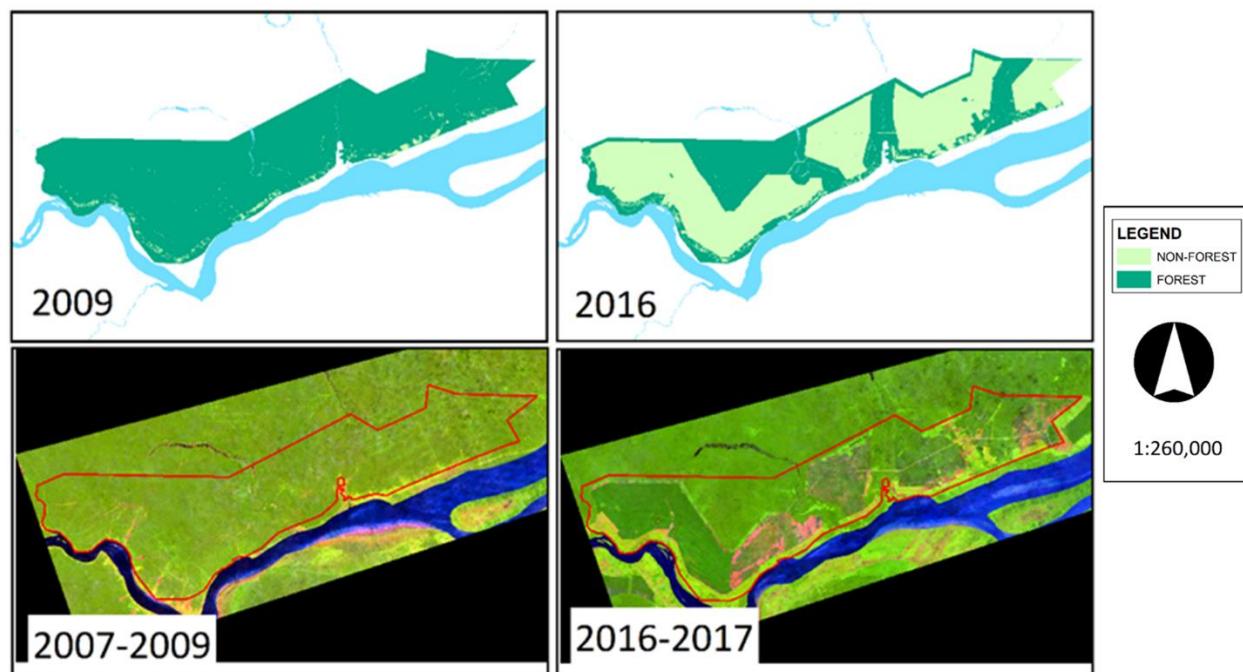
Map 13 - Land cover maps (top) and satellite data (bottom) for PT. Harapan Jaya (Tasik)

Mosaic satellite data used for the above land use classification is listed below.

Table 40 - Satellite Imagery Details for PT. Harapan Jaya (Tasik)

Concession	PT Harapan Jaya			
Sector	Tasik			
Time	Before plantation establishment			
Year	2000-2005			
Satellite	Landsat 5			
Path/ Row	126/60			
Image ID/ Date	Image ID	Date	Image ID	Date
	LT05_126060_20000122	22/01/2000	LT05_126060_20010329	29/03/2001
	LT05_126060_20000223	23/02/2000	LT05_126060_20010601	01/06/2001
	LT05_126060_20000427	27/04/2000	LT05_126060_20010703	03/07/2001
	LT05_126060_20000513	13/05/2000	LT05_126060_20010719	19/07/2001
	LT05_126060_20000529	29/05/2000	LT05_126060_20010905	05/09/2001
	LT05_126060_20000614	14/06/2000	LT05_126060_20010921	21/09/2001
	LT05_126060_20000630	30/06/2000	LT05_126060_20040321	21/03/2004
	LT05_126060_20000716	16/07/2000	LT05_126060_20040508	08/05/2004
	LT05_126060_20000817	17/08/2000	LT05_126060_20040625	25/06/2004
	LT05_126060_20001004	04/10/2000	LT05_126060_20050220	20/02/2005
	LT05_126060_20001020	20/10/2000	LT05_126060_20050612	12/06/2005
	After plantation establishment			
	2006			
	Landsat 5			
	126/60			
	Image ID	Date	Image ID	Date
	LT05_126060_20061208	08/12/2006	LT05_126060_20060530	30/05/2006
	LT05_126060_20060428	28/04/2006	LT05_126060_20061005	05/10/2006

F) **Proxy Area 6. PT. RAPP** (Meranti East and West) is located to the south of the RER project area and strip of land-oriented east to west. The concession was granted in 2009 and was 44,170 hectares. In 2009 the concession contained 43,299 hectares of natural forest and by 2016 this had been reduced to 17,146 hectares through planned deforestation.



Map 14 - Satellite and land cover maps for PT. RAPP (Meranti East and West)

Mosaic satellite data used for the above land use classification is listed below.

Table 41 - Satellite Imagery Details PT. RAPP (Meranti East and West)

Concession	PT. RAPP			
Sector	Meranti East and West			
Time	Before plantation establishment			
Year	2007-2009			
Satellite	Landsat 5			
Path/ Row	126/60			
Image ID/ Date	Image ID	Date	Image ID	Date
	LT05_126060_20070501	01/05/2007	LT05_126060_20081127	27/11/2008
	LT05_126060_20070618	18/06/2007	LT05_126060_20090215	15/02/2009
	LT05_126060_20070922	22/09/2007	LT05_126060_20090709	09/07/2009
	LT05_126060_20080503	03/05/2008	LT05_126060_20090725	25/07/2009
	LT05_126060_20080519	19/05/2008	LT05_126060_20090826	26/08/2009
	LT05_126060_20080722	22/07/2008	LT05_126060_20091013	13/10/2009
	After plantation establishment			
	2016-2017			
	Landsat 8			
	126/60			
	Image ID	Date	Image ID	Date
	LC08_126060_20160203	03/02/2016	LC08_126060_20161117	17/11/2016
	LC08_126060_20160407	07/04/2016	LC08_126060_20161203	03/12/2016
	LC08_126060_20160509	09/05/2016	LC08_126060_20161219	19/12/2016
	LC08_126060_20160626	26/06/2016	LC08_126060_20171019	19/05/2017
	LC08_126060_20160712	12/07/2016	LC08_126060_20170528	28/05/2017
	LC08_126060_20160813	13/08/2016	LC08_126060_20170613	13/06/2017
	LC08_126060_20160930	30/09/2016	LC08_126060_20170816	16/08/2017
	LC08_126060_20161016	16/10/2016	LC08_126060_20171003	03/10/2017

Next, the Project prepared a baseline plan for the development of plantations based on:

1. Allocation of land to conservation area as required by law. This includes the complete protection of primary Peat Dome Forest in PT. GAN concession, the allocation of legally mandated buffer zones around protection areas adjacent to the RER Project Area, and the establishment of large riparian zones around rivers, streams, and other significant water bodies.
2. Identification of development areas, outside of the conservation areas, for conversion to forest plantation and its associated infrastructure. This maximum size of development area within each forest concession was limited to less than 90% of the total land area to allow for the establishment of minimum area of conservation areas.
3. 8-year development plan based on a logical development sequence across all 4 concessions. The development sequence starts in the centre and south of the Project Area, and then progresses north and east/west in large incremental steps. This reflects the

requirement to develop the plantations in conjunction with infrastructure starting from one point and then developing infrastructure and plantations on a sequential basis. The plantations are likely to be managed on a 5-year rotation, but a further 2 years was expected to be needed to complete the development of the most distant areas.

The baseline management plan is a valid and reasonable proposition, meeting Indonesian legal requirements, permissible under the regulations, practical in terms of plantation siting and practical implementation, and technically feasible from an operational perspective.

Using the module BL-PL Equation-4,

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

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 etc of a reference region as a result of planned deforestation as defined in this module; %
Yrs_{pn}	Number of years over which deforestation occurred in land parcel pn in reference region; years
n	Total number of land parcels examined
pn	1, 2, 3, ...n land parcels examined in reference region
i	1, 2, 3, ...M strata

A total of 6 suitable proxy areas were identified (see below table).

Table 42 - Summary of suitable proxy areas

Company	Area (ha)	Annual Deforestation rates (%/year)	Concession Grant Date	Year of First Establishment (t1)	Forest area at t1 (ha)	Year of Last Establishment (t2)	Forest area at t2 (ha)
PT RAPP	11,339	7.26	2009	2011	11,339	2016	6,400
PT. Peranap Timber	32,527	4.3	2002	2006	32,343	2014	19,762
PT. Essa Indah Timber	10,023	7.6	2003	2006	9,822	2014	2,966
PT. Madukoro Lestari	14,903	13.55	2003	2006	14,867	2008	8,810
PT Harapan Jaya	5,084	41.23	2003	2006	5,061	2006	2,965
PT. RAPP	44,170	4.83	2009	2009	32,363	2016	15,290
Total	118,046	7.82%			105,795		56,193

The average projected annual deforestation rate for the proxy areas was estimated to be 7.82%. As noted above, all of these concessions have been developed by the APRIL group in areas adjacent to the RER project. The identical methods were used for planning the baseline plantation development.

Step 1.4 - Likelihood of planned deforestation

Since all pulpwood plantation concessions are zoned for deforestation, are under the private control of the concessionaire, subject to Indonesian law, for the duration of the concession license, the likelihood of deforestation (L-Di) is assumed to be equal to 100%. Proprietary concession management documents controlled by APRIL are also available to provide further proof of this.

Step 1.5 - Risk of abandonment

To assess the risk of abandonment, 6 proxy areas with concession grants dating from at least ten years before the Project APD Start Date were selected using the criteria outlined in Step 1.3 of BL-PL and undertaking the analysis set forth in Step 1.3 above. Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI imagery were downloaded for three time-steps and visually analysed to determine if any areas were abandoned for forest regrowth. All 6 proxy areas showed clear signs of continued deforestation and plantation activities for all three time-steps. Furthermore, APRIL has “directly

applicable existing data” generated from its own and its supply partner’s operating records that show that none of the proxy areas have been abandoned. Additional verified management, operational and financial records are available to support this position. Therefore, the BL-PL module is applicable to this Project.

Step 1.6 - Annual area of deforestation

The annual rate of deforestation in the RER Project baseline is 7.82% over 8 years; although the annual deforestation in the baseline plan varies year on year to accommodate practical considerations of plantation development and on-the-ground constraints. The annual area of deforestation in the baseline can be validated using equation 5 in §1.6 of module BL-PL applied to both the baseline and the proxy areas.

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

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 , %

The annual baseline rate of deforestation of the Project is 7.82%, which is the average rate of deforestation of the proxy areas (7.82%) and within the lower range of deforestation rates of the 6 proxy areas; i.e., between 4.3% and 41.23%.

Table 43 - 8 Year Baseline Plantation Development Program

8 Year Plantation Development Program					
Year	Avoided planned deforestation area (ha)				
	Total	GAN	GCN	SMN	TBOT
2016	10,174	841	2,273	2,756	4,304
2017	10,174	841	2,273	2,756	4,304
2018	10,174	841	2,273	2,756	4,304
2019	10,174	841	2,273	2,756	4,304
2020	10,174	841	2,273	2,756	4,304
2021	10,174	841	2,273	2,756	4,304
2022	10,174	841	2,273	2,756	4,304
2023	7,179	593	1,604	1,944	3,037

Total APD area					
Total Non-forest planted area	30	0	24	2	3
Total Plantation development area	78,395	6,480	17,516	21,234	33,166
Buffer Zones	4,751	0	417	3,292	1,042

Part 2 - Baseline carbon stock change

The Project next applies *Part 2 – Baseline Carbon Stock Change* from BL-PL. For terrestrial carbon pools, stock changes in each pool are calculated by subtracting post-deforestation carbon stocks from forest carbon stocks using equations 6 to 11 also in Part 2 of BL-PL.

$$\Delta C_{ABtree,i} = C_{ABtree_{bsl},i} - C_{ABtree_{post},i}$$

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

$$\Delta C_{BBtree,i} = C_{BBtree_{bsl},i} - C_{BBtree_{post},i}$$

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

$$\Delta C_{DW,i} = C_{DW_{bsl},i} - C_{DW_{post},i}$$

$$\Delta C_{LI,i} = C_{LI_{bsl},i} - C_{LI_{post},i}$$

Where:

$\Delta C_{AB_tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{AB_tree,bal,i}$	Forest carbon stock in aboveground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{AB_tree,post,i}$	Post-deforestation carbon stock in aboveground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{BB_tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BB_tree,bal,i}$	Forest carbon stock in belowground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BB_tree,post,i}$	Post-deforestation carbon stock in belowground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{AB_non-tree,i}$	Baseline carbon stock change in aboveground non-tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{AB_non-tree,bal,i}$	Forest carbon stock in aboveground non-tree vegetation in stratum i ; t CO ₂ -e ha ⁻¹
$C_{AB_non-tree,post,i}$	Post-deforestation carbon stock in aboveground non-tree vegetation in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{BB_non-tree,i}$	Baseline carbon stock change in belowground non-tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BB_non-tree,bal,i}$	Forest carbon stock in belowground non-tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BB_non-tree,post,i}$	Post-deforestation carbon stock in belowground non-tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{DW,i}$	Baseline carbon stock change in dead wood in stratum i ; t CO ₂ -e ha ⁻¹
$C_{DW,bal,i}$	Forest carbon stock in dead wood in stratum i ; t CO ₂ -e ha ⁻¹
$C_{DW,post,i}$	Post-deforestation carbon stock in dead wood in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{LI,i}$	Baseline carbon stock change in litter in stratum i ; t CO ₂ -e ha ⁻¹
$C_{LI,bal,i}$	Forest carbon stock in litter in stratum i ; t CO ₂ -e ha ⁻¹
$C_{LI,post,i}$	Post-deforestation carbon stock in litter in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{SOC,i}$	Baseline carbon stock change in soil organic carbon in stratum i ; t CO ₂ -e ha ⁻¹
$C_{SOC,bal,i}$	Forest carbon stock in soil organic carbon in stratum i ; t CO ₂ -e ha ⁻¹
i	1, 2, 3, ... M strata

To calculate the emissions from deforestation we use the following approach: Determine the annual area of planned plantation development and associated deforestation for RWE+REDD and CIW+REDD baseline scenarios by land cover strata. The land-use change and associated deforestation for the whole project area are summarized in the table above.

Stock changes in above ground biomass are emitted at the time of deforestation. Following deforestation, emissions from below ground biomass are calculated as being emitted at an annual rate of 10% of stock change for 10 years, pursuant to equation 14 of BL-PL, as set forth below:.

$$\begin{aligned} \Delta C_{BSL,i,t} = & AA_{planned,i,t} \times (\Delta C_{AB_{tree,i}} - \Delta C_{WP,i} + \Delta C_{AB_{non-tree,i}} + \Delta C_{LI,i}) \\ & + \left(\sum_{t=10}^t AA_{planned,i,t} \right) \times (\Delta C_{BB_{tree,i}} + \Delta C_{BB_{non-tree,i}} + \Delta C_{DW,i}) * \left(\frac{1}{10} \right) \\ & + \left(\sum_{t=20}^t AA_{planned,i,t} \right) \times (C_{WP100,i}) * \left(\frac{1}{20} \right) \end{aligned}$$

Where:

$\Delta C_{BSL,i,t}$	Sum of the baseline carbon stock change in all terrestrial pools in stratum i in year t , t CO ₂ -e
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum i in year t ; ha
$C_{WP100,i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{AB_tree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{BB_tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{AB_non-tree,i}$	Baseline carbon stock change in aboveground non-tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{BB_non-tree,i}$	Baseline carbon stock change in belowground non-tree biomass in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{WP,i}$	Baseline carbon stock change in wood products in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{DW,i}$	Baseline carbon stock change in dead wood in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{LI,i}$	Baseline carbon stock change in litter in stratum i ; t CO ₂ -e ha ⁻¹
$\Delta C_{SOC,i}$	Baseline carbon stock change in soil organic carbon in stratum i ; t CO ₂ -e ha ⁻¹
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the projected start of the project activity

Note that wood products pool ($WP100$), non-tree vegetation/biomass($non-tree$), deadwood (DW), and litter (LI) are not included in the project.

Part 3 – Greenhouse gas emissions

In the RER Project, we do not include emissions from fossil fuel emissions or biomass burning. However, we assume that fertilizer will be applied to plantation areas in the baseline scenario only and assume that some N₂O emissions would occur. Nonetheless, as §5.4.2, Table 7 of REDD+ MF indicates, we should include N₂O as a carbon pool, but it may be excluded from the accounting if it is “excluded from the baseline” so long as fertilizer use is not enhanced as a leakage avoidance mechanism. As such §5, Part 3 of REDD+ MF Greenhouse Gas Emissions is not used.

5.1.1.3. Baseline Emissions Calculations for WRC (BL-PEAT)

The methods for assessing and estimating net carbon stock changes and assessing GHG emissions in the baseline scenario from peat or SOC in WRC activities, that is for RWE and CIW (i.e., all CIW activity is also APWD), are described in §5.2 through §5.5 of module BL-PEAT and are set forth below.

Area of drained peat at project commencement

At the commencement of the project, a total of 146 km of legacy canals were in place in the RER project area. This drained approximately 9,106.4 ha of peatland. The drainage status at the commencement of the project is described in §3.3.3.3 of the RER-CP VCS-PD entitled “Stratification of Drained Peat and Non-Drained Peatland”. These areas are stratified into RWE and RWE-REDD areas respectively and the areas are described below in sections 5.1.1.3.1 and 5.1.1.3.2 respectively.

Area of peat drained by plantation development

Table 44 - The dimensions and density of new canals created during the baseline development

Canal type	Density	Width	Area
	(m/ha)	(m)	(m ² /ha)
Main canal	1.87	12	22.14
Branch canal	12.12	7.64	92.57
Perimeter canal	0.50	5.42	2.71
Large field drains	12.50	2.00	25.00
Small field drains	53.33	1.2	64.00

Source: APRIL Planning Department

1. The development plan for the 4 concessions has been developed as one contiguous block and with an integrated operational plan. The plantation development is planned to cover 8 years, starting in the southern-central part of the concessions, and progressing south to north, and expanding east and west.
2. Division of the *Acacia* plantation area of each assumed agent's concession into 8 planting years (termed Blok RKT, *Rencana Kerja Tahunan*) over the four concessions, resulting in 20 Major blocks in the Project Area.
3. It is assumed all the natural forest areas within the development area will be clear-felled and developed into either plantation or infrastructure.

Table 45 - 8 Year Baseline Development Programme Areas area table

Block	Total (ha)	Conservation Area	8 Year Baseline Development Programme Areas (ha)								
			Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
PT. GAN	36,525	30,045	6,480	841	841	841	841	841	841	841	593
PT. GCN	20,123	2,583	17,516	2,273	2,273	2,273	2,273	2,273	2,273	2,273	1,604
PT. SMN	32,776	11,540	21,236	2,756	2,756	2,756	2,756	2,756	2,756	2,756	1,944
PT. TBOT	40,666	7,497	33,169	4,304	4,304	4,304	4,304	4,304	4,304	4,304	3,037
Total	130,090	51,664	78,425	10,174	10,174	10,174	10,174	10,174	10,174	10,174	7,179

Table 46 - Baseline Plantation canals and Drains area table

Year	Legacy Canals		Plantation Canals and Drains						All Canals and Drains	
	Length	Area	Main canals	Branch canals	Perimeter canals	Large field drains	Small field drains	Area	Length	Area
	(km)	(ha)	(km)						(km)	(ha)
2016	121.2	2.4	28.2	182.8	7.5	188.5	804.2	31.7	1,332.3	34.1
2017	91.6	1.8	54.7	355.4	14.6	366.4	1,563.5	61.2	2,446.2	63.0
2018	57.6	1.2	84.3	547.4	22.6	564.4	2,408.3	94.0	3,684.6	95.2
2019	36.7	0.7	114.4	742.6	30.6	765.7	3,267.1	127.0	4,957.1	127.8
2020	2.4	0.0	141.9	921.2	38.0	949.9	4,053.0	157.7	6,106.4	157.8

Emission Formulas for RWE and CIW Calculations

The formulas used to calculate baseline emissions are derived from the modules BL-PL and BL-PEAT.

Total baseline emissions from peatlands (WRC)

The baseline net GHG emissions from peatlands for SOC, without any REDD (i.e., APD) activity in the baseline are calculated using equations 1 - 4 of BL-PEAT.

$$GHG_{BSL-PEAT} = \sum_{t=1}^{t^*} \sum_{i=1}^M (A_{peatsoil-BSL,i,t} \times GHG_{peatsoil-BSL,i,t} + A_{ditch-BSL,i,t} \times GHG_{peatditch-BSL,i,t} + A_{peatburn-BSL,i,t} \times GHG_{peatburn-BSL,i,t})$$

Where:

$GHG_{BSL-PEAT}$	Net GHG emissions in the WRC baseline scenario on peatland up to year t^* (t CO ₂ e)
$GHG_{peatsoil-BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{peatditch-BSL,i,t}$	GHG emissions from water bodies in the baseline scenario in stratum i at year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{peatburn-BSL,i,t}$	GHG emissions from burning of peat in the base line scenario in stratum i at year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$A_{peatsoil-BSL,i,t}$	Area of peatland (not open water, not burnt) in stratum i in year t in the baseline scenario (ha)
$A_{ditch-BSL,i,t}$	Area of ditch and other open water in stratum i in year t in the baseline scenario (ha)
$A_{peatburn-BSL,i,t}$	Area of peat burnt in stratum i in year t in the baseline scenario (ha)
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 applies:

$$GHG_{peatsoil-BSL,i,t} = 0$$

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

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

Where:

$t_{PDT-BSL,i}$	Peat Depletion Time in the baseline scenario in stratum i in years elapsed since the project start; estimated in Module X-STR (yr)
$GHG_{peatsoil-BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{peatditch-BSL,i,t}$	GHG emissions from water bodies at year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{peatburn-BSL,i,t}$	GHG emissions from burning of peat in the base line scenario in stratum i at year t (t CO ₂ e ha ⁻¹ 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)

In this baseline, we include net GHG emissions from peatland degradation and from ditches. We do not include emissions from peat burning because it is considered optional²⁰.

Baseline emissions due to peat drainage (CIW/APWD)

The Project assumed that the annual rate of conversion of undrained peatland in the baseline scenario was at a fixed rate as set out above in MR Table 45 – 8 Year Baseline Development Programme.

The Project then calculated the baseline GHG emissions for each unique emissions stratum. This was done by applying the scientifically robust and conservative IPCC (TIER 1) default emission factor for each stratum, using the equations as defined by VMD0042-BL-PEAT and the IPCC's 2013 Wetlands Supplement²¹.

To calculate GHG baseline emissions from each emission stratum, the equation was analogously derived from VMD0042-BL-PEAT equation 6 because $GHG_{peatsoil\ BSL,i,t} = GHG_{proxy\ BSL,i,t}$ as set out in equation 5 of BL-PEAT. The following equation was used:

$$GHG_{peatsoil\ BSL,i,t} = GHG_{peatsoil\ BSL\ CO_2,i,t} + GHG_{peatsoil\ BSL\ CH_4,i,t}$$

Where:

$GHG_{peatsoil\ BSL\ CO_2,i,t}$	CO ₂ emissions from peatsoil within the project's boundaries in the hypothetical baseline scenario in stratum <i>i</i> at year <i>t</i> (tCO ₂ e yr ⁻¹).
$GHG_{peatsoil\ BSL\ CH_4,i,t}$	CH ₄ emissions from peatsoil within the project's boundaries in the baseline scenario in stratum <i>i</i> at year <i>t</i> (tCO ₂ e yr ⁻¹).
<i>i</i>	1,2,3 <i>M_{BSL}</i> strata in the baseline scenario (unitless)
<i>t</i>	1,2,3 <i>t</i> * time elapsed since the project start (yr)

The Project calculated the CO₂ emissions component for each emission stratum of the peatsoil within the project's boundaries for areas converted to plantations using an equation derived from the IPCC²²:

$$GHG_{peatsoil\ BSL\ CO_2,i,t} = A_{i,t} * EF_{CO_2,i,t}$$

Where:

$GHG_{peatsoil\ BSL\ CO_2,i,t}$	CO ₂ emissions from peatsoil within the project's boundaries in the hypothetical baseline scenario in stratum <i>i</i> at year <i>t</i> (tCO ₂ e yr ⁻¹)
$A_{i,t}$	Area of stratum <i>i</i> , at time <i>t</i> (ha)
$EF_{CO_2,i,t}$	Emission factor for CO ₂ emissions which corresponds appropriate stratum <i>i</i> , as provided by IPCC (tCO ₂ e yr ⁻¹)
<i>i</i>	1,2,3 <i>M_{BSL}</i> strata in the baseline scenario (unitless)
<i>t</i>	1,2,3 <i>t</i> * time elapsed since the project start (yr)

The Project calculated the CH₄ emissions component for each stratum of the peatsoil within the project's boundaries for areas converted to plantations using an equation derived from the IPCC²³:

$$GHG_{peatsoil-BSL-CH_4,i,t} = A_{i,t} * (GWP_{CH_4} * EF_{CH_4,i,t})$$

Where

$GHG_{peatsoil-BSL-CH_4,i,t}$	CO ₂ emissions from peatsoil within the project's boundaries in the hypothetical baseline scenario in stratum i at year t (tCO ₂ e yr ⁻¹)
$A_{i,t}$	Area of stratum i, at time t (ha)
GWP_{CH_4}	Global warming potential for CH ₄
$EF_{CH_4,i,t}$	Emission factor for CH ₄ emissions which corresponds appropriate stratum i, as provided by IPCC (tCO 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)

The annual emissions of CO₂ and CH₄ from drained peat soil are estimated using the IPCC allometrics.

Table 47 - Emission factors from drained peat soil

Land Use	GHG	Emission factor	
Fully drained peatland areas	CO ₂ -C	20	tonnes CO ₂ -C ha ⁻¹ yr ⁻¹ *
	CH ₄	2.7	kg CH ₄ ha ⁻¹ yr ⁻¹ **
Source: Table 2.1 from 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland. * To convert to t.CO ₂ -e apply the C; CO ₂ ratio of 44/12 (see RER Monitoring Model.xlsx in the Peatlands Allometrics tab) ** To convert to CO ₂ -e divide by 1000 and multiply by the CH ₄ 's GWP of 28 (see RER Monitoring Model.xlsx in the Peatlands Allometrics tab)			

Baseline Rate of Peatloss

The rate of peat loss due to subsidence was algebraically derived from VMD0016-X-STR, equation 18. The annual rate of peat carbon stock loss due to subsidence in the baseline scenario, $Rate_{peatloss-BSL}$ was quantified annually based on the rate of emissions from peat degradation, the bulk density of peat above water table and the carbon content value. The Project used a conservative value of 0.09 g/cm³ for bulk density of the peat above water table per Hooijer *et al*, 2012²⁴, while the carbon content value of 56% was derived from Page *et al*, 2011²⁵. The cumulative soil organic carbon loss due to subsidence derived from the IPCC default CO₂ emission factor for drained peat soil (20 t CO₂-C ha⁻¹ yr⁻¹)²⁶:

$$Rate_{peatloss-BSL,i,t} = \frac{C_{loss,BSL,CO_2}}{BD_{BSL,i,t} * C_C * 10}$$

Where:

$Rate_{peatloss-BSL,i,t}$	Rate of peatloss due to subsidence in the baseline scenario in stratum i at year t ($m\ yr^{-1}$)
$C_{loss_BSL,i,t}$	Cumulative soil organic carbon loss (in peatlands: due to subsidence) in the baseline scenario ($t\ C\ ha^{-1}$)
$BD_{BSL,i,t}$	Bulk density of peat soil above water table in baseline scenario in stratum i at year t ($kg\ m^{-3}$)
C_c	Carbon content of peat soil ($kg\ kg^{-1}$)

The Project as noted above used the following values:

$C_{loss,BSL,CO_2} = IPCC\ default\ CO_2\ emission\ factor = 20\ t\ CO_2-C\ ha^{-1}\ yr^{-1}$

$BD_{BSL,i,t} = 0.09\ g/cm^3 = 90\ kg/m^3$

$C_c = 56\%$

Such that for the RER Project:

$$Rate_{peatloss-BSL,i,t} = \frac{20}{90 \times 56\% \times 10} = 0.0397\ m\ yr^{-1}$$

See also above at table 47.

Baseline GHG emissions due to ditches and other open water bodies in peatlands (RWE)

GHG emissions from ditches and other water bodies in the baseline are derived on the basis of ditched area and area of open water combined with an emission factor as per equation 7 of BL-PEAT:

$$GHG_{peatditch-BSL,i,t} = GHG_{peatditch-CO_2,i,t} + GHG_{peatditch-CH_4,i,t}$$

Where:

$GHG_{peatditch-BSL,i,t}$	GHG emissions from ditch and other open water stratum i at year t in the baseline scenario ($t\ CO_2e\ ha^{-1}yr^{-1}$)
$GHG_{peatditch-CO_2,i,t}$	Emission of CO_2 from ditch and open water stratum i at year t in the baseline scenario ($t\ CO_2e\ ha^{-1}yr^{-1}$)
$GHG_{peatditch-CH_4,i,t}$	Emission of CH_4 from ditch and open water stratum i at year t in the baseline scenario ($t\ CO_2e\ ha^{-1}yr^{-1}$)
i	1, 2, 3 ... M_{BSL} strata ⁶ in the baseline scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (yr)

The annual emissions of dissolved organic carbon (DOC) and CH_4 from ditches and other open water bodies are estimated using IPCC allometrics.

Table 48 - Emission factors from surface area of canals

Land Use	GHG	Emission Factor	
	Degradation	CH ₄	2,259
Surface area of canals	Dissolved Organic Carbon	DOC	0.82
	Table 2.2 of the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland		

DOC is then converted to CO₂-e by multiplication using the CO₂ to molecular C conversion factor of 3.667²⁷.

5.1.3.1. Baseline Emissions Calculations for RWE

Baseline emissions from peat soils (SOC) for RWE (i.e., APWD) are calculated using equations 1, 6 and 7 of BL-PEAT.

Baseline emissions from peat drainage

Areas of drained land and surface areas of drains in the baseline

The RWE activity encompasses landscapes that have been drained by legacy canals and which will be rewetted by a program of canal blocking. There is no planned deforestation under this scenario because the areas are either in non-forest or are forested without any planned deforestation.

Under the baseline, the canals would have been retained (in contrast to blocking under the project scenario) resulting in peat soil GHG emissions from peatland degradation and GHG emissions from drains. This means under the baseline, emissions ascribed to legacy canals are reduced as the plantation are progressively developed between 2016 and 2022. The legacy canals and the associated drained areas are then replaced by emissions from plantation canals and their associated drained areas. However, the surface area of legacy canals are not used for baseline calculations, except in that when they are areas used in the baseline and included as part of the water table management activity. Therefore, they are used for a reference but are not used for actual baseline emission calculations. Nonetheless, in the project scenario, the legacy canals, although blocked, do in fact have some limited emission.

The area of drained peatland in the RWE activity is 2,478.6 hectares per year.

Table 49 - Areas of drained land and surface areas of drains in the baseline; used in equation 1 of VMD0042 (BL-PEAT).

Year	Drained area estimates ($A_{\text{peatsoil-BSL},i,t}$)	
	Area drained by legacy canals	Area drained by plantation canals
2016	2,479	0
2017	2,479	0
2018	2,479	0
2019	2,479	0
2020	2,479	0

The surface area of the canals in RWE activity is as follows:

Table 50 - Canal surface area statistics; used in equation 1 of VMD0042 (BL-PEAT).

Year	Surface area of drainage canals (ha) ($A_{\text{ditch-BSL},i,t}$)	
	Surface Area of Legacy Canals (ha)	Surface Area of Plantation Canals (ha)
2016	7.5	0.0
2017	7.5	0.0
2018	7.5	0.0
2019	7.5	0.0
2020	7.5	0.0

Emissions from peat soil

Table 51 - Baseline GHG emissions from peat soils

Baseline GHG emissions from peat soils ($\text{GHG}_{\text{proxy-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{proxy-BSL},i,t}$)	CO ₂ -C (t CO ₂ -e) ($\text{GHG}_{\text{proxy-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{proxy-CH}_4,i,t}$)
2016	181,966	181,779	187
2017	181,966	181,779	187
2018	181,966	181,779	187
2019	181,966	181,779	187
2020	181,966	181,779	187

Baseline GHG emissions from ditches and other open water bodies in peatlands

Table 52 - Baseline GHG emissions from ditches and other open water bodies in peatlands; derived from BL-PEAT equation 7 of VMD0042 (BL-PEAT).

Baseline GHG emissions from ditches and other open water bodies in peatlands ($\text{GHG}_{\text{peatditch-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-BSL},i,t}$)	DOC (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CH}_4,i,t}$)
2016	498	23	475
2017	498	23	475
2018	498	23	475
2019	498	23	475
2020	498	23	475

Baseline emissions from peat burning

Emissions from peat burning are excluded from the baseline assessment as there is no significant history or threat of peat or biomass burning in the baseline period. The Project notes that §5.4.4, Table 9 of REDD+ MF also indicates that “it is conservative to exclude” such emissions (see also in this Monitoring Report, endnote no. 10).

5.1.3.2. Baseline Emissions Calculations for RWE+REDD

Baseline emissions from REDD

Baseline emissions for REDD are calculated using equations 5, 6 & 8 of BL-PL. Baseline emissions from peat soils (SOC) for RWE are calculated using equations 1 & 7 of BL-PEAT.

Area of land deforested in baseline

The RWE+REDD activity encompasses landscapes that have been drained by legacy canals and which will be rewetted by a program of canal blocking. 100% of the RWE+REDD area will have planned deforestation under this scenario.

The area of land planned for deforestation and conversion to plantations under RWE+REDD is 6,627.8 hectares.

Table 53 - Areas converted to plantations by land cover and year in the 8 year baseline; used in equation 5 of VMD0006 (BL-PL).

Land Cover Strata	Areas converted to plantations by land cover and year in the 8 year baseline (A _{planned,i})								
	Planting Year								
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Peat dome	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.8
Dense swamp forest	143.0	143.0	143.0	143.0	143.0	143.0	143.0	100.9	1,102.2
Medium swamp forest	345.8	345.8	345.8	345.8	345.8	345.8	345.8	244.0	2,664.7
Sparse swamp forest	371.0	371.0	371.0	371.0	371.0	371.0	371.0	261.8	2,859.1
Non-forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Body	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	860.1	860.1	860.1	860.1	860.1	860.1	860.1	606.9	6,627.8

The annual areas of land planned for deforestation and conversion to plantations under RWE+REDD were calculated by concession license as shown in the table below:

Table 54 - Areas converted to plantations by concession, land cover and year in 8 year RWE+REDD scenarios; used in equation 5 of VMD0006 (BL-PL).

Concession	Land Cover Strata	Areas converted to plantations by concession, land cover and year ($A_{planned,i}$)								
		Planting Year								
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
PT GAN	Peat dome	0	0	0	0	0	0	0	0	0
	Dense swamp forest	4.5	4.5	4.5	4.5	4.5	4.5	4.5	3.2	34.8
	Medium swamp forest	10.9	10.9	10.9	10.9	10.9	10.9	10.9	7.7	83.7
	Sparse swamp forest	76.8	76.8	76.8	76.8	76.8	76.8	76.8	54.2	592.1
	Non-forest	0	0	0	0	0	0	0	0	0
PT GCN	Dense swamp forest	106.8	106.8	106.8	106.8	106.8	106.8	106.8	75.4	823.2
	Medium swamp forest	82.2	82.2	82.2	82.2	82.2	82.2	82.2	58	633.2
	Sparse swamp forest	78.3	78.3	78.3	78.3	78.3	78.3	78.3	55.2	603.1
	Non-forest	0	0	0	0	0	0	0	0	0
	Water Body	0	0	0	0	0	0	0	0	0
PT SMN	Dense swamp forest	31.2	31.2	31.2	31.2	31.2	31.2	31.2	22	240.1
	Medium swamp forest	200.1	200.1	200.1	200.1	200.1	200.1	200.1	141	1,542.2
	Sparse swamp forest	119.8	119.8	119.8	119.8	119.8	119.8	119.8	84.5	923.2
	Non-forest	0	0	0	0	0	0	0	0	0
	Water Body	0	0	0	0	0	0	0	0	0
PT TBOT	Peat dome	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.8
	Dense swamp forest	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	4.2
	Medium swamp forest	52.6	52.6	52.6	52.6	52.6	52.6	52.6	37.1	405.7
	Sparse swamp forest	96.1	96.1	96.1	96.1	96.1	96.1	96.1	67.8	740.8
	Non Forest	0	0	0	0	0	0	0	0	0
	Water Body	0	0	0	0	0	0	0	0	0
Total		860.1	860.1	860.1	860.1	860.1	860.1	860.1	606.9	6,627.8

Changes in terrestrial above ground tree carbon pools in the baseline

The carbon stock changes in above ground biomass are calculated according to the methods described in Section 5.1.1.2 above and summarized in the table below.

Table 55 - Above ground tree carbon stock in the baseline; used in equation 6 of VMD0006 (BL-PL).

Above ground tree carbon stock in the baseline ($C_{AB_tree_bsl,i}$)							
Year	Above ground tree biomass in baseline ($C_{AB_tree_bsl,i}$)				Baseline carbon stock change in above ground biomass		
	Peat dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	AGB (t. d.m.)	C (t)	CO ₂ -e (t) ($\Delta C_{AB_tree_bsl,i}$)
2016	241	103,129	162,136	88,623	52,811	24,821	91,019
2017	205	87,749	137,957	75,406	52,811	24,821	91,019
2018	169	72,370	113,777	62,190	52,811	24,821	91,019
2019	133	56,990	89,598	48,974	52,811	24,821	91,019
2020	97	41,611	65,419	35,758	52,811	24,821	91,019
Total					264,054	124,105	455,094

Changes in terrestrial below ground tree carbon pools in the baseline

The carbon stock changes in below ground biomass are calculated according to the methods described in Section 5.1.1.2 and summarized in the table below.

Table 56 - Below ground tree carbon stock in the baseline; used in equation 8 of VMD0006 (BL-PL).

Below ground tree carbon stock in the baseline ($C_{BB_tree_bsl,i}$)							
Year	Below ground tree biomass in baseline ($C_{BB_tree_bsl,i}$)				Baseline carbon stock change in below ground biomass		
	Peat dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	BGB (t)	C (t)	CO ₂ -e (t) ($\Delta C_{BB_tree_bsl,i}$)
2016	73	31,496	45,779	25,023	15,267	7,175	26,312
2017	63	26,799	38,952	21,291	15,267	7,175	26,312
2018	52	22,102	32,125	17,560	15,267	7,175	26,312
2019	41	17,405	25,298	13,828	15,267	7,175	26,312
2020	30	12,708	18,471	10,096	15,267	7,175	26,312
Total					76,333	35,876	131,559

Greenhouse Gas Emissions from deforestation in the baseline

The Project has followed the requirements of §5.4.2 of REDD+ MF and included N₂O as a carbon pool because of the potential for nitrogen fertilizer application in the baseline scenario. However, because no nitrogen fertilizer application occurs in the project scenario, it has been excluded from the GHG emission reduction accounting as suggested in §5.4.2, Table 7 of REDD+ MF.

Baseline emissions from peat soils

Areas of drained land and surface areas of drains in the baseline

The RWE+REDD activity encompasses landscapes that have been drained by legacy canals and which will be rewetted by a program of canal blocking.

Under the baseline, the legacy canals will be replaced by a plantation drainage canals (in contrast to blocking under the project scenario) resulting in continued peat soil GHG emissions from peatland degradation and GHG emissions from drains.

The annual areas area of land planned for deforestation and conversion to plantations under RWE+REDD is 6,627.8 hectares.

Table 57 - Drained area estimates of legacy & plantation canals; used in equation 1 of VMD0042 (BL-PEAT).

Year	Drained area estimates (ha) ($A_{\text{peatsoil-BSL},i,t}$)	
	Area drained by legacy canals	Area drained by plantation canals
2016	5,505	1,122
2017	4,160	2,468
2018	2,626	4,002
2019	1,671	4,956
2020	111	6,517

The surface area of the canals in RWE+REDD activity is as follows:

Table 58 - Canal surface area statistics; used in equation 1 of VMD0042 (BL-PEAT).

Year	Surface area of drainage canals (ha) ($A_{\text{ditch-BSL},i,t}$)	
	Surface Area of Legacy Canals (ha)	Surface Area of Plantation Canals (ha)
2016	18.9	1.8
2017	16.1	3.6
2018	13.2	5.3
2019	10.4	7.1
2020	7.6	8.9

Baseline emissions from peat soil

Table 59 - Baseline GHG emissions from peat soils

Baseline GHG emissions from peat soils (GHG _{proxy-BSL,i,t})			
Year	Total GHG (t CO ₂ -e) (GHG _{proxy-BSL,i,t})	CO ₂ -C (t CO ₂ -e) (GHG _{proxy-CO2,i,t})	CH ₄ (t CO ₂ -e) (GHG _{proxy-CH4,i,t})
2016	486,587	486,086	501
2017	486,587	486,086	501
2018	486,587	486,086	501
2019	486,587	486,086	501
2020	486,587	486,086	501

Baseline GHG emissions from ditches and other open water bodies in peatlands

Table 60 - Baseline GHG emissions from ditches and other open water bodies in peatlands; derived from BL-PEAT equation 7 of VMD0042 (BL-PEAT).

Baseline GHG emissions from ditches and other open water bodies in peatlands (GHG _{peatditch-BSL,i,t})			
Year	Total GHG (t CO ₂ -e) (GHG _{peatditch-BSL,i,t})	DOC (t CO ₂ -e) (GHG _{peatditch-CO2,i,t})	CH ₄ (t CO ₂ -e) (GHG _{peatditch-CH4,i,t})
2016	1,368	62	1,306
2017	1,300	59	1,241
2018	1,231	56	1,175
2019	1,162	53	1,109
2020	1,093	50	1,044

Baseline emissions from peat burning

Emissions from peat burning are excluded from the baseline assessment as there is no significant history or threat of peat or biomass burning in the baseline period. The Project notes again that §5.4.4, Table 9 of REDD+ MF, indicates that “it is conservative to exclude” such emissions.

5.1.3.3. Baseline Emissions Calculations for CIW

Baseline emissions from peat soils (SOC) for CIW (i.e., APWD) are calculated using equations 1, 6 and 7 of BL-PEAT respectively.

Baseline emissions from peat soils

Areas of drained land and surface areas of drains in the baseline

The CIW activity encompasses landscapes that are undrained and which will be avoiding drainage under the Project. The area has no forest cover and is therefore ineligible for REDD.

Under the baseline, canals will be built and the area will be drained, resulting in peat soil GHG emissions from peatland degradation and GHG emissions from drains.

The area of avoided wetland drainage in the CIW activity is 5.1 hectares.

The length of canals and the surface area of the canals from avoided wetland drainage in CIW activity is as follows:

Table 61 - Areas of drained land and surface areas of drains; used in equation 1 of VMD0042 (BL-PEAT).

Year	Drained area estimates (ha) ($A_{\text{peatsoil-BSL},i,t}$)	
	Area drained by legacy canals	Area drained by plantation canals
2016	0	0.25
2017	0	1.63
2018	0	3.25
2019	0	3.25
2020	0	5.12

The surface area of the canals in CIW activity is as follows:

Table 62 - Canal surface area statistics; used in equation 1 of VMD0042 (BL-PEAT).

Year	Surface area of drainage canals (ha) ($A_{\text{ditch-BSL},i,t}$)	
	Surface Area of Legacy Canals (ha)	Surface Area of Plantation Canals (ha)
2016	0	0.00
2017	0	0.00
2018	0	0.00
2019	0	0.01
2020	0	0.01

Baseline emissions from peat soil

Table 63 - Baseline GHG emissions from peat soils

Baseline emissions from peat soil Baseline GHG emissions from peat soils ($\text{GHG}_{\text{proxy-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{proxy-BSL},i,t}$)	CO ₂ -C (t CO ₂ -e) ($\text{GHG}_{\text{proxy-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{proxy-CH}_4,i,t}$)
2016	49	49	0
2017	97	97	0
2018	146	146	0
2019	195	195	0
2020	244	243	0

Baseline GHG emissions from ditches and other open water bodies in peatlands

Table 64 - Baseline GHG emissions from ditches and other open water bodies in peatlands; derived from equations 1 and 7 of VMD0042 (BL-PEAT) respectively.

Baseline GHG emissions from ditches and other open water bodies in peatlands ($\text{GHG}_{\text{peatditch-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-BSL},i,t}$)	DOC (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CH}_4,i,t}$)
2016	0.1	0.0	0.1
2017	0.2	0.0	0.2
2018	0.3	0.0	0.3
2019	0.4	0.0	0.3
2020	0.5	0.0	0.4

Baseline emissions from peat burning

Emissions from peat burning are excluded from the baseline assessment as there is no significant history or threat of peat or biomass burning in the baseline period. As noted above, REDD+ MF indicates that “it is conservative to exclude” such emissions.

5.1.3.4. Baseline Emissions Calculations for CIW+REDD

Baseline emissions for REDD are calculated using equations 5, 6 and 8 of BL-PL. Baseline emissions from peat soils (SOC) for CIW are calculated using equations 1, 6 and 7 of BL-PEAT.

Baseline emissions from REDD

Area of land deforested in the baseline

The CIW+REDD activity encompasses landscapes that are undrained and which 100% of the area will be avoiding wetland drainage and avoiding deforestation under the project.

The total area of land planned for drainage, deforestation and conversion to plantations under RWE+REDD is 71,768.0 hectares. The area of land planned for deforestation and conversion to plantations under CIW+REDD is shown in the table below.

Table 65 - Areas converted to plantations by land cover and year in the 8 year baseline used in equation 5 of VMD0006 (BL-PL).

Land Cover Strata	Areas converted to plantations by land cover and year in the 8 year Baseline ($A_{\text{planned},i}$)								
	Planting Year								
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Peat dome	119.5	119.5	119.5	119.5	119.5	119.5	119.5	84.3	920.9
Dense swamp forest	1,821.2	1,821.2	1,821.2	1,821.2	1,821.2	1,821.2	1,821.2	1,285.1	14,033.7
Medium swamp forest	5,412.6	5,412.6	5,412.6	5,412.6	5,412.6	5,412.6	5,412.6	3,819.2	41,707.6
Sparse swamp forest	1,960.4	1,960.4	1,960.4	1,960.4	1,960.4	1,960.4	1,960.4	1,383.2	15,105.8
Non-forest	0	0	0	0	0	0	0	0	0
Water Body	0	0	0	0	0	0	0	0	0
Total	9,313.7	9,313.7	9,313.7	9,313.7	9,313.7	9,313.7	9,313.7	6,571.8	71,768.0

The annual areas of land planned for deforestation and conversion to plantations under CIW+REDD by concession license are shown in the table below:

Table 66 - Areas converted to plantations by concession, land cover and year (in the 8 year baseline); used in equation 5 of VMD0006 (BL-PL).

Concession	Land Cover Strata	Areas converted to plantations by concession, land cover and year ($A_{planned,i}$)								
		Planting Year								
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
PT GAN	Peat dome	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.7	18.8
	Dense swamp forest	116.6	116.6	116.6	116.6	116.6	116.6	116.6	82.3	898.8
	Medium swamp forest	398.6	398.6	398.6	398.6	398.6	398.6	398.6	281.2	3,071.2
	Sparse swamp forest	231.1	231.1	231.1	231.1	231.1	231.1	231.1	163	1,780.4
	Non-forest	0	0	0	0	0	0	0	0	0
PT GCN	Dense swamp forest	1,035.0	1,035.0	1,035.0	1,035.0	1,035.0	1,035.0	1,035.0	730.3	7,975.4
	Medium swamp forest	762	762	762	762	762	762	762	537.7	5,872.1
	Sparse swamp forest	208.9	208.9	208.9	208.9	208.9	208.9	208.9	147.4	1,609.5
	Non-forest	0	0	0	0	0	0	0	0	0
	Water Body	0	0	0	0	0	0	0	0	0
PT SMN	Dense swamp forest	473.9	473.9	473.9	473.9	473.9	473.9	473.9	334.4	3,651.6
	Medium swamp forest	1,753.8	1,753.8	1,753.8	1,753.8	1,753.8	1,753.8	1,753.8	1,237.5	13,513.8
	Sparse swamp forest	176.9	176.9	176.9	176.9	176.9	176.9	176.9	124.8	1,363.0
	Non-forest	0	0	0	0	0	0	0	0	0
	Water Body	0	0	0	0	0	0	0	0	0
PT TBOT	Peat dome	117.1	117.1	117.1	117.1	117.1	117.1	117.1	82.6	902.1
	Dense swamp forest	195.7	195.7	195.7	195.7	195.7	195.7	195.7	138.1	1,508.0
	Medium swamp forest	2,498.3	2,498.3	2,498.3	2,498.3	2,498.3	2,498.3	2,498.3	1,762.8	19,250.6
	Sparse swamp forest	1,343.6	1,343.6	1,343.6	1,343.6	1,343.6	1,343.6	1,343.6	948	10,352.9
	Non Forest	0	0	0	0	0	0	0	0	0
	Water Body	0	0	0	0	0	0	0	0	0
Total		9,313.7	9,313.7	9,313.7	9,313.7	9,313.7	9,313.7	9,313.7	6,571.8	71,768.0

Changes in terrestrial above ground tree carbon pools in the baseline

The carbon stock changes in above ground biomass are calculated according to the methods described above in Section 5.1.1.2 and summarized in the table below.

Table 67 - Changes in above ground tree carbon stock in the baseline; used in equation 6 of VMD0006 (BL-PL).

Above ground tree carbon stock in the baseline ($C_{AB_tree_bsl,i}$)							
Year	Above ground tree biomass in baseline ($C_{AB_tree_bsl,i}$)				Baseline carbon stock change in above ground biomass		
	Peat dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	AGB (t)	C (t)	CO ₂ -e (t) ($\Delta C_{AB_tree_bsl,i}$)
2016	125,428	1,313,074	2,537,703	468,226	662,793	311,513	1,142,318
2017	106,723	1,117,257	2,159,258	398,400	662,793	311,513	1,142,318
2018	88,018	921,440	1,780,813	328,574	662,793	311,513	1,142,318
2019	69,313	725,622	1,402,368	258,748	662,793	311,513	1,142,318
2020	50,608	529,805	1,023,923	188,922	662,793	311,513	1,142,318
Total					3,313,967	1,557,564	5,711,589

Changes in terrestrial below ground tree carbon pools in the baseline

The carbon stock changes in below ground biomass are calculated according to the methods described in Section 5.1.1.2 and summarized in the table below.

Table 68 - Changes in below ground tree carbon stock in the baseline; used in equation 8 of VMD0006 (BL-PL).

Below ground tree carbon stock in the baseline ($C_{BB_tree_bsl,i}$)							
Year	Below ground tree biomass in baseline ($C_{BB_tree_bsl,i}$)				Baseline carbon stock change in below ground biomass		
	Peat dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	BGB (t)	CO ₂ -C (t)	CO ₂ -e (t) ($\Delta C_{BB_tree_bsl,i}$)
2016	38,306	401,016	716,528	132,205	192,086	90,281	331,059
2017	32,594	341,213	609,673	112,489	192,086	90,281	331,059
2018	26,881	281,410	502,818	92,774	192,086	90,281	331,059
2019	21,168	221,607	395,963	73,058	192,086	90,281	331,059
2020	15,456	161,804	289,108	53,343	192,086	90,281	331,059
Total					960,431	451,403	1,655,294

Greenhouse Gas Emissions from REDD in the baseline

The Project has followed the requirements of §5.4.2 of REDD+ MF and included N₂O as a carbon pool because of the potential for nitrogen fertilizer application in the baseline scenario. However, because no nitrogen fertilizer application occurs in the project scenario, it has been excluded from the GHG emission reduction accounting as suggested in §5.4.2, Table 7 of REDD+ MF.

Baseline emissions from peat

Areas of drained land and surface areas of drains in the baseline

The CIW+REDD activity encompasses landscapes that are undrained, and which will be avoiding drainage under the project. The area has forest cover which will be 100% cleared for plantation development.

Under the baseline, canals will be built, and the area drained resulting in peat soil GHG emissions from peatland degradation and GHG emissions from drains.

The area of avoided wetland drainage in the CIW+REDD activity is 71,768.0 hectares.

The length of canals and the surface area of the canals from avoided wetland drainage in CIW+REDD activity is as follows:

Table 69 - Drained area estimates of legacy & plantation canals; used in equation 1 of VMD0042 (BL-PEAT).

Year	Drained area estimates (ha) ($A_{\text{peatsoil-BSL},i,t}$)	
	Area drained by legacy canals	Area drained by plantation canals
2016	0	13,947
2017	0	26,835
2018	0	41,126
2019	0	56,274
2020	0	69,447

The surface area of the canals in CIW+REDD activity is as follows:

Table 70 - Canal surface area statistics; derived from equation 1 of VMD0042 (BL-PEAT).

Year	Surface area of drainage canals (ha) ($A_{\text{ditch-BSL},i,t}$)	
	Surface Area of Legacy Canals (ha)	Surface Area of Plantation Canals (ha)
2016	0	19.2
2017	0	38.5
2018	0	57.7
2019	0	77.0
2020	0	96.2

Baseline emissions from peat soil

Table 71 - Baseline GHG emissions from peat soils

Baseline GHG emissions from peat soils ($GHG_{\text{proxy-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($GHG_{\text{proxy-BSL},i,t}$)	CO ₂ -C (t CO ₂ -e) ($GHG_{\text{proxy-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($GHG_{\text{proxy-CH}_4,i,t}$)
2016	683,774	683,070	704
2017	1,367,548	1,366,140	1,408
2018	2,051,323	2,049,210	2,112
2019	2,735,097	2,732,280	2,816
2020	3,418,871	3,415,350	3,521

Baseline GHG emissions from ditches and other open water bodies in peatlands

Table 72 - Baseline GHG emissions from ditches and other open water bodies in peatlands; derived from equation 7 of VMD0042 (BL-PEAT) and used in equation 1 of PL-PEAT.

Baseline GHG emissions from ditches and other open water bodies in peatlands ($\text{GHG}_{\text{peatditch-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-BSL},i,t}$)	DOC (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CH}_4,i,t}$)
2016	1,275	58	1,218
2017	2,551	116	2,435
2018	3,826	174	3,653
2019	5,102	232	4,870
2020	6,377	289	6,088

Baseline emissions from peat burning

Emissions from peat burning are excluded from the baseline assessment as there is no significant history or threat of peat or biomass burning in the baseline period. In §5.4.4, Table 9 of REDD+ MF, it states that “it is conservative to exclude” such emissions.

5.1.2. Total Baseline Emissions – All Activities

Total Baseline emissions for REDD are calculated using equations 5, 6, 8 and 14 of BL-PL. Total Baseline emissions from peat soils (SOC) for CIW and RWE are calculated using equations 1, 6 and 7 of BL-PEAT.

Area of land deforested in baseline

Table 73 - Annual areas converted to plantations by land cover and year in the 8 year baseline, used inequation 5 of VMD0006 (BL-PL).

[illegible]

The annual areas of land planned for deforestation and conversion to plantations under RWE+REDD were calculated by concession license are shown in the table below:

Table 74 - Areas converted to plantations by concession, land cover and year in the 8 year baseline, used in equations 5 of VMD0006 (BL-PL).

[illegible]

Changes in terrestrial above ground tree carbon pools in the baseline

The carbon stock changes in above ground biomass are calculated according to the methods described in Section 5.1.1.2 and summarized in the table below.

Table 75 - Changes in Above ground tree carbon stock in the baseline, used in equations 6 of VMD0006 (BL-PL).

Above ground tree carbon stock in the baseline ($C_{AB_tree_bsl,i}$)							
Year	Above ground tree biomass in baseline ($C_{AB_tree_bsl,i}$)				Baseline carbon stock change in above ground biomass		
	Peat dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	AGB (t)	CO ₂ -C (t)	CO ₂ -e (t) ($\Delta C_{AB_tree_bsl,i}$)
2016	125,669	1,416,203	2,699,839	556,848	715,604	336,334	1,233,337
2017	106,928	1,205,006	2,297,215	473,806	715,604	336,334	1,233,337
2018	88,187	993,809	1,894,591	390,764	715,604	336,334	1,233,337
2019	69,446	782,613	1,491,967	307,722	715,604	336,334	1,233,337
2020	50,705	571,416	1,089,342	224,679	715,604	336,334	1,233,337
Total					3,578,021	1,681,670	6,166,683

Changes in terrestrial below ground tree carbon pools in the baseline

The carbon stock changes in below ground biomass are calculated according to the methods described in Section 5.1.1.2 and summarized in the table below.

Table 76 - Changes in Below ground tree carbon stock in the baseline, see equations 8 and 14 of VMD0006 (BL-PL).

Below ground tree carbon stock in the baseline ($C_{BB_tree_bsl,i}$)							
Year	Below ground tree biomass in baseline ($C_{BB_tree_bsl,i}$)				Baseline carbon stock change in below ground biomass		
	Peat dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	BGB (t)	CO ₂ -C (t)	CO ₂ -e (t) ($\Delta C_{BB_tree_bsl,i}$)
2016	38,380	432,512	762,307	157,228	207,353	97,456	357,371
2017	32,656	368,012	648,625	133,781	207,353	97,456	357,371
2018	26,933	303,512	534,943	110,333	207,353	97,456	357,371
2019	21,209	239,012	421,261	86,886	207,353	97,456	357,371
2020	15,486	174,512	307,579	63,439	207,353	97,456	357,371
Total					1,036,764	487,279	1,786,853

Greenhouse Gas Emissions from deforestation in the baseline

The Project has followed the requirements of §5.4.2 of REDD+ MF and included N₂O as a carbon pool because of the potential for nitrogen fertilizer application in the baseline scenario. However, because no nitrogen fertilizer application occurs in the project scenario, it has been excluded from the GHG emission reduction accounting as suggested in §5.4.2, Table 7 of REDD+ MF.

Baseline emissions from peat soils

Areas of drained land and surface areas of drains in the baseline

The RWE+REDD activity encompasses landscapes that have been drained by legacy canals and which will be rewetted by a program of canal blocking. Under the baseline, the legacy canals will be replaced by plantation drainage canals (in contrast to blocking under the project scenario) resulting in continued peat soil GHG emissions from peatland degradation and GHG emissions from drains.

The total of land planned for deforestation and conversion to plantations is 71,768.0 hectares.

Table 77 - Areas of drained land and surface areas of drains in the baseline; used in equation 1 of VMD0042 (BL-PEAT).

Year	Area drained ($A_{\text{peatsoil-BSL},i,t}$)							
	Total	Legacy canals (ha)			Plantation canals (ha)			
		Total	RWE	RWE+REDD	Total	RWE+REDD	CIW	CIW+REDD
2016	23,053.6	7,984.0	2,478.6	5,505.4	15,069.6	1,122.4	0.3	13,946.9
2017	35,942.8	6,638.6	2,478.6	4,160.0	29,304.3	2,467.9	1.6	26,834.8
2018	50,236.1	5,104.4	2,478.6	2,625.8	45,131.7	4,002.0	3.3	41,126.4
2019	65,384.1	4,150.0	2,478.6	1,671.4	61,234.1	4,956.4	3.3	56,274.4
2020	78,558.3	2,589.7	2,478.6	111.2	75,968.6	6,516.7	5.1	69,446.8

The surface area of the canals in the project area is as follows:

Table 78 - Canal surface area statistics

Year	Surface area of drainage canals							
	Total	Legacy canals			Plantation canals			
		Total	RWE	RWE+REDD	Total	RWE+REDD	CIW	CIW+REDD
2016	47.4	26.4	7.5	18.9	21.0	1.8	0.00	19.2
2017	65.6	23.6	7.5	16.1	42.1	3.6	0.00	38.5
2018	83.8	20.8	7.5	13.2	63.1	5.3	0.00	57.7
2019	102.1	17.9	7.5	10.4	84.1	7.1	0.01	77.0
2020	120.3	15.1	7.5	7.6	105.1	8.9	0.01	96.2

Baseline emissions from peat soil

Table 79 - Baseline GHG emissions from peat soils

Baseline GHG emissions from peat soils ($\text{GHG}_{\text{proxy-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{proxy-BSL},i,t}$)	CO ₂ -C (t CO ₂ -e) ($\text{GHG}_{\text{proxy-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{proxy-CH}_4,i,t}$)
2016	1,352,376	1,350,983	1,393
2017	2,036,199	2,034,102	2,097
2018	2,720,022	2,717,221	2,801
2019	3,403,845	3,400,340	3,505
2020	4,087,668	4,083,458	4,209

Baseline GHG emissions from ditches and other open water bodies in peatlands

Table 80 - Baseline GHG emissions from ditches and other open water bodies in peatlands, derived from equations 7 of VMD0042 (BL-PEAT) and used in equation 1 of BL-PEAT.

Baseline GHG emissions from ditches and other open water bodies in peatlands ($\text{GHG}_{\text{peatditch-BSL},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-BSL},i,t}$)	DOC (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CH}_4,i,t}$)
2016	3,142	143	2,999
2017	4,349	197	4,151
2018	5,556	252	5,303
2019	6,762	307	6,456
2020	7,969	362	7,608

Baseline emissions from peat burning

Emissions from peat burning are excluded from the baseline assessment as there is no significant history or threat of peat or biomass burning in the baseline period. §5.4.4, Table 9 of REDD+ MF also indicates that “it is conservative to exclude”.

5.1.3. Significant Sources of Baseline Emissions

The Project determined that no significance tests were needed given that all carbon pools not already included in the baseline and Project have either been:

- Demonstrated to increase more or decrease less under the Project as against the baseline Scenario, or
- Conservatively excluded.

All sources of GHG emissions have been included or conservatively excluded and mandatory pools have been included. The net emissions from the baseline scenario for the period 06 August 2016 through 31 July 2020 for WRC and 1 January 2017 through 31 July 2020 for APD are 13,737,960 t.CO₂-e (see also Table 124 below).

5.2. Project Emissions

General Procedures and Assumptions

In the future, emissions from the Project Area (including any changes in those emissions) will be in part determined from specific site data. When no specific site data is available, necessary calculations can rely on IPCC default emissions factors, proxy analysis, and any national GHG allometrics based on published scientific research data.

Project scenario emissions accounted for were based on:

1. Water bodies,
2. Above ground stock changes in biomass due to REDD, and
3. Microbial peat decompositions.

Planned Project Activities in relation to climate were:

1. Drained peatland rewetting,
2. Existing undrained peatland conservation,
3. Deforestation and forest degradation avoidance,
4. Revegetation, and
5. Fire control and prevention for nil burning.

Revegetation, fire control, and prevention in the Project are being operationally implemented. However, it is noted that these activities are not included in emissions reduction estimates. This is also conservative.

It is assumed that uncontrolled burning will not occur in the Project Area during the Project Period since rewetting and fire prevention are conducted - therefore no GHG emissions are expected. Notwithstanding this, any emissions resulting from fires that do occur will be accounted for (using VMD0013 (E-BPB) ver. 1.2) under the established fire monitoring plan within the broader fire management activities. The Project assumes that zero non-human induced rewetting will form part of the Project Scenario.

N₂O emissions in the project are not accounted for because there will be no fertilizer applications. Furthermore, rewetting of organic soils decreases N₂O emissions rapidly and falls to virtually zero by the raising of the water table depth, in the event this depth is below the surface by <20cm. CH₄ emissions may be higher before stabilising to levels seen in undrained or never-drained areas during the transient period immediately after rewetting activities. Emissions of CH₄ from rewetting activities in the relevant strata sites commencing from the Project WRC Start Dates will be monitored directly. Once sufficient data has been collected from those sites, emissions of CH₄ will be assessed again and any variability accounted for in quantifications of GHG emissions based on specific site data.

Emission Characteristics in Project Scenario

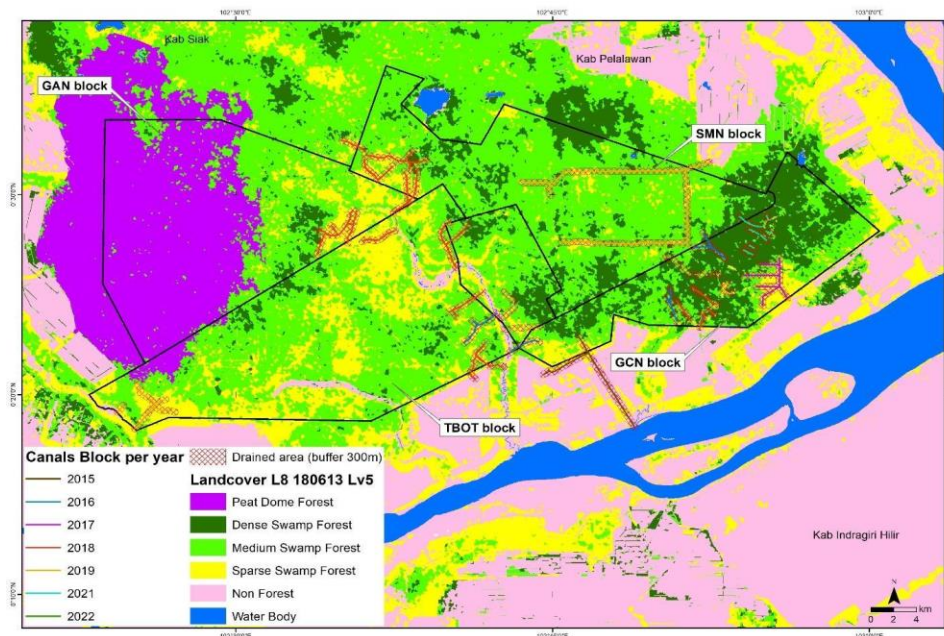
Project Area

The Project Area under the Project Scenario has been stratified according to four classification categories:

- **Land cover** - including Peat Dome Forest, Dense Swamp Forest, Medium Swamp Forest, Sparse Swamp Forest, Non-Forest;
- **Soil and soil depth** – Peat by 50cm peat depth classes;
- **Drainage status** - including drained, undrained; and,
- **Water body** - Water body and land.

The Project Scenario Map (see below map) development process involved the following delineations as at Project WRC Start Dates:

- Existing water bodies such as rivers and lakes,
- Forest and non-forest areas, with further stratification into land cover types,
- Drained areas in proximity to drainage canals and other undrained areas. It was assumed that fully drained areas extend to 300m from the sides of canals. Based on this assumption, the presence of drainage canals consistently results in the lowering of water tables perpendicular to canals at differential levels, and
- An overlay of the above delineations resulted in the Project Scenario Maps in relation to each relevant activity as described below.



Map 15 - Master project scenario map

Emission characteristic stratification under project scenario

Emission characteristic stratification for REDD under project scenario

During the Project Period, there is no deforestation or forest degradation anticipated under the Project Scenario in any area where there is planned deforestation.

Uncontrolled burning is assumed to be zero after project initiation, given the fire prevention programmes. There is no history of unplanned deforestation and forest degradation from illegal land clearing and there is assumed to be no unplanned deforestation and forest degradation.

Carbon enhancement is likely to take place based on the Project Scenario as a result of forest regrowth expected in all forested areas following Project commencement. Measurements of biomass accumulation will be taken as part of periodic monitoring activities.

Emission characteristic stratification for ARR under project scenario

The main Afforestation, Reforestation and Revegetation (ARR) activities under the Project Scenario will be enrichment and reforestation planting aimed at restoring the natural forest to a primary forest condition. All emissions reductions from these activities are excluded from the project emissions calculation and ARR is not a GHG activity under the Project.

Emission characteristic stratification for WRC under project scenario

The locations of WRC activities under the Project Scenario are mapped by taking into account:

- (1) Initial land use, cover, and drainage status,
- (2) Historical timing of land-use changes and drainage status based on planned rewetting under the Project Scenario, and
- (3) Peatland coverage:
 - a. Land cover – forest and non-forest
 - b. Location canals.
 - c. The timings of drainage canal blocking (rewetting) and the impacted canals and surrounding drained areas.

Because the Project Area is entirely covered in deep peat, no specific consideration is required for stratification by peat depth within the rewetted area.

Table 81 - Activity class of each stratum

Description of Strata	Area		Activity class
	(ha)	%	
Forested peatland, undrained and avoiding deforestation and avoiding peatland degradation, from plantation development: Peatland with forest cover present at Project Start Dates, no drainage impact from human-made legacy canals, planned for forest clearing, drainage, and conversion to plantation.	71,768.1	55%	CIW+ REDD
Forested peatland, drained, avoiding deforestation from plantation development, and peatland restoration by canal rewetting: Peatland with forest cover present at Project Start Dates and drainage impact from human-made legacy canals. This covers a 300m belt alongside canals within the plantation development zone. This area was planned for conversion to plantation.	6,627.8	5%	RWE+ REDD
Non-forested peatland and drained and peatland restoration by canal rewetting + Forested peatland and drained and peatland restoration by canal rewetting (but no avoided deforestation): Peatland which will be rewetted but is ineligible under REDD.	2,478.6	2%	RWE
Non-forested peatland, undrained and avoiding peatland degradation, from plantation development: Peatland without forest cover at Project Start Date due to prior logging and burning, with drainage impact from human-made legacy canals.	5.1	0	CIW

This covers a 300m belt alongside canals.			
Undrained peatland with no planned plantation development: Peatland which has been planned for conservation and excluded from plantation development under the baseline.	49,210.4	38%	Not eligible for RWE or REDD
Total	130,090.0	100%	

Under the project, the PP plans to replant selected non-forest areas, restore deselected degraded forest areas and block the legacy canals to rewet the drained landscape. The ARR activities are not included in the project emissions estimates and are not described in detail here.

The strata that are distinguished in the Project Scenario based on this analysis are:

- Drained peatland,
- Undrained peatland.

The quantum of GHG emissions resulting from microbial peat decomposition and loss of DOC via peatlands water bodies has been measured using an explicit temporal and spatial methodology.

Project Emissions Modelling Approach

Separate project emissions calculations have been prepared for 4 separate project activity classes:

1. RWE – Restoration of drained peatland with no avoiding planned deforestation.
2. RWE+REDD – Restoration of drained peatland with avoiding planned deforestation.
3. CIW – Avoiding wetland degradation with no avoiding planned deforestation.
4. CIW+REDD – Avoiding wetland degradation with avoiding planned deforestation.

All the areas developed into plantations under the baseline are protected under the respective project activity. Existing legacy canals will be blocked over a period of 8 years under the project and the drained areas rewetted.

For each stratum in the Project Scenario has been subdivided into the smallest parcel units of land or water body and have relatively uniform spatial variables as shown in Table 82 Temporal variability for Project emissions is accounted for by organization calculations into discrete timing 1-year units. The table below outlines each of the following:

- Variables that determine strata change sequences,
- Temporal variability of parameters for GHG emissions, and
- Temporal restrictions to GHG emissions.

This schematization provides the assurance that GHG emission parameters at the correct spatial location and the correct time have been appropriately used.

Table 82 - Variables adopted for the systematic organization of measurements for GHG emissions arising from microbial peat decomposition and dissolving organic carbon from peatlands under the Project Scenario

Variables	Description
(A) Spatial Variables	
(A1) Type of soil	Distinction between peat and non-peat. This is used to exclude all non-peat parcels from GHG calculation. All the Project Area is deep peat and there is no non-peat.
(A2) Initial peat thickness available for microbial decomposition	Derived from DEM and Peat Thickness Map. This is used as the initial condition for subsequent calculations of the remaining available peat for microbial decompositions
(A3) Initial stratum within the peat area	Stratum of the corresponding parcel at project start date before conversion into other (rewetted) stratum takes effect. All the Project Area is deep peat.
(B) Temporal Variables	
(B1) Year of rewetting	Employed to determine the onset of conversion from initial to rewetted stratum, which sets all relevant parameters and variables related to drainage accordingly. E.g. emission factors for the corresponding land parcels.
(B2) Remaining peat thickness available for microbial decompositions and burnings	Employed for determining whether Project Scenario PDT has been reached for the corresponding land parcel in the corresponding year. The entire Project Area is deep peat with no stratum ever depleting to a thickness of 20 cm and set to zero.

5.2.1. Project Emissions Calculations for REDD (M-REDD)

5.2.1.1. Total project Emissions from REDD

For the project area of REDD project activities, the net GHG emissions in the project case is equal to the sum of stock changes due to deforestation and forest degradation plus the total GHG emissions minus any eligible forest carbon stock enhancement from VCS Module VMD0015 – M-PEAT equation 1:

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

Where:

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

Note under the project, it is assumed that all deforestation and forest degradation will be avoided and that no net carbon stock changes will occur as a result natural disturbance. Therefore, the only contributor to net GHG emissions from REDD will be reductions in emissions from forest carbon stock enhancement. The net GHG emissions from REDD are calculated using this equation and reported separately for CIW-REDD and RWE-REDD.

Project emissions from deforestation and forest degradation

During the Project Period:

1. There will be no deforestation anticipated under the project scenario and no associated emissions,
2. There will be no forest degradation anticipated under the project scenario and no associated emissions, and
3. There will be no emissions from uncontrolled biomass burning.

Because the project assumes no fire and no uncontrolled burning, then the estimation of GHG emissions from biomass and peat burning as described in VCS Module VMD0013 – E-BPB do not apply for this project.

Carbon enhancement from forest growth

After the Project's APD Start Date, forested areas that would otherwise have been converted to plantations or faced degradation are expected to benefit from regrowth and the associated biomass accumulation and CO₂ removal. Under VMD0015 (M-REDD) Version 2.2, changes to net ex-ante carbon stock resulting from enhancement of forest carbon stock is multiplied by the areas where carbon stock is accumulating and the difference in carbon stock (between baseline and project case). The below equation is equation 25 of M-REDD:

$$\Delta C_{P,Enh,i,t} = \sum_{t=1}^t \sum_{i=1}^M ((C_{P,i,t} - C_{BSL,i}) * A_{Enh,UP,i,t})$$

Where:

$\Delta C_{P,Enh,i,t}$	Net carbon stock changes as a result of forest carbon stock enhancement in stratum i in year t ; t CO ₂ -e
$C_{P,i,t}$	Carbon stock in all pools in the project case in stratum i in year t ; t CO ₂ -e
$C_{BSL,i}$	Carbon stock in all carbon pools in stratum i ; t CO ₂ -e ha ⁻¹
$A_{Enh,UP,i,t}$	Project area in stratum i in which carbon stocks are accumulating but that would have undergone unplanned deforestation in the baseline scenario in year t ; ha
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the projected start of the project activity

The process for calculating forest growth in the avoided deforested areas is as follows:

1. The forests are classified by forest type:
 - a. Peat Dome Forest,
 - b. Dense Swamp Forest,
 - c. Medium Swamp Forest, and
 - d. Sparse Swamp Forest.

Each of these forest types has an average tree biomass estimate.

2. The forests are further classified into the year of baseline land clearing.
3. The above ground biomass growth rates of each forest type are based on the following IPCC allometrics:

- It is assumed that the remaining forest will accumulate biomass until an average ABG of 348 t/ha is attained. This is estimated as the average AGB for naturally regenerated tropical forests in Insular Asia²⁸.
- For Dense and Medium Swamp Forest, 3.4 t ha⁻¹ of biomass until an average biomass of 348 t/ha is attained.
- For Sparse Swamp Forest, 13.0 t ha⁻¹ of biomass for 20 years. After 20 years, 3.4 t ha⁻¹ of biomass until an average biomass of 348 t/ha is attained.
- Peat Dome Forest is assumed to be unlogged primary forest and no net forest increment.

The eligible area is determined from the area due to be deforested each year in the baseline. The below equation is equation 26 of M-REDD:

$$A_{Enh,PL,i,t} = D\%_{planned,i,t} * A_{planned,i,t}$$

Where:

$A_{Enh,PL,i,t}$ Project area in stratum i in which carbon stocks are accumulating but that would have undergone planned deforestation in the baseline scenario in year t ; ha

$D\%_{planned,i,t}$ Projected annual proportion of land that will be deforested in stratum i in year t ; %

$A_{planned,i}$ Total area of planned deforestation over the entire project lifetime for stratum i ; ha

i 1, 2, 3, ... M strata

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

Table 83 - Eligible area for deforestation for CIW+REDD activities

Eligible area for deforestation ($A_{plannedEnh,PL,i,t}$)					
Year	Area of LUC by land cover types (ha)				
	Peat Dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	Total area of planned deforestation
2016	0.0%	0.0%	0.0%	0.0%	0.0
2017	13.0%	13.0%	13.0%	13.0%	9,313.7
2018	13.0%	13.0%	13.0%	13.0%	9,313.7
2019	13.0%	13.0%	13.0%	13.0%	9,313.7
2020	13.0%	13.0%	13.0%	13.0%	9,313.7
Total %	51.9%	51.9%	51.9%	51.9%	37,255.0
Total Area	920.9	14,033.7	41,707.6	15,105.8	71,768.0

(A _{planned})					
Total Area (A _{planned,i,t})	478.0	7,285.0	21,650.5	7,841.5	37,255.0
A _{planned} refers to the total planned for deforestation in the whole baseline period. A _{planned,i,t} refers to the total planned for deforestation in the monitoring period.					

The source for these allometrics is the IPCC Good Practice Guidance for LULUCF 2003, table 3A.1.5 and 3A.1.2. Under this full restoration of ABG to primary forest levels will be attained within 58.1, 69.2, and 79.3 years respectively for the dense, medium, and sparse forest, respectively. Carbon stock in the baseline stratum is equal to the C stock of forest at project initiation year. Carbon stock enhancement will be monitored according module M-REDD and will be reported at each monitoring event.

Project emissions

The calculation of project emissions utilises equation 30 of M-REDD:

$$GHG_{P,E,i,t} = E_{FC,i,t} + E_{BiomassBurn,i,t} + N_2O_{direct-N,i,t}$$

Where:

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

No GHG emissions are included in the project. Note:

- There is no expectation of deforestation or forest degradation.
- There is no expectation of planned or unplanned forest fires.
- Fossil fuel combustion is not included.
- The project does not include any land use that uses fertilizers.

5.2.2. Emissions Calculations for RWE AND CIW (M-PEAT)

Total project emissions from peatlands

The Project has followed §5.1 of M-PEAT to determine the net CO₂-equivalent emissions resulting from microbial peat decompositions and water bodies for each land parcel within the Project Area (taking into consideration the temporal and spatial variability). They were estimated using equation 1 of M-PEAT, as shown below:

$$GHG_{WPS-PEAT} = \sum_{t=1}^{t^*} \sum_{i=1}^M (A_{peatsoil-WPS,i,t} \times GHG_{peatsoil-WPS,i,t} + A_{ditch-WPS,i,t} \times GHG_{peatditch-WPS,i,t} + A_{peatburn-WPS,i,t} \times GHG_{peatburn-WPS,i,t})$$

Where:

$GHG_{WPS-PEAT}$	Net GHG emissions in the WRC project scenario on peatland up to year t^* (t CO ₂ e)
$GHG_{peatsoil-WPS,i,t}$	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 ha ⁻¹ yr ⁻¹)
$GHG_{peatditch-WPS,i,t}$	GHG emissions from water bodies within the project boundary in the project scenario in stratum i in year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{peatburn-WPS,i,t}$	GHG emissions from burning of peat within the project boundary in the project scenario in stratum i in year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$A_{peatsoil-WPS,i,t}$	Area of peatland (not open water, not burnt) in stratum i in year t in the project scenario (ha)
$A_{ditch-WPS,i,t}$	Area of ditch and other open water in stratum i in year t in the project scenario (ha)
$A_{peatburn-WPS,i,t}$	Area of peat burnt in stratum i in year t in the project scenario (ha)
i	1, 2, 3 ... M_{WPS} strata in the project scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (years)

Note under the project, it is assumed that no fires will occur. The area of peat burnt and the GHG emissions emitted from peat soil fires will be assumed to equal zero. Therefore, the only contributor to net GHG emissions from RWE / CIW will be GHG emissions from:

- Microbial decomposition of peat soil
- Water bodies

The net GHG emissions from WRC are calculated using this equation and reported separately for CIW-REDD and RWE-REDD.

Project emissions from peat soil degradation

The Project assessed GHG emissions from soil pursuant to §5.2 of M-PEAT using Equation 2:

$$GHG_{peatsoil-WPS,i,t} = GHG_{proxy-WPS,i,t}$$

Where:

$GHG_{peatsoil-WPS,i,t}$	Greenhouse gas 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 ha ⁻¹ yr ⁻¹)
$GHG_{proxy-WPS,i,t}$	GHG emissions as per the chosen proxy in the project scenario in stratum i in year t (t CO ₂ e ha ⁻¹ 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 (years)

Peat soil GHG emissions consist of CO₂ and CH₄, calculated employing equation 3 of M-PEAT as shown below:

$$GHG_{proxy-WPS,i,t} = GHG_{proxy-CO_2,i,t} + GHG_{proxy-CH_4,i,t}$$

Where:

$GHG_{proxy-WPS,i,t}$	GHG emissions as per the chosen proxy in the project scenario in stratum i in year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{proxy-CO_2,i,t}$	Emission of CO ₂ as per the chosen proxy in stratum i in year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{proxy-CH_4,i,t}$	Emission of CH ₄ as per the chosen proxy in stratum i in year t (t CO ₂ e ha ⁻¹ yr ⁻¹)
i	1, 2, 3 ... M_{WPS} strata ⁵ in the project scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (years)

Processes for quantifying carbon stock dynamics and peat losses are similar to those applied to the baseline scenario (see §5.1). The only differences include 1) stratification, 2) strata sequence, and 3) the absence of burning in the Project Scenario that has been assumed.

Subsidence in relation to peat microbial decomposition

For consistency between remaining peat carbon stock and yearly net CO₂-e emissions, yearly loss rates for peat and carbon stock under the Project Scenario were calculated on an annual basis applying the following:

- the rate of emissions stemming from peat microbial decompositions (CO₂ and CH₄),

- bulk peat density above the water table, and
- a conservative carbon content value of 56kg.kg-1 dry mass²⁹.

The equation below was used for these calculations, which was acquired from equation 13 of VMD0016 (X-STR):

$$Rate_{peatloss,i,t} = \frac{\sum_{i=1}^M (GHG_{peatsoil,i,t} + GHG_{peatburn,i,t})}{A_{i,t} \times C_{vol_lower,i,t}} \times 10 \times \frac{12}{44}$$

Where:

$Rate_{peatloss,i,t}$	Rate of peat loss due to subsidence and fire in stratum i in year t (m yr ⁻¹)
$GHG_{peatsoil,CO_2,i,t}$	CO ₂ emissions from the peat soil in stratum i in year t (t CO ₂ e yr ⁻¹)
$GHG_{peatburn,CO_2,i,t}$	CO ₂ emissions from burning of peat in stratum i in year t (t CO ₂ e yr ⁻¹)
$A_{i,t}$	Area of stratum i in year t in baseline or project scenario ($A_{WPS,i,t}$ or $A_{BSL,i,t}$) (ha)
$C_{vol_lower,i,t}$	Volumetric carbon content of the peat below the water table in stratum i in year t (kg C m ⁻³)
12/44	Factor to change from t CO ₂ e yr ⁻¹ to t C yr ⁻¹
10	Conversion from kg m ⁻² to t ha ⁻¹

A yearly assessment for the duration of the Project's total lifetime was conducted for remaining peat thickness, based on the peat loss rate resulting from peat microbial decomposition. The below equation was used for these calculations, which was acquired from equation 9 of X-STR:

$$Depth_{peat-WPS,i,t100} = Depth_{peat-WPS,i,t0} - \sum_{t=1}^{t=100} Rate_{peatloss-WPS,i,t}$$

Where:

$Depth_{peat-WPS,i,t100}$	Average peat depth in the project scenario in stratum i at $t = 100$ (m)
$Depth_{peat-WPS,i,t0}$	Average peat depth in the project scenario in stratum i at project start (m)
$Rate_{peatloss-WPS,i,t}$	Rate of peat loss due to subsidence and fire in the project scenario in stratum i in year t ; alternatively, a conservative (high) value may be applied that remains constant over time (m yr ⁻¹)

Assurance was provided that there are no GHG emissions that have been accounted for in all parcels of stratum by tracking yearly peat carbon stock and thickness in the baseline scenario, once any available peat carbon stock has been depleted. On a conservative basis, it is assumed that peat is depleted when peat thickness available for decomposition has been reduced to 20cm.

The below tables provide detail on the Project emission factors and stratification related to WRC:

Table 84 - Stratification employed for calculation of GHG emissions, the area (ha), and the CO₂ and CH₄ default factors used in each stratum for the specific land use

Description	IPCC default emission factor for CO ₂	IPCC default emission factor for CH ₄	IPCC default emission factor for N ₂ O	IPCC default emission factor for DOC
	(t.CO ₂ -C ha ⁻¹ yr ⁻¹)	(kg.CH ₄ ha ⁻¹ yr ⁻¹)	(kg.N ₂ O ha ⁻¹ yr ⁻¹)	(t.CO ₂ -e ha ⁻¹ yr ⁻¹)
Undrained deforested peatland	0	0	0	N/A
Drained deforested peatland	20	2.7	1.2	N/A
Undrained peatland forest	0	0	0	N/A
Drained peatland forest	20	2.7	5.3	N/A
Water bodies (rivers and canals) on peatland present at project start date	N/A	N/A	N/A	0.82

Project GHG emissions from ditches and other open water bodies in peatlands

The Project assesses GHG emissions from ditches and other open water bodies pursuant to §5.4 of PL-PEAT. The emissions in the baseline are derived on the basis of ditched area and area of open water combined with an emission factor as per equation 4 of M-PEAT:

$$GHG_{peatditch-WPS,i,t} = GHG_{peatditch-CO_2,i,t} + GHG_{peatditch-CH_4,i,t}$$

Where:

$GHG_{peatditch-WPS,i,t}$	GHG emissions from ditch and other open water stratum i in year t in the project scenario (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{peatditch-CO_2,i,t}$	Emission of CO ₂ from ditch and open water stratum i in year t in the project scenario (t CO ₂ e ha ⁻¹ yr ⁻¹)
$GHG_{peatditch-CH_4,i,t}$	Emission of CH ₄ from ditch and open water stratum i in year t in the project scenario (t CO ₂ e ha ⁻¹ yr ⁻¹)
i	1, 2, 3 ... M_{WPS} strata ⁶ in the project scenario (unitless)
t	1, 2, 3, ... t^* time elapsed since the project start (years)

The annual emissions of dissolved organic carbon (DOC) and CH₄ from ditches and other open water bodies are estimated using IPCC allometrics.

Table 85 - Emission factors of surface area of canals

Land Use	GHG	Emission factor		
Surface area of canals	Degradation	CH ₄	2,259	kg CH ₄ ha ⁻¹ yr ⁻¹
	Dissolved Organic Carbon	DO C	0.82	tonnes C ha ⁻¹ yr ⁻¹
Table 2.2 of the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland				

DOC is then converted to CO₂-e by multiplication using the CO₂ to molecular C conversion factor of 3.667³⁰.

Emissions from uncontrolled peat burning

Uncontrolled burning is assumed not to be present under the Project Scenario, since rewetting of peatland and best-practice fire management (such as fire control and prevention, zero burning policies, and others as determined by the relevant authorities) are implemented as Project Activities.

Since Project beginning, APRIL has incorporated the project area within their comprehensive fire monitoring and fire-fighting program, they have implemented a comprehensive community-based program to mitigate fire risks from adjacent communities. Should uncontrolled burning occur during the Project lifetime, any area of fire scare and burn scar depth should be mapped within 3 months of the fire event. Historical hotspot tracking and direct observation data will determine the repetition of burning events in the Project Area, with maps generated of burning areas during the Project lifetime. Deductions from emissions reductions will be undertaken for equivalent and quantified GHG emissions from uncontrolled burning.

GHG emissions from peat burning will be calculated taking into account:

- dry mass loss on the basis of burn scar,
- burn depths,
- combustion factors,
- peat bulk density, and
- GHG potential of specific GHG species.

GHG emissions from the loss of biomass as a result of burning are quantified based on:

- type of land cover,
- combustion factors, and
- GHG potential of specific GHG species.

Scar depths for repeated burnings in the first, second and third (plus) instances of burning will be assumed as 18, 11, and 4cm in depth.

Procedures for the quantifying of peat burning GHG emissions are undertaken in line with REDD-MF and the module E-BPB.

Emissions reductions from peat combustion, using fire reduction premium

Uncontrolled burning is assumed not to be present under the Project Scenario (or the Baseline Scenario for that matter), since rewetting of peatland and best-practice fire management (such as fire control and prevention, zero burning policies, and others as determined by the relevant authorities) are implemented as Project Activities. The emissions from this source from peat combustion are assumed to be zero.

5.2.2.1. Total project emissions from RWE

Project emissions from peat soils

Areas of drained land and surface areas of drains in the project

The legacy canal blocking program and the resultant change in canal length, surface area, and drained area under RWE activity in the monitoring period are shown in the table below:

Table 86 - Areas of drained land and surface areas of drains in the project

Year	Surface Area of Legacy Canals (ha) ($A_{\text{ditch-BSL},i,t}$)	Area Drained by Legacy Canals (ha) ($A_{\text{peatsoil-WPS},i,t}$)
2016	7.38	2,202.7
2017	6.55	2,188.0
2018	6.01	1,313.9
2019	3.78	590.4
2020	1.44	312.6

The RWE activity encompasses landscapes that have been drained by legacy canals and which will be rewetted by a program of canal blocking. There is no planned deforestation under this activity because the areas are either in non-forest or are forested without any planned deforestation.

Under the project, the canals will be blocked over an eight-year period resulting in complete rewetting of the peat soils in the project area. The starting area of drained peatland in the RWE activity is 2,202.7 hectares in 2016 and all canals will be blocked by 2024. These canal areas are based on the progress of the canal blocking project to date.

Project emissions from peat soils

Table 87 - Project GHG emissions from Peat Soils

Project GHG emissions from Peat Soils (GH _{peatsoil-WPS,i,t})			
Year	Total GHG (t CO ₂ -e) (GHG _{peatsoil-WPS,i,t})	CO ₂ -C (t CO ₂ -e) (GHG _{proxy-CO2,i,t})	CH ₄ (t CO ₂ -e) (GHG _{proxy-CH4,i,t})
2016	65,127	65,060	67
2017	160,633	160,468	165
2018	96,457	96,358	99
2019	43,342	43,297	45
2020	13,329	13,315	14
Total	378,888	378,498	390

Project GHG emissions from ditches and other open water bodies in peatlands

Table 88 - Project GHG emissions from ditches and other open water bodies in peatlands

Project GHG emissions from ditches and other open water bodies in peatlands (GHG _{peatditch-WPS,i,t})			
Year	Total GHG (t CO ₂ -e) (GHG _{peatditch-BSLi,t})	DOC (t CO ₂ -e) (GHG _{peatditch-CO2,i,t})	CH ₄ (t CO ₂ -e) (GHG _{peatditch-CH4,i,t})
2016	197	9	188
2017	434	20	414
2018	398	18	380
2019	250	11	239
2020	55	3	53
Total	1,335	61	1,274

Project emissions from peat burning

Emissions from peat burning are excluded from the project.

5.2.2.2. Total project emissions from RWE +REDD

Project Emissions from REDD

Area of avoided deforestation land

The planned areas of deforestation for RWE+REDD activities are:

Table 89 - Eligible area for avoided deforestation in the baseline

Eligible area for deforestation ($A_{\text{plannedEnh,PL,i,t}}$)					
Year	Area of LUC by land cover types (ha)				Total area of planned deforestation
	Peat Dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	
2016	0.0%	0.0%	0.0%	0.0%	0.0
2017	13.0%	13.0%	13.0%	13.0%	860.1
2018	13.0%	13.0%	13.0%	13.0%	860.1
2019	13.0%	13.0%	13.0%	13.0%	860.1
2020	7.5%	7.5%	7.5%	7.5%	499.6
Total %	46.5%	46.5%	46.5%	46.5%	46.5%
Total Area (A_{planned})	1.8	1,102.2	2,664.7	2,859.1	6,627.8
Total Area ($A_{\text{planned,i,t}}$)	0.8	512.2	1,238.3	1,328.6	3,080.0
A_{planned} refers to the total planned for deforestation in the whole baseline period. $A_{\text{planned,i,t}}$ refers to the total planned for deforestation in the monitoring period.					

This is the extent of the “avoiding deforestation” area.

Growth of avoided deforestation areas

The carbon stock changes in above ground biomass are calculated according to the methods described in §5.2.2 and summarized in the table below.

Table 90 - Ex-ante net carbon stock changes as a result of forest carbon stock enhancement in the Project Area

Growth of Avoided Deforestation Areas							
Year	Areas of avoided deforestation (ha)				Growth of avoided deforested forests		
	Peat Dome Forest	Dense Swamp Forest	Medium Swamp Forest	Sparse Swamp Forest	AGB (t)	BGB (t)	CO ₂ -e (t)
2016	0.0	0.0	0.0	0.0	0	0	0
2017	0.5	286.1	691.6	742.1	10,078	2,947	13,024
2018	0.7	429.1	1,037.5	1,113.1	15,117	4,420	19,537
2019	0.9	572.2	1,383.3	1,484.2	20,156	5,893	26,049
2020	0.7	415.4	1,004.3	1,077.6	14,634	4,279	18,912
Total					59,984	17,538	77,522

Project emissions from peat soils

Areas of drained land and surface areas of drains

The legacy canal blocking program and the resultant change in canal length, surface area, and drained area under RWE+REDD activity are shown in the table below:

Table 91 - Areas of drained land and surface areas of drains

Year	Surface Area of Legacy Canals (ha)	Area Drained by Legacy Canals (ha)
2016	21.2	5,812.3
2017	18.9	5,220.7
2018	17.0	3,403.9
2019	10.9	1,339.2
2020	4.1	496.9

The RWE+REDD activity encompasses landscapes that have been drained by legacy canals and which will be rewetted by a program of canal blocking.

Under the project, the canals will be blocked over an eight-year period resulting in complete rewetting of the peat soils in the project area. The starting area of drained peatland in the RWE activity is 5,812.3 hectares in 2016 and all canals will be blocked by 2024.

Table 92 - Drained area estimates of legacy canals

Year	Drained area estimates ($A_{\text{peatsoil-WPS},i,t}$)
	Area drained by legacy canals (ha)
2016	5,812.3
2017	5,220.7
2018	3,403.9
2019	1,339.2
2020	496.9

The surface area of the canals in RWE+REDD activity is as follows:

Table 93 - Canal surface area statistics

Year	Surface area of drained canals (ha) ($A_{\text{ditch-BSL},i,t}$)
2016	21.2
2017	18.9
2018	17.0
2019	10.9
2020	4.1

Project Emissions from peat soil

Table 94 - Project GHG emissions from peat soils

Project GHG emissions from peat soils ($GH_{\text{peatsoil-WPS},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($GHG_{\text{peatsoil-WPS},i,t}$)	CO ₂ -C (t CO ₂ -e) ($GHG_{\text{proxy-CO2},i,t}$)	CH ₄ (t CO ₂ -e) ($GHG_{\text{proxy-CH4},i,t}$)
2016	171,856	171,679	177
2017	383,284	382,890	395
2018	249,896	249,639	257
2019	98,316	98,215	101
2020	21,189	21,167	22
Total	924,541	923,589	952

Project GHG emissions from ditches and other open water bodies in peatlands

Table 95 - Project GHG emissions from ditches and other open water bodies in peatlands

Project GHG emissions from ditches and other open water bodies in peatlands ($\text{GHG}_{\text{peatditch-WPS},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-BSLi},t}$)	DOC (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($\text{GHG}_{\text{peatditch-CH}_4,i,t}$)
2016	568	26	542
2017	1252	57	1196
2018	1149	52	1097
2019	722	33	689
2020	160	7	152
Total	3,851	175	3,677

Project emissions from peat burning

Emissions from peat burning are excluded from the baseline assessment.

5.2.2.3. Total project emissions from CIW

Project emissions from peat soils

Areas of drained land and surface areas of drains in the baseline

There are no legacy canals in CIW project activity area and all the landscape is fully wetted.

Project Emissions from peat soil

Because the landscape is fully wetted, there are no peat soil emissions in the CIW project activity area.

Project GHG emissions from ditches and other open water bodies in peatlands

Because there are no legacy canals in CIW project activity area, there are GHG emissions from ditches in the CIW project activity area.

Project emissions from peat burning

Emissions from peat burning are excluded from the project.

5.2.2.4. Total project emissions from CIW+REDD

Project emissions reductions from REDD

Area of land deforested in baseline

The planned areas of deforestation for CIW+REDD activities are:

Table 96 - Eligible area for deforestation for CIW+REDD activities

Eligible area for deforestation ($A_{\text{plannedEnh,PL,i,t}}$)					
Year	Area of LUC by land cover types (ha)				
	Peat Dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	Total area of planned deforestation
2016	0.0%	0.0%	0.0%	0.0%	0.0
2017	13.0%	13.0%	13.0%	13.0%	9,313.7
2018	13.0%	13.0%	13.0%	13.0%	9,313.7
2019	13.0%	13.0%	13.0%	13.0%	9,313.7
2020	13.0%	13.0%	13.0%	13.0%	9,313.7
Total %	51.9%	51.9%	51.9%	51.9%	37,255.0
Total Area (A_{planned})	920.9	14,033.7	41,707.6	15,105.8	71,768.0
Total Area ($A_{\text{planned,i,t}}$)	478.0	7,285.0	21,650.5	7,841.5	37,255.0
A_{planned} refers to the total planned for deforestation in the whole baseline period. $A_{\text{planned,i,t}}$ refers to the total planned for deforestation in the monitoring period.					

Growth of avoided deforestation areas

The carbon stock changes in above ground biomass are calculated according to the methods described in §5.2.2 and summarized in the table below.

Table 97 - Ex-ante net carbon stock changes as a result of forest carbon stock enhancement in the Project Area

Growth of Avoided Deforestation Areas							
Year	Areas of avoided deforestation (ha)				Growth of avoided deforested forests		
	Peat Dome Forest	Dense Swamp Forest	Medium Swamp Forest	Sparse Swamp Forest	AGB (t)	BGB (t)	t CO ₂ -e
2016	0.0	0.0	0.0	0.0	0	0	0
2017	239.0	3,642.5	10,825.3	3,920.7	107,754	31,382	139,136
2018	358.5	5,463.7	16,237.9	5,881.1	161,631	47,073	208,704
2019	478.0	7,285.0	21,650.5	7,841.5	215,508	62,764	278,272
2020	347.1	5,289.1	15,718.9	5,693.1	156,465	45,568	202,033
Total					641,358	186,787	828,145

Project emissions from peat soils

Areas of drained land and surface areas of drains in the baseline

There are no legacy canals in CIW+REDD project activity area and all the landscape is fully wetted.

Project Emissions from peat soil

Because the landscape is fully wetted, there are no peat soil emissions in the CIW+REDD project activity area.

Project GHG emissions from ditches and other open water bodies in peatlands

Because there are no legacy canals in CIW+REDD project activity area, there are GHG emissions from ditches in the CIW+REDD project activity area.

Project emissions from peat burning

Emissions from peat burning are excluded from the project.

5.2.3. Project Emissions – All Activities

Project Emissions from REDD

Area of land deforested in baseline

The planned areas of deforestation for the project area are:

Table 98 - Eligible area for deforestation for REDD activities

Eligible area for deforestation ($A_{\text{plannedEnh,PL,i,t}}$)					
Year	Area of LUC by land cover types (ha)				Total area of planned deforestation (ha)
	Peat Dome forest	Dense swamp forest	Medium swamp forest	Sparse swamp forest	
2016	0.0%	0.0%	0.0%	0.0%	0.0
2017	13.0%	13.0%	13.0%	13.0%	10,173.9
2018	13.0%	13.0%	13.0%	13.0%	10,173.9
2019	13.0%	13.0%	13.0%	13.0%	10,173.9
2020	13.0%	13.0%	13.0%	13.0%	10,173.9
Total %	51.9%	51.9%	51.9%	51.9%	51.9%
Total Area (A_{planned})	922.6	15,136.0	44,372.4	17,964.9	78,395.9
Total Area ($A_{\text{planned,i,t}}$)	478.9	7,857.1	23,033.8	9,325.7	40,695.5
A_{planned} refers to the total planned for deforestation in the whole baseline period. $A_{\text{planned,i,t}}$ refers to the total planned for deforestation in the monitoring period.					

This is the extent of the “avoiding deforestation” area.

Growth of avoided deforestation areas

The carbon stock changes in above ground biomass are calculated according to the methods described in §5.2.2 and summarized in the table below.

Table 99 - Ex-ante net carbon stock changes as a result of forest carbon stock enhancement in the Project Area

Growth of Avoided Deforestation Areas							
Year	Areas of avoided deforestation (ha)				Growth of avoided deforested forests		
	Peat Dome Forest	Dense Swamp Forest	Medium Swamp Forest	Sparse Swamp Forest	AGB (t)	BGB (t)	CO ₂ -e (t)
2016	0	0	0	0	0	0	0
2017	239	3,929	11,517	4,663	117,832	34,329	152,160
2018	359	5,893	17,275	6,994	176,748	51,493	228,241
2019	479	7,857	23,034	9,326	235,664	68,657	304,321
2020	348	5,704	16,723	6,771	171,098	49,847	220,945

Project emissions reductions from peat soils

Areas of drained land and surface areas of drains

Under the project, the canals will be blocked over an eight-year period resulting in complete rewetting of the peat soils in the project area. The starting area of drained peatland in the project area is 8,015.0 hectares in 2016 and all canals will be blocked by 2024.

Table 100 - Area drained by legacy canals

Year	Area drained ($A_{\text{peatsoil-WPS},i,t}$)		
	Legacy canals (ha)		
	Total	RWE	RWE+REDD
2016	8,015	2,203	5,812
2017	7,409	2,188	5,221
2018	4,718	1,314	3,404
2019	1,930	590	1,339
2020	809	313	497

The surface area of the canals in RWE+REDD activity is as follows:

Table 101 - Canal surface area statistics

Year	Surface area of drainage canals		
	Legacy canals (ha)		
	Total	RWE	RWE+REDD
2016	28.5	7.4	21.2
2017	25.4	6.6	18.9
2018	23.0	6.0	17.0
2019	14.7	3.8	10.9
2020	5.6	1.4	4.1

Project Emissions from peat soil

Table 102 - Project GHG emissions from peat soils

Project GHG emissions from peat soils ($GH_{\text{peatsoil-WPS},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($GHG_{\text{peatsoil-WPS},i,t}$)	CO ₂ -C (t CO ₂ -e) ($GHG_{\text{proxy-CO}_2,i,t}$)	CH ₄ (t CO ₂ -e) ($GHG_{\text{proxy-CH}_4,i,t}$)
2016	236,983	236,739	244
2017	543,918	543,358	560
2018	346,354	345,997	357
2019	141,658	141,512	146
2020	34,517	34,482	36

Project GHG emissions from ditches and other open water bodies in peatlands

Table 103 - Project GHG emissions from ditches and other open water bodies in peatlands

Project GHG emissions from ditches and other open water bodies in peatlands ($GH_{\text{peatditch-WPS},i,t}$)			
Year	Total GHG (t CO ₂ -e) ($GHG_{\text{peatditch-BSLi},t}$)	DOC (t CO ₂ -e) ($GHG_{\text{peatditch-CO2},i,t}$)	CH ₄ (t CO ₂ -e) ($GHG_{\text{peatditch-CH4},i,t}$)
2016	765	35	730
2017	1686	77	1610
2018	1547	70	1477
2019	972	44	928
2020	215	10	205

Project Emissions from peat burning

Emissions from peat burning are excluded from the baseline assessment. As such, the emissions from peat burning are “0” during the monitoring period.

5.2.4. Total Project Emissions

Total Project Emissions for all REDD+CIW, REDD+RWE, CIW and RWE activity during the monitoring period, that is between 06 August 2016 and 31 July 2020, are 402,949 t CO₂-e (see Table 124 below).

5.3. Leakage

5.3.1. Applicability of Leakage Modules

According to REDD+ MF, leakage shall be considered for all project activities using the following leakage modules, including:

- Planned deforestation / degradation: module LK-ASP
- Unplanned deforestation / degradation: module LK-ASU
- Fuelwood/charcoal collection: module LK-DFW
- Pre-project agricultural activities: module LK-ARR
- Ecological leakage: module LK-ECO

Module LK-ASU is not relevant because there is no avoided unplanned deforestation in the project. Module LK-ME is not relevant because the project does not consider the impacts of reduction of wood supply on local markets. Modules BL-DFW and LK-DFW are not relevant because there was no pre-project history of unsustainable fuelwood collection.

The baseline activity is defined as (i) planned deforestation and (2) peatland drainage from conversion to *Acacia* fibre plantations. The Project is therefore categorized as Avoiding Planned Deforestation (APD) in combination with Conservation of Undrained and Partially drained Peatland (CUPP) and Rewetting of Drained Peatland (RDP) activities.

Potential sources of leakage emissions include:

- The displacement of planned and unplanned deforestation activities;
- The displacement of pre-project agricultural activities on non-forest land, and;
- The displacement of fuelwood collection activities, and;
- Ecological leakage due to possible alterations of mean annual water table depth in adjacent areas.

The applicability of the above-referenced leakage modules to the project activities is described in the table below:

Table 104 - Applicability of leakage modules

Module	Applicability
Estimation of emissions from activity shifting for avoiding planned deforestation/ degradation (LK-ASP)	Applicable. The Project may cause activity shifting of avoided planned deforestation.
Estimation of emissions from activity shifting for avoiding unplanned deforestation/ degradation: module LK-ASU	Not Applicable. The Project is not categorized as avoiding planned deforestation.
Estimation of emissions from the displacement of fuelwood extraction (LK-DFW)	Not Applicable. The Project is not categorized as avoiding fuelwood extraction.
Estimation of emissions from the displacement of pre-project agricultural activities (LK-ARR)	Not Applicable. The Project is not categorized as avoiding afforestation, revegetation, and revegetation and is not categorized as pre-project agricultural activities.
Estimation of emissions from ecological leakage (LK-ECO)	Applicable. The Project is categorized as WRC and may cause ecological leakage.

5.3.2. Where the Specific Deforestation Agent has been Identified

5.3.2.1. RER Estimation of Leakage Emissions from Activity Shifting for Avoiding Planned Deforestation and Planned Degradation (LK-ASP)

As discussed previously, the most likely class of deforestation agent in the baseline has been identified as specific industrial *Acacia* plantation operators.

Module LK-ASP is the applicable methodology for estimating the leakage emissions due to activity shifting from forest lands that are legally authorized and documented to be converted to non-forest land, including activity shifting to forested peatland that is drained as a consequence of project implementation. Under these situations, displacement of baseline activities can be controlled and measured directly by monitoring the baseline deforestation agents or class of agents. This tool must be used for projects in areas where planned deforestation happens on forested peatlands, regardless of the absence of peatland within the project boundaries.

Step 1 – Determination of the Baseline Rate of Forest Clearance by the Deforestation Agent

Option 1.1: Historical Deforestation Trend

§ 5.1.1 of Module LK-ASP provides three options for estimating the baseline rate of forest clearance by the deforestation agent. We select Option 1.1 – Historical Deforestation Trend for this analysis.

Annual baseline deforestation is estimated by extrapolation the historical annual trend using linear regression as per equation 2 of LK-ASP:

$$WoPR_{i,t} = a + b \times t$$

Where:

$WoPR_{i,t}$	Deforestation by the baseline agent of the planned deforestation in the absence of the project in stratum i in year t^3 (ha)
a	Estimated intercept of the regression line (ha)
b	Slope of the linear regression (ha yr ⁻¹)
t	1, 2, 3, ... t^3 time elapsed since the projected start of the project activity (years)

Data for this analysis was obtained from Kementerian Lingkungan Hidup dan Kehutanan (KLHK - Ministry of Environment and Forestry of The Republic of Indonesia) describing forest plantation concessions issued between 1995 and 2019.

Table 105 - Official data on historic HTI concession licenses granted

Year SK	HTI concessions licensed	Cumulative number of HTI licensed	Licensed Area (ha)	Cumulative licensed area (ha)
1995	2	2	18,845	18,845
1996	13	15	1,288,475	1,307,320
1997	21	36	459,980	1,767,300
1998	18	54	547,946	2,315,246
1999	2	56	52,830	2,368,076
2000	2	58	104,812	2,472,888
2001	4	62	85,729	2,558,618
2002	3	65	33,605	2,592,223
2003	9	74	124,734	2,716,957
2004	5	79	267,631	2,984,588
2005	3	82	44,659	3,029,247
2006	13	95	236,474	3,265,721
2007	25	120	693,320	3,959,040
2008	3	123	73,238	4,032,278
2009	38	161	1,449,173	5,481,451
2010	11	172	414,084	5,895,535
2011	17	189	585,938	6,481,473
2012	12	201	269,259	6,750,732
2013	14	215	963,231	7,713,964
2014	24	239	910,951	8,624,914
2015	5	244	203,057	8,827,972
2016	11	255	212,793	9,040,765
2017	12	267	527,017	9,567,782
2018	19	286	1,287,618	10,855,401
2019	12	298	432,975	11,288,375

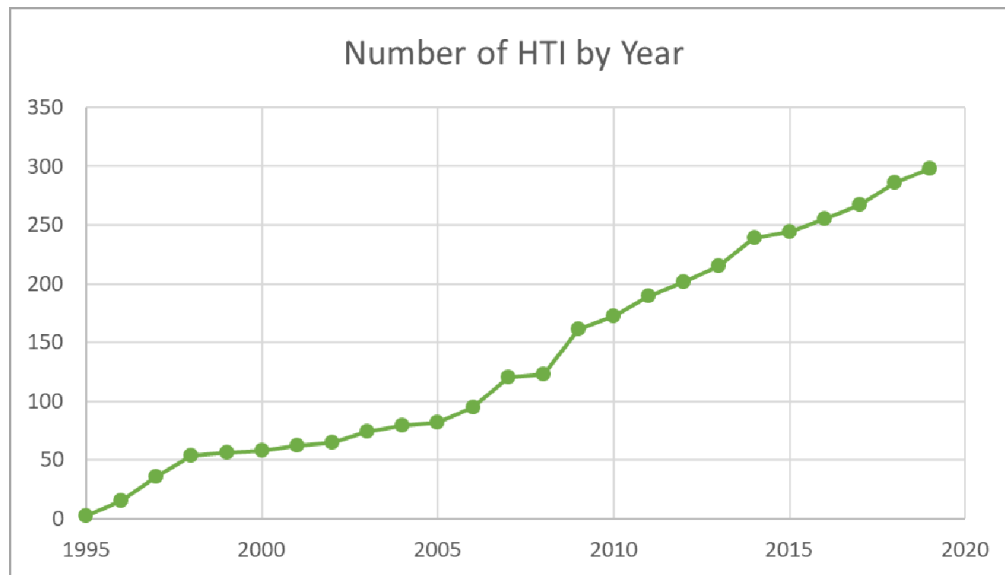


Figure 10 - Number of HTI 1995-2020

A regression analysis was conducted to estimate the historical trend in the cumulative area licensed for conversion to HTI plantations between 2005 and 2015 (Figure 11). The following equation was generated from the regression line of Figure 11.

$$\text{Area of HTI} = -123099541 + 619382.6919 * \text{Year}$$

Where:

Area of HTI = Total license area of HTI plantation concessions

YEAR = The year of HTI issuance.

The ANOVA indicates that the regression model and the regression parameter estimates were significant at a 95% confidence level.

Table 106 - Historical Trends Regression statistics

Multiple R	0.992
R Square	0.984
Adjusted R Square	0.982
Standard Error	278,573
Observations	11

Table 107 - Historical Trends Regression ANOVA

ANOVA						
Source	SS	df	MS	F	Significant Diff	R2
Model	4.22E+13	1	4.22E+13	543.8	Yes	98.4%
Error	6.98E+11	9	7.76E+10			
Total	4.29E+13	10				

Table 108 - Historical Trends Regression Parameter Estimates

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1239099541	53387430	-23.2096	2.43E-09	-1.4E+09	-1.1E+09	-1.4E+09	-1.1E+09
X Variable 1	619382.6919	26560.88	23.31936	2.33E-09	559297.8	679467.6	559297.8	679467.6

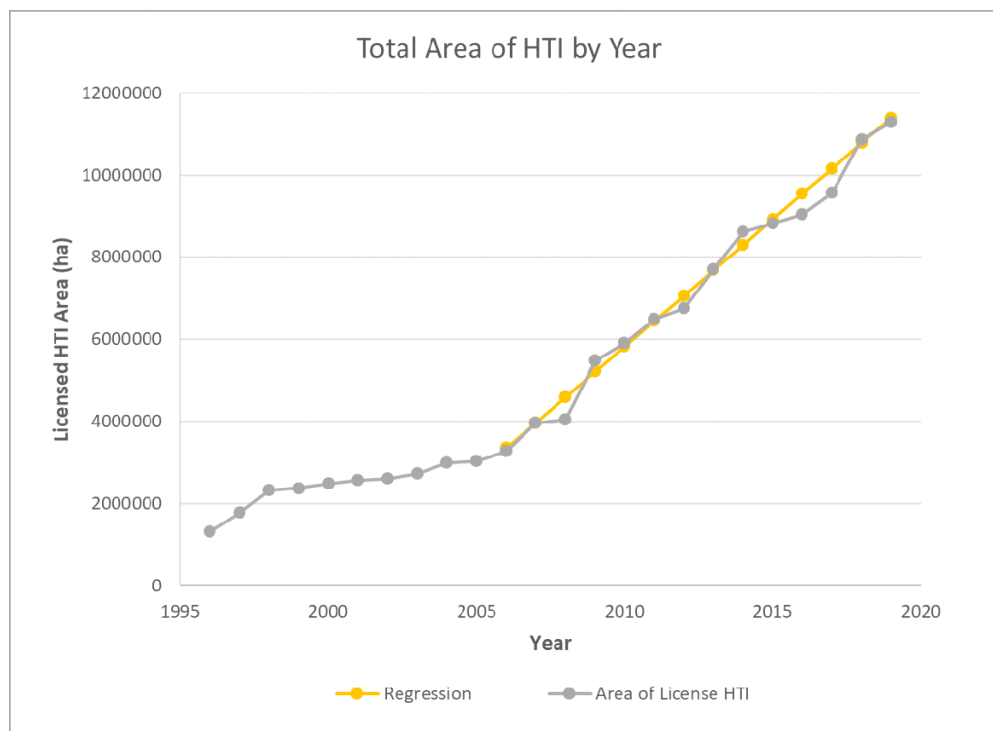


Figure 11- Results of the regression analysis to test the significance of the historical trend in the cumulative area licensed for conversion to HTI plantations between 2005 and 2015.

The regression analysis has been used to estimate the annual area licensed in Table 108. The total projected area of HTI as of 2072 is projected to be 44,225,575 hectares. Applicable laws and common practices suggest that 10% of the total licensed concession area would be reserved for

conservation while the remaining 90% would be converted. Then by applying the 7.97% baseline deforestation rate as mandated by the LK-ASP, we produce the following deforestation estimates in the table below. We note that from 2031, the area of plantation development is limited to the area remaining after 10% of the area is conserved. We have used KLHK land cover charts to estimate the total plantation area as 1.6 million hectares as of 2015. The future areas are calculated by summing the previous year's planting to the current year's plantation conversion area. In 2072, the estimated plantation area is calculated as 39,245,573 hectares.

Table 109 - Deforestation Estimates

Year	Estimated HTI area	Increase in HTI area	Area Plantation	Area deforestation and conversion to plantation (WOPR, t)
	(ha)			
2016	9,540,144	619,383	1,621,027	684,315
2017	10,159,527	619,383	2,305,342	728,743
2018	10,778,910	619,383	3,034,085	773,171
2019	11,398,292	619,383	3,807,256	817,600
2020	12,017,675	619,383	4,624,855	862,028

Step 2 – Estimate New Projection of Forest Clearance by the Baseline Agent of Deforestation with Project Implementation if No Leakage is Occurring

The new area of annual deforestation by the baseline class of deforestation agents was calculated by subtracting the annual area of clearance by the class of agents in the absence of the Project by the total annual area of planned baseline deforestation as per equation 5 of LK-ASP:

$$NewR_{i,t} = WoPR_{i,t} - (D\%_{planned,i,t} \times A_{planned,i})$$

Where:

$NewR_{i,t}$	New calculated forest clearance in stratum i in year t by the baseline agent of the planned deforestation where no leakage is occurring (ha)
$WoPR_{i,t}$	Deforestation by the baseline agent of the planned deforestation in stratum i in year t in the absence of the project (ha)
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in project stratum i in year t (percent)
$A_{planned,i}$	Total area of planned deforestation over the baseline period for project stratum i (ha)
i	1, 2, 3, ... M strata (unitless)
t	1, 2, 3, ... t^* time elapsed since the projected start of the project activity (years)

Table 110 - New area of annual deforestation by the baseline class of deforestation agents in which no leakage occurs.

Year	Unadjusted forest clearance estimate WoPR _{i,t} (ha)	New forest clearance estimate NewR _{i,t} (ha)
2016	684,315	670,079
2017	728,743	712,902
2018	773,171	757,068
2019	817,600	802,865
2020	862,028	860,805

Step 3 – Monitor All Areas Deforested by Baseline Agent of Deforestation Through the Years in Which Planned Deforestation was Forecast To Occur

For each monitoring period, we will estimate all areas deforested by the class of agents in the country by monitoring the total area licensed for conversion to HTI concessions and the actual deforestation. The KLHK is now publishing annual land cover maps showing concession boundaries, natural forest, plantation, and non-plantation land uses, and data is available for 1990, 1996, 2000, 2003, 2006, 2009, 2011, 2012, 2013, 2015, and 2019. Land cover maps will be prepared annually from 2020. It is also anticipated that more historic annual land cover maps are likely to become available in the future.

Actual leakage will be calculated using the following equation as per equation 6 of LK-ASP:

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

Where:

$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i 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)

For this Project, we assume no leakage will occur. Monitoring will verify if leakage occurs in the future.

Step 4 – Monitoring of GHG Emissions Outside the Project Boundary by Baseline Agent of Deforestation

This can only be monitored and quantified when a specific deforestation agent is identified and is not considered by this Project.

5.3.3. Peatlands and Tidal Wetlands

The project is located on peatlands and the planned deforestation baseline land use requires the drainage of the peatland. Therefore, the GHG emissions from drainage and degradation of the peatlands must be accounted for. The net GHG emissions due to wetland degradation from planned deforestation displaced from the project area are estimated as per equation 10 of LK-ASP.

$$GHG_{LK-WRC-AS,planned} = \Delta C_{LK-ASP-PEAT} + \Delta C_{LK-ASP-TW}$$

Where:

$GHG_{LK-WRC-AS,planned}$	Net GHG emissions due to wetland degradation from planned deforestation displaced from the project area up to year t^* (t CO ₂ e)
$\Delta C_{LK-ASP-PEAT}$	Net GHG emissions due to peatland drainage from planned deforestation displaced from the project area up to year t^* (t CO ₂ e)
$\Delta C_{LK-ASP-TW}$	Net GHG emissions due to tidal wetland degradation from planned deforestation displaced from the project area up to year t^* (t CO ₂ e)

Note that this project only includes peatlands and does not include tidal wetlands.

Step 1 – Estimate Soil Organic Carbon Loss in All of Agent's Concessions

PDT in the undrained peatland of alternative areas was used to determine the emission factors for activity shifting leakage within peatlands. We estimate the cumulative carbon lost at t_{PDT} as per equation 11 of LK-ASP.

$$C_{loss-PDT} = (C_{t0} - C_{PDT}) \times 44/12$$

Where:

$C_{loss-PDT}$	Cumulative peat loss at t_{PDT} (t CO ₂ e ha ⁻¹)
C_{t0}	Soil organic carbon stock at t_0 (t C ha ⁻¹)
C_{PDT}	Soil organic carbon stock at t_{PDT} (t C ha ⁻¹)
t_{PDT}	Peat Depletion Time (years)

By using the land-use designation of the Indonesian Production Forest, the Project was able to consider areas that could potentially generate peat emissions as a result of potential shifting

leakage. Licensed plantation concessions (HTI) and other unlicensed Production Forest were identified for this analysis using the KLHK land cover and soil map information.

At any point that there is deforestation in the peatlands, the Project assumed that there is simultaneous drainage. To be conservative, the Project assumed that drained peatland is equal to deforested peatland area. This assumption is made because as a general rule, industrial-level conversion and deforestation on large areas of peatlands result in canal development that leads to oxidation. By making this assumption, i.e. deforested areas were drained, the Project conservatively ensured the inclusion of the most likely scenario that licensed HTI or unlicensed HP areas would eventually be drained.

From the analysis:

- Approximately 1,369,621 ha (54%) of the licensed HTI in HP area was estimated to have been deforested at the project's APD start date.
- Approximately 914,479 ha (29.3%) of the unlicensed HP area was estimated to have been deforested at the project's APD start date.

We assumed conservatively that all peatlands in the unlicensed area are forested and undrained. This assumption considered a higher AGB carbon stock in peatlands despite the actual vegetation composition, hence a more conservative approach for accounting growth rate and emission factors.

Table 111 - Deforested and forested area in HTI and unlicensed HP areas right before the project start.

Land cover type	Peatland		Non-Peatland		Peatland + Non-Peatland	
	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)
HTI						
Natural forest	1,125,346	45%	4,348,386	50%	5,473,732	49%
Plantation	734,302	29%	1,369,469	16%	2,103,770	19%
Non-forest	635,319	25%	2,993,059	34%	3,628,379	32%
Total HTI plantation	2,494,968	100%	8,710,914	100%	11,205,881	100%
Unlicensed HP areas						
Natural forest	2,204,101	71%	37,254,172	84%	39,458,273	83%
Plantation	408,379	13%	2,118,498	5%	2,526,878	5%
Non-forest	506,050	16%	5,058,125	11%	5,564,175	12%
Total unlicensed HP areas	3,118,530	100%	44,430,795	100%	47,549,325	100%
Total HTI + Unlicensed HP areas						
Natural forest	3,329,447	59%	41,602,558	78%	44,932,005	76%
Plantation	1,142,681	20%	3,487,967	7%	4,630,648	8%
Non-forest	1,141,369	20%	8,051,184	15%	9,192,554	16%
Total HTI + unlicensed HP areas	5,613,497	100%	53,141,709	100%	58,755,206	100%

We summarized the total peatland area and carbon stock loss at t_{PDT} in licensed HTI *Acacia* plantations and unlicensed HP areas in the table below. The amount of carbon loss at t_{PDT} was based on peat thickness loss at t_{PDT} and an average bulk density in Riau of 69.8 Kg C / m³:

Table 112 - Summary of Peat Thickness and average carbon loss t_{PDT} in all HTI and Unlicensed HP Concessions

Peat Depth Class			HTI			Unlicensed HP		
Range (m)	Avg peat depth (m)	%	Area (ha)	Avg C_{peatloss} (t.C.ha ⁻¹)	Total Peat Loss (t.C.yr ⁻¹)	Area (ha)	Avg C_{peatloss} (t.C.ha ⁻¹)	Total Peat Loss (t.C.yr ⁻¹)
<1	0.75	1%	13,666	524	7,154,312	17,082	524	8,942,374
1-2	1.5	4%	93,262	1,047	97,645,564	116,571	1,047	122,049,907
2-3	2.5	10%	245,719	1,745	428,780,352	307,132	1,745	535,944,494
3-4	3.5	17%	418,613	2,443	1,022,672,085	523,236	2,443	1,278,266,298
4-5	4.5	13%	327,603	3,141	1,028,999,977	409,480	3,141	1,286,175,706
5-6	5.5	28%	701,941	3,839	2,694,750,913	877,375	3,839	3,368,244,155
6-7	6.5	25%	631,725	4,537	2,866,136,869	789,611	4,537	3,582,464,231
>7	7	3%	62,438	4,886	305,071,741	78,043	4,886	381,317,659
Total		100 %	2,494,968		8,451,211,813	3,118,530		10,563,404,824
Carbon density for Riau peatlands = 69.8 Kg C m ⁻³								

The total soil organic carbon (t C) is estimated to be 8,451,211,813 and 10,563,404,824 for HTI and Unlicensed HP. This equates to an average soil organic carbon loss ($C_{t0}-C_{PDT}$) of 3,387 t C ha⁻¹.

This converts to cumulative peat loss at t_{PDT} ($C_{\text{loss-PDT}}$) of 12,420 t CO₂-e ha⁻¹.

Step 2 – Estimate CO₂ Emission Factor for Leakage to Peatland Per Hectare

We estimate the CO₂ emissions factor from leakage to undrained peatlands at **12,420 t CO₂-e ha⁻¹** as per equation 13 of LK-ASP.

$$L_{KEF-PEAT} = C_{\text{loss-PDT}}$$

Where:

$L_{KEF-PEAT}$ CO₂ emission factor from leakage to undrained peatlands (t CO₂e ha⁻¹)

$C_{\text{loss-PDT}}$ Cumulative peat loss at t_{PDT} (t CO₂e ha⁻¹)

In its analysis, the Project used the proportion of deforested area (54.8%) in the HP area licensed for HTI concessions, to estimate the proportion of deforested and drained peatland before the beginning of the Project's APD and CIW start dates.

RER assumed the projected undrained peatland that would be drained in the baseline in HP areas licensed for HTI to be equal to the forested peatland without the area designated for conservation (10% of the peatland). It was further estimated the projected undrained peatland that would be drained in the unlicensed HP areas is equal to 61% of the peatland area.

Table 113 - Projection of undrained peatland in HP areas as alternative areas for leakage to peatland.

Category	HTI		Unlicensed HP	
	Area (ha)	Area (%)	Area (ha)	Area (%)
Peatland	2,494,968	100%	3,118,530	100%
Deforested / drained peatland	1,369,621	55%	914,429	29%
Forested peatland	1,125,346	45%	2,204,101	71%
Conservation area	249,497	10%	311,853	10%
Projection of undrained peatland in the baseline scenario	875,850	35%	1,892,248	61%

RER notes that the emission factor for leakage to peatlands is the average loss of carbon from peat soils per ha in all of the class of agents' concessions at PDT, expressed as tonnes of CO₂-e.

The total amount of $C_{\text{peatloss,tPDT}}$ was factored by the percentage of drained peatland. It is estimated as LK_{EF} for licensed and unlicensed HP areas and is summarized below.

Table 114 - Estimated emission factors of leakage to peatland.

Parameters	HTI plantations in HP	Unlicensed HP area
$C_{\text{peatloss,tPDT}}(\text{t C})$	3,811,889,626	7,465,956,368
Total undrained area of peatlands in alternative areas	875,850	1,892,248
$LK_{\text{EF}}(\text{t.CO}_2\text{-e ha}^{-1})$	15,958	14,467

Step 3 – Estimate Net GHG Emissions Due to Leakage to Undrained Peatland as a Result of Implementation of a Planned Deforestation Project

The Project was able to calculate the proportion of undrained peatlands in alternative areas based on licensed HTI, unlicensed HP area, and undrained peatland areas. The results are set forth below.

Table 115 - The proportion of undrained peatland areas in the alternative area.

Category	HTI plantations in HP area	Unlicensed HP area
	(ha)	
Alternative area (HP area)	11,205,881	47,549,324.9
Undrained peatlands	875,850	11,408,775.87
$PROP_{\text{PEAT-AGENT}}$	0.0782	0.2399

RER will calculate emissions due to leakage to undrained peatlands during project monitoring as per equation 15 of LK-ASP.

$$\Delta C_{LK-ASP-PEAT} = \sum_{t=1}^{t^*} \sum_{i=1}^M LKA_{planned,i,t} \times PROP_{PEAT-AGENT} \times LK_{EF-PEAT}$$

Where:

$\Delta C_{LK-ASP-PEAT}$	Net GHG emissions due to peatland drainage from planned deforestation displaced from the project area up to year t^* (t CO ₂ e)
$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i in year t (ha)
$PROP_{PEAT-AGENT}$	Proportion of undrained peatland areas in the agent's concessions with respect to the total area of such concessions (unitless)
$LK_{EF-PEAT}$	CO ₂ emission factor from leakage to undrained peatlands (t CO ₂ e ha ⁻¹)
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the project activity

5.3.3.1. Total emissions from activity shifting for avoiding planned deforestation

At each monitoring event, RER is able to calculate the total emissions from activity shifting leakage for APD. This calculation will be based on the parameters described in Steps above as per equation 17 of LK-ASP.

$$\Delta C_{LK-ASP-PEAT} = \sum_{t=1}^{t^*} \sum_{i=1}^M (D\%_{planned,i,t} \times A_{planned,i} \times LK_{CP-ME,c,i} \times LK_{MAF} \times PROP_{PEAT-ALT} \times LK_{EF-PEAT})$$

Where:

$\Delta C_{LK-ASP-PEAT}$	Net GHG emissions due to peatland drainage from planned deforestation displaced from the project area up to year t^* (t CO ₂ e)
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i in year t (percent)
$A_{planned,i}$	Total area of planned deforestation over the baseline period for stratum i (ha)
$LK_{CP-ME,c,i}$	Leakage factor for displacement of class of planned deforestation agents (unitless)
LK_{MAF}	Leakage management adjustment factor (unitless)
$PROP_{PEAT-ALT}$	Proportion of undrained peatland areas in the alternative areas with respect to the total alternative areas (unitless)
$LK_{EF-PEAT}$	CO ₂ emission factor from leakage to undrained peatlands (t CO ₂ e ha ⁻¹)
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the start of the project activity

The RER Project assumes that no leakage will occur. There are leakage mitigation activities in place for the RER Project and there will be monitoring and reporting of any leakage that occurs will during the t crediting period. Any leakage will be reported at the verification events. In this Monitoring Period emissions from activity shifting leakage is "0".

5.3.3.2. Estimation of Emissions from Ecological Leakage (LK-ECO)

Module VMD0044 (LK-ECO) requires that ecological leakage affecting the soil (peat) carbon pool does not occur, by ensuring that the effect of hydrological connectivity with adjacent areas is insignificant. This can be achieved by demonstrating an appropriate design (e.g. by establishing an impermeable dam, by rewetting peatland that is surrounded by undrained peatland or by rivers), or by a buffer zone within the project boundary.

The Project Area consists entirely of an intact peat swamp forest which requires relatively small but significant intervention in terms of rewetting. As such, the risk of ecological leakage is by definition limited to comparatively small areas along the legacy canals that existed at the commencement of the Project.

Since the commencement of the Project in 2016, 126 km out of 146 km of the original legacy canals have been successfully blocked and only 18.6 km of canals remain to be blocked within the Project Area. The risk of ecological leakage is minimal as demonstrated by conditions in this area and its surrounding peatlands at project start:

- In the Project Area where rewetting is being undertaken (9,148 ha), or about 7% of the total Project Area, the canal blocking is taking place in a cascade design manner such that each canal has a blockage, not at a single location, but at locations determined by the gradient of the slope the canal. This stepwise approach to canal blocking will also result in limiting water flow in the event of a breach or failure of any of the dams.
- It should be noted that the size of the canals that are being blocked are as part of the rewetting effort are not sizable. They are generally between 2-3 meters wide and about 1 to 1.5 meters deep. These relatively small dimensions also limit the amount of downstream water discharge, which in turn severely limits the risk of ecological leakage. Even were a dam to lose structural integrity and fail, the potential for ecological leakage remains minimal as demonstrated by conditions in this area and its surrounding peatlands prior to and at the Project RWE Start Date.
- The conditions of the Project Area, that is, the geography and hydrological layout of the Project Area and the additional peatlands that surround the area is such that flooding does, in fact, occur regularly. However, the reason for the flooding is from substantial rainfall that regularly occurs in the region and is not likely to be linked to the interventions of the WRC Project activities.
- Lastly, none of the blocked canals are situated in a way that would allow discharge to leak into the neighbouring landscape. All of the canals drain into natural waterways (the Serkap, Sangar, and Turip Rivers) which in turn drains into the Kampar river that itself discharges directly into the sea. These Rivers would easily be able to take on the additional water discharged from a dam breach and would further act to mitigate any leakage.

No ecological leakage is anticipated to take place in the project scenario. Through the Project's ongoing monitoring activities, using subsidence poles, dipwells, and automatic level-loggers that

have been installed, and will continue to be installed near the blocked canals where they discharge into a River or have some other type of main outlet. Monitoring will take place regularly, both during the wet and dry seasons, and is outlined in more detail in Chapter 5. The automatic level-loggers that will be installed in these areas will provide regular data on a daily basis. And if a dam loses integrity, it will be promptly repaired, in-line with the requirements of § 6.3 of LK-ECO.

Further, the quantity of water that could potentially be leaked beyond the boundaries of the concession is limited and would not increase GHG emissions because:

- a) Even where some or all dams rupture, the in situ natural waterways (i.e. rivers) and, to a much lesser extent, man-made waterways have adequate capacity, would be easily able to absorb the extra discharge, and would not lead to additional GHG emissions.
- b) All of the land surrounding the project area is currently wetlands as well, and there are no dryland areas that could be accidentally converted to wetlands (i.e. causing increased CH₄ emissions).
- c) Further, even if there was some leakage into the adjacent areas, not captured by the in-situ waterways because all of the surrounding areas are already in wetland forest, there would be no vegetative die-off as all of the surrounding areas already well adapted to the regular seasonal natural flooding conditions.
- d) There is no situation, in the event of the breach of a dam none in the Project area that would create a situation where an area outside of the Project boundary would suffer lowering of the water table that would lead to increased N₂O emissions.

In this Monitoring Period emissions from ecological leakage is “0”.

In this Monitoring Period, the emission from all leakage combined is “0”

5.4. Net GHG Emission Reductions and Removals

5.4.1.1. General

Net GHG emission reductions from REDD, ARR, and WRC prescribed in REDD+ MF.

Note that the project does not include ARR activities and ARR emissions are not calculated.

5.4.1.2. Total Net GHG Emission Reductions for REDD Project Activity

The total net GHG reductions of the REDD project activity are calculated as per equation 2 of REDD+ MF.

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

Where:

NER_{REDD}	Total net GHG emission reductions of the REDD project activity up to year t^* (t CO ₂ e)
$\Delta C_{BSL-REDD}$	Net GHG emissions in the REDD baseline scenario up to year t^* (t CO ₂ e)
$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD project scenario up to year t^* – from Module <i>M-REDD</i> (t CO ₂ e)
$\Delta C_{LK-REDD}$	Net GHG emissions due to leakage from the REDD project activity up to year t^* (t CO ₂ e)

Note that the RER Project assumes that no leakage will occur and net emissions from leakage are assumed to be zero.

The net GHG emissions in the REDD baseline scenario ($\Delta C_{BSL-REDD}$) are calculated as per equation 3 of REDD+ MF.

$$\Delta C_{BSL-REDD} = \Delta C_{BSL,planned} + \Delta C_{BSL,unplanned} + \Delta C_{BSL,deg rad-FW/C}$$

Where:

$\Delta C_{BSL-REDD}$	Net GHG emissions in the REDD baseline scenario up to year t^* (t CO ₂ e)
$\Delta C_{BSL,planned}$	Net GHG emissions in the baseline scenario from planned deforestation up to year t^* – from Module <i>BL-PL</i> (t CO ₂ e)
$\Delta C_{BSL,unplanned}$	Net GHG emissions in the baseline scenario from unplanned deforestation up to year t^* – from Module <i>BL-UP</i> (t CO ₂ e)
$\Delta C_{BSL,deg rad-FW/C}$	Net GHG emissions in the baseline scenario from degradation caused by fuelwood collection and charcoal making up to year t^* – from Module <i>BL-DFW</i> (t CO ₂ e)

Note that the RER Project excludes emissions from unplanned deforestation and degradation from fuelwood/charcoal production and net emissions from these are assumed to be zero.

The total net GHG reductions of the REDD project activity are presented in the table below.

After exclusions and zero-rated emissions sources are accounted for, total net GHG reductions of the REDD project activity ($\Delta C_{BSL-REDD}$) are equivalent to the total net GHG emissions in the baseline scenario from planned deforestation ($\Delta C_{BSL,planned}$).

Table 116 - Total net GHG Emission Reductions from REDD Activity (annual & adjusted to crediting period)

Year	Net GHG reductions in the REDD project activity (NER_{REDD}) (t CO ₂ e)	Net GHG emissions in the REDD baseline scenario ($C_{BSL-REDD}$) (t CO ₂ e)	Net GHG emissions in the REDD project scenario ($C_{WPS-REDD}$) (t CO ₂ e)	Net GHG emissions due to leakage from the REDD project activity ($C_{LK-REDD}$) (t CO ₂ e)
2016	0	0	0	0
2017	1,456,971	1,304,811	-152,160	0
2018	1,568,788	1,340,548	-228,241	0
2019	1,680,606	1,376,285	-304,321	0
2020	1,041,078	820,133	-220,945	0
Total	5,747,443	4,841,776	-905,667	0

5.4.1.3. Total Net GHG Emission Reductions for ARR Project Activity

GHG removals from ARR activities are not included in the RER project.

5.4.1.4. Total Net GHG Emission Reductions for WRC Project Activity

5.4.4.1. Net GHG emissions in the WRC project activity

The total net GHG emissions of the WRC project activity are calculated as per equation 6 of REDD+ MF.

$$NER_{WRC} = GHG_{BSL-WRC} - GHG_{WPS-WRC} - GHG_{LK-WRC}$$

Where:

NER_{WRC}	Total net GHG emission reductions in the WRC project up to year t^* (t CO ₂ e)
$GHG_{BSL-WRC}$	Net GHG emissions in the WRC baseline scenario up to year t^* (t CO ₂ e)
$GHG_{WPS-WRC}$	Net GHG emissions in the WRC project scenario up to year t^* (t CO ₂ e)
GHG_{LK-WRC}	Net GHG emissions due to leakage from the WRC project activity up to year t^* (t CO ₂ e)

Note that the RER Project assumes that no leakage will occur and net emissions from leakage (GHG_{LK-WRC}) are assumed to be zero.

5.4.4.2. Net GHG emissions in the WRC baseline scenario

For CIW-REDD, RWE-REDD, and CIW project activities in the baseline, net GHG emissions in the WRC baseline scenario are calculated as per equation 7 of REDD+ MF.

$$GHG_{BSL-WRC} = GHG_{BSL-PEAT} + GHG_{BSL-TW}$$

Where:

$GHG_{BSL-WRC}$	Net GHG emissions in the WRC baseline scenario up to year t^* (t CO ₂ e)
$GHG_{BSL-PEAT}$	Net GHG emissions in the WRC baseline scenario on peatland up to year t^* (t CO ₂ e)
GHG_{BSL-TW}	Net GHG emissions in the WRC baseline scenario on tidal wetland up to year t^* (t CO ₂ e)

Note that the RER Project is located entirely on peatland and there are no tidal wetlands within the project area. It is assumed net emissions from tidal wetlands (GHG_{BSL-TW}) are zero.

For CIW-REDD, RWE-REDD, and CIW project activities in the baseline, net GHG emissions in the WRC baseline scenario on peatland are calculated as per equation 8 of REDD+ MF.

$$GHG_{BSL-PEAT} = GHG_{BSL-PEAT,planned} + GHG_{BSL-PEAT,unplanned}$$

Where:

$GHG_{BSL-PEAT}$	Net GHG emissions in the WRC baseline scenario on peatland up to year t^* (t CO ₂ e)
$GHG_{BSL-PEAT,planned}$	Net GHG emissions in the baseline scenario from planned peatland degradation up to year t^* – from Module <i>BL-PL</i> (t CO ₂ e)
$GHG_{BSL-PEAT,unplanned}$	Net GHG emissions in the baseline scenario from unplanned peatland degradation up to year t^* – from Module <i>BL-UP</i> (t CO ₂ e)

Note that the RER Project excludes emissions from unplanned peatland degradation and net emissions from this $GHG_{BSL-PEAT,unplanned}$ is assumed to be zero.

For RWE project activities in the baseline, baseline fossil fuel is excluded from GHG emissions estimation.

For RWE project activities in the baseline, net GHG emissions in the WRC baseline scenario on peatland are calculated as per equation 10 of REDD+ MF.

$$GHG_{BSL-WRC} = GHG_{BSL-PEAT} + GHG_{BSL-TW} + GHG_{BSL-fuel}$$

Where:

$GHG_{BSL-WRC}$	Net GHG emissions in the WRC baseline scenario up to year t^* (t CO ₂ e)
$GHG_{BSL-PEAT}$	Net GHG emissions in the WRC baseline scenario on peatland up to year t^* (t CO ₂ e)
GHG_{BSL-TW}	Net GHG emissions in the WRC baseline scenario on tidal wetland up to year t^* (t CO ₂ e)
$GHG_{BSL-fuel}$	Net CO ₂ e emissions from fossil fuel use in the baseline scenario up to year t^* (from Module <i>BL-TW</i>) (t CO ₂ e)
i	1, 2, 3, ... M strata
t	1, 2, 3, ... t^* years elapsed since the projected start of the WRC project activity

Note that the RER Project is located entirely on peatland and there are no tidal wetlands within the project area. It is assumed net emissions from tidal wetlands (GHG_{BSL-TW}) are zero.

Note also that the RER Project excludes emissions from fossil fuel use ($GHG_{BSL-FUEL}$) and these are assumed to be zero.

After exclusions and zero-rated emissions sources are accounted for, total net GHG reductions of the REDD project activity ($\Delta C_{BSL-WRC}$) is equivalent to the total net GHG emissions in the baseline scenario from on peatland ($\Delta C_{BSL-PEAT}$), which in turn is equivalent to the total net GHG emissions in the baseline scenario from planned deforestation ($\Delta C_{BSL-planned}$).

5.4.4.3. Net GHG emissions in the WRC project scenario

The net GHG emissions in the WRC project scenario are calculated as per equation 11 of REDD+ MF.

$$GHG_{WPS-WRC} = GHG_{WPS-PEAT} + GHG_{WPS-TW}$$

Where:

$GHG_{WPS-WRC}$	Net GHG emissions in the WRC project scenario up to year t^* (t CO ₂ e)
$GHG_{WPS-PEAT}$	Net GHG emissions in the WRC project scenario on peatland up to year t^* (t CO ₂ e)
GHG_{WPS-TW}	Net GHG emissions in the WRC project scenario on tidal wetland up to year t^* (t CO ₂ e)

Note that the RER Project is located entirely on peatland and there are no tidal wetlands within the project area. It is assumed net emissions from tidal wetlands (GHG_{WPS-TW}) are zero.

Note also that the RER Project is located entirely on peatland and there are no tidal wetlands within the project area. It is assumed net emissions from tidal wetlands (GHG_{WPS-TW}) are zero.

Note that the RER Project assumes that no leakage will occur and net emissions from leakage are assumed to be zero.

5.4.4.4. Total Net GHG Emission Reductions for WRC project activity

After exclusions and zero-rated emissions sources are accounted for, total net GHG emissions in the WPS project scenario ($GHG_{WPS-WRC}$) is equivalent to the total net GHG emissions in the WRC project scenario on peatland ($GHG_{WPS-PEAT}$).

Table 117 - Net GHG Emissions from WRC Activity (Annual & adjusted to crediting period)

Year	Net GHG reductions in the WRC project activity (NER_{WRC}) (t CO ₂ -e)	Net GHG emissions in the WRC baseline scenario ($C_{BSL-WRC}$) (t CO ₂ -e)	Net GHG emissions in the WRC project scenario ($C_{WPS-WRC}$) (t CO ₂ -e)	Net GHG emissions due to leakage from the WRC project activity (C_{LK-WRC}) (t CO ₂ -e)
2016	32,257	270,004	237,748	0
2017	1,494,943	2,040,547	545,604	0
2018	2,377,676	2,725,577	347,901	0
2019	3,267,977	3,410,607	142,630	0
2020	2,344,104	2,378,836	34,732	0
Total	9,516,956	10,825,572	1,308,616	0

5.4.2. Summary of GHG Emission Reductions and Removals

5.4.1.1. GHG emission reductions and removals by emissions class

Net GHG emission reductions from REDD and WRC activities are calculated as per equation 1 of REDD+ MF.

$$NER_{REDD+} = NER_{REDD} + NGR_{ARR} + NER_{WRC}$$

Where:

NER_{REDD+} Total net GHG emission reductions of the REDD+ project activity up to year t^* (t CO₂e)

NER_{REDD} Total net GHG emission reductions of the REDD project activity up to year t^* (t CO₂e)

NGR_{ARR} Total net GHG removals of the ARR project activity up to year t^* (t CO₂e)

NER_{WRC} Total net GHG emission reductions of the WRC project activity up to year t^* (t CO₂e)

Note that the project does not include ARR activities and ARR emissions are estimated to be zero.

Table 118 - GHG Emission Reductions and Removals by Emissions Class (Annual & adjusted for crediting period)

Years	Total net GHG emission reductions of REDD+ project activities	Total net GHG emission reductions of REDD project activities	Total net GHG emission reductions of WRC project activities
	(NER _{REDD+})	(NER _{REDD})	(NER _{WRC})
	(t CO ₂ e)	(t CO ₂ e)	(t CO ₂ e)
2016	32,257	0	32,257
2017	2,951,914	1,456,971	1,494,943
2018	3,946,464	1,568,788	2,377,676
2019	4,948,582	1,680,606	3,267,977
2020	3,385,182	1,041,078	2,344,104
Total	15,264,400	5,747,443	9,516,956

5.4.1.2. GHG emission reductions and removals by baseline and project case

Table 119 - Estimated annual net GHG emissions reductions (t CO₂-e) (Annual & adjusted to crediting period)

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)	Buffer pool allocation	VCUs eligible for issuance
2016	270,004	237,748	0	32,257	3,226	29,031
2017	3,345,358	393,444	0	2,951,914	295,191	2,656,723
2018	4,066,125	119,661	0	3,946,464	394,646	3,551,818
2019	4,786,892	-161,690	0	4,948,582	494,858	4,453,724
2020	3,198,969	-186,213	0	3,385,182	338,518	3,046,664
Total	15,667,348	402,949	0	15,264,400	1,526,440	13,737,960

5.5. Uncertainty Analysis

Per VMD0017 (X-UNC), uncertainties were calculated for the project's REDD and WRC components in both the Project and baseline scenarios.

5.5.1.1. Uncertainty in REDD baseline estimates

Step 1: Assess Uncertainty in Projection of Baseline Rate of Deforestation

It is here assumed that there is zero uncertainty in baseline rate of deforestation are based on actual deforestation plans. Furthermore, there is assumed to be no unplanned deforestation in the baseline. In this case:

$$Uncertainty_{BSL,RATE} = 0$$

The uncertainty in the baseline rate of deforestation as zero is supported since:

- An unquestionably conservative deforestation rate was used.
- An actual deforestation plan was prepared according to existing regulations and using common practices as verified against proxy areas all located in the immediately adjacent to the Project Area.
- Furthermore, as set forth below, the total uncertainty in the combined carbons stocks and greenhouse gas sources in the REDD baseline was determined to be 8.6%. Therefore, the cumulative uncertainty in the REDD baseline scenario is 8.6%. The Ex-Post uncertainty in the REDD Project Scenario was set to zero since no ex-post (re-) measurements of carbon pools or GHG sources have been made. Uncertainties will be reassessed when carbon pools are re-measured.

Step 2: Assess Uncertainty of Emissions and Removals in Project Area in Baseline

The parameters and modules used in this analysis are shown in the table below:

Table 120 - Uncertainty Parameters and Modules

Parameters	Modules	Comment
C _{AB-tree}	CP-AB	AGB has been directly measured in the AGB inventory. Uncertainty calculations have been included for this parameter.
C _{BB-tree}	CP-AB	BGB is estimated using proxy values from tier 2 allometrics for natural forest in Indonesia. Uncertainty calculations have not been included for this parameter.
C _{DW}	CP-D	Deadwood carbon pool is not included in this project. Uncertainty for this parameter is assumed to be zero and calculations have not been included.
C _{LI}	CP-L	Litter carbon pool is not included in this project.

		Uncertainty for this parameter is assumed to be zero and calculations have not been included.
C _{SOC}	CP-S	Soil organic carbon pool is included in the WRC uncertainty calculations. Uncertainty for this parameter is assumed to be zero and calculations have not been included.
C _{WP frp}	CP-W	The long-term wood products pool is not included in this project. Uncertainty for this parameter is assumed to be zero and calculations have not been included.
E _{biomassburn}	E-BPB	Biomass burning is not included in this project. Uncertainty for this parameter is assumed to be zero and calculations have not been included.
E _{FC}	E-FFC	Emissions from fossil fuel combustion are not included in this project. Uncertainty for this parameter is assumed to be zero and calculations have not been included.
N ₂ O _{direct-N}	E-NA	Nitrate emissions are not included in the baseline. Nitrate emissions from project activities are assumed to be zero. Uncertainty for this parameter is assumed to be zero and calculations have not been included.

The uncertainty is calculated for AGB stratum using the following equation:

$$U_{REDD-BSL,SS,i} = \frac{\sqrt{\sum_1^n (U_{REDD-BSL,SS,i,pool\#} \times E_{REDD-BSL,SS,i,pool\#})^2}}{\sum_1^n E_{REDD-BSL,SS,i,pool\#}}$$

Where:

$U_{REDD-BSL,SS,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario in stratum i (%)
$U_{REDD-BSL,SS,i,pool\#}$	Percentage uncertainty for carbon stocks and greenhouse gas sources in the REDD baseline scenario in stratum i (%)
$E_{REDD-BSL,SS,i,pool\#}$	Carbon stock or GHG sources in the REDD baseline scenario (t CO ₂ e)
i	1, 2, 3 ... M strata (unitless)

From the AGB inventory, the uncertainty is estimated as 8.65% as follows.

Table 121 - AGB Uncertainty Estimates

LC Class	Area	Avg BM	Stdev	No. plots	t stat	CI 95%	Uncertainty
Dense swamp forest	19,287	150.3	43.7	50	2.010	12.4	8.3%
Medium swamp forest	63,328	112.7	31.3	92	1.986	6.5	5.7%
Sparse swamp forest	22,439	78.4	38.4	17	2.120	19.7	25.2%
Peat Dome Forest	23,748	199.3	55.9	10	2.262	40.0	20.1%
$U_{REDD-BSL,SS,i}$							8.65%

Step 3: Estimate Total Uncertainty in REDD Baseline Scenario

Rate uncertainty is incorporated as follows:

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

Where:

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

Given that the baseline rate uncertainty equals zero and the REDD uncertainty equals 8.65%, then the total uncertainty equals 8.65%.

5.5.1.2. WRC uncertainty

Using the standard error data for the peat emission factors provided by the IPCC (IPCC Wetlands Supplement 2013) the uncertainties of CO₂ and CH₄ emissions from microbial decompositions of peat and Dissolved Organic Carbon from water bodies were calculated in both the baseline and project scenarios. The uncertainty of GHG emissions from uncontrolled peat burning in the project scenario was also set to zero as it was assumed all fires in the baseline and Project will be prevented. Based on these assumptions the WRC uncertainty in the baseline and Project Scenarios were calculated to be 0.82% and 2.93% respectively.

The total error in the REDD+ project activity was calculated as 0.87%. Considering the 15% uncertainty threshold, no VCU deductions were made due to uncertainty. Further detail on all calculations is provided in Annex 17.

5.6. Calculation of AFOLU Pooled Buffer Account Contribution

Pursuant to §8.4.5 of REDD+ MF, the number of credits to be held in the AFOLU pooled buffer account is determined as a percentage for the total carbon stock benefits. For REDD project activities, this is equal to the net emissions in the baseline minus the net emissions from in the project case. For WRC project activities, the proxy net change in carbon stocks applied in the REDD-MF methodology is NER_{WRC}

The Project has used the following equations number 13, 14 and 18 respectively from REDD+ MF to estimate the buffer withholding:

$$Buffer_{Total} = Buffer_{Planned} + Buffer_{Unplanned} + Buffer_{Degrad - FW / C} + Buffer_{WRC} + Buffer_{ARR}$$

$$Buffer_{Planned} = \left(\frac{\left(\Delta C_{BSL,Planned} - \sum_{t=1}^{t^*} \sum_{i=1}^M (E_{FC,j,t} + N_2O_{direct,j,t}) \right) - \left(\Delta C_{P,Planned} - \sum_{t=1}^{t^*} \sum_{i=1}^M (E_{FC,j,t} + N_2O_{direct,j,t}) \right)}{\Delta C_{BSL,Planned} - \sum_{t=1}^{t^*} \sum_{i=1}^M (E_{FC,j,t} + N_2O_{direct,j,t})} \right) \times Buffer\%$$

$$Buffer_{WRC} = NER_{WRC} \times Buffer\%$$

Where:

BufferTotal	Total permanence risk buffer withholding (t CO ₂ e)
BufferPlanned CO ₂ e)	Buffer withholding for avoiding planned deforestation project activities (t
BufferWRC	Buffer withholding for WRC activities (t CO ₂ e)
ΔC _{BSL,Planned}	Net GHG emissions in the baseline from planned deforestation (t CO ₂ e)
ΔC _P	Net GHG emission in the project area in the project scenario (t CO ₂ e)
E _{FC,i,t}	Emission from fossil fuel combustion in stratum <i>i</i> in year <i>t</i> (t CO ₂ e)
N ₂ O _{direct-N,i,t}	Direct N ₂ O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum <i>i</i> in year <i>t</i> (t CO ₂ e)

Any variable in the above equation that is not used by the Project is calculated a zero.

The Non-Permanence Risk Buffer Assessment Report (See Appendix 3 of the Monitoring Report) determined that the combined non-permanence risk rating for the project is 10%. As set forth in REDD+ MF, the annual buffer withholding amounts are determined as a percentage of the total carbon stock benefit, excluding leakage emissions. N₂O emissions, fossil fuel combustion emissions, and biomass burning emissions were omitted from the calculations as the Project does not account for them.

Table 122 - Non-Permanence Risk Buffer Withholding (Annual & adjusted to crediting period)

Year s	REDD net GHG emissions reductions (t CO ₂ e)	WRC net GHG emissions reductions (t CO ₂ e)	Non-Permanence risk buffer (10%) (Buffer _{Total}) (t CO ₂ e)
2016	0	32,257	3,226
2017	1,456,971	1,494,943	295,191
2018	1,568,788	2,377,676	394,646
2019	1,680,606	3,267,977	494,858
2020	1,041,078	2,344,104	338,518
Total	5,747,443	9,516,956	1,526,440

5.7. Calculation of Verified Carbon Units

The Verified Carbon Units (VCU) are calculated as per equation 19 of REDD+ MF.

$$VCU_t = (Adjusted_NER_{REDD+,t_2} - Adjusted_NER_{REDD+,t_1}) - Buffer_{Total}$$

Where:

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

$Adjusted_NER_{REDD+,t_2}$ Total net GHG emission reductions of the REDD+ project activity up to year t_2 and adjusted to account for uncertainty (t CO₂e)

$Adjusted_NER_{REDD+,t_1}$ Total net GHG emission reductions of the REDD+ project activity up to year t_1 and adjusted to account for uncertainty (t CO₂e)

$Buffer_{Total}$ Total permanence risk buffer withholding (t CO₂e)

NER_{WRC} Total net GHG emission reductions of the WRC project activity up to year t^* (t CO₂e)

The baseline and project scenarios are calculated on a calendar year starting from 1 January to 31 December. But the VCU's are calculated from the WRC project start dates, 06/08/2016 for RWE and 01/01/2017 for CIW) to the project end date of 23 July 2072. No start date factor is needed for APD and CIW as they begin on the first day of the year, i.e., 1/1/2017. Therefore, only a percentage of carbon emissions in the start and end year are eligible for VCUs. The following adjustment factors have been calculated to estimate the percentage of emissions reductions that are eligible as VCUs in the start and end year:

Table 123 - Net emissions adjustment factors at project start and end years

Period	Date	Start / end year eligibility factor
RWE Start	06/08/2016	0.4027
End	23/07/2072	0.5589

The methodology requires adjustment of estimated NER to account for uncertainty. As explained previously, the project level uncertainty falls below the 15% uncertainty threshold, so no VCU deductions were made due to uncertainty are due.

The VCU's originated by the Project are calculated by subtracting the VCS Non-Permanence risk buffer withholding amounts from the uncertainty adjusted net emission reductions for each separate Project Activity as set forth in Table 123 above and 124 below.

Table 124 - Calculation of VCUs

Year	Baseline emissions or removals (t CO ₂ -e)	Project emissions or removals (t CO ₂ -e)	Leakage emissions (t CO ₂ -e)	Net GHG emission reductions or removals (t CO ₂ -e)	Buffer pool allocation (VCUs)	VCUs eligible for issuance
2016	270,004	237,748	0	32,257	3,226	29,031
2017	3,345,358	393,444	0	2,951,914	295,191	2,656,723
2018	4,066,125	119,661	0	3,946,464	394,646	3,551,818
2019	4,786,892	-161,690	0	4,948,582	494,858	4,453,724
2020	3,198,969	-186,213	0	3,385,182	338,518	3,046,664
Total	15,667,348	402,949	0	15,264,400	1,526,440	13,737,960

The total estimated emission reductions (i.e., VCUs) for the Project in the Monitoring Period are 13,737,960 t.CO₂-e (for the period 06 August 2016 through 31 July 2020 for WRC and 1 January 2017 through 31 July 2020 for APD).

6. APPENDIX

Appendix 1 – 210419 RER-CP MRV Plan(detailed)v3.0.pdf

Appendix 2 – 230109_submission RER Monitoring Model

Appendix 3 – 230109 RER Non-Permanence-Risk-Report.pdf

Appendix 4 –230109 RER Risk Report Calculation Tool.xlsx

7. REFERENCES

¹ APRIL is the former owner of the four concessions, however, because of statutory requirements of Indonesian corporation law, they no longer formally own the concessions or any corporate stock related to the four concessions. PT. GCN, PT. SMN, PT. TBOT and PT. GAN. They are wholly domestic corporations without any foreign ownership. Any references in the PD related to APRIL's policies, procedures, staff etc. are made in the context that although APRIL sponsors RER-CP activity, both on its own and through its Pulp and Paper business entity RAPP, that it has no actual corporate share-holding in the four concession and said concession operate as wholly separate legal entities, but is nonetheless a Project Proponent.

² RER and RER-Carbon Project are not legal entities as such, they are programmes that are sponsored and supported as part of APRIL's conservation efforts in Riau Province, Indonesia.

³ PT GCN is the lead concession of the four concessions that make up RER-Carbon Project; it is the decision maker and first among equals of the four concession (PT. GCN, PT. SMN, PT. TBOT and PT. GAN). PT. GCN's corporate decisions are implemented uniformly through all four concessions and PT GCN takes the lead in all RER-CP decision making.

⁴ The Project Crediting Period is over 57 individual years (i.e. 2006-2072) but the actual amount of crediting during that time period is 56 years, 1 month and 7 days.

⁵ Indonesia Secretariat for Sustainable Development Goals, *Roadmap of SDGs Indonesia, a highlight*, (2018), Ministry of National Development and Planning.

<https://www.unicef.org/indonesia/media/1626/file/Roadmap%20of%20SDGs.pdf> accessed on 01 Oct 2020.

⁶ Indonesia Secretariat for Sustainable Development Goals, *supra*, p. 80.

⁷ Indonesia Secretariat for Sustainable Development Goals, *supra*, p. 81.

⁸ Indonesian NDCs as provided to the UNFCCC Secretariat:

https://unfccc.int/sites/default/files/resource/163_Indonesia%20Input%20for%20TalanPoPpra%20Dialogue%20-%20202%20April%202018%20clean.pdf accessed on 01 Oct 20120P

⁹ The RER-CP is exempt from the AFOLU Safeguards as it contracted with the VVB prior to the 19 March 2020 deadline when the new safeguard requirements of the VCS Standards version 4.3 became mandatory.

¹⁰ The Project saw several instances (as indicated in this column) of negative "growth rates". The reason for this is that some of the sample plots in question were not located at exactly the same location as the boundary markers and had disappeared since the plots were first measured. Therefore, the remeasurement plots were measured as close to the original location as was possible in accordance with the methodology. Differences in the plot locations will add variation to the estimates of plot growth and in some instances, this will generate negative growth estimates at the plot level. This effect has nothing to do with deforestation

¹¹ VMD009 Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP), see §5.1 under Step 1, Option 1.1, Historical Deforestation Trend requires that to determine the trend, the project proponent "survey the deforestation agent and examine official records to determine the total area deforested by the deforestation agent each year over the previous five years within the country.

Annual data for a minimum of five years and a maximum of ten years must be used to create a linear regression. The results of the analysis must produce a statistically significant regression with a $p \leq 0.05$ and an adjusted r^2 of ≥ 0.75 "

¹² RER has conducted a small area of ARR as part of the project in the form of afforestation of small non-forest areas. The historical rate of this afforestation is reported but the company makes no claims to continue this work but may voluntarily do so if the need arises and resources are available. RER is largely relying on natural forest regeneration and natural forest restoration, which likely would have occurred in any case. Because of the small planting areas in the project scenario, there are no significant emissions removal gains from afforestation and they would be well below any significance threshold. Therefore, any emissions removals from the *de minimus* afforestation can be conservatively excluded.

¹³ Intergovernmental Panel on Climate Change. 2016. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 4.3 Carbon Fraction of Aboveground Forest Biomass

¹⁴ *Supra* Warren. et al. 2017.

¹⁵ The majority of IU PHHK-HT licenses are held by Asia Pulp & Paper Co. Ltd (APP) and Asia Pacific Resources International Limited (APRIL) Group. Both own pulp and paper mills in Riau Province. License holders that are not directly owned by these main two concession holders typically are dedicated suppliers to one or the other, as there are no other pulp and paper production facilities in Riau Province

¹⁶ Universitas Riau 2019. *Laporan Akhir Peat Depth Survey Project at Lanscape di Kesatuan Hidrologi Gambut Sungai Siak – Sungai Kampar*. Pusat Studi Lingkungan Hidup, Lembaga Penelitian dan Pengabdian kepada Masyarakat Universitas Riau

¹⁷ Margono, B. A., Turubanova, S., Zhuravleva, Potapov, P., Tyukavina, A., Baccini, A., Goetz, S., Hansen, M. C. (2012). Mapping and monitoring deforestation and forest degradation in Sumatra (Indonesia) using Landsat time series data sets from 1990 to 2010. *Environ. Rest. Lett.*, 7:034010.

¹⁸ Potapov PV, Turubanova SA, Hansen MC, Adusei B, Broich M, Altstatt A, Mane L and Justice CO. (2012). *Quantifying forest cover loss in Democratic Republic of the Congo 2000–2010 with Landsat ETM+data*. *Remote Sensing of Environment*. 122: 106-116.

¹⁹ Rocha, A. V. and Shaver, G. R. 2009. *Advantages of a two band EVI calculated from solar and photosynthetically active radiation fluxes*. *Agricultural and Forest Meteorology*. doi:10.1016/j.agrformet.2009.03.016

²⁰ VMD0042 (BL-PEAT) ver. 1.1 §5.1.1 at bullet point 5 (p. 6) indicates that "In peatland rewetting and conservation projects, emissions from peat fires are always lower compared to the baseline emissions and emissions from peat fires can conservatively be neglected. Accounting for peat fires emissions in the baseline is therefore optional."

²¹ IPCC 2013 Supplement for the 2006 Guidelines for National GHG Inventories: Wetlands, §2.2.1.1 On-site CO₂ emissions /removals from drained inland organic soils, Equation 2.3 Annual on-site CO₂-C Emissions/removals from drained organic soils excluding emissions from fire, Chapter 2, p 2.9.

²² IPCC 2013 Supplement for the 2006 Guidelines for National GHG Inventories: Wetlands, §2.2.1.1 On-site CO₂ emissions /removals from drained inland organic soils, Equation 2.3 Annual

on-site CO₂-C Emissions/removals from drained organic soils excluding emissions from fire, Chapter 2, p 2.9.

²³ IPCC 2013 Supplement for the 2006 Guidelines for National GHG Inventories: Wetlands, §2.2.2 Non-CO₂ emissions and removals from drained inland organic soils, Equation 2.6, Chapter 2, p 2.22.

²⁴ Hooijer, A., Page, S., Jauhiainen, J., Lee, W.A., Lu, X.X., Idris, A., Anshari, G., 2012. Subsidence and carbon loss in drained tropical peatlands. Biogeosciences 9, 1053-1071. (Page 13 of 19, Section 4.)

²⁵ Page, S.e., Rieley, J.O., Banks, C.J., 2011. Global and regional importance of the tropical peatland carbon pool. Global Change Biology 17, 798-818 (Page 43 of 59)

²⁶ IPCC 2013 Supplement for the 2006 Guidelines for National GHG Inventories: Wetlands, §2.2.1.2 Off-site CO₂ emissions via waterbody carbon losses from drained inland organic soils, Table 2.2, Chapter 2, p 2.20. It is also referenced in table 84 of the MR.

²⁷ *Supra* Indonesian National Carbon Accounting System. 2015:1

²⁸ Intergovernmental Panel on Climate Change. 2016. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Table 4.7 Above-Ground Biomass in Forests

²⁹ Page, S.e., Rieley, J.O., Banks, C.J., 2011. Global and regional importance of the tropical peatland carbon pool. Global Change Biology 17, 798-818 (Page 43 of 59)

³⁰ *Supra* Indonesian National Carbon Accounting System. 2015:1