



T-VER-P-METH-13-09

Voluntary GHG Reduction Methodology

for

Rewetting of Drained Peatland

Version 01

Sector 14: Afforestation and reforestation

Effective Date 26 November 2025

1. Methodology	Rewetting of Drained Peatland
2. Project Type	Reduction, absorption, and storage of greenhouse gases from the forestry and agriculture sectors.
3. Sector	14 –Afforestation and reforestation
4. Project Outline	Activities aimed at reducing greenhouse gas emissions resulting from area degradation, as well as enhancing carbon sequestration in biomass through peatland restoration.
5. Applicability	5.1 The project area must possess legal land-use rights documentation as prescribed by law. 5.2 The project must implement water level management activities in degraded peatlands and may include other integrated activities as follows: ● Measures for the prevention and control of forest fires in peatlands. ● Measures for peatland restoration.
6. Project Conditions	6.1 The project area may consist of multiple aggregated sites. 6.2 Project activities must be additional to those required by law and must not conflict with relevant legislation, except for activities conducted by government agencies, state enterprises, and organizations under state supervision. 6.3 The project area must be peatland that has been fully or partially drained due to human-induced drainage activities for at least 10 years prior to the project start date and would continue to be drained in the absence of the project. Agricultural land is excluded. 6.4 At the project start date, it must be demonstrated that no entity within the project area intends to carry out additional drainage. 6.5 Project activities involve the construction of permanent or semi-permanent structures to impound water in waterways to increase water levels within the project area (rewetting). The structural design must not cause negative impacts on the ecosystem to ensure that water level changes occur gradually and align as closely as possible

	with nature. Durable and environmentally friendly materials must be selected to ensure long-term structural integrity and minimize environmental impact. 6.6 The project must not cause ecological leakage resulting from project activities, subject to the following conditions: 1) The project area has no hydrological connectivity with adjacent areas (outside the project boundary); or 2) Hydrological connectivity exists and the project developer cannot confirm that there is no risk of leakage. In this case, an appropriate buffer zone must be established to prevent ecological leakage to adjacent areas. The buffer zone must have permission from the landholder or legal rights holder and should include a water management agreement that is binding throughout the project duration. 6.7 The project must not result in an overall increase in peatland drainage compared to the baseline scenario. In the event of accidental or unplanned drainage, remediation must be completed to restore the area to its original condition within 1 year, and a report must be prepared to demonstrate that the impact was temporary and insignificant to long-term carbon sequestration or the peatland ecosystem. 6.8 Where the project implements fire prevention and control measures in peatlands, the project developer must ensure that no human-induced fires occur, subject to the following conditions: 1) It must be demonstrated that frequent peat fires occurred within 10 to 15 years prior to the project start date, with at least 10% of the project area affected by fire. 2) In the baseline scenario, the project area remains at risk of human-induced peat fires both currently and in the future. 3) Fire prevention and control practices or measures must align with academic standards or be accepted by experts or scholars, and
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	must not impact the normal ecological dynamics of the peat forest. Details must be clearly specified in the Project Design Document (PDD). 4) Performance against the above practices must be monitored, and implementation results must be stated in the carbon credit certification request. 6.9 Where the project implements peatland restoration measures, the following conditions must be met: 1) Restoration must occur on non-forested peatland that has remained non-forested for at least 10 consecutive years prior to the project start date. 2) Planting, maintenance, and management of the plantation must be conducted correctly according to best practices. 3) Reforestation or restoration in the project area must use native species original to the local peat forest. The structure of the original forest should be studied, and multi-layered canopy planting should be promoted to create a forest structure that closely resembles nature and increases biodiversity. 4) Soil disturbance is permitted only during the planting period and must not exceed 10% of the planting activity area to prevent carbon dioxide emissions from organic soils.
6 Project Start Date	The project start date refers to the date on which the project developer begins project activities that result in the reduction of greenhouse gas emissions or the enhancement of greenhouse gas removals, such as the construction of structures to increase water levels in the peatland.
7 Remarks	

Definitions and Acronyms

Term	นิยาม
Peatland	An inland wetland characterized by the accumulation of organic soil matter that remains in a process of partial decomposition, having an ash content of no more than 35 % by weight, a peat layer depth of at least 30 centimeters, and an organic carbon content of at least 12% by weight.
Peat Depletion Time (PDT)	The duration of time until peat is lost from an area due to natural disasters or human activities, particularly fire and/or drainage, until it reaches a level that no longer facilitates further oxidation of soil organic matter.
Degraded Peatland	Peatland that has been affected by human activities or natural events leading to changes in the physical, chemical, or biological properties of the ecosystem. Such changes result in a reduction of the biodiversity of species associated with the peatland ecosystem, the amount of carbon stored in the soil, and/or the complexity of other ecosystem functions previously present in the area.
Drained Peatland	Peatland experiencing a significant decrease in the groundwater level relative to the ecosystem, resulting from the excavation of canals or the construction of drainage structures to support various land uses, such as commercial timber planting, peat extraction, or agriculture. Such drainage results in the organic soil layer being increasingly exposed to air, which accelerates the oxidation process, peat subsidence, and greenhouse gas emissions.
Shallow Peat	A peat layer with a depth of less than 30 centimeters.
Mineral Soil	Soil primarily composed of inorganic matter derived from the weathering of minerals, mixed with organic matter, covering the earth's surface in a thin layer, possessing the following properties: In cases where the soil is saturated with water (accumulated) for less than 30 days per year and has an organic carbon content of less than 20% by weight; or

Term	นิยาม
	- In cases where the soil is saturated with water for more than 30 days per year and: - Has an organic carbon content of less than 18% by weight if it contains 60% or more clay minerals; or - Has an organic carbon content of less than 12% by weight if it contains no clay minerals.
Peatland Restoration	Processes or measures aimed at restoring the structure, function, and ecological processes of peatlands to a state near their natural conditions.
Peatland Rewetting	The process of restoring and maintaining groundwater levels in drained peatlands with the objective of returning moisture conditions to a state near their natural condition. This is generally achieved through the construction of permanent and/or temporary structures to raise groundwater to natural levels, which helps reduce greenhouse gas emissions and restores the ecological functions of the peatland.
Legal land-use rights documentation	Documents indicating land ownership or legal land-use rights, such as land title deeds (N.S. 4), certificates of utilization (N.S. 3), documents granting permission to utilize land in Agricultural Land Reform areas (S.P.K.), letters requesting the use of public land, permits for land utilization in self-help settlements (N.K. 3), or land-use permits from relevant government agencies, etc.

Voluntary Greenhouse Gas Reduction Methodology Details for Water Level Management in Degraded Peatlands

1. Scope of Project

1.1 Operation Characteristics

Implementation of water level management activities in degraded peatlands to reduce greenhouse gas emissions from peatland drainage by increasing water levels in drained peatlands to maintain the moisture of the peat layer, reduce organic matter oxidation, and minimize fire risk. The project may include other integrated activities as follows:

- Measures for the prevention and control of forest fires in peatlands.
- Measures for peatland restoration.

This methodology cannot be used under the following conditions:

- Greenhouse gas emission reduction activities from legally permitted deforestation and forest degradation, such as compensatory tree planting in areas granted mining concessions at the end of the contract, etc., including planned forest degradation, land-use change, crop cultivation, or livestock raising.
- Afforestation or reforestation activities implemented alone.
- Afforestation or reforestation activities that replace agricultural land by more than 50% of the project area.
- Agricultural activities.

1.2 Project Scope

1.2.1 Geographical Boundaries

The spatial boundaries of the project must be clearly defined for convenience in measurement, monitoring, accounting, and validation of the project's greenhouse gas emission reductions and removals. Project activities may encompass more than one site, and the following information must be provided in full:

1. Location and position of the areas.
2. Maps (preferably in digital format).

3. Geographic coordinates of each boundary vertex along with documentation of accuracy from geo-referenced digital maps.
4. Total project area, including buffer zones (if any).
5. Details of the landowner and land-use rights.

The project developer must specify the project location, providing detailed coordinates, position, and area descriptions, along with legal land-use rights documentation as prescribed by law.

1.2.2 Buffer Zone

To avoid indirect impacts that may lead to greenhouse gas emissions outside the project boundary, the project design must appropriately consider the maintenance of hydrological connectivity with surrounding areas. This specifically includes controlling against significant changes in mean annual water levels, or the frequency and duration of flooding in adjacent areas. If the assessment during the project design stage finds that hydrological changes may cause significant greenhouse gas emissions outside the project boundary, the project developer should consider adjusting the implementation model or expanding the project boundary to cover such affected areas to prevent ecological leakage.

In cases where the project area has hydrological connectivity with surrounding areas, the project developer should define a buffer zone to monitor and mitigate potential hydrological impacts, such as a decrease in water levels in areas outside the project. The buffer zone may be located within or outside the project's geographical boundary, subject to the following conditions:

- 1) The buffer zone must be clearly mapped with defined geographical boundaries and cannot be considered for carbon credit certification.
- 2) In cases where the buffer zone is outside the project boundary, it must be adjacent to the project area and must obtain permission from the landholder or legal land-use rights holder. There should also be a water management agreement that is binding throughout the project duration.
- 3) The size of the buffer zone must be sufficient to monitor impacts both inside and outside the project area. This must be demonstrated through hydrological modeling, documentation verified by experts, or relevant academic documents as follows:

- Hydrological Modeling The buffer zone should be defined based on quantitative hydrological models conducted by experts to predict water flow and water storage capacity.
 - Topographical Consideration The buffer zone should be designed consistent with topographical features, such as elevation and slope, to increase water retention efficiency and reduce runoff.
- 4) Changes in groundwater levels are the primary indicator for monitoring and assessing hydrological leakage. Therefore, there should be a system to continuously monitor the peat water table depth in both the project area and the buffer zone to assess potential hydrological leakage resulting from project activities. This should be done using field surveys from observation wells or piezometers at least every 3 months, or through remote sensing, such as Synthetic Aperture Radar (SAR) sensors. Monitoring of groundwater levels should be conducted alongside the collection of other factors, such as rainfall, evaporation, canal water levels, and horizontal surface and subsurface water flow. If significant hydrological leakage from the project area is detected, emissions from ecological leakage must be assessed. The project developer must take corrective action within one year and provide evidence that there are no significant hydrological impacts.

1.3 Stratification

Stratification is conducted to enhance the precision and accuracy of carbon sequestration and greenhouse gas emission assessments by defining the boundaries of peatland and non-peatland areas (e.g., canals, buffer zones) and stratifying the peatland area based on peat depth and other relevant factors according to specific conditions, such as subsidence rates and peat thickness.

1.3.1 Land use and land cover

In cases where the project area is physically heterogeneous or has diverse land uses, stratification is necessary and may additionally consider land-use types, vegetation, and vegetation cover.

When remote sensing data is used, it must be georeferenced in a standard geodetic system and processed according to international best practices. The resulting strata must be validated

using field data, official government documents, or high-resolution aerial photography from independent data sources.

For the project scenario, stratification can be carried out based on the characteristics of the implemented activities.

1.3.2 Stratification of Peatland and Non-Peatland Areas

Peatland stratification is a fundamental and critical step in assessing greenhouse gas emissions and removals for projects implemented in wetlands. This process is conducted through peatland mapping, which requires both field data and remote sensing data to accurately identify the boundaries and characteristics of the area. In cases where existing maps are utilized, additional field surveys must be conducted to ensure the peatland maps are up to date.

Project developers can stratify the peatland area based on factors correlated with greenhouse gas emission rates, including:

- Land use type: For example, natural peatlands typically exhibit lower greenhouse gas emissions compared to agricultural peatlands that have undergone drainage.
- Land management practice: For example, drained peatlands have higher greenhouse gas emissions than non-drained peatlands.
- Vegetation cover: For example, peatlands with dense vegetation will have higher carbon sequestration in biomass than open peatlands.
- Groundwater level (Water table depth): This factor affects the oxidation and decomposition processes of organic matter. When the groundwater level is low, the peat soil is increasingly exposed to air, triggering oxidation and the release of carbon dioxide. A water level at approximately 0 cm from the peat surface can be assumed to result in zero carbon dioxide emissions from the oxidation process. The classification of drained and non-drained peatlands can utilize direct groundwater level measurements, local expert assessments, land management manuals, canal water levels, distance from canals, land use, and vegetation characteristics. Additionally, hydrological models may be used to estimate spatial and temporal groundwater depths.
- Peat subsidence rate: Caused by drainage, which leads to the rapid decomposition of organic matter, resulting in soil mass reduction and rapid soil subsidence. This serves

as an indicator of peatland degradation; a high subsidence rate indicates a significant volume of greenhouse gas emissions from the peat soil.

- Area of canals and open water bodies: Project developers must distinguish the area of canals and open water bodies from other strata. Assessing the size of these areas in both the baseline and project scenarios is essential, as they impact the water balance and greenhouse gas emission rates of the overall peatland ecosystem. The project developer may choose not to assess emissions from these sources if empirical evidence demonstrates that:
 - 1) Project implementation does not result in hydrological changes or management practices that significantly increase methane emissions from channels and ditches compared to the baseline; or
 - 2) Such channels and ditches are stable and have no changes in usage or structure resulting from project activities; or
 - 3) Field survey data, models, or academic reports show that methane emissions from these water sources have not significantly increased compared to the baseline. The decision to exclude methane emissions from channels and ditches in the project's greenhouse gas assessment must be supported by verifiable documentation and must adhere to the principle of conservativeness.
- Peat fire status: Burned and unburned peatland areas (excluding open water) in both the baseline and project scenarios are critical factors for calculating differences in remaining carbon, as burning results in large and rapid greenhouse gas emissions.
- Shallow peat strata: Greenhouse gas emissions are determined by the depth of the peat. In cases of alternating peat and mineral soil layers located above the groundwater level, as well as shallow peat, these may be conservatively considered to have the same characteristics as mineral soil layers. The greenhouse gas emissions from these strata are assumed to be similar to drained mineral soils and must be classified as specific strata.

1.3.3 Stratification based on peat depth

The oxidation of organic matter in peat soil is the primary mechanism leading to greenhouse gas emissions, particularly in areas where groundwater levels are consistently lowered. In aerobic environments, soil microorganisms accelerate the decomposition of organic matter accumulated in the peat layer, resulting in higher emission rates. Consequently, thick peat layers tend to release larger quantities of greenhouse gases compared to shallow peat.

Peatland stratification can be performed based on peat depth (or peat layer thickness), which is a critical factor for assessing long-term greenhouse gas changes. The operational guidelines are as follows:

- 1) If the proportion of the project area that is not peat or has a peat depth of less than 30 centimeters exceeds 5%, the project developer must prepare a peat depth map delineating specific peatland boundaries where depth is 30 centimeters or more. Shallow peat layers must be treated in the same manner as mineral soil strata to adhere to the principle of conservativeness.
- 2) The project developer must demonstrate whether, at year 100 ($t=100$) of project implementation, the peat in the project area decreases by more than 5% compared to the same stratum in the baseline scenario. A peat depth map must be prepared, and affected strata must be identified by calculating the peat thickness at $t=100$ using the following steps:
 - Determine the initial peat thickness (T_0) by measuring the peat layer at the start of the project.
 - Assess the subsidence rates (SR) using conservative values from reliable sources, such as academic journals, government reports, or study reports demonstrating peatland activities consistent with the project area. These are typically expressed in centimeters/year or meters/year.
 - Calculate the total subsidence over a 100-year period ($t=100$) as $SR \times 100$.
 - Calculate the peat thickness at year $t = 100$ as $T_0 - (SR \times 100)$
- 3) In cases where the Peat Depletion Time (PDT) in the baseline scenario is shorter than the project's crediting period (e.g., years while the crediting period is 15 years)-meaning there are no further greenhouse gas emissions from peat oxidation in that area-and such areas exceed 5% of the project area, the project developer must prepare a peat

depth map. The area must be stratified based on the time until peat disappears to isolate areas where peat will be exhausted before the end of the project's crediting period. For strata where peat is depleted before the end of the crediting period, carbon credit calculation must cease immediately to prevent overestimation of project benefits.

- 4) Stratification based on peat depth is not required if the peat depth in at least 95% of the project area exceeds the specified minimum threshold and meets all the conditions mentioned above, demonstrating that there is no significant spatial variation in terms of carbon sequestration potential or peat depletion time.

1.3.3.1 Creation of the Peat Depth Map

Project developers must create a map to stratify peat depth that is most suitable for the project context. The peat depth map must have a spatial resolution of at least 30 meters x 30 meters and must be validated in the field.

- **Field Measurement:** Peat depth is measured using a soil auger or peat probing rod with an accuracy level of ± 10 centimeters. This must be conducted systematically, such as along transects covering the peatland while accounting for spatial variability. In the field survey design, the distance between measurement points along a transect should not exceed 100 meters, and the distance between transects should not exceed 200 meters. However, if peat depth variability is low (Coefficient of Variation (CV) not exceeding 10%), meaning the measured depths in those areas differ very little, the distance may be increased up to 500 meters. There must be at least 4 measurement points per square kilometer. In cases of site restrictions, such as inaccessible areas, transects may be defined along accessible points and routes, combined with topographical data to estimate peat layer depth according to the principle of conservativeness, without requiring drilling for samples in those specific areas.
- **Remote Sensing:** Remote sensing technology may be used in conjunction with validated field sampling data. Geostatistical techniques such as Kriging or Inverse Distance Weighting (IDW), which use spatial relationships between measured points to

predict peat depth at unmeasured locations, can be applied to create a conservative peat depth map that accounts for spatial variability.

- Interval Selection: The choice of intervals should reflect significant differences in carbon sequestration and peat subsidence risk. For peat layers with a depth between 30 centimeters and 2 meters, where peat properties change significantly, the class interval should not exceed 50 centimeters. For deep peat layers, such as those with a depth of 2 meters or more where chemical and physical properties are stable, a class interval of 1 meter or more may be defined¹.

Project developers must prepare the peat depth map for the project area before starting project activities. They must demonstrate that the map represents the condition of the area prior to the start of project activities and accurately reflects the actual project conditions in the baseline scenario, as subsidence or area disturbance may occur after mapping and before the project start date.

If the project area is disturbed after the project start date, that area may have a peat depth lower than the baseline at the project start date, potentially leading to a decrease in baseline greenhouse gas emission values. However, undisturbed areas must be managed carefully by segregating them from the disturbed areas. If site-specific data is unavailable, the project developer may select peat accumulation rates from relevant reference documents according to the principle of conservativeness.

When creating the peat depth map for the project area, the depth must be categorized into intermediate strata (k). This map will be used to monitor greenhouse gas emissions within the peatland. The project developer determines the appropriate intervals, with the first stratum starting at a depth from 0 centimeters up to 30 centimeters, which is the minimum depth for peat soil according to the peatland definition.

Once the peat depth stratification is complete, the average peat depth for each stratum k at the project start date is calculated as follows:

$$D_{Peat,k,t=0} = \frac{\sum_{PD_{D,min,k}}^{PD_{D,max,k}} (A_{PD_{D,k,t=0}} * PD_D)}{A_k}$$

¹ Kenönen, M., Jauhiainen, J., Laiho, R., Kusin, K., & Vasander, H. (2020). Tropical peat physical and chemical properties on stabilized land-use types. *Mires and Peat*.

Where:

$D_{peat,k,t=0}$ = Average peat depth in stratum k at the project start date (centimeters)

$PD_{D,max,k}$ = Maximum value of peat depth class D within stratum k (centimeters)

$PD_{D,min,k}$ = Minimum value of peat depth class D within stratum k (centimeters)

$A_{PD_D,k,t=0}$ = Area of stratum k of peat depth class D at the project start date (rai)

PD_D = Peat depth of peat depth class D (centimeters)

A_k = Total area in stratum k (rai)

k = Peat depth stratum 1, 2, 3, ..., k

1.3.3.2 Calculation of Peat Depletion Time (PDT)

Drained peatlands (dry peat) undergo organic matter oxidation, resulting in continuous subsidence. This may lead to the reduction of peat levels to a point where oxidation can no longer occur under the baseline scenario. Peat existing before project implementation (at time $t=0$) may be entirely lost within the project period, specifically before the end of the project's carbon crediting period. In the event of a peat fire, the rate of peat loss may increase significantly.

Peat Depletion Time (PDT) refers to the duration required for the peat in the project area to reduce to a level that no longer supports oxidation, marking the end of greenhouse gas emissions from organic matter decomposition in the peat soil.

For baseline scenario assessment, project developers should stratify the peatland based on depth and peat characteristics. This helps in determining appropriate subsidence rates (SR) for each stratum, which are used to track annual changes in peat depth.

Case: No Peat Soil Disturbance

$$PDT_k = \frac{D_{peat,k,t=0}}{SR_k}$$

Where:

PDT_k = Peat depletion time in stratum k (years)

$D_{peat,k,t=0}$ = Average peat depth in stratum k at the project start date (centimeters)

$$SR_k = \text{Peat subsidence rate in stratum } k \text{ (centimeters per year)}$$

Project developers should use a conservative (high) subsidence rate based on reliable data sources, such as field surveys in the project area or similar sites, expert opinions, government documents/reports, or academic research.

Case: Peat Burning A peat depth map must be prepared for the project area post-fire in the baseline scenario by subtracting the burned peat depth in each stratum (k) using the following equation:

$$D_{peat,B,pb,k,t} = D_{peat,B,k,t=0} - D_{peatburn,B,k,t}$$

Where:

$D_{peat,B,pb,k,t}$ = Average peat depth post-fire in the baseline scenario for stratum k in year t (centimeters)

$D_{peat,B,k,t=0}$ = Average peat depth in stratum k at the project start date (t=0) (centimeters)

$D_{peatburn,B,k,t}$ = Peat depth burned in the baseline scenario in stratum k in year t (centimeters); value derived from field surveys, satellite imagery, burn scar surveys, or academic references.

This method conservatively assumes that after the first fire event, no further fires will occur in the baseline scenario. The average post-fire peat depth is subtracted from the peat depth map at the project start date, with each stratum representing the burned peat depth (centimeters) in the baseline scenario.

The calculation of Peat Depletion Time (PDT) in the case of fire is performed using the following equation:

$$PDT_k = \frac{D_{peat,B,pb,k,t}}{SR_k}$$

Where:

PDT_k = Peat depletion time in stratum j (years)

$D_{peat,B,pb,k,t}$	=	Average peat depth post-fire in the baseline scenario for stratum k in year t (centimeters)
SR_k	=	Peat subsidence rate in stratum k (centimeters per year)

Additional factors that may affect the peat subsidence rate include:

- **Peat Composition:** The type and composition of peat can affect the rate of decomposition and subsidence. Fibric peat has a low decomposition rate, hemic peat has a moderate decomposition rate, and sapric peat has a high decomposition rate.
- **Climate:** Temperature and rainfall affect the decomposition and subsidence rates of peat. Higher temperatures and lower humidity can accelerate peat oxidation.
- **Fire Frequency and Severity:** The frequency and severity of fires can significantly impact peat reduction through combustion and accelerated oxidation.
- **Water Management:** Effective water management, including rewetting activities and maintaining appropriate water levels, can reduce peat decomposition and subsidence rates.
- **Drainage Depth:** Deeper drainage levels lead to faster peat loss. The subsidence rate is directly correlated with drainage depth, which is the primary factor affecting the oxidation rate of peat organic matter. Increased drainage depth results in faster oxidation and higher subsidence rates. For example, Hooijer et al. (2012) reported that peat with an average drainage depth of 70 centimeters has a subsidence rate of approximately 5 centimeters per year. In Thailand, Khampeera et al. (2016) reported that the drainage depth in peat swamp forests during the dry season ranges between 0.1 meters and 0.5 meters.
- **Human Activities:** Activities such as logging, agriculture, and infrastructure development can accelerate peatland degradation and loss.

Project developers may choose to use a time-variable subsidence rate to reflect annual changes based on past practices or expert judgment, providing evidence of suitability for the project area. However, for ease of calculation and to ensure consistent distribution of greenhouse gas emission values throughout the project duration, and in accordance with the principle of conservativeness, project developers may use a linear average subsidence rate.

2 Identification of baseline scenario and demonstration of additionality

Project developers must prepare information regarding land-use patterns in the project area before starting project implementation to determine a baseline scenario that is appropriate and consistent with the area's context. Furthermore, it must be clearly proven that the project carries out activities that are additional to business-as-usual operations by using calculation tool T-VER-P-TOOL-01-01: Combined tool to identify the baseline scenario and demonstrate additionality in forest project activities.

Project developers must prepare evidence that can be used to assess the risk of land-use pattern changes or the risk of peatland drainage, such as:

- 1) Government land-use plans (in cases of public and managed peatlands).
- 2) Community management plans (in cases of public peatlands under community care).
- 3) Landowner land-use plans (in cases of private peatlands).
- 4) Other verifiable evidence, such as satellite imagery or aerial photographs, historical reports of peatland reduction, or research reports in the project area.

Additionally, project developers must specify activities in the baseline scenario that may affect the hydrological processes of the project area, such as the construction of embankments, dams, or weirs, deforestation, and the excavation of ditches or drainage systems. Because such activities may impact water flow, surface runoff, and sediment accumulation in the peatland, considering long-term impacts—such as sediment accumulation from check dams or the control of sediment erosion—is essential and must be clearly specified in the project document.

3 Greenhouse Gas Emission Activities Used in Calculations

3.1 Carbon Pools Used in Calculations

Carbon Pool	Condition	Details
Aboveground biomass	Assessed	Calculated from the biomass of trees or saplings stored above the ground, including stems, branches, and leaves, depending on project activities.

Carbon Pool	Condition	Details
Belowground biomass	Not assessed	Because belowground biomass in waterlogged areas has a low increment rate and experiences high mortality of fine roots, which become organic matter contributing to peat accumulation.
Dead wood	Not assessed	Exclusion is based on the principle of conservativeness.
Litter	Not assessed	Exclusion is based on the principle of conservativeness.
Soil organic carbon	Not assessed	Soil organic carbon components are included within the peat soil components.
Peat	Assessed	This is the primary carbon pool for project activities. Calculated from the quantity of peat soil.

3.2 Emission Sources and Greenhouse Gas Types Used in Calculations

Emission Source	Greenhouse Gas	Condition	Details
Baseline Scenario			
Peat	CO ₂	Assessed	CO ₂ emissions from burned peat or drainage.
	CH ₄	Assessed	CH ₄ emissions from burned peat or drainage.
	N ₂ O	Assessed	N ₂ O emissions from drained peatlands. N ₂ O emissions from peat burning in the baseline may be higher than during the project period; therefore,

Emission Source	Greenhouse Gas	Condition	Details
Baseline Scenario			
			non-assessment is based on the principle of conservativeness.
Project Scenario			
Burning of woody biomass	CO ₂	Not assessed	CO ₂ emissions from burned woody biomass are included in the assessment of carbon stock changes in aboveground biomass.
	CH ₄	Assessed	Non-CO ₂ emissions from burned aboveground biomass, depending on project activities.
	N ₂ O	Assessed	
Peat	CO ₂	Assessed	CO ₂ emissions from burned peat or drainage.
	CH ₄	Assessed	CH ₄ emissions from burned peat or drainage.
	N ₂ O	Assessed	N ₂ O emissions from drained peatlands. N ₂ O emissions from peat burning in the baseline may be higher than during the project period; therefore, non-assessment is based on the principle of conservativeness.

Note: For the assessment of emission sources or greenhouse gas removals, project developers must consider significant changes in carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄) emissions. This consideration must involve a comparison with the baseline scenario, examining the relationship between activities implemented under the project and their potential impacts on greenhouse gas emissions, using tool T-VER-P-TOOL-01-09: Tool for Testing Significance of GHG emissions in Forest Project Activities.

4 Baseline Net GHG Emissions and Removals by Sinks

The baseline scenario represents the decomposition of drained peat. Microorganisms decompose organic matter within the peat soil, releasing carbon dioxide into the atmosphere. Furthermore, dry peatlands are at risk of forest fires, which also release greenhouse gases.

The calculation of the net change in greenhouse gas emissions and removals for the baseline scenario considers two primary sources: peat soil and aboveground biomass. The total net baseline emissions and removals, including both sequestration and emissions, are calculated as follows:

$$C_{BSL,t} = \sum_{j=1}^m (E_{BSL,Peat,j,t} + \Delta C_{BSL,AG,j,t})$$

Where:

$C_{BSL,t}$	=	Net baseline greenhouse gas emission and removal changes in year t (tonnes of carbon dioxide equivalent)
$E_{BSL,Peat,j,t}$	=	Total greenhouse gas emissions from peat soil for stratum j in the baseline scenario in year t (tonnes of carbon dioxide equivalent)
$\Delta C_{BSL,AG,j,t}$	=	Total change in aboveground biomass carbon sequestration for stratum j in the baseline scenario in year t (tonnes of carbon dioxide equivalent)
j	=	Strata 1, 2, 3, ... m in the baseline scenario.

4.1 Calculation of Total Greenhouse Gas Emissions from Peat

Assessing greenhouse gas emissions from peat soil resulting from oxidation in the baseline scenario must account for factors that influence emission rates, such as groundwater depth and peat subsidence rates.

Because water level management and control activities generally result in lower peat burning during the project period compared to the baseline, project developers may choose not to assess emissions from peat burning in accordance with the principle of conservativeness.

The total greenhouse gas emissions from peat soil, including emissions from both drainage and peat burning, are calculated as follows:

$$E_{BSL,Peat,j,t} = E_{BSL,Drain,j,t} + E_{BSL,DOC,j,t} + E_{BSL,Burn,j,t}$$

Where:

$E_{BSL,Peat,j,t}$	=	total greenhouse gas emissions from peat soil in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent)
$E_{BSL,Drain,j,t}$	=	Greenhouse gas emissions resulting from peatland drainage in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent)
$E_{BSL,DOC,j,t}$	=	Greenhouse gas emissions from dissolved organic carbon (DOC) resulting from peatland drainage in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent)
$E_{BSL,Burn,j,t}$	=	Greenhouse gas emissions resulting from peat burning in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent)

For any stratum j where the crediting period exceeds the Peat Depletion Time (PDT), the following values must be set to zero for all years where $t > PDT$:

$$\begin{aligned} E_{BSL,Drain,j,t} &= 0 \\ E_{BSL,DOC,j,t} &= 0 \\ E_{BSL,Burn,j,t} &= 0 \end{aligned}$$

4.1.1 Calculation of Greenhouse Gas Emissions from Peatland Drainage

Project developers classify drained peatland areas using groundwater level measurement data, expert assessments, land management manuals, land use data, hydrological models, canal

water levels, or the distance from canals. The calculation for greenhouse gas emissions resulting from peatland drainage is as follows:

$$E_{BSL,Drain,j,t} = E_{BSL,Drain,CO_2,j,t} + E_{BSL,Drain,CH_4,j,t} + E_{BSL,Drain,N_2O,j,t}$$

Where:

- $E_{BSL,Drain,j,t}$ = Total greenhouse gas emissions from peatland drainage in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent).
- $E_{BSL,Drain,CO_2,j,t}$ = Carbon dioxide emissions from peatland drainage in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent).
- $E_{BSL,Drain,CH_4,j,t}$ = Methane emissions from peatland drainage in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent).
- $E_{BSL,Drain,N_2O,j,t}$ = Nitrous oxide emissions from peatland drainage in the baseline scenario for stratum j in year t (tonnes of carbon dioxide equivalent).

4.1.1.1 Calculation of Carbon Dioxide Emissions from Peatland Drainage

The amount of carbon dioxide emissions from peatland drainage can be calculated as follows:

$$E_{BSL,Drain,CO_2,t} = \sum_{j=1}^m (A_{BSL,PeatDrain,j,t} \times EF_{BSL,Drain,CO_2,j})$$

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- $E_{BSL,Drain,CO_2,t}$ = Annual carbon dioxide emissions from peatland drainage in the baseline scenario in year t (tonnes of carbon dioxide equivalent).
- $A_{BSL,PeatDrain,j,t}$ = Peatland area with drainage for stratum j in the baseline scenario in year t (rai).

$EF_{BSL,Drain,CO_2,j}$ = Carbon dioxide emission factor from peatland drainage for stratum j in the baseline scenario (tonnes of carbon dioxide per rai per year); IPCC default values from Table 2.1 of the IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2 may be used.

The carbon dioxide emission factor for peatland drainage can be determined using default values from the IPCC 2013 Wetlands Supplement, which is considered to adhere to the principle of conservativeness. However, to increase the precision and reliability of the assessment, this coefficient can be determined through site-specific studies using field data or water level models to evaluate the relationship between water levels and CO₂ emissions

Field data collection can be performed by measuring CO₂ emissions using closed chamber instruments, eddy covariance towers, or regular groundwater level monitoring via observation wells or piezometers. Water level modeling can be conducted using empirical models or process-based models.

Furthermore, project developers may consider using remote sensing data and Geographic Information Systems (GIS) to identify drained peatland areas. Integrating remote sensing for the assessment of drained peatlands, alongside the use of water level models and field observations from observation wells or piezometers, will ensure the calculation of carbon dioxide emissions from peatland drainage is both comprehensive and accurate.

4.1.1.2 Calculation of Methane (CH₄) Emissions from Peatland Drainage

The amount of methane emissions resulting from peatland drainage can be calculated as follows:

$$E_{BSL,Drain,CH_4,t} = \sum_{j=1}^m ((A_{BSL,PeatDrain_land,j,t} \times EF_{BSL,CH_4,land,j}) + (A_{BSL,Ditch,j,t} \times EF_{BSL,CH_4,ditch,j})) \times GWP_{CH_4}$$

Where:

$E_{BSL,Drain,CH_4,t}$ = Quantity of methane emissions from peatland drainage in the baseline scenario in year t (tonnes of carbon dioxide equivalent).

$A_{BSL,PeatDrain_land,t}$ = Drained peatland area excluding watercourses (ditches/canals) for stratum j in the baseline scenario in year t (rai).

$A_{BSL,Ditch,j,t}$ = Area of watercourses (ditches/canals) in stratum j in the baseline scenario in year t (rai).

$EF_{BSL,CH4,land,j}$ = Methane emission factor from drained peatland for stratum j in the baseline scenario (tonnes of methane per rai per year). This can be sourced from Table 2.3 of the IPCC 2013 Wetlands Supplement, Chapter 2.

$EF_{BSL,CH4,ditch,j}$ = Methane emission factor for watercourses (ditches/canals) resulting from peatland drainage for stratum j in the baseline scenario (tonnes of methane per rai per year). This can be sourced from Table 2.4 of the IPCC 2013 Wetlands Supplement, Chapter 2.

GWP_{CH4} = Global Warming Potential of methane.

4.1.1.3 Calculation of Nitrous Oxide (N₂O) Emissions from Peatland Drainage

Because N₂O emissions from drained peatlands in the baseline scenario may be higher than those during the project period (following water level increase activities), project developers may choose not to assess them based on the principle of conservativeness.

If assessed, the amount of nitrous oxide emissions from peatland drainage can be calculated as follows:

$$E_{BSL,Drain,N2O,t} = \sum_{j=1}^m (A_{BSL,PeatDrain,j,t} \times EF_{N2O,j}) \times GWP_{N2O}$$

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$E_{BSL,Drain,N2O,t}$ = Quantity of nitrous oxide emissions from peatland drainage in the baseline scenario in year t (tonnes of carbon dioxide equivalent).

$A_{BSL,PeatDrain,j,t}$ = Drained peatland area for stratum j in the baseline scenario in year t (rai).

$EF_{N2O,j}$ = Nitrous oxide emission factor from drained peatland for stratum j in the baseline scenario (tonnes of nitrous oxide per rai per year). This can be sourced from Table 2.5 of the IPCC 2013 Wetlands Supplement, Chapter 2.

GWP_{N2O} = Global Warming Potential of nitrous oxide.

4.1.2 Calculation of GHG Emissions from Dissolved Organic Carbon (DOC) from Peatland Drainage

Dissolved organic carbon that is leached and carried away from peatlands via water flow into water bodies will subsequently decompose and release carbon dioxide into the atmosphere. The calculation of greenhouse gas emissions from DOC resulting from peatland drainage is an essential component of the environmental impact assessment and is calculated as follows:

$$E_{BSL,DOC,t} = \sum_{j=1}^m (A_{BSL,PeatDrain,j,t} \times EF_{BSL,DOC_Drained,j})$$

Where:

$E_{BSL,DOC,t}$ = Quantity of greenhouse gas emissions from dissolved organic carbon resulting from peatland drainage in the baseline scenario in year t (tonnes of carbon dioxide equivalent).

$A_{BSL,PeatDrain,j,t}$ = Drained peatland area for stratum j in the baseline scenario in year t (rai).

$EF_{BSL,DOC_Drained,j}$ = Carbon dioxide emission factor from dissolved organic carbon leached from drained peatlands for stratum j in the baseline scenario (tonnes of carbon dioxide equivalent per rai per year). This can be sourced from Table 2.2 of the IPCC 2013 Wetlands Supplement, Chapter 2.

The emission factor for greenhouse gas emissions from DOC leached from drained peatlands can be determined using IPCC 2013 Wetlands Supplement default values or values derived from validated and published academic literature.

4.1.3 Calculation of Greenhouse Gas Emissions from Peat Burning

Water management or water level control activities typically result in lower peat burning compared to the baseline scenario. Therefore, project developers may choose not to assess greenhouse gas emissions from peat burning in accordance with the principle of conservativeness

$$E_{BSL,Burn,j,t} = 0$$

In cases where the project includes integrated measures for the prevention and control of forest fires in peatlands, developers may assess and claim carbon credits from the reduction of greenhouse gas emissions from peat burning, provided the following conditions are met:

- It must be demonstrated that at least 10% of the project area experienced peat burning over a historical period of no less than 10 years but no more than 15 years prior to the project start date.
- In the baseline scenario, the project area must remain at risk of human-induced peat fires in both the present and the future.
- The project must implement fire prevention and control measures or practices that follow academic principles or are accepted by experts or scholars, with details clearly specified in the Project Design Document (PDD).
- Performance of the aforementioned practices must be monitored and reported during the carbon credit certification process.

The amount of greenhouse gas emissions resulting from peat burning can be calculated as follows:

$$E_{BSL,Burn,t} = E_{BSL,Burn,CO_2,t} + (E_{BSL,Burn,CH_4,t} \times GWP_{CH_4})$$

$$E_{BSL,Burn,CO2,t} = \frac{M_{BSL,Burn,t} \times EF_{Burn,CO2}}{1,000}$$

$$E_{BSL,Burn,CH4,t} = \frac{M_{BSL,Burn,t} \times EF_{Burn,CH4}}{1,000}$$

$$M_{BSL,Burn,t} = \sum_{j=1}^m (D_{BSL,BurnDepth,j,t} \times A_{BSL,Burn,j,t}) \times 1,600 \times BD_j$$

Where:

$E_{BSL,Burn,t}$ = Greenhouse gas emissions from peat burning in the baseline in year t (tonnes of carbon dioxide equivalent).

$E_{BSL,Burn,CO2,t}$ = Carbon dioxide emissions from peat burning in the baseline in year t (tonnes of carbon dioxide equivalent).

$E_{BSL,Burn,CH4,t}$ = Methane emissions from peat burning in the baseline in year t (tonnes of methane).

$M_{BSL,Burn,t}$ = Quantity of peat soil burned in the baseline in year t (tonnes).

$EF_{Burn,CO2}$ = Carbon dioxide emission factor from peat burning (kilograms of CO₂ per tonne of dry peat weight); default values from the IPCC 2013 Wetlands Supplement may be used.

$EF_{Burn,CH4}$ = Methane emission factor from peat burning (kilograms of CH₄ per tonne of dry peat weight); default values from the IPCC 2013 Wetlands Supplement may be used.

$D_{BSL,BurnDepth,j,t}$ = Depth of peat soil burned for stratum j in the baseline in year t (meters); can be assessed from field surveys, historical data, or reliable reports of peat fire events in similar areas.

$A_{BSL,Burn,j,t}$ = Burned peat area for stratum j in the baseline in year t (rai); can be assessed from historical data, field surveys, and remote sensing.

BD_j = Total bulk density of peat soil for stratum j (tonnes per cubic meter); derived from field surveys or published academic literature.

GWP_{CH_4} = Global Warming Potential of methane.

Cases Involving Fire Prevention and Control Measures If project activities fail and a fire occurs within the project area, the greenhouse gas emissions from peat burning in the baseline are set to 0 in accordance with the principle of conservativeness. The project developer must then calculate the greenhouse gas emissions resulting from that peat fire for the relevant monitoring period.

An exception is made for extreme events, such as the El Niño phenomenon. If the fire is caused by such an extreme event and the project developer has demonstrated best efforts in managing water levels and fires, it will not affect carbon credit certification. However, the project developer must still calculate the actual greenhouse gas emissions resulting from that peat fire.

4.2 Calculation of Total Change in Aboveground Biomass Carbon Sequestration

Changes in tree biomass carbon sequestration in the baseline scenario are assumed to be zero. Furthermore, because increasing water levels in peatlands results in a lower probability of fire during the project period compared to the baseline scenario, greenhouse gas emissions from biomass burning in the baseline are not assessed, adhering to the principle of conservativeness:

$$\Delta C_{BSL,AG} = 0$$

In cases where the project includes peatland restoration activities through additional tree planting, project developers may assess and claim carbon credits from the resulting increase in biomass carbon sequestration, provided the following conditions are met:

- Land Status: The area must not currently be a forest (meaning the average canopy cover of trees with a potential height of at least 3 meters must be less than 30% of the area).
- Management: Planting, maintenance, and plantation management must follow correct and appropriate methods.

- Species Selection: Afforestation or reforestation must use native species originally found in the peat forests of that specific location. Developers should study the original peat forest structure and encourage multi-layered canopy planting to create a forest structure that closely mimics nature and enhances biodiversity.
- Soil Protection: Soil disturbance is permitted only during the planting period and must not exceed 10% of the planting activity area to prevent carbon dioxide emissions from organic soil.

The change in total aboveground biomass carbon sequestration in the baseline scenario is calculated as follows:

$$\Delta C_{BSL,AG,j,t} = \Delta C_{BSL,TREE,j,t} + \Delta C_{BSL,SAP,j,t}$$

Where:

$\Delta C_{BSL,AG,j,t}$ = Total change in aboveground biomass carbon sequestration for stratum j in the baseline scenario in year t (tonnes of carbon dioxide equivalent).

$\Delta C_{BSL,TREE,j,t}$ = Change in carbon sequestration of trees for stratum j in the baseline scenario in year t (tonnes of carbon dioxide equivalent). This is performed according to the ΔC_{TREE} calculation in tool T-VER-P-TOOL-01-02: Calculation for carbon stocks and change in carbon stocks of trees in forest project activities.

$\Delta C_{BSL,SAP,j,t}$ = Change in carbon sequestration of saplings for stratum j in the baseline scenario in year t (tonnes of carbon dioxide equivalent). This is performed according to the ΔC_{SAP} calculation in tool T-VER-P-TOOL-01-02: Calculation for carbon stocks and

j = Strata 1, 2, 3, ... m in the baseline scenario.

4.3 Forecasting Changes in Net Greenhouse Gas Emissions and Removals for the Baseline Scenario

Project developers must assess the baseline scenario by referencing a historical period of at least 10 years prior to the project start date to ensure that the baseline reflects long-term trends and variability accurately. Historical data serves as a critical foundation for establishing the credibility of greenhouse gas emission forecasts. Projections for greenhouse gas emissions from peat and biomass burning should consider historical trends using actual event data—such as remote sensing, peat fire reports, or data from relevant agencies—to ensure that forecasts are appropriate and consistent with best practices.

When forecasting changes in net greenhouse gas emissions, project developers should use the same forecasting datasets for both the baseline and project scenarios. This is especially important when considering the impacts of climate change (e.g., rainfall volume, evaporation rates). Utilizing the same dataset allows for precise comparison of results and clearly identifies the true impact of the project.

Additionally, project developers must periodically reassess the baseline scenario to ensure it continues to reflect actual environmental conditions and serves as an appropriate reference point for evaluating the project's impact on greenhouse gas emissions. A new baseline assessment must be conducted at least every 10 years or as specified by the TGO. Reassessments of the baseline scenario should account for external factors that may have significant impacts, such as changes in government policy, technological advancements, or unpredictable environmental shifts.

5 Calculation of Net GHG Emissions and Removals from Project Activities

The calculation of the net change in greenhouse gas emissions and removals from project activities considers two primary sources: aboveground biomass and peat soil. It is calculated as follows:

$$C_{PRJ,t} = \sum_{j=1}^m (E_{PRJ,Peat,j,t} - \Delta C_{PRJ,AG,j,t})$$

$C_{PRJ,t}$	=	Net greenhouse gas emissions and removals from project activities in year t (tonnes of carbon dioxide equivalent)
$E_{PRJ,Peat,j,t}$	=	Total greenhouse gas emissions from project activities for stratum j in year t (tonnes of carbon dioxide equivalent)
$\Delta C_{PRJ,AG,j,t}$	=	Change in carbon sequestration from peatland planting and restoration activities for stratum j in project activities in year t (tonnes of carbon dioxide equivalent), conducted according to calculation tool T-VER-P-TOOL-01-02: Calculation for carbon stocks and change in carbon stocks of trees in forest project activities.
j	=	Strata 1, 2, 3, ... m for project activities.

5.1 Calculation of Total Greenhouse Gas Emissions from Peat in Project Activities (Project Emissions)

The calculation of greenhouse gas emissions resulting from project activities involves monitoring and assessing the volume of greenhouse gas emissions that may occur within the project boundary following the start of project implementation and throughout the project duration, as follows:

$$E_{PRJ,Peat,j,t} = E_{PRJ,Drain,j,t} + E_{PRJ,DOC,j,t} + E_{PRJ,Burn,j,t}$$

Where:

$E_{PRJ,Peat,j,t}$	=	Total greenhouse gas emissions from peat soil from project activities for stratum j in year t (tonnes of carbon dioxide equivalent)
$E_{PRJ,Drain,j,t}$	=	Greenhouse gas emissions resulting from peatland drainage in project activities for stratum j in year t (tonnes of carbon dioxide equivalent)
$E_{PRJ,DOC,j,t}$	=	Greenhouse gas emissions from dissolved organic carbon (DOC) resulting from peatland drainage in project activities for stratum j in year t (tonnes of carbon dioxide equivalent)

$E_{PRJ,Burn,j,t}$ = Greenhouse gas emissions resulting from peat burning in project activities for stratum j in year t (tonnes of carbon dioxide equivalent)

5.1.1 Calculation of Greenhouse Gas Emissions from Peatland Drainage in the Project Scenario

The greenhouse gas emissions resulting from peatland drainage can be calculated as follows:

$$E_{PRJ,Drain,j,t} = E_{PRJ,Drain,CO2,j,t} + E_{PRJ,Drain,CH4,j,t} + E_{PRJ,Drain,N2O,j,t}$$

Where:

$E_{PRJ,Drain,j,t}$ = Total greenhouse gas emissions from peatland drainage from project activities for stratum j in year t (tonnes of carbon dioxide equivalent).

$E_{PRJ,Drain,CO2,j,t}$ = Carbon dioxide emissions from peatland drainage from project activities for stratum j in year t (tonnes of carbon dioxide equivalent).

$E_{PRJ,Drain,CH4,j,t}$ = Methane emissions from peatland drainage from project activities for stratum j in year t (tonnes of carbon dioxide equivalent).

$E_{PRJ,Drain,N2O,j,t}$ = Nitrous oxide emissions from peatland drainage from project activities for stratum j in year t (tonnes of carbon dioxide equivalent).

5.1.1.1 Calculation of Carbon Dioxide Emissions from Peatland Drainage

The amount of carbon dioxide emissions from peatland drainage can be calculated as follows:

$$E_{PRJ,Drain,CO2,t} = \sum_{j=1}^m (A_{PRJ,PeatDrain,j,t} \times EF_{PRJ,Drain,CO2,j})$$

Where:

$E_{PRJ,Drain,CO2,t}$ = Carbon dioxide emissions from peatland drainage from project activities in year t (tonnes of carbon dioxide equivalent).

$A_{PRJ,PeatDrain,j,t}$ = Peatland area with drainage for stratum j from project activities in year t (rai). This can be identified using groundwater level measurement data in the project area, expert assessments, land management manuals, land use data, hydrological models, canal water levels, or the distance from canals.

$EF_{PRJ,Drain,CO2,j}$ = Carbon dioxide emission factor from peatland drainage for stratum j from project activities (tonnes of carbon dioxide per rai per year). Standard IPCC values from Table 3.1 of the IPCC 2013 Wetlands Supplement, Chapter 3, may be used.

5.1.1.2 Calculation of Methane Emissions from Peatland Drainage

While rewetting activities aim to reduce drainage, some ditches or open water bodies may remain or be created from ditch blocking. Project developers may choose to exclude these from assessment if the ditches or channels existed prior to the project start and it is demonstrated that greenhouse gas emissions in the project scenario will not exceed those in the baseline scenario. Such exclusions are based on the principle of conservativeness.

The amount of methane emissions resulting from peatland drainage is calculated as follows:

$$E_{PRJ,Drain,CH4,t} = \sum_{j=1}^m ((A_{PRJ,PeatDrain_land,j,t} \times EF_{PRJ,CH4,land,j}) + (A_{PRJ,Ditch,j,t} \times EF_{PRJ,CH4,ditch,j})) \times GWP_{CH4}$$

Where:

$E_{PRJ,Drain,CH4,t}$ = Quantity of methane emissions from peatland drainage from project activities in year t (tonnes of carbon dioxide equivalent).

$A_{PRJ,PeatDrain_l}$ = Drained peatland area from project activities, excluding watercourses (ditches/canals), for stratum j in year t (rai).

$A_{PRJ,Ditch,j,t}$ = Area of watercourses (ditches/canals) in stratum j from project activities in year t (rai).

$EF_{PRJ,CH4,land,j}$ = Methane emission factor from peatland drainage for stratum j from project activities (tonnes of methane per rai per year). Standard IPCC values from Table 3.3 of the IPCC 2013 Wetlands Supplement, Chapter 3, may be used.

$EF_{PRJ,CH4,ditch,j}$ = Methane emission factor for watercourses (ditches/canals) from peatland drainage for stratum j from project activities (tonnes of methane per rai per year). Standard IPCC values from Table 2.4 of the IPCC 2013 Wetlands Supplement, Chapter 2, may be used.

GWP_{CH4} = Global Warming Potential of methane.

5.1.1.3 Calculation of Nitrous Oxide (N₂O) Emissions from Peatland Drainage

The annual nitrous oxide emissions resulting from peatland drainage can be calculated as follows:

$$E_{PRJ,Drain,N2O,t} = \sum_{j=1}^m (A_{PRJ,PeatDrain,j,t} \times EF_{N2O,j}) \times GWP_{N2O}$$

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$E_{PRJ,Drain,N2O,t}$ = Annual nitrous oxide emissions resulting from peatland drainage in project activities in year t (tonnes of carbon dioxide equivalent).

$A_{PRJ,PeatDrain,j,t}$ = Peatland area with drainage for stratum j from project activities in year t (rai).

$EF_{N2O,j}$ = Nitrous oxide emission factor from peatland drainage for stratum j in the project scenario (tonnes of nitrous oxide per rai per year). Standard IPCC values from Table 2.5 of the IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2, may be used.

GWP_{N2O} = Global Warming Potential of nitrous oxide.

5.1.2 Calculation of Greenhouse Gas Emissions from Dissolved Organic Carbon (DOC) resulting from Peatland Drainage

Calculating greenhouse gas emissions from dissolved organic carbon leached from peatlands due to drainage is a critical component of environmental impact assessment and is calculated as follows:

$$E_{PRJ,DOC,t} = \sum_{j=1}^m (A_{PRJ,PeatDrain,j,t} \cdot EF_{PRJ,DOC_Drained,j})$$

Where:

$E_{PRJ,DOC,t}$	=	Quantity of greenhouse gas emissions from dissolved organic carbon resulting from peatland drainage in project activities in year t (tonnes of carbon dioxide equivalent).
$A_{PRJ,PeatDrain,j,t}$	=	Area where drainage occurs from peatland for stratum j from project activities in year t (rai).
$EF_{PRJ,DOC_Drained,j}$	=	Carbon dioxide emission factor from dissolved organic carbon leached from peatlands due to drainage for stratum j from project activities (tonnes of carbon dioxide equivalent per rai per year). Standard IPCC values from Table 2.2 of the IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2, may be used.

Project developers may choose not to assess greenhouse gas emissions resulting from dissolved organic carbon in the project scenario. In such instances, the quantity of DOC emissions in the project scenario is assumed to be equal to the quantity of DOC emissions in the baseline scenario, and the project will not claim any emission reductions from dissolved organic carbon. This approach adheres to the principle of conservativeness.

5.1.3 Calculation of Greenhouse Gas Emissions from Peat Burning

The quantity of greenhouse gas emissions resulting from peat burning can be calculated as follows:

$$E_{PRJ,Burn,t} = E_{PRJ,Burn,CO2,t} + (E_{PRJ,Burn,CH4,t} \times GWP_{CH4})$$

$$E_{PRJ,Burn,CO2,t} = \frac{M_{PRJ,Burn,t} \times EF_{Burn,CO2}}{1,000}$$

$$E_{PRJ,Burn,CH4,t} = \frac{M_{PRJ,Burn,t} \times EF_{Burn,CH4}}{1,000}$$

$$M_{PRJ,Burn,t} = \sum_{j=1}^m (D_{PRJ,BurnDepth,j,t} \times A_{PRJ,Burn,j,t}) \times 1,600 \times BD_j$$

Where:

- $E_{PRJ,Burn,t}$ = Quantity of greenhouse gas emissions resulting from peat burning from project activities in year t (tonnes of carbon dioxide equivalent).
- $E_{PRJ,Burn,CO2,t}$ = Quantity of carbon dioxide emissions resulting from peat burning from project activities in year t (tonnes of carbon dioxide equivalent).
- $E_{PRJ,Burn,CH4,t}$ = Quantity of methane emissions resulting from peat burning from project activities in year t (tonnes of methane).
- $M_{PRJ,Burn,t}$ = Quantity of peat soil burned from project activities in year t (tonnes).
- $EF_{Burn,CO2}$ = Carbon dioxide emission factor from peat burning (kilograms of carbon dioxide per tonne of dry peat weight); standard values from the IPCC 2013 Wetlands Supplement may be used.

EF_{Burn,CH_4} = Methane emission factor from peat burning (kilograms of methane per tonne of dry peat weight); standard values from the IPCC 2013 Wetlands Supplement may be used.

$D_{PRJ,BurnDepth,t}$ = Depth of peat soil burned for stratum j from project activities in year t (meters); can be assessed through field surveys, historical data, or reports from reliable sources regarding peat fire events in similar areas.

$A_{PRJ,Burn,j,t}$ = Area of peat soil burned for stratum j from project activities in year t (rai); can be assessed from historical data, field surveys, and remote sensing.

BD_j = Peat bulk density for stratum j (tonnes per cubic meter); reference values derived from field surveys or published academic literature may be used.

GWP_{CH_4} = Global Warming Potential of methane.

In cases where the project includes integrated fire prevention and control measures for peatlands, if project activities fail and a fire occurs within the project area, the baseline emissions from peat burning are set to 0 in accordance with the principle of conservativeness. The project developer must then calculate the actual greenhouse gas emissions resulting from the peat fire for that specific monitoring period.

An exception is made for extreme events, such as the El Niño phenomenon. If a fire occurs due to such an event despite the project developer's best efforts in water level and fire management, it will not affect carbon credit certification. However, the project developer must still calculate the actual greenhouse gas emissions resulting from that fire.

Furthermore, the project developer must monitor soil subsidence for at least 3 years following a fire. If soil subsidence is detected, the net greenhouse gas emissions and removals of the baseline scenario must be reassessed.

5.2 Calculation of Total Change in Aboveground Biomass Carbon Sequestration from Project Activities

In cases where the project involves peatland restoration activities through additional tree planting and complies with the specified conditions, the assessment of aboveground biomass carbon sequestration and its changes can be calculated as follows:

$$\Delta C_{PRJ,AG,j,t} = (\Delta C_{PRJ,TREE,j,t} + \Delta C_{PRJ,SAP,j,t}) - GHG_{PRJ,Burning,j,t}$$

Where:

$\Delta C_{PRJ,AG,j,t}$ = Total change in aboveground biomass carbon sequestration for stratum j from project activities in year t (tonnes of carbon dioxide equivalent).

$\Delta C_{PRJ,TREE,j,t}$ = Change in carbon sequestration of trees for stratum j from project activities in year t (tonnes of carbon dioxide equivalent). This is calculated according to the ΔC_{TREE} methodology in tool T-VER-P-TOOL-01-02: Calculation for carbon stocks and change in carbon stocks of trees in forest project activities.

$\Delta C_{PRJ,SAP,j,t}$ = Change in carbon sequestration of saplings for stratum j from project activities in year t (tonnes of carbon dioxide equivalent). This is calculated according to the ΔC_{SAP} methodology in tool T-VER-P-TOOL-01-02: Calculation for carbon stocks and change in carbon stocks of trees in forest project activities.

$GHG_{PRJ,Burning,j,t}$ = Total greenhouse gas emissions resulting from biomass burning for stratum j from project activities in year t (tonnes of carbon dioxide equivalent). This is calculated using tool T-VER-P-TOOL-01-05: Calculation for non-CO2 greenhouse gas emissions from burning of biomass in forest project activities.

6 Calculation of Leakage Emission

If project activities result in changes to land use or ecosystems in areas outside the project boundary, the project developer must assess and calculate the quantity of leakage emissions using the following equation:

$$LK_t = LK_{AGR,t} + LK_{Ecological,t}$$

Where:

LK_t	=	Total greenhouse gas emissions from leakage in year t (tonnes of carbon dioxide equivalent).
$LK_{AGR,t}$	=	Leakage emissions resulting from the displacement of agricultural activities in year t (tonnes of carbon dioxide equivalent).
$LK_{Ecological,t}$	=	Ecological leakage emissions from project activities in year t (tonnes of carbon dioxide equivalent).

6.1 Assessment of Activity Displacement Leakage

This type of leakage occurs when land-use activities (such as agriculture or livestock grazing) that were previously conducted within the project area are shifted to other areas. This results in greenhouse gas emissions outside the project boundary due to the displacement of agricultural activities and the potential encroachment into new lands. This is calculated using tool T-VER-P-TOOL-01-06: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in forest project activities.

If project implementation does not lead to land-use changes in areas outside the project boundary, or if the new areas where activities are relocated already have the same type of land use (such as established agricultural land), the project developer may set this type of leakage to zero.

6.2 Assessment of Ecological Leakage

Ecological leakage refers to greenhouse gas emissions occurring outside the project boundary as a result of project implementation, specifically activities that cause hydrological changes in adjacent areas connected to the project site, which lead to increased emissions.

Project activities may cause water to leak into adjacent areas, which could change water table depths outside the project area (compared to a scenario where the project was not implemented). If the project developer chooses to monitor water level changes, levels should be tracked in both the project area and the adjacent areas to demonstrate that there is no significant change in the average annual groundwater depth or that the change is limited to levels that do not significantly affect greenhouse gas emissions.

When tracking water level changes, if the project defines a buffer zone, monitoring gauges must be installed in both the project area and the buffer zone. The number and spacing of these gauges should be determined by hydrological models and/or expert judgment.

The developer may set this value to zero if evidence from hydrological models or field data shows that project activities do not significantly affect areas outside the project boundary and the following conditions are met:

1. There is no significant change in groundwater levels in adjacent areas.
2. Adjacent non-peatland areas are not converted into peatlands.
3. Open watercourses in adjacent areas are not converted into wetlands or peatlands.
4. There is no management that causes vegetation degradation or loss in the area.

Estimation of ecological leakage can be calculated as follows:

$$LK_{Ecological,t} = \sum_{i=1}^k (E_{post,i,t} - E_{pre,i,t})$$

Where:

$LK_{Ecological,t}$ = Quantity of ecological leakage from project activities in year t (tonnes of carbon dioxide equivalent).

$E_{post,i,t}$ = Greenhouse gas emissions from source i in areas outside the project boundary after project implementation in year t (tonnes of carbon dioxide equivalent).

$E_{pre,i,t}$ = Greenhouse gas emissions from source i in areas outside the project boundary before project

implementation in year t (tonnes of carbon dioxide equivalent).

i = 1, 2, 3, ..., k (number of leakage sources).

7 Net GHG Emission Reduction and Removals from Project Implementation

$$NER_t = (C_{BSL,t} - C_{PRJ,t} - LK_t) \times (100\% - U_{Error} + 15\%)$$

Where:

NER_t = Quantity of net greenhouse gas emission reductions and removals from project implementation in year t (tonnes of carbon dioxide equivalent).

$C_{BSL,t}$ = Net baseline greenhouse gas emissions and removals in year t (tonnes of carbon dioxide equivalent).

$C_{PRJ,t}$ = Net greenhouse gas emissions and removals from project activities in year t (tonnes of carbon dioxide equivalent).

LK_t = Greenhouse gas emissions from leakage in year t (tonnes of carbon dioxide equivalent).

U_{Error} = Project uncertainty. (If uncertainty exceeds 15% at a 95% confidence level, the value will be adjusted by the amount that the uncertainty exceeds the allowable level).

15% = The allowable uncertainty in this methodology is +/- 15% at a 95% confidence level.

8 Uncertainty

Managing uncertainty in the estimation and calculation of greenhouse gas (GHG) emissions is a critical component for the credibility of the assessment of emission reductions or removal enhancements. The sources of uncertainty and the methods used to manage them are described as follows:

8.1 Sources of Uncertainty

1. **Measurement Uncertainty:** This type of uncertainty arises from variance in field data collection, which may be caused by the precision of measurement instruments, calibration errors, and local environmental impacts. Examples of data that may be affected include soil carbon quantity, groundwater levels, and plant biomass, all of which are essential for calculating GHG emissions. These uncertainties must be controlled through the selection of appropriate tools, regular calibration, and the design of careful data collection plans.
2. **Model Uncertainty:** Models used to estimate GHG emissions are based on assumptions and the simplification of ecological processes, which may affect the level of model uncertainty.
3. **Spatial and Temporal Variability:** Peatlands have diverse physical and ecological characteristics, such as differences in soil properties, vegetation types, and hydrological conditions, resulting in spatial variability. Additionally, seasonal changes and long-term climate trends are factors that contribute to uncertainty in GHG emission assessments.
4. **Data Gaps:** Incomplete or discontinuous data may impact the accuracy of field measurements and models.

8.2 Management of Uncertainty

Project developers should manage uncertainties systematically using the following guidelines:

1. **Calibration and validation:** Regularly calibrating measurement tools and validating models by comparing them with field data and making necessary adjustments is a vital step in reducing uncertainty.
2. **Uncertainty assessment:** Utilizing statistical methods to assess uncertainty in measurements and model results-such as Monte Carlo simulation, sensitivity analysis, and Bayesian inference-helps clarify uncertainty in terms of probability.
3. **Data integration:** Analyzing data from multiple sources, including remote sensing, field surveys, and historical data, helps increase the completeness, continuity, and accuracy of greenhouse gas emission estimates.
4. **Use of expert judgment:** In cases where data uncertainty is high or data cannot be measured directly, using the knowledge and experience of experts to interpret data and model results helps reduce uncertainty.

5. Continuous monitoring and tracking: Establishing a long-term monitoring system to continuously collect data on changes in greenhouse gas emissions will help identify trends, improve models, and effectively reduce uncertainty.

Implementing these guidelines aims to ensure that the assessment of greenhouse gas emissions from project implementation is accurate, reliable, and verifiable.

8.3 Assessment of Uncertainty

Assessing emissions and carbon sequestration from activities in the Agriculture, Forestry, and Other Land Uses (AFOLU) sector involves uncertainties related to key variables such as area size, carbon quantity, biomass increment rate, and other coefficients used in calculations. Assessing the uncertainty of these variables should be conducted by referencing certified and reliable sources, such as standard values from the IPCC (2006) and GPG-LULUCF (2003), expert judgment, or statistical sampling. In cases where uncertainty values cannot be specified directly, project developers may use estimates based on the principle of conservativeness, with uncertainty assessments determined at a 95% confidence level.

8.3.1 Uncertainty in the Baseline Scenario

The combined uncertainty for each variable across strata can be calculated using the following formula:

$$U_{BSL,i} = \frac{\sqrt{\sum (U_{BSL,p,i} \times E_{BSL,p,i})^2}}{\sum E_{BSL,p,i}}$$

Where:

$U_{BSL,i}$	=	Uncertainty in stratum i from the baseline scenario (%)
$U_{BSL,p,i}$	=	Uncertainty of the parameter in stratum i from the baseline scenario (%)
$E_{BSL,p,i}$	=	Net greenhouse gas emissions or removals for the parameter in the baseline scenario (tonnes of carbon dioxide equivalent)
i	=	Stratum (1, 2, 3, ..., m)
p	=	Parameter used in the baseline greenhouse gas emission assessment, such as $E_{BSL,Drain}$, $E_{BSL,DOC}$, $E_{BSL,Burn}$

Total combined uncertainty for the baseline scenario is calculated as follows:

$$U_{BSL} = \frac{\sqrt{\sum (U_{BSL,i} \times A_i)^2}}{\sum A_i}$$

Where:

U_{BSL} = Total combined uncertainty from the baseline scenario (%)

$U_{BSL,i}$ = Uncertainty in stratum i from the baseline scenario (%)

A_i = Total area of stratum i (rai)

i = Stratum (1, 2, 3, ..., m)

8.3.2 Uncertainty from Project Activities

The combined uncertainty for each variable across strata for project activities can be calculated using the following formula:

$$U_{PRJ,i} = \frac{\sqrt{\sum (U_{PRJ,p,i} \times E_{PRJ,p,i})^2}}{\sum E_{PRJ,p,i}}$$

Where

$U_{PRJ,i}$ = Uncertainty in stratum i from project activities (%)

$U_{PRJ,p,i}$ = Uncertainty of the parameter in stratum i from project activities (%)

$E_{PRJ,p,i}$ = Net greenhouse gas emissions or removals for the parameter from project activities (tonnes of carbon dioxide equivalent)

i = Stratum (1, 2, 3, ...,m)

p = Parameter used to assess project greenhouse gas emissions, such as $E_{PRJ,Drain}$, $E_{PRJ,DOC}$, $E_{PRJ,Burn}$

Total combined uncertainty for project activities is calculated as follows:

$$U_{PRJ} = \frac{\sqrt{\sum (U_{PRJ,i} \times A_i)^2}}{\sum A_i}$$

Where:

U_{PRJ} = Total combined uncertainty from project activities (%)

$U_{PRJ,i}$ = Uncertainty in stratum i from project activities (%)

A_i = Total area of stratum i (rai)

i = Stratum (1, 2, 3, ..., m)

8.3.3 ความไม่แน่นอนรวมของโครงการ

The total uncertainty of the project is calculated using the combined uncertainty from the baseline scenario and the combined uncertainty from the project activities according to the following formula:

$$U_{Error} = \frac{\sqrt{(U_{BSL} \times C_{BSL})^2 + (U_{PRJ} \times C_{PRJ})^2}}{C_{BSL} + C_{PRJ}}$$

Where:

U_{Error} = The total uncertainty for the project (%)

U_{BSL} = Total combined uncertainty from the baseline scenario (%)

U_{PRJ} = Total combined uncertainty from project activities (%)

C_{PRJ} = Net greenhouse gas emissions and removals from the baseline scenario (tonnes of carbon dioxide equivalent)

C_{PRJ} = Net greenhouse gas emissions and removals from project activities (tonnes of carbon dioxide equivalent)

9. Monitoring Procedures

Project developers are required to develop a comprehensive monitoring and evaluation plan that follows the specific methodology and relevant calculation tools. All parameters to be

monitored, measurement methods, and the frequency of monitoring must be detailed in the Project Design Document (PDD) and must comply with the requirements of the Thailand Greenhouse Gas Management Organization (TGO).

A plan for monitoring must include robust Quality Assurance and Quality Control (QA/QC) procedures covering the following aspects:

1. Project Implementation Monitoring

- 1) Hydrology Monitoring: Monitoring the ground water level (Water Table Depth) is a critical requirement as it is the primary indicator used to estimate greenhouse gas emissions resulting from peat oxidation (the decomposition of organic matter).
- 2) Peat Soil Assessment: The status and changes in peat soil must be monitored and evaluated as defined in the methodology's requirements.
- 3) Project Infrastructure: Monitoring must include tracking the characteristics, location, construction status, maintenance, and inspection of all relevant infrastructure.
- 4) Fire Prevention and Control Measures: Results from the implementation of fire management practices must be tracked and reported. This includes data on the volume of peat soil burned, the total area affected by fire, and the depth of the burn.

2. Monitoring of Greenhouse Gas Emissions Outside the Project Boundary (Leakage)

Ecological Leakage: Monitoring must be conducted to demonstrate that project activities do not lead to a significant increase in greenhouse gas emissions outside the project area. If a buffer zone or an impermeable dam is constructed, water level gauges must be installed, or vegetation types and categories must be assessed. These must be compared with the same area at the project start to demonstrate the effectiveness of the mitigation measures. Monitoring may also extend to areas outside the project boundary, such as tracking land-use activities to confirm that no additional drainage ditches have been created and that no land-use changes or livestock grazing have occurred in those areas.

3. Assessment of Greenhouse Gas Reductions or Removals

4. Project developers must prepare detailed documentation of all field measurements conducted within the project area to ensure that sampling is reproducible. Training must be provided for all personnel involved in field measurements or data analysis, and Standard Operating Procedures (SOPs) must be followed.

10. Relevant Parameters

The selection of Emission Factors (EF) or Default Factors for greenhouse gas (GHG) assessments must be based on the principles of reliability, representativeness, and conservativeness. The guidelines for selecting these values are as follows:

1. Source-Specific Guidance: Selecting emission values based on the specific type of source, such as using data from closed chamber measurement instruments.
2. Reference to Credible Standards: Default factors and standards must be selected from recognized, credible, and publicly available sources, such as:
 - IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories: Wetlands
 - IPCC 2006 Guidelines for National GHG Inventories and 2019 Refinements
 - IPCC 2003 Good Practice Guidance for LULUCF
 - Peer-reviewed literature
3. Project-Specific or Site-Specific Data: Consideration should be given to using data that is specific to the project or a similar area (Project-specific data), particularly when determining complex values such as the Peat Subsidence Rate.
4. Principle of Conservativeness: In cases where there are multiple options for EFs, default factors, or data, and where uncertainty is high, values must be selected that ensure the assessment of net GHG project benefits tends to be an under-estimate rather than an over-estimate.

10.1 Parameters not monitored

Parameter	D_{peat}
Unit	Centimetres or metres

Meaning	Average peat depth as of the project start date
Source of data	Field data collection or remote sensing
Monitoring method	Stratification based on peat depth should be conducted by referring to peat depth data obtained from field surveys, such as using a steel rod (peat probing rod) and/or validated remote sensing data. Geostatistical techniques, such as Kriging or Inverse Distance Weighting (IDW), which utilize spatial relationships between measured points to predict peat depth at unmeasured locations, can be applied to create a conservative peat depth map while accounting for spatial variability.
Note	-

Parameter	$D_{BSL, BurnDept, j, t}$
Unit	Metres
Meaning	Peat soil depth burned in the baseline scenario
Source of data	Field data collection by measuring peat burn depth, academic document references, or analysis of satellite imagery data
Monitoring method	Assessment of burn depth can be performed by comparing soil surface levels before and after fire occurrence, such as through direct measurement using tree root or stump positions as reference points to estimate pre-fire soil surface levels. Additionally, satellite imagery data, such as Sentinel-2 from multiple time periods, can be used to analyze changes in reflectance values or spatial indices such as the Normalized Burn Ratio (NBR) or Differenced NBR (dNBR), which is calculated from the NBR before and after fire, to evaluate fire severity. The use of field data in conjunction with satellite imagery is an internationally accepted approach.
Note	

Parameter	BD
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Unit	Tonnes per cubic metre
Meaning	Peat soil density
Source of data	Field data collection or academic documents
Monitoring method	Conservative estimation must be made from literature or determined from field samples and laboratory analysis. In cases of referencing academic documents, project proponents must demonstrate that the values used are representative of peatlands with similar characteristics or are conservative values.
Note	Measuring peat density is a process that must be performed meticulously, starting from area survey and depth-based stratification, followed by systematic soil/peat sampling (e.g., using peat corers) for laboratory Bulk Density measurement according to reliable standards.

Parameter	SR (Peat subsidence rate)
Unit	Centimetres per year or metres per year
Meaning	Peat soil subsidence rate
Source of data	From field surveys using steel poles or remote sensing, which must be measured relative to a fixed point
Monitoring method	Analysis of field data or remote sensing. In field data surveys, steel poles should be installed to monitor peat soil subsidence in areas where fire might occur, and peat thickness loss due to fire must be distinguished from loss caused by the oxidation process of organic matter in the peat. For inaccessible areas, project developers may reference subsidence rates based on other factors such as vegetation cover or groundwater levels.
Note	

Parameter	$\Delta C_{BSL,TREE,j,t}$, $\Delta C_{BSL,SAP,j,t}$
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Unit	Tonnes of carbon dioxide equivalent
Meaning	Amount of carbon stock change in above-ground biomass of trees or saplings for stratum j of the baseline scenario in year t
Source of data	Monitoring report
Monitoring method	Conduct according to calculation tool T-VER-P-TOOL-01-02 "Calculation for carbon stocks and change in carbon stocks of trees in forest project activities"
Note	Project developers must specify parameters appearing in the calculation tool in the Project Design Document (PDD).

Parameter	$A_{BSL,Peatdrain}$
Unit	Rai
Meaning	Peat area with drainage in the baseline scenario
Source of data	Field data collection or remote sensing
Monitoring method	Can be assessed from field surveys using Geographical Information System (GIS) tools in conjunction with remote sensing from satellite imagery.
Note	Can be classified from groundwater level measurement data in the project area, expert assessment, land management manuals, land use, hydrological models, canal water levels, or distance from canals.

Parameter	$A_{BSL,Peatdrain_land}$
Unit	Rai
Meaning	Peat area with drainage excluding watercourses (canals/ditches) in the baseline scenario
Source of data	Field data collection or remote sensing

Monitoring method	Can be assessed from field surveys using Geographical Information System (GIS) tools in conjunction with remote sensing from satellite imagery.
Note	Can be classified from groundwater level measurement data in the project area, expert assessment, land management manuals, land use, hydrological models, canal water levels, or distance from canals.

Parameter	$A_{BSL,Ditch}$
Unit	Rai
Meaning	Area of watercourses (canals/ditches) in the baseline scenario
Source of data	Field data collection or remote sensing
Monitoring method	Can be assessed from field surveys using Geographical Information System (GIS) tools in conjunction with remote sensing from satellite imagery.
Note	Can be classified from groundwater level measurement data in the project area, expert assessment, land management manuals, land use, hydrological models, canal water levels, or distance from canals.

Parameter	$EF_{BSL,Drain,CO2,j} \cdot EF_{PRJ,Drain,CO2,j}$
Unit	Tonnes of carbon dioxide per rai per year
Meaning	Carbon dioxide emission coefficient from peatland drainage for stratum j from the baseline scenario
Source of data	Table 2.1 of IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2 - Drained Inland Organic Soils
Monitoring method	-
Note	-

Parameter	$EF_{BSL,CH_4,land,j}$, $EF_{PRJ,CH_4,land,j}$
Unit	Tonnes of methane per rai per year
Meaning	Methane emission coefficient from peatland drainage for stratum j in rewetting peat areas
Source of data	Table 2.3 of IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2 - Drained Inland Organic Soils
Monitoring method	-
Note	-

Parameter	$EF_{BSL,CH_4,ditch,j}$, $EF_{PRJ,CH_4,ditch,j}$
Unit	Tonnes of methane per rai per year
Meaning	Methane emission coefficient in watercourses (canals/ditches) from peatland drainage for stratum j
Source of data	Table 2.4 of IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2 - Drained Inland Organic Soils
Monitoring method	-
Note	-

Parameter	$EF_{N_2O,j}$
Unit	Tonnes of nitrous oxide per rai per year
Meaning	Nitrous oxide emission coefficient from peatland drainage for stratum j
Source of data	Table 2.5 of IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2

Monitoring method	-
Note	-

Parameter	$EF_{BSL,DOC_Drained,j}$, $EF_{PRJ,DOC_Drained,j}$
Unit	Tonnes of carbon dioxide equivalent per rai per year
Meaning	Carbon dioxide emission coefficient from dissolved organic carbon leached from peatlands due to drainage
Source of data	Table 2.2 of IPCC 2013 Wetlands Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories, Chapter 2
Monitoring method	-
Note	-

Parameter	$A_{BSL,Burn}$
Unit	Rai
Meaning	Area where peat soil is burned
Source of data	Field data collection or remote sensing
Monitoring method	Field data collection and remote sensing, such as using satellite imagery and Geographic Information System (GIS) data to identify fire locations and burned area size (e.g., data from MODIS, Sentinel-2, and VIIRS) to process indices such as the Normalized Burn Ratio (NBR) and Differenced NBR (dNBR), combined with field data analysis to verify area characteristics and damage, and identifying damage coordinates using GPS to prepare monitoring reports covering burned area, fire frequency, fire severity, and changes compared to the previous year.
Note	-

10.2 Parameters to be monitored

Parameter	Project Location
Unit	UTM or Latitude, Longitude
Meaning	Coordinate values indicating the location of the project area
Source of data	Monitoring report
Monitoring method	Geographic coordinates from geographic positioning tools or values from government agency maps for at least 4 points identifying cardinal directions: northernmost, southernmost, easternmost, and westernmost.
Monitoring frequency	According to the monitoring assessment cycle for certification.
Note	-

Parameter	<i>Peat water table depth</i>
Unit	Metres
Meaning	Peat groundwater level
Source of data	From field surveys using observation wells or piezometers
Monitoring method	Field data analysis using piezometers or observation wells made from 1 - 2 inch PVC pipes with side perforations, installed at depths corresponding to the peat depth in the area, and measuring peat groundwater levels with a water level tape or digital water level meter. Additionally, project developers can use field data in conjunction with remote sensing, such as satellite imagery analysis to assess surface soil moisture (Normalized Difference Water Index: NDWI) or statistical models to estimate groundwater levels from rainfall data and surface water levels in nearby areas.

Measurement frequency	At least every 3 months
Note	Proxies may be used to estimate peat groundwater levels in inaccessible areas.

Parameter	SR (Peat subsidence rate)
Unit	Centimetres per year or metres per year
Meaning	Peat soil subsidence rate
Source of data	From field surveys using steel poles or remote sensing, which must be measured relative to a fixed point
Monitoring method	Analysis of field data or remote sensing. In field data surveys, steel poles should be installed to monitor peat soil subsidence in areas where fire might occur, and peat thickness loss due to fire must be distinguished from loss caused by the oxidation process of organic matter in the peat. For inaccessible areas, project developers may reference the subsidence rate based on other factors such as vegetation cover or groundwater levels.
Measurement frequency	At least once per year
Note	-

Parameter	Land cover change
Unit	-
Meaning	Land use change
Source of data	From field surveys and remote sensing
Monitoring method	Monitoring of land use change can be performed by remote sensing from satellite imagery data (such as Sentinel-2, Landsat 8/9, Planet Scope), land use indices (such as NDVI, EVI, NDWI), or land use map databases (such as

	Copernicus Land Monitoring, Global Forest Watch). Land use change data from remote sensing should be conducted in conjunction with field surveys using GPS tools to record the actual land use type for use in correcting land use classification from remote sensing to increase accuracy.
Measurement frequency	Once per year
Note	-

Parameter	Mortality rate
Unit	Percentage (%)
Meaning	Survival rate of trees within tree planting activities
Data Source	Field surveys
Monitoring Method	Field data analysis through permanent sample plots or random sampling. A commonly used plot size is 10 x 10 meters, depending on the plant species and density. The number of plots must appropriately cover the restoration area, such as 5-10% of the total planting area
Frequency of Measurement	Once a year
Remark	Mortality rate is the survival rate of trees within tree planting activities

Parameter	$\Delta C_{PRJ,TREE,j,t}$, $\Delta C_{PRJ,SAP,j,t}$
Unit	Tonnes of carbon dioxide equivalent
Meaning	The change in carbon sequestration of trees and saplings from project activities in year t
Data Source	Monitoring report

Monitoring Method	Conducted according to calculation tool T-VER-P-TOOL-01-02: Calculation for carbon stocks and change in carbon stocks of trees in forest project activities
Frequency of Measurement	According to the monitoring evaluation cycle for certification
Remark	Project developers must specify the parameters appearing in the calculation tool within the Project Design Document (PDD)

Parameter	$GHG_{PRJ,Burning,j,t}$
Unit	Tonnes of carbon dioxide equivalent
Meaning	Total greenhouse gas emissions resulting from biomass burning for stratum j from project activities
Data Source	Monitoring report
Monitoring Method	Conducted according to calculation tool T-VER-P-TOOL-01-05: Calculation for non-CO ₂ greenhouse gas emissions from burning of biomass in forest project activities
Frequency of Measurement	According to the monitoring evaluation cycle for certification
Remark	Project developers must specify the parameters appearing in the calculation tool within the Project Design Document (PDD)

Parameter	$A_{PRJ,PeatDrain,j,t}$
Unit	Rai
Meaning	Peatland area with drainage resulting from project activities
Data Source	Field data collection or remote sensing

Monitoring Method	This area can be identified using groundwater level measurement data in the project area, expert assessments, land management manuals, land use data, hydrological models, canal water levels, or the distance from canals.
Frequency of Measurement	Once per year
Remark	-

Parameter	$A_{PRJ,Ditch,j,t}$
Unit	Rai
Meaning	Area of watercourses (ditches/canals) within the project area with drainage resulting from project activities
Data Source	Field data collection or remote sensing
Monitoring Method	Assessing the width and length of watercourses.
Frequency of Measurement	Once per year
Remark	-

Parameter	$A_{PRJ,Burn,j,t}$
Unit	Rai
Meaning	Burned peat soil area
Data Source	Field data collection or remote sensing
Monitoring Method	This parameter can be assessed through field surveys using Geographical Information System (GIS) tools in conjunction with remote sensing from satellite imagery.

Frequency of Measurement	Once per year
Remark	

Parameter	$D_{PRJ,BurnDepth,j,t}$
Unit	Meter
Meaning	Depth of burned peat soil for stratum j from project activities in year t of the project scenario
Data Source	Field data collection by measuring the depth of peat burning, references from academic documents, or satellite imagery data analysis.
Monitoring Method	The assessment of burn depth can be conducted by comparing soil surface levels before and after a fire event, such as through direct measurement using tree root positions or stumps as reference points to estimate pre-fire soil surface levels. Additionally, multi-temporal satellite data (e.g., Sentinel-2) can be used to analyze changes in reflectance or spatial indices such as the Normalized Burn Ratio (NBR) or Differenced NBR (dNBR)—calculated from NBR before and after the fire—to assess fire severity. The integrated use of field data and satellite imagery is an internationally accepted approach.
Frequency of Measurement	Once per year
Remark	-

Parameter	GWP_{CH_4}
Unit	tCO ₂ e/tCH ₄
Meaning	Global Warming Potential of methane

Data Source	Climate change assessment reports prepared by the Intergovernmental Panel on Climate Change (IPCC) as announced by the Thailand Greenhouse Gas Management Organization
Monitoring Method	<u>For Project Design Document (PDD) preparation</u> – Use the latest GWP_{CH_4} value announced by TGO <u>For monitoring greenhouse gas emission reductions</u> Use the GWP_{CH_4} value announced by TGO for evaluating the greenhouse gas quantity according to the specific crediting period requested for certification.
Frequency of Measurement	-
Remark	-

Parameter	GWP_{N_2O}
Unit	tCO ₂ e/tN ₂ O
Meaning	Global Warming Potential of nitrous oxide
Data Source	Climate change assessment reports prepared by the IPCC as announced by TGO.
Monitoring Method	<u>For Project Design Document (PDD) preparation</u> – Use the latest GWP_{N_2O} value announced by TGO <u>For monitoring greenhouse gas emission reductions</u> Use the GWP_{N_2O} value announced by TGO for evaluating the greenhouse gas quantity according to the specific crediting period requested for certification.
Frequency of Measurement	-
Remark	-

Parameter	LE_{AGR}
Unit	Tonnes of carbon dioxide equivalent
Meaning	Greenhouse gas emissions from leakage due to the displacement of agricultural activities.
Data Source	Monitoring report.
Monitoring Method	Conducted according to calculation tool T-VER-P-TOOL-01-06: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in forest project activities.
Frequency of Measurement	According to the monitoring evaluation cycle for certification.
Remark	Project developers must specify the parameters appearing in the calculation tool within the Project Design Document (PDD).

Parameter	$E_{post,i,t}$
Unit	Tonnes of carbon dioxide equivalent
Meaning	Greenhouse gas emissions from source i in areas outside the project boundary after project implementation in year t.
Data Source	Field data collection and remote sensing after project commencement.
Monitoring Method	Use the same assessment guidelines as those used for assessing greenhouse gas emissions within the project area under this methodology.
Frequency of Measurement	According to the monitoring evaluation cycle for certification.
Remark	-

Parameter	$E_{pre,i,t}$
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Unit	Tonnes of carbon dioxide equivalent
Meaning	Greenhouse gas emissions from source i in areas outside the project boundary before project implementation in year t.
Data Source	Field data collection combined with remote sensing.
Monitoring Method	Use the same assessment guidelines as those used for assessing greenhouse gas emissions within the project area under this methodology.
Frequency of Measurement	According to the monitoring evaluation cycle for certification.
Remark	-

References

- 1) 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry
- 2) 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- 3) 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands: Wetlands Supplement)
- 4) 2019 Refinement to 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- 5) Alm, J., Talanov, A., Saarnio, S., Silvola, J., Ikkonen, E., Aaltonen, H., Nykanen, H., & Martikainen, P. J. (2007). Reconstruction of the carbon balance for microsites in a boreal oligotrophic pine fen, Finland *Oecologia*, 110, 423–431
- 6) AR-AMS0003 Afforestation and reforestation project activities implemented on wetlands
- 7) GCCMA003: GCC NBS Methodology for Rewetting Drained Peatlands
- 8) 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(3), 1053-1071. doi:<https://doi.org/10.5194/bg-9-1053-2012>
- 9) Hooijer, A., Silvius, M., Wosten, H., & Page, S. (2006).
- 10) Khampeera, K., Bhuridej, N., & Nuthammachot, N. (2016). Multi-criteria decision analysis for forest fire risk assessment by coupling AHP and GIS: A case study in a peat swamp forest in Thailand *Environment, Development and Sustainability*, 18(5), 1231-1245
- 11) Peatlands mapping and monitoring – Recommendations and technical overview. (FAO, 2020)
- 12) VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning (E-BPB)
- 13) VMD0016 - Methods for Stratification of the Project Area (X-STR)
- 14) VMD0042 - Estimation of baseline soil carbon stock changes and greenhouse gas emissions in peatland rewetting and conservation project activities (BL-PEAT)
- 15) VMD0044 – Estimation of emissions from ecological leakage (LK-ECO)
- 16) VMD0046 - Methods for monitoring of soil carbon stock changes and greenhouse gas emissions and removals in peatland rewetting and conservation project activities (MPEAT)



Edition Log

Version	Revision	Effective Date	Details
01	-	26 Nov 2025	-