CORRECTIONS AND CLARIFICATIONS TO *VM0047 AFFORESTATION, REFORESTATION AND REVEGETATION, V1.0*

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This document provides corrections and clarifications applicable to Verified Carbon Standard (VCS) methodology *VM0047 Afforestation, Reforestation and Revegetation, v1.0*. Such corrections and clarifications are effective on their issuance date. Project proponents and validation/verification bodies (VVBs) shall apply and interpret *VM0047, v1.0* consistent with the corrections and clarifications set out in this document.

These updates will be incorporated into the next issued version of the methodology.

Correction/ Clarification	Description
Clarification 1	Clarification of applicability conditions for land exclusions, including the addition of a definition for "managed forest"
Correction 1	Change of the expression of project carbon stock change from "in year *t*" to "through year *t*" in Equation (1)
Correction 2	Change of the expression of project emissions from "in year *t*" to "in the monitoring interval ending in year *t*" in Equations (15), (16), and (24)
Correction 3	• Change of the expression of carbon dioxide removals from "in year *t*" to "in the monitoring interval ending in year *t*" in Equations (30) and (31) • Addition of a minimum function in Equation (30) to return a value that is less than or equal to $\Delta C_{WP,t}$ in all cases (even where PB_t is negative)
Correction 4	Addition of Equation (32) to calculate annualized carbon dioxide removals from the cumulative carbon dioxide removals calculated over the monitoring interval ending in year *t*

CLARIFICATION 1

Clarification:

The following additions (highlighted in green) are required for Sections 2, 3, and 4 when applying *VM0047, v1.0*.

2 SUMMARY DESCRIPTION OF THE METHODOLOGY

Additionality and Crediting Method[1]	
Additionality	Performance Method or Project Method
Crediting Baseline	Performance Method or Project Method

The methodology applies to afforestation, reforestation, and revegetation (ARR) activities and provides two quantification approaches: area-based and census-based. Project activities must establish, increase, or restore vegetative cover in non-forest areas (applicable to both approaches), or activities must enhance forest carbon stocks in areas with existing forest cover that have not been managed for wood products in the past ten years (applicable to the area-based approach only).

[…]

1) **Area-based approach:**

[…]

c) *The area-based approach applies to ARR projects that change land cover from non-forest to forest or enhance stocks in existing forests. Projects may include direct (e.g., manual planting, broadcast seeding) and indirect activities (e.g., activities that permit or facilitate natural regeneration, like herbivory exclosures).*

[…]

[1] See ~~Section 0~~ Section 7 for additional information

3 DEFINITIONS

[…]

Managed forests

Forest lands actively managed for wood products, including saw timber, pulpwood, and fuelwood. This includes both plantation forests and natural forests (primary and secondary) where harvesting or silvicultural activities occur.

[…]

4 APPLICABILITY CONDITIONS

[…]

This methodology is not applicable under the following conditions:

[…]

6) The project occurs on lands that have met the definition of managed forest at any point in the 10-year period immediately preceding the project start date.

Background:

The original applicability conditions lack clarity regarding the exclusion of lands that have met the definition of managed forest in the 10 years prior to the project start date.

CORRECTION 1

Correction:

The following replaces the original Equation (1) and description of parameters, using "through year *t*" instead of "in year *t*":

The carbon stock change from the start of the project through year *t* is estimated as follows:

$$\Delta C_{WP,t} = (\Delta C_{WP-biomass,t} + \Delta C_{WP-SOC,t}) \times \frac{44}{12} \quad (1)$$

Where:

$\Delta C_{WP,t}$	=	Project carbon stock change through year *t* (t CO_2e)
$\Delta C_{WP\text{-}biomass,t}$	=	Change in carbon stock in biomass carbon pools in the project scenario through year *t* (t C)
$\Delta C_{WP\text{-}SOC,t}$	=	Change in SOC stock in the project scenario through year *t* (t C)
44/12	=	Ratio of molecular weight of carbon dioxide to carbon (unitless)
t	=	1, 2, 3, …, *t* years elapsed since the project start date

Background:

Project carbon stock change is calculated "through year *t*" instead of "in year *t*."

CORRECTION 2

Correction:

The following replaces the original Equations (15), (16), (20), (21), (22), 23) and (24), using "in the monitoring interval ending in year *t*" instead of "in year *t*":

Project emissions resulting from biomass burning and use of fertilizer in the area- and census-based approaches are estimated as:

$$PE_t = PE_{bburn,t} + PE_{fert,t} \quad (15)$$

Where:

PE_t	=	Project emissions from biomass burning and fertilizer use in the monitoring interval ending in year *t* (t CO_2e)
$PE_{bburn,t}$	=	Project emissions due to biomass burning in the monitoring interval ending in year *t* (t CO_2e)
$PE_{fert,t}$	=	Project emissions from nitrogen fertilizer in the monitoring interval ending in year *t* (t CO_2e)

[…]

$$PE_{bburn,t} = A_{burn,t} \times \sum_{g=1}^{G} (GWP_g \times EF_g \times B_{WP,t} \times COMF \times 10^{-3}) \quad (16)$$

Where:

$PE_{bburn,t}$	=	Project emissions due to biomass burning in the monitoring interval ending in year *t* (t CO_2e)

[…]

$$PE_{fert,t} = PE_{Ndirect,t} + PE_{Nindirect,t} \quad (20)$$

Where:

$PE_{fert,t}$	=	Project emissions from nitrogen fertilizer in the monitoring period ending in year *t* (t CO_2e)
$PE_{Ndirect,t}$	=	Direct nitrous oxide emissions due to fertilizer use in the project scenario in the monitoring period ending in year *t* (t CO_2e)
$PE_{Nindirect,t}$	=	Indirect nitrous oxide emissions due to fertilizer use in the project scenario in monitoring interval ending in year *t* (t CO_2e)
t	=	1, 2, 3, …, *t* years elapsed since the project start date

$$PE_{Ndirect,t} = (F_{wp,SN,t} + F_{wp,ON,t}) \times EF_{Ndirect} \times \frac{44}{28} \times GWP_g \quad (21)$$

Where:

$PE_{Ndirect,t}$	=	Direct nitrous oxide emissions due to fertilizer use in the project scenario in year *t* (t CO_2e)
$F_{wp,SN,t}$	=	Synthetic N fertilizer applied in the project scenario in year *t* (t N)
$F_{wp,ON,t}$	=	Organic N fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N)
$EF_{Ndirect}$	=	Emission factor for nitrous oxide emissions from N additions due to synthetic fertilizers, organic amendments and crop residues (t N_2O-N/t N applied)
GWP_g	=	Global warming potential for gas *g* (here, nitrous oxide) (dimensionless)
44/28	=	Ratio of molecular weight of N_2O to molecular weight of N (applied to convert N_2O-N emissions to N_2O emissions) (unitless)
t	=	1, 2, 3, …, *t* years elapsed since the project start date

$$\boldsymbol{F_{wp,SN,t} = M_{wp,SF,t} \times NC_{wp,SF,t}} \quad (22)$$

Where:

$F_{wp,SN,t}$	=	Synthetic N fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N)
$M_{wp,SF,t}$	=	Mass of N-containing synthetic fertilizer applied in the project scenario in the monitoring interval ending in the monitoring period ending in year *t* (t fertilizer)
$NC_{wp,SF,t}$	=	N content of synthetic fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N/t fertilizer)
t	=	1, 2, 3, …, *t* years elapsed since the project start date

$$F_{wp,ON,t} = M_{wp,OF,t} \times NC_{wp,OF,t} \quad (23)$$

Where:

$F_{wp,ON,t}$	=	Organic N fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N)
$M_{wp,OF,t}$	=	Mass of N-containing organic fertilizer applied in the project scenario in the monitoring interval ending in the monitoring period ending in year *t* (t fertilizer)
$NC_{wp,OF,t}$	=	N content of organic fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N/t fertilizer)
t	=	1, 2, 3, …, *t* years elapsed since the project start date

$$PE_{Nindirect,t} = Nfert_{wp,volat,t} + Nfert_{wp,leach,t} \quad (24)$$

Where:

$PE_{Nindirect,t}$	=	Indirect nitrous oxide emissions due to fertilizer use in the project scenario in monitoring interval ending in year *t* (t CO_2e)
$Nfert_{wp,volat,t}$	=	Indirect nitrous oxide emissions produced from atmospheric deposition of N volatilized due to nitrogen fertilizer use in the monitoring period ending in year *t* (t CO_2e)
$Nfert_{wp,leach,t}$	=	Indirect nitrous oxide emissions produced from leaching and runoff of N, in regions where leaching and runoff occurs, due to nitrogen fertilizer use in the monitoring interval ending in year *t* (t CO_2e)

$$Nfert_{wp,volat,t} = \left[\left(F_{wp,SN,t} \times Frac_{GASF}\right) + \left(F_{wp,ON,t} \times Frac_{GASM}\right)\right] \times EF_{Nvolat} \times \frac{44}{28} \times GWP_g \quad (25)$$

Where:

$Nfert_{wp,volat,t}$	=	Indirect nitrous oxide emissions produced from atmospheric deposition of N volatilized due to nitrogen fertilizer use in the monitoring period ending in year *t* (t CO_2e)
$F_{wp,SN,t}$	=	Synthetic N fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N)
$Frac_{GASF}$	=	Fraction of all synthetic N added to soils that volatilizes as NH_3 and NO_x (dimensionless)
$F_{wp,ON,t}$	=	Organic N fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N)
$Frac_{GASM}$	=	Fraction of all organic N added to soils that volatilizes as NH_3 and NO_x (dimensionless)
EF_{Nvolat}	=	Emission factor for nitrous oxide emissions from atmospheric deposition of N on soils and water surfaces (t N_2O-N/(t NH_3-N + NO_x-N volatilized))
GWP_g	=	Global warming potential for gas *g* (here, nitrous oxide) (dimensionless)
44/28	=	Ratio of molecular weight of N_2O to molecular weight of N (applied to convert N_2O-N emissions to N_2O emissions) (unitless)
t	=	1, 2, 3, …, *t* years elapsed since the project start date

$$Nfert_{wp,leach,t} = \left(F_{wp,SN,t} + F_{wp,ON,t}\right) \times Frac_{LEACH} \times EF_{Nleach} \times \frac{44}{28} \times GWP_g \quad (26)$$

Where:

$Nfert_{wp,leach,t}$	=	Indirect nitrous oxide emissions produced from leaching and runoff of N, in regions where leaching and runoff occurs, due to nitrogen fertilizer use in the monitoring period ending in year *t* (t CO_2e)
$F_{wp,SN,t}$	=	Synthetic N fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N)
$F_{wp,ON,t}$	=	Organic N fertilizer applied in the project scenario in the monitoring period ending in year *t* (t N)
$Frac_{LEACH}$	=	Fraction of synthetic or organic N added to soils that is lost through leaching and runoff, in regions where leaching and runoff occurs (dimensionless)
EF_{Nleach}	=	Emission factor for nitrous oxide emissions from leaching and runoff (t N_2O-N/t N leached and runoff)

GWP_g	=	Global warming potential for gas *g* (here, nitrous oxide) (dimensionless)
44/28	=	Ratio of molecular weight of N_2O to molecular weight of N (applied to convert N_2O-N emissions to N_2O emissions) (unitless)
t	=	1, 2, 3, …, *t* years elapsed since the project start date

Background:

Project emissions are quantified over "the monitoring interval ending in year *t*," instead of "in year *t*."

CORRECTION 3

Correction:

Equations (30) and (31) and descriptive text are replaced as follows:

8.5 Estimated Carbon Dioxide Removals

For monitoring intervals longer than one year, carbon dioxide removals are calculated by comparing the carbon stock at the current monitoring year (*t*) to the carbon stock at *t* minus the length of the monitoring interval (e.g., *t* − 5 for a five-year interval). The total removals for the period are then divided by the number of years in the monitoring interval (Eq. (32)) to calculate an annualized value, ensuring equal removals (CR_t) are assigned to each year within the interval.

Area-based quantification

$$CR_t = \left(\text{MIN}\left(\Delta C_{WP,t}, \Delta C_{WP,t} \times (1 - PB_t)\right) \times (1 - UNC_t)\right) - PE_t - LK_t - \left(\left(\text{MIN}\left(\Delta C_{WP,t-x}, \Delta C_{WP,t-x} \times (1 - PB_{t-x})\right) \times (1 - UNC_{t-x})\right) - PE_{t-x} - LK_{t-x}\right) \quad (30)$$

Where:

CR_t	=	Carbon dioxide removals from the project activity in the monitoring interval ending in year *t* (t CO_2e)
$\Delta C_{WP,t}$	=	Project carbon stock change through year *t* (t CO_2e)
PB_t	=	Performance benchmark for the monitoring interval ending in year *t* (percent)
LK_t	=	Leakage through year *t* (t CO_2e)
PE_t	=	Project emissions from biomass burning and fertilizer use in the monitoring period ending in year *t* (t CO_2e)

UNC_t	=	Uncertainty in cumulative removals through year *t* (percent)
x	=	Length of the monitoring period

Census-based quantification

Carbon dioxide removals using census-based quantification are calculated with carbon stock changes in the baseline scenario (see Section 6) and leakage (see Section 8.3) implicitly set equal to zero.

$$CR_t = \left(\Delta C_{WP,t} \times (1 - UNC_t)\right) - \left(\Delta C_{WP,t-x} \times (1 - UNC_{t-x})\right) - PE_t \quad (31)$$

Where:

CR_t	=	Carbon dioxide removals from the project activity in the monitoring interval ending in year *t* (t CO_2e)
$\Delta C_{WP,t}$	=	Project carbon stock change through year *t* (t CO_2e)
PE_t	=	Project emissions from biomass burning and fertilizer use in the monitoring interval ending in year *t* (t CO_2e)
x	=	Length of the monitoring period

Background:

Carbon dioxide removals are calculated over the monitoring interval ending in year *t*, instead of "in year *t*." Additionally, a minimum function has been introduced in Equation (30) to return a value that is less than or equal to $\Delta C_{WP,t}$ in all cases (even where PB_t is negative).

CORRECTION 4

Correction:

Where the project combines area- and census-based quantification approaches, total removals are the sum of the removals calculated independently for each approach (applied to non-overlapping areas).

Where the project activity includes harvesting, the project proponent must also follow guidance in the most recent version of the *VCS Standard* for applying the long-term average greenhouse gas benefit as an upper limit on calculated carbon dioxide removals.

8.5.1 Annualized Carbon Dioxide Removals

To calculate annualized carbon dioxide removals ($CR_{annualized}$), divide the total removals in the monitoring interval (CR_t) by the length of the monitoring interval (*x*):

$$CR_{annualized} = \frac{CR_t}{x} \quad (32)$$

Where:

$CR_{annualized}$	=	Annualized carbon dioxide removals (t CO_2e/yr)
CR_t	=	Carbon dioxide removals from the project activity in the monitoring interval ending in year *t* (t CO_2e)
x	=	Length of the monitoring period (years)

Background:

Equation (32) has been added to calculate the annualized carbon dioxide removals from the cumulative carbon dioxide removals calculated over the monitoring interval ending in year *t*.