METHODOLOGY ASSESSMENT REPORT FOR VM0042 VERSION 2.0 AND VMD0053 VERSION 2.0

Document Prepared By Doug Baldwin and Carolin Judd

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Prepared By	SCS Global Services (SCS)
Contact	2000 Powell Street, Suite 600, Emeryville, CA 94608, USA http://www.scsglobalservices.com Email: cpollet-young@scsglobalservices.com Telephone: +1 (510) 452-8000
Approved By	Christie Pollet-Young
Work Carried Out By	Lead Auditor: Doug Baldwin Auditor: Carolin Judd Auditor: Letty B. Brown Auditor: Saroop Sandhu Technical Reviewer: Barbara Toole O'Neil

Summary

This report describes the methodology revision assessment of VM0042 and VMD0053 V2 (the "Methodology"), an Agricultural Land Management Methodology, that was conducted by SCS. The purpose of the assessment was to conduct, in accordance with the VCS Program rules, an independent review of the revisions associated with version 2 of the Methodology. The assessment engagement was carried out through a combination of document review and interviews with relevant personnel. As part of the assessment engagement **47** findings were raised: **1** Non-Conformity Report, **30** New Information Requests and **16** Observations. These findings are described in Appendix A of this report and all findings have been closed prior to the preparation of this report. The Methodology complies with the VCS Rules and Requirements, and SCS holds no restrictions or uncertainties with respect to the compliance of the Methodology with the assessment criteria.

Update (7-April-2023): the audit team added two terms to the table in section 3.9.1 and additional findings (findings 37+) to Appendix A. These updates coincided with Verra's final review of the methodology revisions.

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1 INTRODUCTION

1.1 Objective

SCS carried out an independent assessment of the conformance of the Methodology revisions in accordance with the VCS Standard and Program rules (see the below Section 2.1 for full reference). In accordance with Section 5 of the VCS Validation and Verification Manual, V3.2, the assessment objectives include ensuring the Methodology conforms to VCS rules and scientific best practice. In accordance with Section 7.2 (and by proxy 6.1) of the VCS Methodology Approval Process V4.0, the objectives include ensuring that all stakeholder comments, the structure and clarity of the revisions, and the appropriateness of the revisions to key components of the methodology (applicability, project boundary, baseline scenario, etc.) have been considered.

1.2 Summary Description of the Methodology

The Methodology provides procedures to estimate the greenhouse gas (GHG) emission reductions and removals associated with the increase of soil organic carbon (SOC) that results from changes in agricultural management practices. The methodology quantifies net emissions of CO_2, CH_4, and N_2O from agricultural operations.

The crediting baseline and additionality are determined via a project method. The baseline scenario assumes the continuation of pre-project agricultural management practices, and data used to develop a baseline scenario is drawn from a 3-year historic look-back period. There are 3 different avenues for quantifying emissions reductions and removals: (1) measure and model, (2) measure and re-measure (based on appropriate performance benchmarks or linked baseline control sites), and (3) a default calculation based upon the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Emissions removals based upon changes in SOC must be quantified using either the (1) measure and model or (2) measure and re-measure approach. The Methodology revisions formally introduce the (2) measure and re-measure approach for SOC quantification, and the project uncertainty quantification was substantially adjusted in these Methodology changes.

Additionality is demonstrated by satisfying regulatory surplus requirements, identifying institutional barriers, and demonstrating the ensemble of adopted farm management activities for the project are not common practice. After reviewing Section 7 and stakeholder comments related to additionality, the audit team requested further clarification about some items associated with Additionality (see findings 23-24), and Verra provided more details in Section 7 on how to demonstrate Additionality.

A practice adoption rate in a region must be less than 20% for it to be considered additional. A practice change constitutes adoption of a new, cessation of a pre-existing practice, adjustment to a pre-existing practice, or some combination thereof. Any quantitative adjustment must exceed 5% of the pre-existing value to demonstrate additionality. One substantive change in the Methodology revisions is the enabling of using stratification according to soils and major cropping zones for the common practice demonstration if data about practice adoption rates is not available when using geopolitical boundaries for stratification.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

The criteria for the assessment were the following documents:

- VCS Program Guide, V4.1
- VCS Standard, V4.3 (note: during this assessment in June 2022, the standard version changed from 4.2 to 4.3)
- VCS Methodology Approval Process, V4.0
- VCS Methodology Requirements, V4.2 (note: during this assessment in June 2022, the methodology requirements version changed from 4.1 to 4.2)
- VCS Program Definitions, V4.1
- VCS Validation and Verification Manual, V3.2

The assessment engagement was conducted through a combination of document review and interviews with relevant personnel and experts, as discussed in Sections 2.2 through 2.4 of this report. At all times, an assessment was made for conformance to the criteria listed above this paragraph. As discussed in Section 2.5 of this report, findings were issued to ensure conformance to all requirements. The audit team also assessed Verra's responses to each stakeholder comment and memorialized these responses (see Ref /3/ below).

2.2 Document Review

The following documentation, provided by project personnel or gathered independently by the audit team, was reviewed:

Document	File Name	Ref.
Revised VM0042 methodology	VM0042_v2.0_SCS-Verra-shared_v12.docx	/1/
Revised VMD0053 module	VMD0053_v2.0_ChangesAfterPublicComment_SCS-Verra-shared.docx	/2/
Stakeholder comments with Verra responses	VM42v2.0_Comments_SCS101322.xlsx	/3/
Research paper	Cowie et al 2018.pdf	/4/
Research paper	Wendt and Hauser 2013.pdf	/5/
Research paper	Smith et al 2019.pdf	/6/
Research paper	Peterson et al 2020.pdf	/7/
Research paper	Sekaran et al 2021.pdf	/8/
Research paper	Malliard and Angers 2014.pdf	/9/
Statistics textbook	Som (1995) Practical Sampling Techniques: 2nd Ed.	/10/
Statistics textbook	Cochran (1977) Sampling Techniques: 3rd Ed.	/11/
Agricultural Carbon Offset Methodology	Soil Enrichment Protocol V1.1	/12/
Agricultural Carbon Offset Methodology	USDA Quantifying GHG Fluxes in Agriculture and Forestry (2014)	/13/
IPCC Guidance	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories - Chapter 11	/14/
Methodology Source	VM0017	/15/
Methodology Source	VM0022	/16/
Methodology Source	VM0026	/17/
Methodology Source	CDM AR-AMS007	/18/
Methodology Source	CDM AR-TOOL 14	/19/
Methodology Source	CDM Tool for testing significance of GHG emissions in A/R CDM project activities	/20/
Methodology Source	CDM Tool-24	/21/

2.3 Interviews

The process used in interviewing project personnel was a process wherein the audit team elicited information from project personnel regarding (1) the research references in support of the Methodology revisions; (2) actions undertaken to ensure conformance with various requirements, and (3) the project personnel's responses to stakeholder comments.

The following personnel associated with the project proponent and/or implementing partner were interviewed.

Individual	Affiliation	Role	Date(s) Interviewed
Stefan Jirka	Verra	Senior Manager	Throughout the audit
Viridiana Alcantara-Shivapatham	Verra	Senior Program Officer	Throughout the audit
Dan Kane	TerraCarbon	Senior Manager	Throughout the audit

2.4 Assessment Team

Area of required expertise	Individual(s) on audit team containing required expertise	Summary of relevant qualifications
Proficiency in relevant chemical processes underpinning key assumptions and quantitative approaches of agricultural offset methodologies	Carolin Judd, Saroop Sandhu	Familiar with chemical makeup of fertilizer and its release into greenhouse gas emissions and how these processes are represented in methodologies
Proficiency in relevant biological processes underpinning key assumptions and quantitative approaches of agricultural offset methodologies	Carolin Judd, Doug Baldwin, Letty Brown, Saroop Sandhu	Familiar with enteric fermentation, crop growth, root turnover into soil carbon, and other emissions-related processes featured in methodologies and soil carbon models
Relevant experience in auditing agricultural carbon offset projects internationally	Carolin Judd, Doug Baldwin, Letty B. Brown	Familiar with common agricultural practices and corresponding methodologies for

		agricultural carbon offset projects
Proficiency in soil carbon quantification	Doug Baldwin, Saroop Sandhu	Experience utilizing biogeochemical modeling to predict soil carbon stock change and associated greenhouse gas emissions or reductions in agricultural systems
Relevant experience in developing agricultural carbon offset projects	Carolin Judd, Doug Baldwin, Letty B. Brown	Familiar with establishing baseline scenarios, soil sampling procedures, establishing additionality, and other aspects of agricultural offset project development

2.5 Resolution of Findings

Any potential or actual discrepancies identified during the audit process were resolved through the issuance of findings. The types of findings typically issued by SCS during this type of verification engagement are characterized as follows:

- Non-Conformity Report (NCR): An NCR signified a discrepancy with respect to a specific requirement. This type of finding could only be closed upon receipt by SCS of evidence indicating that the identified discrepancy had been corrected. Resolution of all open NCRs was a prerequisite for issuance of a verification statement. Note that the Verra equivalent is a Corrective Action Request (CAR).
- New Information Request (NIR): An NIR signified a need for supplementary information to determine whether a material discrepancy existed with respect to a specific requirement. Receipt of an NIR did not necessarily indicate that the project was not in compliance with a specific requirement. However, resolution of all open NIRs was a prerequisite for issuance of a verification statement. Note that Verra equivalent is a Clarification Request (CR).
- Observation (OBS): An OBS indicates an area where immaterial discrepancies exist between the observations, data testing results or professional judgment of the audit team and the information reported or utilized (or the methods used to acquire such information) within the GHG assertion. A root cause analysis and corrective action plan are not required, but highly recommended. Observations

are considered by the audit team to be closed upon issuance, and a response to this type of finding is not necessary.

As part of the audit process, 1 NCR, 30 NIRs and 16 OBS were issued. All findings issued by the audit team during the audit process have been closed. In accordance with Section 4.1.14 of the VCS Standard, all findings issued during the audit process, and the impetus for the closure of each such finding, are described in Appendix A of this report.

3 ASSESSMENT FINDINGS

3.1 Relationship to Approved or Pending Methodologies

As stated in the methodology: "This methodology is based on the following methodologies:

- *VM0017 Adoption of Sustainable Agricultural Land Management*
- *VM0022 Quantifying N2O Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer Rate Reduction*
- *VM0026 Sustainable Grassland Management*
- *AR-AMS007- Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on lands other than wetlands*

This methodology uses the latest versions of the following Clean Development Mechanism (CDM) tools:

- *AR-Tool-14 Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*
- *Tool for testing significance of GHG emissions in A/R CDM project activities*
- *Tool-24, v3.1, Common practice*

The audit team has no reservations that the Methodology appropriately lists relevant, similar methodologies. None of the above methodologies contain all of the components (eg, project boundary, GHG sources and sinks, carbon pools) of VM0042, so a standard revision of these methodologies would not substitute the Methodology revisions assessed here.

3.2 Stakeholder Comments

The audit team reviewed 290 stakeholder comments associated with VM0042 revisions and 82 stakeholder comments associated with VMD0053 revisions. The audit team attests that all comments have been answered by Verra, and any follow-up actions required to address findings from this audit related to stakeholder comments have been completed by Verra. The document showing all stakeholder comments, Verra's responses, and SCS's responses (Ref. /3/) will be made public.

3.3 Structure and Clarity of Methodology

Regarding the clarity of the methodology:

- The revisions follow the template, besides some minor proofreading issues. The criteria and procedures of the Methodology have been documented in the appropriate sections. Note, the audit team did issue an observation (finding 18) that emphasizes a thorough check of typos and minor proofreading issues during the post-VVB assessment (note: section 4.5, "Step 5" of the methodology review process in VCS Methodology Approval Process, V4.0)
- The terminology is consistent with Program rules and GHG accounting. Terms used throughout the methodology are consistent with related methodologies.
- The terminology is consistent with the defined usage of "must", "should", and "may" discussed in section 5.2 of the VCS Validation and Verification manual, V3.2. The audit team also inquired about this directly with finding 14.
- After multiple findings related to clarifying and condensing the highly complex procedures of the Methodology, the audit team is reasonably assured the revisions are now clearer and more consistent throughout the documents to a point where it may be applied and understood consistently by project proponents.
- As mentioned above, multiple findings were issued to better condense, clarify, and ensure consistency in explanations of the complex procedures. The language has been modified and new figures were provided that clarify the procedures for auditors.

The Methodology revisions provide a structure that is clear and consistent enough where project developers and auditors can interpret these procedures in a consistent manner.

3.4 Definitions

All terms in section 3 of the Methodology do not appear in the VCS Program Definitions, V4.1, appear in alphabetical order. These terms are consistently used throughout the Methodology.

3.5 Applicability Conditions

Applicability conditions for VM0042 and VMD0053 have been clearly described in section 4 of both documents.

The conditions for VM0042 relate to changing agricultural management practices, avoiding conversion from grassland to cropland and vice versa (with 2 exceptions), implementation on lands not cleared of native ecosystems in the past 10 years, project activity avoiding a decrease of agricultural productivity of greater than 5%, exclusion of biochar from the improved practices, and absence of wetlands.

Applicability conditions for VMD0053 include its application on biogeochemical models that are publicly available, supported by peer-reviewed research, can run model simulations with consistent results, and validated model parameters must be the exact same when applied to the project area.

All applicability conditions are sufficiently clear, so that the eligibility of project activity may be assessed against these conditions in a consistent manner across agricultural systems from different environments and climates. This is based upon how Verra has considered stakeholder comments and the audit team's findings into the Methodology revisions (see Appendix A and Ref /3/).

3.6 Project Boundary

The Methodology revisions have not changed the scope of the project boundary, which has already been assessed in version 1 of the Methodology. A requirement that the soil organic carbon pool not be *de minimis* increases the conservativeness of the Methodology, as a range of improved practice changes must be implemented during the project to ensure emissions removals (i.e., soil organic carbon increase), instead of significant emissions reductions alone.

3.7 Baseline Scenario

The baseline scenario is constructed in the same manner as the already assessed Methodology, V1.0, with the added inclusion of the Quantitative Approach 2 (i.e., measure and re-measure). This approach relies on either an established performance benchmark or linked control sites to maintain a clear comparison between project activity outcomes of soil organic carbon stock change and the baseline scenario.

Verra has adequately considered stakeholder comments and auditor findings (see Appendix A and Ref. /3/) when specifying procedures for Quantitative Approach 2. For instance, a requirement for geographic proximity of 250 km distance between control sites and project instances, which is based upon stakeholder feedback. Verra also clarified their requirements associated with topography in Table 7 of the methodology in response to finding 16.

The audit team has reviewed the requirements and responses of Quantitative Approach 2 and Table 7 in context of Program rules, stakeholder feedback, and general scientific best practice and has concluded the procedures are appropriately formulated and clearly described.

3.8 Additionality

The requirements for Additionality have not been substantially altered since V1.0 of the Methodology from the resulting revisions. Stakeholder feedback has been considered regarding the practice adoption rate threshold of < 20 % to count as being additional (see Ref /3/). The audit team has regarded these responses as sufficient, given the conservative nature of this requirement along with the flexibility of weighting multiple practices into the overall Additionality assessment.

3.9 Quantification of GHG Emission Reductions and Removals

3.9.1 Baseline Emissions

The following are substantial changes made by revisions of the Methodology with respect to V1.0:

- Implementation of Quantitative Approach 2: see Section 3.7 for an analysis of this change
- Uncertainty quantification: the audit team spent time extensively reviewing stakeholder comments, statistics textbooks and other methodologies (Refs /10-13/), interviewing TerraCarbon, and issuing findings to resolve any issues regarding formulas and procedures underlying the revised uncertainty quantification.
- Clarification of back-modelling SOC stocks: this has been addressed with findings 1 and 17.

- Equivalent soil mass approach to sampling: the audit team spent extensive time reviewing research papers (see Ref /5/ and citations therein) alongside the proposed equations and procedures underlying this change. After resolving stakeholder concerns and auditor findings, this procedure has been clarified.
- Recommended use of stratification for sampling: Verra has responded adequately to stakeholder comments and audit team findings regarding the recommendation of applying a stratified random sampling procedure to SOC stocks.

The audit team conducted a thorough check of terms, units, and definitions in all equations. The following parameters available at validation were assessed:

Data/Parameter	Units	Description
A_0	Unit area	Project area
$Activity_{an}$	unitless	proposed project activity commitments $Activity_{a1}$ to $Activity_{an}$
AR	Percent	Weighted average adoption rate
$Area_{an}$	Hectares or acres	Area of proposed project-level adoption of each activity
$AWMS_{i,t,l,P,S}$	dimensionless	Fraction of total annual VS for each livestock type that is managed in manure management system *S* in the project area, for productivity system *P*
CF_c	Proportion of pre-fire fuel biomass consumed	Combustion factor for agricultural residue type c
$EF_{c,CH4}$	g CH_4/kg dry matter burnt	Methane emission factor for the burning of agricultural residue type c
$EF_{c,N2O}$	g N_2O/kg dry matter burnt	Nitrous oxide emission factor for the burning of agricultural residue type c
$EF_{CH4,md,l,P,S}$	g CH4/(kg volatile solids)	Emission factor for methane emissions from manure deposition for livestock type *l* for productivity system *P* and manure management system *S*
$EF_{CO2,j}$	t CO_2e/liter	Emission factor for the type of fossil fuel *j* (gasoline or diesel) combusted
$EF_{Dolomite}$	tonne of C (tonne of dolomite)$^{-1}$	Emission factor for the application of dolomite ($CaMg(CO_3)_2$), i.e., liming
$EF_{ent,l,P}$	kg CH_4/(head * year)	Enteric fermentation emission factor for livestock type *l* and productivity system *P*
$EF_{Limestone}$	tonne of C (tonne of limestone)$^{-1}$	Emission factor for the application of calcitic limestone ($CaCO_3$) i.e., liming
$EF_{N2O,md,l,S}$	kg N_2O-N/kg N input	Emission factor for nitrous oxide from manure and urine deposited on soils by livestock type *l* for manure management system *S*
$EF_{Ndirect}$	t N_2O-N/t N applied	Emission factor for direct nitrous oxide emissions from N additions from synthetic fertilizers, organic amendments and crop residues
EF_{Nleach}	t N_2O-N / t N leached and runoff	Emission factor for nitrous oxide emissions from leaching and runoff
EF_{Nvolat}	t N_2O-N /(t NH_3-N + NOx-N volatilized)	Emission factor for nitrous oxide emissions from atmospheric deposition of N on soils and water surfaces
ER_{an}	Percent	Adoption rate of the n largest most common proposed project activity in the region
$FFC_{bsl,j,i,t}$	Liters	Consumption of fossil fuel type *j* (gasoline or diesel) for sample unit *i* in year *t*

$Frac_{GASF,l,S}$	Dimensionless	Fraction of all synthetic N added to soils that volatilizes as NH_3 and NO_x for manure management system *S* and for livestock type *l*
$Frac_{GASM,l,S}$	Dimensionless	Fraction of all organic N added to soils and N in manure and urine deposited on soils that volatilizes as NH_3 and NO_x for livestock type *l* and manure management system *S*
$Frac_{LEACH,l,S}$	Dimensionless	Fraction of N added (synthetic or organic) to soils and N in manure and urine deposited on soils that is lost through leaching and runoff, in regions where leaching and runoff occurs
GWP_{CH4}	t CO2e/t CH_4	Global warming potential for CH_4
GWP_{N2O}	t CO_2e / t N_2O	Global warming potential for N_2O
$MB_{bsl,c,i,t}$	Kilograms	Mass of agricultural residues of type *c* burned in the baseline scenario for sample unit *i* in year *t*
$MB_{g,bsl,i,t}$	t dm	Annual dry matter, including aboveground and below ground, of N-fixing species *g* returned to soils for sample unit *i* at time *t*
$M_{bsl,OF,i,t}$	t fertilizer	Mass of baseline N containing organic fertilizer applied for sample unit *i* in year *t*
$M_{bsl,SF,i,t}$	t fertilizer	Mass of baseline N containing synthetic fertilizer applied for sample unit *i* in year *t*
$M_{Dolomite,bsl,i}$	tonnes yr^{-1}	Amount of dolomite ($CaMg(CO_3)_2$) applied to sample unit *i* in year *t*
$M_{Limestone,bsl,I}$	tonnes yr^{-1}	Amount of calcic limestone ($CaCO_3$) applied to sample unit *i* in year *t*
$MS_{bsl,l,i,t}$	Fraction of N deposited	Fraction of nitrogen excretion of livestock type *l* that is deposited on the project area
$NC_{bsl,OF,i,t}$	t N/t fertilizer	N content of baseline organic fertilizer applied
$NC_{bsl,SF,i,t}$	t N/t fertilizer	N content of baseline synthetic fertilizer applied
$N_{content,g}$	t N/t dm	Fraction of N in dry matter for N-fixing species *g*
$Nex_{l,P}$	kg N deposited/head/year	Annual average nitrogen excretion of per head of livestock type *l* of productivity system *P*
$P_{bsl,l,i,t,P}$	Head	Population of grazing livestock in the baseline scenario of type *l* in sample unit *i* in year *t*
$P_{bsl,p}$	Productivity (e.g., kg) per hectare or acre	Average productivity for product p during the historical look-back period
$RP_{bsl,p}$	Productivity (e.g., kg) per hectare or acre	Average regional productivity for product p during the same years as the historical look-back period
$VS_{rate,l,P}$	kg volatile solids/(1000 kg animal mass * day)	Default volatile solids excretion rate for livestock type *l* and productivity system *S*

The following parameters to be monitored were assessed:

Data/Parameter	Units	Description
$\Delta_{\bullet,t}$ *and* $\bullet_t$	t CO_2e/unit area	Average emission reductions from pool or source •, or stock of pool •, in year *t*
•	Dimensionless	Gas or pool
Ai	Unit area	Area of sample unit *i*
AR	Percent	Weighted average adoption rate

$Area_{an}$	Unit area (hectares or acres)	Area of proposed project-level adoption of each activity
$Buffer_{,t}$	tCO2e	Number of buffer credits to be contributed to the AFOLU pooled buffer account in year *t*
c	Dimensionless	Type of agricultural residue
$CC_{prj,l,t}$	fraction	Carbon content of manure applied as fertilizer on the project area from livestock type l in year *t*
D	mm	Inside diameter of probe or auger
EA_{an}	Percent	Adoption rate of the n largest most common proposed project activity in the region
$ƒ(SOC_{bsl,i,t-1})$	t CO_2e/unit area	Modeled soil organic carbon stocks pool in the baseline scenario for sample unit *i* at time *t* following Quantification Approach 1
$ƒCH4soil_{bsl,i,t}$	t CH4/unit area	Modeled methane emissions from the soil organic carbon pool in the baseline scenario for sample unit *i* at time *t*
$FFC_{wp,j,i,t}$	Liters	Consumption of fossil fuel type *j* in the project for sample unit *i* in year *t*
$ƒN2Osoil_{bsl,i,t}$	t N2O/unit area	Modeled nitrous oxide emissions from soil in the baseline scenario for sample unit *i* at time *t*
g	Dimensionless	Type of N-fixing species
i	Dimensionless	Sample unit; defined area that is selected for measurement and monitoring, such as a field or stratum; see also definition in section 3
j	Dimensionless	Type of fossil fuel combusted
l	Dimensionless	Type of livestock
$LE_{,t}$	tCO2e	Leakage in year *t*;
$M\_manure_{prj,l,t}$	tonnes	Project manure applied as fertilizer on the project area from livestock type *l* in year *t*
$MB_{g,wp,i,t}$	t dm	Annual dry matter, including aboveground and below ground, of N-fixing species *g* returned to soils for sample unit *i* in year *t*
$MB_{wp,c,i,t}$	Kilograms	Mass of agricultural residues of type *c* burned in the project for sample unit *i* in year *t*
MDD	t CO_2e/unit area	Minimum detectable difference of SOC stocks between two points in time
$MOC_{n,dl,soc}$	g	Soil mass in one sample depth layer
$M_{wp,OF,i,t}$	t fertilizer	Mass of N containing organic fertilizer applied in the project for sample unit *i* in year *t*
$M_{wp,SF,i,t}$	t fertilizer	Mass of N containing synthetic fertilizer applied in the project for sample unit *i* in year *t*
N	unitless	Number of cores sampled
n	Dimensionless	Number of samples required to detect a minimum difference
$OC_{n,dl}$	g/kg	Organic carbon concentration in each sample
OF	Dimensionless	Type of organic N fertilizer
p	Categorical variable	Crop/livestock product
$PC_{wp,p}$	Productivity (e.g., kg) per hectare or acre	Average productivity for product p during the project period

$P_{wp,l,i,t}$	Head	Population of grazing livestock in the project scenario of type *l* in sample unit *i* in year *t*
$RP_{wp,p}$	Unitless	Average regional productivity for product p during the same years as the project period
S	Dimensionless	standard deviation of the difference in SOC stocks between t0 and t1
SF	Dimensionless	Type of synthetic N fertilizer
$SOC_{bsl,i,t}$	t CO_2e/unit area	Areal-average soil organic carbon stocks in the baseline scenario for sample unit *i* in year *t*
$SOC_{bsl,i,t-1}$	t CO_2e/unit area	Areal-average soil organic carbon stocks in the baseline scenario for sample unit *i* in year *t-1*
$SOC_{wp,i,t}$	t CO_2e/unit area	Areal-average soil organic carbon stocks in the project scenario for sample unit *i* in year *t*
$SOC_{wp,i,t-1}$	t CO_2e/unit area	Areal-average soil organic carbon stocks in the project scenario for sample unit *i* in year *t-1*
t	Dimensionless	Values of the t-distribution given a certain power level (1-b) and a level (i.e., significance level)
v	Dimensionless	Degrees of freedom for the relevant t-distribution
$W_{bsl,l,i,t,P}$	kg animal mass/head	Average weight in the project scenario of livestock type *l* for sample unit *i* in year *t* for productivity system *P*
$\Delta C_{SHRUB,bsli,t}$	t CO_2e/unit area	Change in carbon stocks in shrubs in the baseline
$\Delta C_{SHRUB,wp,i,t}$	t CO_2e/unit area	Change in carbon stocks in shrubs in the project
$\Delta C_{TREE,bsl,i,t}$	t CO_2e/unit area	Change in carbon stocks in trees in the baseline
$\Delta C_{TREE,wp,i,t}$	t CO_2e/unit area	Change in carbon stocks in trees in the project
ΔP	Percent	Change in productivity
ΔPR	Percent	Change in productivity ratio
S	Categorical variable	Manure management system (the symbol may change in the final VM0042 document)
P	Categorical variable	Productivity system

The following parameters not included in previous lists were assessed:

Data/Parameter	Units	Description
$\Delta_{\bullet bsl}$	t CO_2e	Modeled estimate of change in Δ• in baseline scenario
$\Delta_{\bullet hit}$	t CO_2e/unit area	Estimated emissions reduction of gas or pool • on an area basis in year *t* in stratum *h,* at point *j*
$\Delta_{\bullet ht}$	t CO_2e/unit area	Areal average emissions reduction of gas or pool • in stratum at time , computed as the average across the sample points in stratum (areal average),
$\Delta_{\bullet pr}$	t CO_2e	Modeled estimate of change in Δ• in project scenario
A	acres or hectares	Total project area
A_h	acres or hectares	Area of stratum *h*
Bd_{corr}	g/cm3	corrected bulk density of the fine soil fraction (after subtracting the mass proportion of the coarse fragments)
$Buffer_t$	t CO_2e	Number of buffer credits to be contributed to the AFOLU pooled buffer account in year *t*

$CH4bb_{bsl,i,t}$	t CO_2e/unit area	Methane emissions in the baseline scenario from biomass burning for sample unit *i* in year *t*
$CH4bb_{wp,i,t}$	t CO_2e/unit area	Methane emissions in the project scenario from biomass burning for sample unit *i* in year *t*
$CH4ent_{bsl,i,t}$	t CO2e/unit area	Areal average methane emissions from livestock enteric fermentation in the baseline scenario for sample unit i in year t
$CH4ent_{wp,i,t}$	t CO2e/unit area	Areal average methane emissions from livestock enteric fermentation in the project scenario for sample unit i in year t
$CH4md_{bsl,i,t}$	t CO_2e/unit area	Baseline areal average CH_4 emissions from manure deposition in the baseline scenario for sample unit *i* in year *t*
$CH4md_{wp,i,t}$	t CO_2e/unit area	Baseline areal average CH_4 emissions from manure deposition in the project scenario for sample unit *i* in year *t*
$CH4soil_{bsl,i,t}$	t CO_2e/unit area	Areal average methane emissions from soil organic carbon pool in the baseline scenario for sample unit *i* in year *t*
$CH4soil_{wp,i,t}$	t CO_2e/unit area	Areal average methane emissions from soil organic carbon pool in the project scenario for sample unit *i* in year *t*
$CO2ff_{bsl,i,t}$	t CO_2e/unit area	Areal average carbon dioxide emissions from fossil fuel combustion in the baseline scenario for sample unit *i* in year *t*
$CO2ff_{wp,i,t}$	t CO_2e/unit area	Areal average carbon dioxide emissions from fossil fuel combustion in the project scenario for sample unit *i* in year *t*
$CO2_{limebsl,i,t}$	t CO_2e/unit area	Areal average carbon dioxide emissions from liming in the baseline scenario for sample unit *i* in year *t*
$COV(SOC_{pr,ht} ; SOC_{pr,hs})$	(t CO_2e)^2	Covariance of estimates of soil carbon stocks at t_{final} and t_{start} in the project scenario in stratum h
$E[Var(\tau\hat{}\mid s)]$		Estimate of model uncertainty which is the expectation of the conditional variance given the sample design.
$EFF_{bsl,j,i,t}$	t CO_2e/unit area	Areal average carbon dioxide emissions from fossil fuel combustion in the baseline scenario for sample unit *i* in year *t*
$EL_{bsl,i,t}$	t CO_2e	Carbon dioxide emissions from liming in the baseline scenario for sample unit *i* in year *t*
$E_{red,n,t}$	t CO_2e	Estimated net GHG emissions reductions in year t
$E_{rem,n,t}$	t CO_2e	Estimated net GHG emissions removals in year *t*
$ERR_{n,t}$	t CO_2e	Estimated net GHG emission reductions and removals in year *t*
$error_j$	t CO_2e/unit area	Difference between the predicted estimate of SOC on an area basis and the observed SOC at point j in the randomly selected validation dataset
f		Farmer identifier
$F_{bsl,manure,l,i,t,P}$	kg N	Amount of nitrogen in manure and urine deposited on soils by livestock type *l* for productivitiy system *P* in sample unit *i* in year *t*
$FCR_{,bsl,,i,t}$	t N	Amount of N in N-fixing species (above and below ground) returned to soils in the baseline scenario for sample unit *i* in year *t*
$FON_{,bsl,i,t}$	t N	Baseline organic N fertilizer applied for sample unit *i* in year *t*
$FSN_{,bsl,i,t}$	t N	Baseline synthetic N fertilizer applied for sample unit *i* in year *t*

h		Stratum identifier (= 1, … , H) and H is the total number of strata across the entire project area
j		Field identifier
$f_{CH4soilbsl,i,t}$	t CH_4e/unit area	Modeled methane emissions from the soil organic carbon pool in the baseline scenario for sample unit *i* in year *t*
$f_{N2Osoil_{bsl,i,t}}$	t N_2O/unit area	Modeled nitrous oxide emissions from soil (summed across the reporting period for sample unit *i*
l		MC simulation index (l = 1, … , L) where L is the total number of MC simulations
MDD		minimum detectable difference
mean error	t CO_2e/unit area	Mean of all estimates of errorj across all points k in the validation dataset
$M_{n,dl,soc}$	kg/ha	SOC mass in one soil sample n for each depth layer dl
$M_{n,dl,soil}$	g	Soil mass of sample n for each given depth layer dl
$N2O\_fert_{bsl,leach,i,t}$	t CO_2e	Indirect nitrous oxide emissions produced from leaching and runoff of N, in regions where leaching and runoff occurs, due to fertilizer use for sample unit *i* in year *t*
$N2O\_fert_{bsl,volat,i,t}$	t CO_2e	Indirect nitrous oxide emissions produced from atmospheric deposition of N volatilized due to fertilizer use for sample unit *i* in year *t*
$N2O\_md_{bsl,direct,i,t}$	t CO_2e/unit area	Direct nitrous oxide emissions due to manure deposition in the baseline scenario for sample unit *i* in year *t*
$N2O\_md_{bsl,indirect,i,t}$	t CO_2e/unit area	Indirect nitrous oxide emissions due to manure deposition in the baseline scenario for sample unit *i* in year *t*
$N2O\_md_{bsl,leach,i,t}$	t CO_2e	Indirect nitrous oxide emissions produced from leaching and runoff of N, in regions where leaching and runoff occurs, as a result of manure deposition for sample unit *i* in year *t*
$N2O\_md_{bsl,volat,i,t}$	t CO_2e	Indirect nitrous oxide emissions produced from atmospheric deposition of N volatilized due to manure deposition for sample unit *i* in year *t*
$N2Obb_{bsl,i,t}$	t CO_2e/unit area	Areal average nitrous oxide emissions in the baseline scenario from biomass burning for sample unit *i* in year *t*
$N2Obb_{wp,i,t}$	t CO_2e/unit area	Areal average nitrous oxide emissions in the project scenario from biomass burning for sample unit *i* in year *t*
$N2Ofert_{bsl,direct,i,t}$	t CO_2e/unit area	Direct nitrous oxide emissions due to fertilizer use in the baseline scenario for sample unit *i* in year *t*
$N2Ofert_{bsl,i,t}$	t CO_2e/unit area	Nitrous oxide emissions due to fertilizer use in the baseline scenario for sample unit *i* in year *t*
$N2Ofert_{bsl,indirect,i,t}$	t CO_2e/unit area	Indirect nitrous oxide emissions due to fertilizer use in the baseline scenario for sample unit *i* in year *t*
$N2Omd_{bsl,i,t}$	t CO_2e/unit area	Nitrous oxide emissions due to manure deposition in the baseline scenario for sample unit *i* in year t
$N2ONfix_{bsl,i,t}$	t CO_2e/unit area	N_2O emissions from crop residues due to the use of N-fixing species in the baseline scenario for sample unit *i* in year *t*

$N2Osoil_{bsl,i,t}$	t CO_2e/unit area	Areal average direct and indirect nitrous oxide emissions due to nitrogen inputs to soils in the baseline scenario for sample unit *i* in year *t*
$N2Osoil_{wp,i,t}$	t CO_2e/unit area	Areal average direct and indirect nitrous oxide emissions due to nitrogen inputs to soils in the project scenario for sample unit *i* in year *t*
P	Categorical variable	Productivity system
Pa_{an}	unitless	ratio of proposed project-level adoption of Activity an relative to proposed project-level adoption of Activity a1 + Activitya2 + … + Activityan in region
$S^2_{\Delta\bullet,t}$	(t CO_2e/unit area)^2	Variance of the estimate of ¯(Δ•) t. (¯(Δ•) t = mean emission reductions from gas and pool • at time t);
S^2_{model}	(t CO_2e)^2	Variance of the estimate of Δ• *(*Δ• = emission reductions in gas and pool •*, notation suppressed)* due to model prediction error
$S^2_{model,\bullet}$	(t CO_2e/unit area)^2	Estimated variance of errors made by the model's prediction of emissions of the gas or pool · (estimated from measurements in fields that need not be side-by-side trials with baseline and project scenarios
$S^2_{model,\Delta\bullet}$	(t CO_2e/unit area)^2	Variance of modeled estimates of Δ• (emission reductions in gas or pool •)
$S^2_{sampling}$	(t CO_2e)^2	Variance of Δ• (Δ• = emission reductions in gas and pool •, notation suppressed) due to sampling error at time t across the entire project area
$S^2_{sampling,\Delta\bullet,f}$	(t CO_2e)^2	Variance of Δ• *(*Δ• = emission reductions in gas and pool •*)* due to sampling error for farmer f (i.e. the primary sampling unit) at time t
$S^2_{sampling,\Delta\bullet,f,t}$	(t CO_2e)^2	Variance of Δ• *(*Δ• = emission reductions in gas and pool •*)* due to sampling error for farmer f (i.e. the primary sampling unit) at time t
$S^2_{sampling,\Delta\bullet,ht}$	(t CO_2e)^2	Variance of Δ• *(*Δ• = emission reductions in gas and pool •*)* within stratum due to sampling error at time t
$S^2_{sampling,\Delta\bullet,t}$	(t CO_2e)^2	Variance of Δ• *(*Δ• = emission reductions in gas and pool •*)* due to sampling error at time across the entire project area
$S^2_{sampling,h}$	(t CO_2e)^2	Variance of Δ• (Δ• = emission reductions in gas and pool •, notation suppressed) within stratum h due to sampling error at time t
$S^2_{SOC,pr,fs}$	(t CO_2e)^2	Variance of the estimate of soil carbon stocks in the project scenario at t_{start} for farmer f
$S^2_{SOC,pr,fx}$	(t CO_2e)^2	Variance of the estimate of soil carbon stocks in the project scenario at t_{final} for farmer f
$S^2_{SOCmodel}$	(t CO_2e)^2	Variance of the estimate of soil carbon stocks attributable to prediction error of the soil spectroscopy model
$S^2_{SOCpr,hf}$	(t CO_2e)^2	Variance of the estimate of soil carbon stocks in the project scenario at t_{final} in stratum h

$S^2_{SOCpr, hf,model}$	$(t\ CO_2e)^2$	Variance of the estimate of soil carbon stocks in the project scenario at t_{final} in stratum h attributable to prediction error of the soil spectroscopy model
$S^2_{SOCpr, hf,sample}$	$(t\ CO_2e)^2$	Variance of the estimate of soil carbon stocks in the project scenario at t_{final} in stratum h attributable to sampling error
$S^2_{SOCpr, hs}$	$(t\ CO_2e)^2$	Variance of the estimate of soil carbon stocks in the project scenario at t_{start} in stratum h
$S^2_{\Delta SOC,bsl,ft}$	$(t\ CO_2e)^2$	Variance of the estimate of total SOC removals in baseline (control) plots in verification period *t* paired with farmer f calculated as the difference in SOC stocks at the beginning and end of period t
$S^2_{\Delta SOC,ft}$	$(t\ CO_2e)^2$	Variance of the estimate of total SOC removals in verification period *t* for farmer f calculated as the difference in net change between the project and baseline scenarios over period t
$S^2_{\Delta SOC,pr,ft}$	$(t\ CO_2e)^2$	Variance of the estimate of total SOC removals in the project plots in verification period *t* for farmer f calculated as the difference in SOC stocks at the beginning and end of period t
$S^2_{\Delta SOC,t}$	$(t\ CO_2e/unit\ area)^2$	Variance of the estimate of mean SOC removals in verification period *t* across the entire project area, calculated as the difference in net change between the project and baseline scenarios over period *t*
$S^2_{\Delta SOCbsl,h,t}$	$(t\ CO_2e)^2$	Variance of the estimate of total SOC removals in baseline (control) plots in verification period *t* paired with project stratum h calculated as the difference in SOC stocks at the beginning and end of period
$S^2_{\Delta SOCh,t}$	$(t\ CO_2e)^2$	Variance of the estimate of total SOC removals in verification period *t* in stratum *h* calculated as the difference in net change between the project and baseline scenarios over period t
$S^2_{\Delta SOCpr, h,f}$	$(t\ CO_2e)^2$	Variance of the estimate of soil carbon stocks in the project scenario at t_{final} in stratum h
$S^2_{\Delta SOCpr, h,s}$	$(t\ CO_2e)^2$	Variance of the estimate of soil carbon stocks in the project scenario at t_{start} in stratum h
$S^2_{\Delta SOCpr, h,t}$	$(t\ CO_2e)^2$	Variance of the estimate of total SOC removals in the project plots in verification period *t* in stratum h calculated as the difference in SOC stocks at the beginning and end of period t
$SOC^*_{pr,fs}$	$t\ CO_2e$	Average estimated SOC stocks for farmer f across their total land area based on data collected at tstart for farmer f across all fields
$SOC^*_{pr,fsj}$	$t\ CO_2e$	Estimated SOC stocks for farmer f across their total land area based on data collected at tstart for farmer f in field j
$SOC_{content}$	g/kg	soil organic carbon content
SOC_{fhsji}	$t\ CO_2e$	Estimated SOC stock equivalent at point i in stratum h in field j for farmer f at t_{start}
SOC_{model}	t/ha	soil organic carbon stock as model input data

$SOC_{model,j}$	t CO_2e/unit area	Predicted estimate of SOC on an area basis at point j in the randomly selected validation dataset
$SOC_{observed,j}$	t CO_2e/unit area	Observed SOC on an area basis at point j in the randomly selected validation dataset, determined through conventional lab analysis and field sampling
$SOC_{pr,f}$	t CO_2e	Mean estimate of total soil carbon stocks in the project scenario across the entire project at t_{final} averaged across all *L* simulations
$SOC_{pr,fl}$	t CO_2e	Estimate of total soil carbon stock on an area basis in the project scenario across the entire project at t_{final} in the lth simulation
$SOC_{pr,hf}$	t CO_2e/unit area	Mean estimate of soil carbon stocks across all points in the project scenario at t_{final} in stratum h
$SOC_{pr,hfl}$	t CO_2e/unit area	Mean estimate of soil carbon stocks across all points in the project scenario at t_{final} in stratum h in the l^{th} simulation
$SOC_{pr,hif}$	t CO_2e/unit area	Estimate of soil carbon stock on an area basis at point i in the project scenario at t_{final} in stratum h
$SOC_{pr,hifl}$	t CO_2e/unit area	Estimate of soil carbon stock on an area basis at point in the project scenario at tfinal in stratum h in the lth simulation
$SOC_{pr,his}$	t CO_2e/unit area	Estimate of soil carbon stock on an area basis at point i in the project scenario at t_{start} in stratum h
$SOC_{pr,hs}$	t CO_2e/unit area	Mean estimate of soil carbon stocks across all points in the project scenario at t_{startl} in stratum h
T		Critical value of a student's t-distribution for significance level a=0.975 and 0.025 with degrees of freedom appropriate to the sampling design used.
$UNC_{\Delta\bullet,t}$	% between 0 and 100	Uncertainty deduction in year *t* for gas or pool · (expressed as the extent to which the half width of t interval, as a percentage of the mean, exceeds the threshold of A%)
$UNC_{t,CH4soil}$	fraction between 0 and 1	Uncertainty deduction in year *t* when using *Quantification Approach 1* to model methane emission reductions from increasing uptake into the SOC pool
$UNC_{t,CO2}$	fraction between 0 and 1	Uncertainty deduction in year t associated to modeling or measuring SOC stock changes
$UNC_{t,N2Osoil}$	fraction between 0 and 1	Uncertainty deduction in year t when using *Quantification Approach 1* to model nitrous oxide emission reductions from nitrification/denitrification
$Var(E[\tau\hat{}\mid s])$		Estimate of the uncertainty due to sampling design, i.e., the variance of the conditional expectation
VCU_t	t CO_2e	Number of VCU in year *t*
$VS_{l,i,t,P}$	kg volatile solids/(head * day)	Average volatile solids excretion per head for livestock type *l* in sample unit *i* for productivity system *P* in year *t*
$\tilde{y}_{fjhil}$	t CO_2e/unit area	Predicted emissions reduction for the l^{th} simulation at point l in stratum h in field j for farmer f
$\tilde{y}_{hi}$	tCO_2e/unit area	MC estimate of areal mean GHG emission reductions for point *i* in stratum h

$\tilde{y}_{hil}$	t CO_2e/unit area	Predicted GHG emission reduction on an area basis for point i in stratum h, and MC simulation l
$\tilde{z}_{bsl, fjhil}$	t CO_2e/unit area	Predicted GHG emissions in the baseline scenario for the l^{th} simulation at point i in stratum h in field j for farmer f
$\tilde{z}_{bsl, hil}$	t CO_2e/unit area	Predicted GHG emissions in the baseline scenario on an area basis for point i in stratum h, and MC simulation
$\tilde{z}_{pr, fjhil}$	t CO_2e/unit area	Predicted GHG emissions in the project scenario for the l^{th} simulation at point i in stratum h in field j for farmer f
$\tilde{z}_{pr, hil}$	t CO_2e/unit area	Predicted GHG emissions in the project scenario on an area basis for point i in stratum h, and MC simulation
$Z_{70\%}$		z-score of the 70th percentile of a standard normal distribution ≈ 0.5244005127
$\Delta \bullet^{*}_{f}$	t CO_2e	Estimated emissions reduction of gas or pool • for farmer f across their total land area based on data collected at time t for farmer f across all fields k
$\Delta \bullet^{*}_{fj}$	t CO_2e	Estimated emissions reduction of gas or pool • for farmer f across their total land area based on data collected at time t for farmer f in field j
$\Delta \bullet t$	t CO_2e/unit area	Mean estimated emissions reduction for gas · across the entire project area in year t
$\Delta CH4bb_t$	t CO_2e	Total methane emission reductions from avoided or reduced biomass burning in year *t*
$\Delta CH4ent_t$	t CO_2e	Total methane emission reductions from livestock enteric fermentation in year *t*
$\Delta CH4md_t$	t CO_2e	Total methane emission reductions from manure deposition in year *t*
$\Delta CH4soil_t$	t CO_2e	Total methane emission reductions from increasing uptake into the SOC pool in year *t*
$\Delta CO2ff_t$	t CO_2e	Total carbon dioxide emission reductions from fossil fuel combustion in year *t*
$\Delta CO2soil_t$	t CO_2e	Total carbon dioxide emission removals from increasing the SOC pool in year *t*
$\Delta CSHRUB_t$	t CO_2e	Total carbon dioxide emission removals from increasing shrub biomass in year *t*
$\Delta CTREE_t$	t CO_2e	Total carbon dioxide emission removals from increasing tree biomass in year *t*
$\Delta N2Obb_t$	t CO_2e	Total nitrous oxide emission reductions from avoided or reduced biomass burning in year *t*
$\Delta N2Osoil_t$	t CO_2e	Total nitrous oxide emission reductions from nitrification/denitrification in year *t*
$\hat{\mu}$	t CO_2e/unit area	Areal average unbiased estimator of emissions reduction for gas or pool • in year *t*
$\hat{\mu}_h$	tCO_2e/unit area	MC estimate of areal mean GHG emission reductions in stratum *h*
ρ		Correlation of errors in project and baseline scenario pairs (which is estimated from side-by-side field trials with baseline and project scenarios)

$\hat{T}$	t CO_2e	Monte Carlo estimate (MC mean) of total GHG emissions reductions for a given source across the whole project area
$\hat{T}_f$	t CO_2e	Monte Carlo estimate (MC mean) of GHG emissions reductions for a given source for farmer f
$\hat{T}_{fj}$	t CO_2e	Monte Carlo estimate (MC mean) of GHG emissions reductions for a given source in field j for farmer f
$\hat{T}_{fjl}$	t CO_2e	Monte Carlo estimate (MC mean) of GHG emissions reductions for a given source in field j for farmer f in the l^{th} simulation
$\hat{T}_{fl}$	t CO_2e	Monte Carlo estimate (MC mean) of GHG emissions reductions for a given source farmer f in the l^{th} simulation
$\hat{T}_h$	t CO_2e	Monte Carlo estimate (MC mean) of GHG emissions reductions a given source within stratum *h*
$\hat{T}_{hl}$	tCO_2e	Total GHG emission reductions in stratum *h* for the l^{th}MC simulation of the project
$\hat{T}_l$	tCO_2e	Total GHG emission reductions for the l^{th}MC simulation of the project

3.9.2 Project Emissions

Project emissions are quantified in the same way as the Baseline scenario. Please see section 3.9.1 above.

3.9.3 Leakage

Leakage has not been substantially changed since V1 of the Methodology. Verra has adequately responded to input made by stakeholders regarding leakage (see Ref /3/).

3.9.4 Net GHG Emission Reductions and Removals

This section has changed from V1.0 of the Methodology with respect to applying new uncertainty quantification procedures. The audit team reviewed the extensive stakeholder response, formulas, outside material, and conducted interviews with TerraCarbon. Verra has responded adequately to all comments and findings (see Ref /3/ and Appendix A).

3.10 Monitoring

The following major changes have occurred regarding Monitoring:

- Inclusion of parameters related to the Equivalent Soil Mass approach: see section 3.9.1 about the audit team's assessment.

- Inclusion of parameters from the Uncertainty quantification: see section 3.9.1 about the audit team's assessment.

4 ASSESSMENT CONCLUSION

The audit team asserts, with no qualifications or limitations, that

- The Methodology (v2) complies with the assessment criteria for projects set out in VCS, V4.3, and associated Program Rules.

5 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

The following is a record of SCS Global Services' methodology assessment experience:

- The World Bank: Sustainable Agriculture Land Management Methodology
- The Earth Partners: Soil Carbon Quantification Methodology
- CH2M Hill: Methodology for Coastal Wetland Creation
- Silvestrum: Revision and Extension to VM0007: REDD+ Methodology Framework
- Ecotrust: Improved Forest Management Methodology
- Face the Future: Improved Forest Management Methodology
- Terra Global Capital: Mosaic REDD Methodology
- The Nature Conservancy: Revision of Methods for Monitoring of GHG Emissions and Removals
- Terra Global Capital: Avoided Planned Deforestation of Peat Methodology
- WWF Germany: Rewetting of Tropical Peatlands Methodology
- Environmental Defense Fund: Rice Methodology
- United Nations Food and Agriculture Organization: Sustainable Grassland Management Methodology
- Carbon Credit Corp.: Improved Forest Management on Lands Subject to Unextinguished Indigenous Rights & Title

- Silvestrum VoF: Belarus Peatland Rewetting
- ForCERT: Combined IFM & REDD Methodology
- Pacific Carbon Trust: Forest Carbon Offset Protocol
- Terra Global Capital: Tool for Calculating Deforestation Rates Using Incomplete Remote Sensing Images
- Terra Global Capital: Calculating Emission Reductions in Rice Management Systems Methodology
- Terra Global Capital: Tool for Remote Sensing Biomass Measurement
- Mountain Association for Community Economic Development, Inc. (MACED): Methodology for Improved Forest Management in Non-industrial Private Forests
- Mpingo Conservation and Development Initiative: Avoiding Degradation through Fire Management

The following is a subset of SCS Global Services' project validation experience:

- Community Based Avoided Deforestation Project In Guinea-Bissau (Project ID: VCS 2324)
- San Juan National Forest Carbon Demonstration Project (II) (Project ID: ACR197)
- Tumring REDD+ Project (ID: VCS 1689)
- Blue Source - Middlebury Improved Forest Management Project (Project ID: ACR 368)
- The Purus REDD+ Project (Project ID: VCS 963)
- Abote Community-Managed Reforestation Project (Project ID: CCB 1627)
- COMACO Landscape Management Project (Project ID: VCS 1532)
- Emission Reductions in Midsouth Rice Management Systems (Project ID: ACR 230)
- Peri-Urban Bamboo Planting Around South African Townships (Project ID: VCS 721)
- Rimba Raya Biodiversity Reserve Project (Project ID: VCS 674)
- Restoring A Forest Legacy At Upper Ouachita National Wildlife Refuge (Project ID: CCB 1636)

- The Nature Conservancy Washington Rainforest Renewal Project (Project ID ACR574)
- Boden Creek Ecological Preserve Forest Carbon Project (Project ID: VCS 647)
- Replacement of SF6 as a Cover Gas at U.S. Magnesium (Project ID: ACR 261)
- Restoring A Forest Legacy At Grand Cote And Lake Ophelia National Wildlife Refuges
- (Project ID: CCB 1635)
- Emission Reductions in Midsouth Rice Management Systems (Project ID: ACR 230)
- Madre De Dios Amazon Redfd Project (Project ID: VCS 844)
- The Southern Cardamom REDD+ Project (Project ID: VCS 1748)
- Restoring Wetlands on California Department of Water Resources-Owned Areas of Twitchell and Sherman Islands (Project ID: ACR 410)

6 SIGNATURE

Signed for and on behalf of:

Name of entity: SCS Global Services

Signature:

Name of signatory: Doug Baldwin, Lead Auditor

Date: 11/22/2022

APPENDIX A: LIST OF FINDINGS

Note: findings start on the next page.

NCR 1 Dated 17 May 2022
Standard Reference: VCS Standard v4.2;
VCS Methodology Requirements v4.1
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: The VCS standard states in section 4.1.8: "In addition to the requirements set out in ISO 14064-3:2006, the following shall apply: 3) The objective of validation or verification shall be in conformance with the VCS Program rules and the methodology applied to the project." In section 2.1, the Methodology Requirements state: "Establishing consistent and standardized criteria for development and assessment of methodologies is
critical to ensuring their integrity."

In Section 8.1 for Quantification Approach 1, the methodology states: "An acceptable model is used to estimate GHG flux based on edaphic characteristics and actual agricultural practices implemented, measured initial SOC stocks, and climatic conditions in sample units.", and "For projects employing Quantification Approach 1 for the quantification of SOC stock changes, the subsequent direct SOC measurement will be used in the same manner as in the first year of the project, as the input to the model simulation for that year. The output SOC stock from that simulation would then be compared to the output SOC stock from the simulation of the prior monitoring period to determine the SOC stock change, and thereby incorporating any adjustment (i.e., "true up") based on the direct measurement."

In Table 8: Guidance on collection of model inputs for the project scenario, where required by the model selected for the category "Soil organic carbon content and bulk density to calculate SOC stocks", the table states for Timing: "Determined at project start (re measured every 5 years or less)" and for Approach: "Directly measured via conventional analytical laboratory methods, e.g., dry combustion, or estimated via emerging technologies (INS, LIBS, MIR and Vis-NIR) with known uncertainty following the criteria in Appendix 4, every 5 years or less. See parameter table for SOCwp,i,t."

In section 8.6.1.1, it states: "Further, the initial quantity of SOC for both the baseline and the project is measured, greatly reducing the uncertainty of the initial SOC conditions."

However, in section 9.2, for comments of the parameter SOCwp,i,t , it states: "The soil organic carbon stocks at time t=0 are calculated based on directly measured soil organic carbon content and bulk density at t=0 or (back-) modeled to t =0 from measurements collected within +/-5 years of t=0, or determined for t=0 via emerging technologies (INS, LIBS, MIR and Vis-NIR) with known uncertainty following the criteria in Appendix 4, and must be used in both the baseline and with- project scenario for the length of the project. Note that bulk density measurements are not necessarily required to determine SOC stock changes on an ESM basis." This comment indicates that projects may not need to measure at t=0 (initial project instance year), which contradicts the previous statements. Given this inconsistency, it is not possible for verifiers to judge conformance with respect to the timing of project SOC measurements in a consistent manner.

Project Personnel Response: Verra recognizes that the statement describing parameter SOCwp,i,t was confusing, and sees the need to clarify that baseline estimates of SOC at t=0 are required, with the option of conducting measurements within +/- 5 years and (back-) modelling them to t=0. Therefore, the guidance in the first row of table 6 clarifies under the column "Timing" that SOC content and bulk density to calculate SOC stocks (initial) must be "Determined ex ante via direct measurements at t=0 or (back-) modeled to t =0 from measurements collected within +/-5 years of t =0." Similar clarifications have been made to the parameters pertaining to SOC in section 9.2.
Auditor Response: Thank you for the revisions. The new information is helpful and appreciated.

One additional clarification: in section 9.2 for the SOCwp,i,t table it states: "Initial SOC stocks are the same in both the baseline and project scenarios at the outset of the project (i.e., SOCwp,i,0 = SOCbsl,i,0), under Quantification Approach 1." This is quite clear, but the same instructions are absent in the table for SOCbsl, and we are assuming this means the initial direct measurement = SOCwp,i,0 = SOCbsl,i,0. If this is correct, please clarify in section 9.2 for these two parameters.
Project Personnel Response 2: We added this clarification to the first paragraph of section 8.2.1, to section 8.5.1 and the parameter tables in section 9.2 for parameters SOCwp,i,t and SOCbsl,i,t:
"The initially measured SOC (at t=0 determined through direct measurements or (back-) modeled to t =0 from measurements collected within +/-5 years of t =0) is the same in both the baseline and project scenarios at the outset of the project (i.e., SOC_wp,i,0=SOC_bsl,i,0) when following Quantification Approach 1; "
Auditor Response 2: Thank you for the update. Guidelines of how to collect and use SOC measurements and the SOC parameter in general have been clarified. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA): C

NIR 2 Dated 17 May 2022
Standard Reference: VCS Standard v4.2
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of transparency seems relevant to this finding: "disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence."

The SOCwp,i,t parameter in Section 9.2 is complicated to measure, model, and monitor. The methodology provides a lot of information to help users maintain accuracy when measuring and estimating SOC stocks related in the project scenario. However, the table entry is multiple pages in length, and already there is an inconsistency in the Comment section of this table and text in other areas of the methodology. The audit team requests more information into whether soil measurement protocols and other necessary information for SOCwp,i,t could be centralized in a sub-section in the main text, where the table could point to this sub-section to minimize the size of this entry.
Project Personnel Response: Verra agrees with this finding and had addressed this through the shortening of the guidance in parameter SOCwp,i,t. The content was transferred and restructured to an expanded section 8.2.1 Soil Organic Carbon Stocks covering all important issues related to the measurement of SOC content and soil mass/bulk density to quantify SOC stocks and stock changes. We believe this restructuring should address this NIR.
Auditor Response: Thank you for reorganizing the content about soil sampling. The soil sampling guidance is now easier to follow and aligned throughout the document. This finding has been closed.
Bearing on Material Misstatement or Conformance (M/C/NA): NA

NIR 3 Dated 17 May 2022
Standard Reference: VCS Standard v4.2;
VCS Validation and Verification Manual v3.2
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: Note: this finding corresponds to stakeholder comments in rows: 10, 12, 62, 74, 76, 80, 82, 112, 166, 211, 285, 286

The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information". The validation and verification manual states in section 1.5: "For example, where a project does not use data and methods that enable meaningful comparisons of GHG related information, the VVB must note it as a non-conformance with the VCS principle of consistency. In some cases, VVBs may need to use professional judgment in applying the VCS principles."

The above relate to a potential issue VVBs may encounter with the degree of flexibility project developers have in picking from a wide range of soil sampling strategies that differ in terms of i) number of samples needed, ii) where samples should be taken, iii) how deep samples must be taken, and iv) what time of year samples should be taken. Given the myriad of options now available, it would be challenging for a VVB to validate whether a project chose a workable strategy for a given agricultural system to both be accurate enough to represent SOC variability across the system but also offer enough precision where future re-measurements can capture a change in carbon stocks related to project activitiy.

The audit is aware that Verra is developing a tool to aid users in developing or validating sampling designs, and this would be a highly beneficial complement to this methodology. However, this new version of the methodology will be available in the relatively near future, likely before this tool is available. The audit team requests the following could be taken into consideration: 1) A limited list of sampling strategies from which developers could pick for their project (potentially requiring a deviation for a strategy not listed), and 2) tapping into outside expertise to review such a list and a list of corresponding references, so that there is a resource for deciding on sampling before the sampling tool becomes available. A competant VVB should be able to use best judgement to validate a sampling strategy, but we perceive there is currently a risk where a project will choose a completely unworkable sampling approach that will cause additional sampling costs and fewer credits at the start of project development before an audit takes place.
Project Personnel Response: Under the newly structured section 8.2.1 under Soil sampling, Verra has specified that stratified random sampling should be used as a sampling strategy. This strategy has been widely recommended by experts consulted in relation to the VM0042 methodology development, and is referenced by specialized handbooks for SOC monitoring from the FAO and the World Bank, as well as the ISO 18400-104:2018. A different sampling scheme will only be allowed through a methodology deviation fulfilling the requirements in the VCS Standard v4.3 section 3.18.

In terms of the question how deep samples must be taken, VM0042 has a requirement to sample to a minimum depth of 30cm. The methodology also includes this paragraph addressing the question when to take soil samples: “Sampling and re-sampling campaigns after several years should be conducted during the same season. If organic amendments are applied, projects should delay sampling or re-sampling to the latest time possible after the previous application and the shortest time possible before the next one.”

Auditor Response: Thank you for your response. This finding has been closed.
Bearing on Material Misstatement or Conformance (M/C/NA): NA

OBS 4 Dated 17 May 2022
Standard Reference: VCS Standard v4.2
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of transparency seems relevant to this finding: "disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence."

Section 8 of VM0042 contains a lot of information an experienced project developer could navigate and use to design a well functioning project. However, the quantification is relatively complex, and this is exemplified by 3 quantitative approaches and up to 87 equations. The audit team understands this is likely unavoidable, given the complexity of soil and agricultural systems, in general. The audit team does note that Figure 3 in section 8.6.4 was very helpful in visualizing the decisions and process one must go through in order to conduct one aspect of the complex uncertainty deduction assessement. The audit team perceives that more figures such as Figure 3 would help clarify the quantitative aspects of VM0042 for both developers and VVBs, and ideally this observation is especially timely, given the reworking of the methodology's uncertainty sections.

Project Personnel Response: Verra has contracted Terra Carbon to address all public comments related to the uncertainty section 8.6. This is where most equations were contained in the draft v2.0 posted for public consultation. Terra Carbon has proposed including further flowcharts illustrating decision processes for how to make choices relative to uncertainty estimation and deductions at the beginning of section 8.6. Furthermore, the Verra team will update Figure 1. Equation map in section 8.2 to visualize which equations pertain to which GHG/C pool and to which of the three quantification approaches.
Auditor Response: Thank you for additional information. The audit team has sent a list of questions for Terra Carbon, one of which asks about a potential figure laying out the newly developed uncertainty quantification pathways that Terra Carbon mentions is forthcoming. These questions are being tracked over email with Verra and Terra Carbon.
Bearing on Material Misstatement or Conformance (M/C/NA): NA

NIR 5 Dated 17 May 2022
Standard Reference: VCS Methodology Requirements v4.1
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: Note: this finding corresponds to stakeholder comments in rows: 3, 25, 50, 169, 198, 228, 229, 255, 263, 273

The methodology requirements state in section 2.3.1:"Methodologies shall include sufficient information and evidence to allow the reader to reach the same assessment conclusion on the appropriateness and rigor of the standardized method reached as reached under the methodology approval process, noting that the confidentiality of proprietary data may be protected as set out in Section 3.4.6(5)".

The new grassland-to-cropland and vice versa exceptions in Section 4(2) and Appendix 2 have been well received by stakeholders. The cited CDM tool "“Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" would enable project developers to demonstrate degradation in the project area at the start of the project. The audit team does need more clarity on how many conversions are allowed (assuming one conversion at project start, but not entirely clear). Furthermore, the audit team requests a review of the language in Section 4 and in Appendix 2 by an expert agronomist for an opinion on whether the exception language is robust enough to enable a determination as to whether a project's stated conversion plan could reverse degradation. Point 2 in Appendix 2 states: "Evidence types may include relevant local, regional, national or international studies and local expert analysis.", which is generally reasonable, but citing international studies seems like a relatively vague criterion for demonstrating expected improvements from a planned land conversion in a local area. The main issue underpinning this finding is that the audit team is not nearly as familiar with studies about land conversion reversing degradation as an outside expert would be and is not familiar with the extent of relevant studies that currently exist from which project developers could cite as evidence.

Project Personnel Response: 1. We propose that a one-time conversion be restricted to the second type of allowed land use change focused on reversing degradation. We added the following red text into the second bullet of Applicability condition 2: "A one-time conversion from grassland to cropland or vice versa …" and into the third paragraph of Appendix 2: "This exception allows for a one-time conversion from grassland to cropland or vice versa and requires.."
For the first type of allowed land use change focused on converting temporary grassland into cropland using Integrated Crop-Livestock Systems and related management systems, we believe the conversion could happen more than once and still deliver positive benefits, i.e., annual crops could be reintroduced into a grassland system that was initially incorporated into degraded cropland. This the crux of these highly integrated and holistic ICL systems that essentially maximize synergies between animals and plants – see for example Peterson, et al., 2020 (https://doi.org/10.1371/journal.pone.0231840) or Sekaran, et al., 2021 (https://doi.org/10.1016/j.jafr.2021.100190). The details for this would be outlined in the required long-term management plan for the system which could be verified by the VVB and outside expertise as needed.

2. We agree that international studies may not be relevant if not conducted under similar conditions as in the proposed project region. We reached out to numerous experts who have published in the area of land degradation and restoration including Dr Leigh Ann Winowiecki, Dr Annette Cowie, Dr Pete Smith, Dr Sarah Wolff and Dr Hans-Peter Liniger. Drs Smith and Cowie (who published this meta-analysis on practices that combat land degradation in GCB, https://doi.org/10.1111/gcb.14878, and this framework for reversing land degradation in Env Sci & Pol, https://doi.org/10.1016/j.envsci.2017.10.011, respectively) responded. Both expressed support for the overall approach described in Appendix 2 and noted the importance of allowing LUC to enable restoration. They further noted that international studies can be applicable where they pertain to similar soil types, environments and interventions, and suggested some additional evidence types. Based on this we modified the text so that the relevant sentences now read "Evidence types may include local expert analysis and relevant local, regional, or national studies. Where those are not available, international studies conducted under similar biophysical and climatic conditions and with comparable management practices may be used. Evidence may further include quantification of recognized indicators of degradation by direct measurement, proximal or remote sensing, and/or modelling."
Auditor Response: The audit team appreciates the additional references and the consultation with outside experts in land degradation and restoration. The revisions make sense with what is presented in the literature sources. This finding has been closed.
Bearing on Material Misstatement or Conformance (M/C/NA): NA

NIR 6 Dated 17 May 2022
Standard Reference: VCS Standard v4.2
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of conservativeness seems relevant to this finding: "Use conservative assumptions, values and procedures to ensure that net GHG emission reductions or removals are not overestimated".

In Section 8.6.4, for point 2 (description of Case N3), the methodology states at the end of the paragraph: "Therefore, the uncertainty deduction for case N3 that is based on SOC uncertainty alone needs to be greater than the uncertainty deduction based on combined SOC and direct N2O uncertainty for case N1." This phrase implies that a project that chooses Case N3 (using approach QA3) may have to conduct an analysis using both the Case N1 approach along with Case N3 in order to come to a reasonable assurance that the "uncertainty deduction for case N3 that is based on SOC uncertainty alone needs to be greater than the uncertainty deduction based on combined SOC and direct N2O uncertainty for case N1." The audit team realizes the uncertainty section is under revision, but it would be good to clarify how one determines that the uncertainty for N3 is greater than N1, assuming one does not have to do an assessment of both cases, which seems to be what Figure 3 implies.
Project Personnel Response: Terra Carbon has flagged that the current approach for determining uncertainty deduction linked to the quantification approach for estimating N2O emissions is too complicated for the average user to follow. They propose applying a default uncertainty deduction to avoided N2O quantified using emissions factors, thus simplifying the pathways to be followed by project proponents. The final revised draft will be submitted to SCS for assessment.
Auditor Response: Thank you for additional information. The audit team has reviewed section 8.6 and confirms the relatively complex quantification pathways for N2O quantification have been removed. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA): NA

NIR 7 Dated 17 May 2022
Standard Reference: VCS Standard v4.2
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: Note: this finding corresponds to stakeholder comments in row 238

The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of transparency seems relevant to this finding: "Disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence".

Appendix 1 in the methodology lists "Groundwater level management" under "Improve water management/irrigation" activities, but it is unclear what constitutes an improvement for groundwater level management. The other two points under "Improve water management/irrigation" do have examples, which is helpful for putting these actions into context. Please provide additional information as to what constitutes an improvement for groundwater level management.
Project Personnel Response: We have included an example of groundwater level management as suggested by the commenter that recommended inclusion of this practice: Groundwater level management (e.g., adjust groundwater levels to reduce peat oxidation). We are aware that some lands that contain peat soils may be classified as wetlands and would be excluded per the VM0042 applicability conditions. However, where the PP could demonstrate that the project lands are not wetlands, this could be an eligible practice given that oxidation of peatlands is a significant source of global GHG emissions.
Auditor Response: Thank you for the additional information. This finding has been closed.
Bearing on Material Misstatement or Conformance (M/C/NA): NA

OBS 8 Dated 17 May 2022
Standard Reference: N/A
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared
Finding: As alluded to in other findings, the audit team acknowledges the complexity of VM0042, but this is unavoidable given how it provides guidance for offset projects dealing with soil carbon and agricultural. Verra does provide nice workbooks and examples for other methodologies, and the audit team thinks an example workbook for various uncertainty and quantification approaches would be highly beneficial for both project developers and VVBs.
Project Personnel Response: As part of the overhaul to section 8.6 on assessing uncertainty, worked examples will be provided to clarify calculation steps. Furthermore, Verra is building out a dedicated auditing and accreditation team, which will provide direct and structured support to VVBs through formalized and targeted VVB training as well as ongoing support. For the agriculture sector, VM0042 will be a key methodology to focus on.
Auditor Response: Thank you for the additional information. This finding has been closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 9 Dated 6 Jun 2022
Standard Reference: N/A
Document Reference: VM0042_v2.0_ChangesAfterPublicComment_SCS-Verra-shared_v2
Finding: In response to the stakeholder comment from row 196, "emission reduction and removals" occurs in Section 2, before section 8.6.
Project Personnel Response: Verra has added the acronym ERR to section 2.
Auditor Response: Thank you for the revision. This finding has been closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 10 Dated 13 Jul 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_shared_v4.docx
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

In section 8.2.1 Soil Organic Carbon Stocks, Calculation of SOC stocks (page 40/191 with All Markup visible), the first paragraph states: "To ensure that changes in SOC stocks do not solely arise from a temporal change in bulk density (related to management practices), SOC stock changes based on measurements (including. for baseline and true-up measurements under Quantification Approach 1), must be calculated on an equivalent soil mass (ESM) basis as follows:."

The response to the comment in row 26 indicates that the ESM approach is only applicable to Quantification Approach 2, but the above language in the methodology indicates ESM is also required for Quantification Approach 1. Please clarify when ESM is required.
Project Personnel Response: The text in the methodology is correct. We have amended the comment response in row 26 to reflect this. ESM is valid for both quantification approaches 1 and 2 where direct measurement is used (for QA1 direct measurement is required for true-up every 5 years or less).
Auditor Response: Thank you. This finding is now closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 11 Dated 13 Jul 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_shared_v4.docx
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of transparency seems relevant to this finding: "disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence."

Section 8.2.1 concerning Calculation of SOC stocks properly displays the mass equation from Wendt and Hauser (2013) that underpins the equivalent soil mass (ESM) approach to quantifying soil carbon stocks from soil measurements. Equation 2 (as assigned in the noted revision version) essentially combines Equations 4 and 5 from Wendt and Hauser (2013), and similar terms of 'mass' (dry sample mass, soil mass) are used that have different units along with ESM's standard depth increment that must be chosen for sampling.

The audit team would like more information about the requirements of conducting an ESM sampling in a clear form in Section 8.2.1, as well as a clearer indication of mass terms to avoid confusion about different components and corresponding units. Finally, the units for OCn,dl are spelled out nicely in Equation 2, but the SOC content term in Equation 3 mentions mass-% as units. Please clarify as this is ambiguous given the other 'mass' related terms being used in these equations.
Project Personnel Response: It is correct that we merged equations 4 and 5 from Wendt and Hauser (2013) into Equation 2 of VM0042. We changed the parameter description from "Dry mass of soil sample..." to "Soil mass of sample..." to avoid confusion, and added this last sentence under Collection of soil samples: "Drying and sieving procedures must follow laboratory-specific SOPs and must be consistent for all samples collected as part of the project."

We added further clarifications in paragraphs 2 and 3 under sub-heading Collection of soil samples in section 8.2.1 regarding the sampling depth and required depth layers to enable following the ESM approach. We included a screenshot of the ESM spreadsheet provided by Wendt and Hause 2013 as a new Figure 2 to further illustrate the calculation procedures. This information was verified by the authors of the paper to make sure we are providing the correct guidance.

In Equation 3, we have changed the unit of SOC content from the ambiguous mass-% to g/kg and adjusted the conversion factor to 1000 for converting g/cm2 to t/ha.
Auditor Response: The updates are helpful, so thank you for the clarification. One more issue in now Equation 5: the units of the output (t/ha) do not seem to be associated with the 1000 value conversion factor in the equation. The audit team will provide an example spreadsheet to highlight the issue we need to clarify.
Project Personnel Response 2: We corrected the conversion factor 1000 to 10 based on the reference equation in p.38 of World Bank. 2021. Soil Organic Carbon MRV Sourcebook for Agricultural Landscapes © World Bank, Washington, DC.
Auditor Response 2: Thank you for the corrections. Note: this has been resolved in detail over email. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 12 Dated 13 Jul 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_shared_v4.docx
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of transparency seems relevant to this finding: "disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence."

Section 8.2.1 concerning calculation of SOC stocks, it is implied in references and guidance cited that one stops at 30 cm or upon encountering a restrictive layer < 30 cm deep. The audit team is aware of confusion from VM0042 v1.0 implementation about what to do if 30 cm cannot be reached because of a restrictive layer (e.g., hardpan, bedrock, etc.). Please provide guidance on what to do when one cannot physically sample soil to a depth of 30 cm.

Project Personnel Response: We have clarified in section 8.2.1, under sub-heading Collection of soil samples that soils less than 30cm must be sampled as deep as possible.
Auditor Response: The audit team confirms that the clarification has been added to section 8.2.1, however:

"SOC stocks and stock changes must be reported to a minimum depth of 30 cm. To enable the ESM approach, soil samples must be taken as contiguous cores divided into at least 2 short increments (e.g., 5 or 10 cm in length). To eliminate the need for extrapolation outside of the measured range, soils must be sampled one increment deeper than the minimum 30 cm required (i.e., down to 35 or 40 cm). In total, at least three depth layers must be sampled (e.g., 0-10 cm, 10-30 cm, and 30-40 cm)."

The audit team needs more clarification about the ESM process description, starting with the first underlined phrase: if a minimum depth of 30 cm is divided into at least 2 short increments, one would likely choose cores of 15 cm length / 3 cores of 10 cm length / etc, so the 5 cm example is unclear. Overall, the description seems to indicate that the client may not need to analyze the whole core, which is the source of confusion for the audit team. Please confirm if this is the case.
Project Personnel Response 2: We discussed with John Wendt and made some adjustments to the paragraph describing the depth increments required to sample. Your interpretation is correct that only the soil sample mass is needed and not the SOC content. We also adjusted the example shown in the newly introduced Fig. 2 to reflect the updated guidance. We can make further clarifications as needed.
Auditor Response 2: Thank you for the corrections. Note: this has been resolved in detail over email. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 13 Dated 13 Jul 2022 **Standard Reference**: VCS Standard v4.3 **Document Reference**: VM0042_v2.0_shared_v4.docx **Finding**: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information". Equations 32 and 33 apply terms to calculate emissions reductions and removals, respectively, but these terms have units in their descriptions that do not align with the output of these equations. Please clarify the units of therms used in Equations 32-33. **Project Personnel Response**: Thank you for catching this error. In response to the public comments related to the separated calculation of emission reductions and removals, we had changed the multiplication with the area of sample unit i to the equations in sections 8.5.1-3. Therefore, the units in equations 32 and 33 are no longer tCO2e/unit area, but only tCO2e. We have corrected this in the parameters below the equations 32 and 33. **Auditor Response**: Thank you for the updates. Please note there are still inconsistencies in Equation 34 (ie, 'Areal average' in the parameter descriptions), and the bars above the terms in Equations 34-35 indicate that these are averages, which differ from their descriptions and symbolism in Equations 37-41. Equation 34 also seems to have multiple terms that are already accounted for in Equation 41, however we do realize delta_CH4_soil is treated different than the other components of delta_CH4 (from Eq 41) with its uncertainty deduction. Given this current structure for Equation 34, it is unclear where the output of Equation 41 is then used (the audit team could certainly be overlooking something). **Project Personnel Response 2**: We have removed the bars above the terms in equations 34-35 and corrected "areal average" to "total" in the respective parameter descriptions below the equations. Where pertinent, we added bars above terms and added the specification "areal average" in the parameter descriptions of several equations in section 8.2. We agree that equation 41 summarizing CH4 emissions was duplicative and have removed it to ensure consistency and avoid confusion. The same is valid for former equation 46 summarizing N2O emissions. Equations 37-48 (in sections 8.5.1-3.) have been now corrected and calculate the total emission reductions/removals as the result of multiplying the areal averages per sample unit multiplied by A - Area of the sample unit i. **Auditor Response 2**: Thank you for the corrections. The equation symbology and descriptions are consistent. This finding is closed. **Bearing on Material Misstatement or Conformance (M/C/NA):**

OBS 14 Dated 13 Jul 2022
Standard Reference: n/a
Document Reference: VM0042_v2.0_shared_v4.docx
Finding: The term "should" is used 16 times in version 1.0 of the methodology and 58 times in the revised version. The audit team notes that an increased number of the term "should" throughout the revised methodology may lead to confusion as to whether or not a section is to be understood as guidance or a requirement by the project proponent. Consider reducing the occurrence of this term.
Project Personnel Response: We have reviewed all instances of the term "should" and updated several to "must" to denote a requirement. However, most we have left as should to denote a recommendation but not a requirement. As we shared in our last call, Verra has internal guidance on the use of these terms as follows: 'The methodology must use key words “must,” “should,” and “may” appropriately. Consistent with best practice, “must” is to be used to indicate a firm requirement, “should” is to be used to indicate a (non-mandatory) recommendation, and “may” is to be used to indicate a permissible or allowable option. The term “shall” is reserved for VCS Program documents and is generally not appropriate for methodologies.' Our methodologies team is aware of the importance of socializing this guidance with both VVBs and PPs and is working to make this happen in the near future via a program update or other means.
Auditor Response: Thank you for providing additional context. This finding has been closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 15 Dated 8 Aug 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_shared_v7.docx
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

Equation 26 as a time component in the units for Fbsl,manure and Nex that do not seem to be consistent (one has days, another year).
Project Personnel Response: We have corrected the unit of Nex_l,P to "kg N deposited/head/year"
Auditor Response: Thank you. The units have been updated. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 16 Dated 9 Aug 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_shared_v7.docx
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

Specific to the comment response in row 190: "We have amended the threshold guidance for topography to read "dominant" instead of "average"; only the latter requires a resolution."

The audit team takes dominant to mean that when assigning slope classes to sample units and baseline control sites, one would use the 'mode', or the most frequent slope class found within the control site or sample unit, rather than averaging slope and assigning a class based upon that. The audit team is confused about how an average-derived slope class requires a resolution but dominant does not: slope values would be mapped based on elevation contours or a digital elevation model, which inherently has a resolution, regardless whether one then takes an average from slope values within the unit or takes the most frequent slope class within the unit.
Project Personnel Response: We agree with this response and that dominant can be interpreted as mode -- the most frequent slope class in the control site and sample unit. We have amended the text pertaining to Topography in the first row of Table 7 to the following: "Most frequent slope class must be the same in sample units and control sites (to be determined from a slope map or via a GIS slope analysis)." We will finalize additional guidance describing steps to determine the most frequent slope class in the coming days and add it to Appendix 5.
Auditor Response: This updated explanation is much clearer. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 17 Dated 16 Sep 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM42_8.6uncertainty_SCSshared.docx
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of transparency seems relevant to this finding: "disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence."

The audit team is seeking additional clarification from Terra Carbon about Section 8.6. The audit team's questions regarding units, model re-intialization, and monte carlo error propagation must be addressed before the audit process is completed.
Project Personnel Response:
Auditor Response: Verra and TerraCarbon have addressed all of the audit team's questions over email. This email chain (named 'Finding 11') has been archived on SCS's servers.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 18 Dated 13 Oct 2022
Standard Reference: N/A
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The audit team has concluded its review of the final drafts of VM0042 v2 and VMD0053 v2, but given all of the corrections, a thorough check of text formatting, typos, and other minor proof-reading should be conducted before its release. Verra has mentioned a proofreading step will be conducted after the conclusion of the audit that will not affect the content. Please also pay close attention to parameter tables in the Monitoring section: equation numbers are not referenced correctly and the tables are not in alphabetical order.
Project Personnel Response:
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 19 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

In Equation 47, deltaCH4_bb9,t is presented with units of tCO2e/unit area, which is incorrect. This finding is open given confusion with units with other equations found during techncial review. Please revise for clarity.
Project Personnel Response: We changed the unit for deltaCH4_bbi,t to tCO2e
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 20 Dated 13 Oct 2022
Standard Reference: N/A
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The final equation in section 8.6 is numbered Equation 66, but then the next equation becomes Equation 85. Also, equation references in the parameter tables need to be double-checked during the proofreading phase.
Project Personnel Response:
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 21 Dated 13 Oct 2022
Standard Reference: N/A
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: Appendix 6 has been placed in the middle of the document, which makes sense given it was copied from an external document along with the rest of the uncertainty section (Section 8.6), but this should be fixed in the proofreading phase.
Project Personnel Response:
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 22 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

In equation A6.1, the first term listed beneath the equation (s2_sampling,delta,t) has units of (tCO2e/unit area)^2, which does not appear entirely correct. This appendix is an example, and the equations in the main section (Section 8.6) all appear to have consistent and correct units for their terms. We request new information about the units for this equation.
Project Personnel Response: We corrected the units for s2_sampling,delta,t in Equation A6.1 to (t CO2e)^2.
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 23 Dated 10 Nov 2022
Standard Reference: VCS Methodology Requirements v4.2
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: In section 'Additionality' (note, section numbers need to be fixed throughout), the methodology states "The project proponent must demonstrate regulatory surplus in accordance with the rules and requirements regarding regulatory surplus set out in the latest version of the VCS Methodology Requirements (see VCS Methodology Requirements v4.1, Section 3.5.3)." The latest version of the methodology is now v4.2. Also, 'Step 1' in the Methodology Requirements is about Regulatory Surplus, while 'Step 1' in the VM0042 methodology starts at Implementation Barriers. This could be potentially confusing to readers familiar with Methodology Requirements, and regulatory surplus is an actual step in Additionality demonstration. The text does indicate this with "In addition to the demonstration of regulatory surplus, project proponent(s) must:..", but overall, this finding is an observation about clarity.
Project Personnel Response:
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 24 Dated 10 Nov 2022
Standard Reference: VCS Methodology Requirements v4.2
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: Section 3.5.4 of the Methodology Requirements, Version 4.2, for Implementation Barriers state:

"The project shall face one or more distinct barrier(s) compared with barriers faced by alternatives to the project:
1) Investment barrier: Project faces capital or investment return constraints that can be overcome by the additional revenues associated with the sale of GHG credits.
2) Technological barriers: Project faces technology-related barriers to its implementation.
3) Institutional barriers: Project faces financial (other than identified in investment barrier above), organizational, cultural or social barriers that the VCU revenue stream can help overcome."

During the technical review, it was not clear whether an investment barrier has been identified as part of the methodology. Please confirm and clarify if investment barriers are a facet of VM0042's Additionality demonstration.
Project Personnel Response: The methodology specifically points to Instituitional barriers in the Step 2 Implementation Barriers described in the VCS Methodology Requirements. Investments barriers are not included. We've clarified this in the Additionality section by making the following text additions:
"1. Identify institutional barriers that …"
"Step 1: Identify institutional barriers that …"
"The project proponent must determine whether there are cultural and/or social barriers (e.g., cultural practices and social norms, attitudes and beliefs) to the proposed change(s)..."
Auditor Response: Thank you for adding additional clarity about specific barriers. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 25 Dated 10 Nov 2022
Standard Reference: VCS Methodology Requirements v4.2
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: In the section 'Quantification of GHG Emission Reductions and Removals', the methodology states:

"Approaches to quantification of contributing sources for CO2, CH4 and N2O are listed in Table 5. For a given pool/GHG source, projects may set the baseline scenario equal to the performance benchmark where an applicable performance benchmark exists. Where more than one quantification approach is allowable for a given gas and source, more than one approach may be used provided that same approach is used for a given sample unit for both the project and baseline scenarios."

During the technical review, it was noted that:

1) "projects may set the baseline scenario equal to the performance benchmark where an applicable performance benchmark exists." is too vague to offer guidance on how an applicable performance benchmark would be appropriately chosen. And,

2) Section 2.2.3 of the Methodology Requirements state: "Methodologies may use any combination of project, performance or activity methods for determining additionality and the crediting baseline. However, methodologies shall provide only one method (i.e., a project method or performance method) for determining the crediting baseline (i.e., methodologies shall not provide the option of using either a project method or a performance method for the crediting baseline)."

Quantitative Approach 2 seems to utilize both a project method (utilization of baseline control sites) and performance method (performance benchmark) for crediting the baseline.

Please provide more information about performance benchmarks to resolve the above questions.

Project Personnel Response: To clarify allowed quantification approaches we've removed reference to the performance benchmark throughout the methodology: paragraph 2 pg 5; QA2 description section and last paragraph pg 6; last paragraph pg 21; QA2 description pg 23; QA2 introduction pg 25; paragraph 2 pg 62
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 26 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

In Section 'Baseline Emissions' under 'Quantitative Approach 2', the methodology states the following: "Where a Verra-approved applicable performance benchmark exists, the baseline may be set equal to the performance benchmark. Where an applicable performance benchmark does not exist, the baseline may be measured and remeasured directly at baseline control sites which are linked to sample units."

Overall, it is not explicit if this refers to baseline SOC stocks or SOC stocks and other variables, which may cause confusion. Please revise to improve clarity.
Project Personnel Response: This refers only to baseline SOC stocks. However, we removed all references to performance benchmarks including this one to clarify that under QA2 only baseline control sites are used.
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 27 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

For equation 5, the methodology states: "Note that under Quantification Approach 1, SOC stocks for model calibration and validation may be calculated using Equation 5 when data is not available as SOC stocks in t/ha or an equivalent unit."

The audit team notes that most processed-based SOC models require bulk density inputs, rather than just SOC stocks, and the methodology directs users to measure SOC stocks in the project area with the ESM approach. To initialize models for QA1, users may still need to sample bulk density in the project area if they use models that require bulk density inputs. Please revise to improve clarity.
Project Personnel Response: We have added new information to the text preceding Equation 5 to clarify that bulk density measurements should be taken following the recommended procedures where the model requires BD inputs for initialization. We also clarified that SOC stocks are for model initialization, not calibration/validation which is handled separately under VMD0053. The new text reads:

"Note that under Quantification Approach 1, SOC stocks for model initialization may be calculated using Equation 5 (if models use SOC stocks as an input rather than ingesting SOC content and bulk density values separately). Further, if models require bulk density inputs, such bulk density measurements must be taken following the approach described above in Measurements of Bulk Density. "
Auditor Response: The additional information provides more specific guidance for projects that use models that require bulk density inputs. Audit team confirms text in the response has been added. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 28 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

For equation 6, the f(SOC_bsl) term's definition states: "Modeled soil organic carbon stocks in the baseline scenario for sample unit i at the end of period t-1; tCO2e/unit area"

Given that models do not necessarily output SOC estimates at yearly time-steps, it makes sense why 't' in this case is defined by 'period' rather than 'year'; however, this stands in contrast with the term Year in the Definitions section, which states: "A time period t equal to the portion of the monitoring period contained within a single calendar year. May be less than 365 days." Please revise to ensure consistency.
Project Personnel Response: We have revised the f(SOC_bsl) term definition to state "…year t-1…" to bring it in line with the Year definition
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 29 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

For equation 10, the definition for EL_bsl states "Carbon dioxide emissions from liming in the baseline scenario for sample unit i in year t; tonne C". Generally, it is implied that this would be tonnes yr-1, like the units in other terms of Equation 10, but the units for this term are not explicitly tonnes yr-1, which may cause confusion. Please revise to ensure consistency.
Project Personnel Response: We believe that EL_bsl should be tCO2e and Mlimestone and Mdolomite should be tonnes and have changed the term definitions. The yr-1 should not be included as these are absolute amounts, not per time period t.
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 30 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

For equation 34, the definition for CCprj,l,t states: "Carbon content of manure applied as fertilizer on the project area from livestock type l in year t; fraction". The term 'fraction' appears to correspond to tC/t of manure, but this is not clear in the description. Please revise.
Project Personnel Response: We have revised the CCprj,l,t term unit to "t C/t manure"
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 31 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

For equation 34, the term 'project term' in the definition for value '0.12' is unclear. Please define 'project term' and confirm if this value will remain constant or if it will change over time.
Project Personnel Response: We have removed reference to "project term" as it's not a defined VCS term. 0.12 is a static fraction that remains constant over time. It represents the average proportion of manure-C remaining in soil as established in Maillard and Angers (2014).
Auditor Response: Thank you for clarifying the text by removing 'project term'. The audit team reviewed Maillard and Angers (2014) and agree with Verra about 0.12 being a static fraction. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 32 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

For equations 42 and 43, the parameters definitions list 'baseline carbon stock' for the project scenario and vice versa. Please revise.
Project Personnel Response: We have corrected these in Equations 42 and 43 so that baseline and project definitions align with the terms
Auditor Response: Confirmed. This finding can be closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 33 Dated 10 Nov 2022
Standard Reference: N/A
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: FSN (FON) definition states: "synthetic (organic) N fertilizer applied for sample unit...", but this could potentially imply that "N fertilizer" is the mass of a stand-alone fertilizer. Equations 20-21 should ensure that a reader will understand it is the mass of N within a particular fertilizer (ie, it is not just the fertilizer mass itself applied in Equation 19), but the audit team notes that more precise language may be needed in the FSN and FON term definitions to lessen confusion even further.
Project Personnel Response:
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 34 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principle of consistency seems relevant to this finding: "enable meaningful comparisons in GHG-related information".

The definition for N2O_Nfix is "Areal average nitrous oxide emissions due to the use of N-fixing species in the baseline scenario for sample unit i in year t; t CO2e/unit area", which was noted as confusing during the technical review, as it may imply nitrogen fixing plants are directly emitting N2O. The audit team notes Equation 5.25 from the Soil Enrichment Protocol is the same equation, but the description relates emissions calculated by this equation to crop residues, including those from N-fixing species (SEP also has 'Nfix' in this equation's output's symbol). Please clarify the above definition to avoid further confusion.
Project Personnel Response: We have clarified the defintion of N2O_nfix to "N2O emissions from crop residues due to the use of N-fixing species…" This is now inline with the SEP definition of the term.
Auditor Response: The audit team could not confirm this change made it into the methodology document. Finding remains open.
Project Personnel Response 2: There were two instances of N_fix definition that needed updating. Both are now updated -- see pg 45 Eq 17 and pg 48 Eq 25
Auditor Response 2: Audit team has confirmed the update. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 35 Dated 10 Nov 2022
Standard Reference: VCS Standard v4.3
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: The VCS standard mentions principles from ISO 14064-2:2006 that guide the application of the VCS program rules and requirements. Specifically, the principles of accuracy and relevance seems relevant to this finding: 1) "Reduce bias and uncertainties as far as is practical", and 2) "Select the GHG sources, GHG sinks, GHG reservoirs, data and methodologies appropriate to the needs of the intended user."

The conversion factor "44/28" has been included in several equations (example eq. 19) throughout the methodology and defined as "Ratio of molecular weight of N2O to molecular weight of N applied to convert N2O-N emissions to N2O emissions".

While this definition does describe the ratio of molecular weight of N2O to "molecular" weight of N, the use of "N" rather than "N2" suggests atomic weight instead. In addition, the audit team notes that the inclusion of the language "[...] applied to convert N2O-N emissios to N2O emissions" is confusing as "N2O-N" has not been defined in the methodology.

Please revise this conversion factor definition for the purpose of clarity.
Project Personnel Response: 44/28 is the molecular weight ratio of N2O/N2O-N. In IPCC and other authoritative references this ratio is always used to convert N mass into N2O mass.

N2O-N refers to the N mass in for example N containing fertilizers. Again there is precedent to use this annotation in IPCC and other references. See for example https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch11_Soils_N2O_CO2.pdf.

We have changed the 44/28 definition to "Molar mass ratio of N2O to N ..." in all four equations where the term is referenced to clarify.

Auditor Response: Thank you for your response. This finding is closed, however, the audit team notes that the use of "N" rather than "N2" suggests atomic weight/mass rather than molecular weight/mass remains an opportunity for improvement.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 36 Dated 10 Nov 2022
Standard Reference: Approved VCS Methodology VM0025, Version 1.0
Document Reference: VM0042_v2.0_SCS-Verra-shared_v12
Finding: Given the complexity of this methodology, the audit team notes that it might be helpful to include a conceptual route map in section 2 (similar to the one depicted in section 2 of VM0025), to provide the reader with an overview of steps that must be taken throughout the course of project development.
Project Personnel Response: Verra agrees and will consider including such a conceptual route map in a future iteration of VM42, perhaps in conjunction with Finding 43 below
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 37 Dated 28 Mar 2023
Standard Reference: VCS Methodology Requirements v4.2
Document Reference: VM0042_v2.0_v14_Verra review; Methodology Review Report_VM0042 - Post VVB_VM42_v2.0_21NOV22
Finding: The requirements state in section 2.2: "Methodologies may employ a modular approach in which a framework document provides the structure of the methodology and separate modules and/or tools are used to perform specific methodological tasks. Such methodologies shall use the VCS Methodology Template for the framework document and the VCS Module Template for the modules and tools."

Verra is aware that the template must be updated (finding 1 of the methodology review report). This serves as an observation, as the required template update cannot be completed until after the track changes are accepted. These track changes provide a necessary record of revisions from version 1, so they must be memorialized, which means the template cannot be updated at this stage. The audit team trusts Verra will update the methodology to the latest template after this review is complete.

Project Personnel Response: Verra will update with the latest template after this review
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 38 Dated 28 Mar 2023
Standard Reference: VCS Methodology Requirements v4.2
Document Reference: VM0042_v2.0_v14_Verra review; Methodology Review Report_VM0042 - Post VVB_VM42_v2.0_21NOV22
Finding: The requirements state in section 2.2: "Methodologies may employ a modular approach in which a framework document provides the structure of the methodology and separate modules and/or tools are used to perform specific methodological tasks. Such methodologies shall use the VCS Methodology Template for the framework document and the VCS Module Template for the modules and tools."

The audit team notes that some comments related to finding 2 in the methodology review report will be addressed after this review, given difficulties with track changes. The audit team trusts Verra will address remaining formatting and equation numbering issues brought up by these comments after this review is complete.
Project Personnel Response: Verra will address during the technical edit final step prior to publication
Auditor Response:
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 39 Dated 28 Mar 2023
Standard Reference: VCS Methodology Template v4.2
Document Reference: VM0042_v2.0_v14_Verra review
Finding: In section 5 for Table 2, the template states: "Describe the project boundary and identify the GHG sources, sinks and reservoirs (controlled by the project proponent, related to the project or affected by the project) included in or excluded from the project boundary."

The audit team understands the methodology should be updated to the new template version, and the above requirement is taken from the latest version of the template. Currently, there is no Justification/Explanation for Belowground Woody biomass in Table 2.
Project Personnel Response: We have updated Table 2 justification/explanation for belowground woody biomass to state "Belowground woody biomass may optionally be included where project activities significantly increase the pool compared to the baseline. "
Auditor Response: Thank you for the addition. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 40 Dated 28 Mar 2023
Standard Reference: VCS Methodology Requirements v4.2
Document Reference: VM0042_v2.0_v14_Verra review; Methodology Review Report_VM0042 - Post VVB_VM42_v2.0_21NOV22
Finding: Section 3.6.6 of the methodology requirements states: "Where ARR or IFM projects include harvesting, the loss of carbon due to harvesting shall be included in the quantification of project emissions. The maximum number of GHG credits available to projects shall not exceed the long-term average GHG benefit."

The developer's responded: "The developer has inserted a requirement to calculate the long-term average GHG benefit when woody biomass is harvested following the guidance in the latest version of the VCS Methodology Requirements, Section 3.6 and the latest version of the VCS Standard, Section 3.2. Clarifications have been added to Table 2, Table 5, Section 8.2.2 and Section 8.3."

The audit team has no issues with the above response, besides that we cannot locate clarifications about calculating the long-term average in Table 2.
Project Personnel Response: The requirement to follow the LTA approach is specified in Table 5, Section 8.2.2 and Section 8.3. Table 2 included a deletion referencing the CDM tool -- that is what we meant by including Table 2 in the list.
Auditor Response: Okay, this clarifies why Table 2 was mentioned in the findings response. The audit team agrees that Table 5, Section 8.2.2, and Section 8.3 are all relevant places to include the LTA clarification. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 41 Dated 28 Mar 2023
Standard Reference: VCS Methodology Requirements v4.2; VCS Methodology Requirements v4.3
Document Reference: VM0042_v2.0_v14_Verra review
Finding: Note: the assessment was concluded before methodology revisions 4.3 was in force (assessment report date of issue: 28 Nov 2022). However, methodology requirements v4.3 have updated section 2.4.4, which is relevant to this finding.

Point 3 in section 2.4.4 of the methodology requirements v4.3 state: "The methodology shall include procedures for calculation and application of a conservativeness deduction as follows:". We focus on two terms of the equation:

"Uncertainty: Half-width of the 90% confidence interval as a percentage of the mean estimate; %

$t_{\alpha=10\%}$: t-value for the two-sided 90% confidence interval, approximately 1.6449; dimensionless"

Equation 64 in the methodolgy outputs Uncertainty, defined as: "Half-width of the one standard deviation interval as a percentage of the mean of the emissions reduction or removal estimate for gas or pool • in verification period t; %". The equation involves dividing the square root of the "Variance estimate of mean reduction in gas/pool at time t" (a.k.a the standard deviation) into the 'mean estimated reduction in gas/pool at time t". The audit team sees how "one standard deviation as a percentage of the mean .... reduction or removal estimate..." is relevant to Uncertainty, given the setup of Equation 64.

However, the audit team needs more information about how the '$t_{\alpha=10\%}$' term was or was not incorporated into Equation 64 of VM0042 and how the 'half-width of on standard deviation interval as a percentage of the mean' (VM0042 Uncertainty) relates to 'Half-width of the 90% confidence interval as a percentage of the mean' (methodology requirements Uncertainty).

Project Personnel Response: Equation 64 is a simplified form of a similar set of equations where t-alpha10% is still explicitly used. See below.

〖UNC〗_((Δ•)̅,t)=(Uncertainty)/t_(α=0.1) × t_(α=0.666)

Uncertainty=(t_(α=0.1) × √(s_((Δ•)̅,t)^2))/(Δ•)̅_t × 100%

[Note: we can share a screenshot of this equation if needed to better understand the subscripts, Excel doesn't allow for proper equation formatting in these text boxes]

The 'Uncertainty' term is calculated as the half-width of the two-sided 90 percent confidence interval. But per the methodology guidance section 2.4.4, the discount factor (UNC-delta-dot) is based on dividing the uncertainty term by t-alpha-10%. So, the two t-alpha terms cancel out, hence the simplified form currently in VM0042. In the case of VM0042 there is a procedure for estimating the standard deviation of ERR estimates, from which you can estimate the 90% confidence interval using the standard deviation and t-alpha-10%. But that may not be the case across all methodologies on VCS, and the 90% confidence interval would perhaps need to be estimated through other means. Thus, Section 2.4.4 of the methodology guidance was written to be more generally applicable. If necessary, the above equation forms can be used instead of the current ones and would produce the same result.

Auditor Response: Thank you for the response: the t-alpha10% term does cancel out in the set-up underlying Equation 64, so this now makes sense. One additional comment is that the square root of n (sample size) is also used when calculating the confidence interval, which may not cancel out like the t-alpha10% term when relating the uncertainty discount equation in section 2.4.4 of Methodology Requirements to VM0042's Equation 64. However, not accounting for square-root(n) leads to a higher uncertainty deduction in VM0042's Equation 64, which is conservative. The developer is welcome to address this further, but the audit team is closing this finding for now.

Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 42 Dated 28 Mar 2023
Standard Reference: VCS Standard v4.4
Document Reference: VM0042_v2.0_v14_Verra review; VMD0053_v2.0_Verra review
Finding: The standard states for the principle of Consistency in section 2.2.1: "Enable meaningful comparisons in GHG-related information."

Appendix 6 of VM0042 discusses a useful example in how to calculate uncertainty when a stratified sampling strategy has been implemented (discussed for soil organic carbon sampling in section 8.2.1 of VM0042). Stratified random sampling is the recommended approach, as section 8.2.1.2 of VM0042 states: "Soil sampling must be conducted following the stratified random sampling strategy. Each sampling unit within the project area should be divided into homogenous strata based on factors influencing SOC stock distribution (see below) and random samples taken in each stratum."

For calculating sampling error, Appendix 6 follows the methodology's guidelines, and also defines strata as "3. Within-field strata, designed based on physical (e.g. topographic indices) or soil data (e.g. clay content)." However, VMD0053 states the following requirement in Box 1: "Documentation of all internal model parameter sets, including proof that parameter sets are defined at a resolution no finer than one climate zone or one nationally defined agricultural land region, depending on which is declared by the project (Section 5.2.2). If there is justification to claim an allowance for crop growth parameter sets to vary within climate zones/nationally defined agricultural land region (e.g., varying maturity groups), documentation must be provided for each zone/region where the crop will be simulated, specifying all crop growth parameter sets used in the zone/region and the rules used to select which parameter set is used for a given simulation."

If model parameters do not vary at resolutions smaller than agricultural land regions and climate zones, then model output would vary according to different agricultural management inputs, which differ at the field-level (note: Appendix 6 in VM0042 states: "since the field is the level at which improved management is typically implemented"). If 's2_sampling' (equation A6.1) is the "variance of emissions reductions in gas and pool", and Quantification Approach 1 is used, then the SOC model output would be used to calculate s2_sampling. However, based upon VMD0053 modeling requirements, the output would not vary across within-field strata, assuming management activity varies at the field-level (field is larger than strata in Appendix 6's example).

The audit team would like to confirm with the developers whether the previous paragraph accurately represents what would happen if a VMD0053 approved model is used to calculate sampling error (equation A6.1). It seems that the VM0042 sampling strata occur at a different resolution than zones/regions (or 'crop functional groups and practice categories') where internal parameter sets vary in VMD0053. Overall, this may be fine, but the sampling error variance as taken from model outputs when using Quant Approach 1 could potentially be lower than what the developer may be expecting. Also, it is currently unclear in the methodology how VMD0053's method grouping model parameters relates to and differs from VM0042's sampling strata.

Project Personnel Response: The requirements regarding model parameters in VMD0053 should be considered separately from sample design in stratification as described in VM0042. Model parameters generally represent soil biogeochemical processes such as microbial decomposition and do not include model inputs (e.g. soil carbon stocks, soil clay content, management activities, precipitation, temperature, etc.). Soil sampling in VM0042 is specifically meant to provide the data on soil carbon stocks to initialize those models. Different points within the same field that have different initial soil carbon stocks are then modeled separately, and you can reasonably expect that model results will differ at those different points even if model parameters are the same. As such, estimates of sampling error are non-zero and should represent the variance in modeled change, even if model parameters and management activities do not differ at those points.

Stratification and sample design guidance in VM0042 is intended to guide project developers in a manner that they collect a representative, unbiased sample of soil carbon data such that the estimate of that variance is accurate and statistically valid. Model parameter requirements in VMD0053 are intended to constrain model development in manner that models cannot be tuned to specific contexts in a manner that creates false precision. For example, if the model includes microbial decomposition parameters, those parameters should be the same in an area where project conditions are expected to be the same and cannot be arbitrarily substituted. If such parameters are expected to respond dynamically/non-linearly to environmental conditions (e.g. soil temperature), the model should include the necessary equations to do so.
Auditor Response: Thank you for this response. We do agree that VMD0053 model parameter assignment is serving a different purpose than VM0042's stratification for sampling, and the explanation provided by the developer is very clear and understandable overall.

This has helped us focus on the issue: is there explicit language in VM0042 that would guide a project developer/proponent to run the model at a point scale, or as stated in the response, "Different points within the same field that have different initial soil carbon stocks are then modeled separately,...?" What in the methodology currently and clearly prevents a developer from summarizing SOC for model initialization at the broader VMD0053 level and then running the model with the same initial SOC stock at different points within the more precise VM0042 stata/field-level? Our concern is that projects may initialize the model with summarized SOC stocks at a scale greater than the VM0042 strata/field-level (such as VMD0053's climate zones/nationally defined agricultural land region groupings), which would then cause model outputs to be the same/very similar across VM0042 strata. The audit team is concerned clear guidance is not available to prevent developers from doing this and that the language is not available for VVBs to easily raise findings during this scenario.
Project Personnel Response 2: We agree that this issue merits attention. It's our view that the methodology already specifies the requirement to run models on a point basis. However, to further clarify and underscore this, we added new text in blue highlights to sample unit definition (pg 8), intro paragraph Section 8.2.1 (pg 29), and last paragraph Section 8.2.1.2 (pg 31). Furthermore, we addressed this point in some of the comments raised during the public consultation -- see responses to comments in rows 163, 164 and 210 for further demonstration that the methodology changes in v2.0 address these concerns.

Auditor Response 2: The additions now help the audit team easily point to language explicitly stating modeling occurs at the point-level. From Section 8.2.1:

"Soil sampling and modeling should occur on a point or small plot (i.e., composite sample) basis to allow for accurate estimation of sampling error and its contribution to the uncertainty of credit estimates. Points should be allocated within the lowest level sample units using an acceptable approach." (underlines given by audit team for emphasis).

Thank you for the additional clarifications. This finding is closed.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 43 Dated 28 Mar 2023
Standard Reference:
Document Reference: VM0042_v2.0_v14_Verra review; Methodology Review Report_VM0042 - Post VVB_VM42_v2.0_21NOV22
Finding: The audit team reviewed Appendix 6 of VM0042 and could follow the examples that were provided. Also, the following is mentioned as a response to finding 11 in the methodology review report: "In addition, the developer will work on an exemplary database and a calculation tool based on the equations in the published version of VM0042 v2.0 for project proponents to be able to perform exemplary calculations themselves. Because this will be an extra product, the developer plans to publish it in Q2/Q3 2022 as an additional but separate resource after VM0042 v2.0 is published."

The audit team notes that establishing an example dataset along with a calculation tool would be very beneficial for project developers, VVBs, and other users to better understand the uncertainty quantification approach in section 8.6.
Project Personnel Response: Verra agrees and intends to pursue development of a tool such as this in the future
Auditor Response: Thank you.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 44 Dated 28 Mar 2023
Standard Reference:
Document Reference: VM0042_v2.0_v14_Verra review
Finding: Two different parameters named 'S' are provided in section 9.2 of VM0042: S for standard deviation of the difference in SOC stocks between time t0 and t1 (Equations 2-3) and S for the category 'manure management system' (Equation 13). They are applied in different equations, but a name adjustment to one of them may alleviate confusion in the future.
Project Personnel Response: Verra will address during the technical edit final step prior to publication
Auditor Response: Thank you.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 45 Dated 29 Mar 2023
Standard Reference: Methodology Template, v4.2
Document Reference: VM0042_v2.0_v14_Verra review
Finding: The header for section 8.2.1 has each word capitalized, but the subsections that follow only have the first word capitalized while remaining words are not. In addition, the font of footnotes 41 and 42 differs. In addition, the font color/style in the parameter tables for S and P does not match the body of the document.
Project Personnel Response: Verra will address during the technical edit final step prior to publication
Auditor Response: Thank you.
Bearing on Material Misstatement or Conformance (M/C/NA):

OBS 46 Dated 29 Mar 2023
Standard Reference: VCS Standard, v4.4
Document Reference: VM0042_v2.0_v14_Verra review
Finding: Section 2.2.1 of the VCS Standard, v4.4, defines the principle of Transparency as "Disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence."

The audit team notes that the order of steps listed in section 8.2.1.3 appears confusing. For example: • steps 2 and 7 sound conflicting / • the language in step 7 is not clear / • the language in step 6.b is unclear and appears to overlap with step 6.e / • step 8 appears to overlap with step 6.d and/or 6.e / • steps 10 and 11 appear to be more introductory.

Consider reducing the number of steps listed in this section or revising the language to improve clarity.
Project Personnel Response: Verra will address during the technical edit final step prior to publication
Auditor Response: Thank you.
Bearing on Material Misstatement or Conformance (M/C/NA):

NIR 47 Dated 30 Mar 2023
Standard Reference: VCS Standard, v4.4
Document Reference: VM0042_v2.0_v14_Verra review; Methodology Review Report_VM0042 - Post VVB_VM42_v2.0_21NOV22
Finding: According to section 2.2 (Principles) of the VCS Standard V4.4, the principle of completeness states that “Include all relevant GHG emissions and removals. Include all relevant information to support criteria and procedures”.

Section 8.4.3 (Accounting for Leakage from Productivity Declines) states that “to ensure leakage is not occurring, the following steps must be completed every 10 years”. Further, another paragraph of this section states that “With project productivity averages must be based on data collected in the previous 10 years.” The audit team requires additional information regarding the 10-year period and the reason for having a 10-year period. Furthermore, we request clarification on how to address leakage when the verification period for a project is less than 10 years.

In addition, section 8.4.3, step 3 states that if a productivity decline is limited to specific factors, those factors will become ineligible for future crediting. For example, if a 10% decline in corn yields occurs due to reduced fertilizer rates, then the reduction in fertilizer rates on corn fields will no longer be eligible for future crediting. The audit team notes that this example is based on multiple project activities in a given strata or a field. We request clarification on what happens when there is only one project activity (e.g., change in crop rotation) and productivity decline is greater than 5%, making that activity ineligible. Is there any potential for reversals associated with the ineligibility of that project activity?
Project Personnel Response: First, 10 years was chosen because it aligns with the baseline reassessment timeframe requirement in the VCS Standard which is also set to 10 years. However, we now note the importance of conducting leakage assessment more frequently and have changed the text to require leakage productivity assessment at each verification event starting at year 5 of project implementation (we don't require it sooner because we know that it can take 3 years or more for producers to transition to new practices and regain any productivity losses). Text changes made in first paragraph of Section 8.4.3 and last paragraph before Step 2 in same section.

Second, if after Step 3 the PP finds that there is only one project activity leading to productivity declines >5% for a given crop/livestock product, the project activity becomes ineligible, but it does not result in a reversal. This is the same as for two or more project activities that lead to a decline -- they are not treated differently. In theory the project activity(ies) will have led to ERRs which are explicitly not reversals, it's just that the methodology posits that these situations lead to (market) leakage and the penalty is that they become ineligible. In practice, we think it's highly unlikely that producers will tolerate sustained productivity declines 5+ years into a project, and if this does happen they are more likely to drop out of the project than remain and suffer low yields. In such cases, the VCS rules around activity instances leaving projects would come into effect.

Auditor Response: Thank you for updating the methodology and for the clarifications. The audit team agrees with this change. Given that the rules around project instances leaving the project are based in the standard (and not directly in the methodology), the audit team does not see a reason to keep this finding open. However, this is what the standard mentions about project instances leaving the project (in section 3.2.16): "When an instance leaves a grouped project or non-grouped project with multiple activity instances before the end of its 30-year longevity period, the project shall: 1) Conservatively assume a loss of all previously verified emission reductions and removals associated with the instance; or 2) Continue to monitor the instance for the remainder of the instance's 30-year longevity period following the monitoring requirements of the applied VCS methodology. If it can be demonstrated that the applied VCS methodology monitoring requirements cannot be followed (e.g., due to loss of access to the project area), a robust remote-sensing-based approach for the project types may be used to detect loss events, upon Verra approval. If a loss is identified, the size of the loss shall be quantified according to the applied methodology. Where this is not possible, the project shall conservatively assume a loss of all previously verified emission reductions and removals associated with the instance." As mentioned, these rules exist at the level of the standard and not VM0042 specifically, so this finding is closed. **Bearing on Material Misstatement or Conformance (M/C/NA):**