The Regenerative Standard

Regenerative Soil Organic Carbon Methodology for Rangeland, Grassland, Agricultural, and Conservation Lands

Version 1.1

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Open-Access

Applied Ecological Institute

Preface

The Regenerative Standard is a family of protocols authored by scientists focused on regeneration and restoration of ecosystems and their soil organic carbon, water resources, biodiversity, avoided crown fire emissions, peat land restoration. Version 1.1 is focused on soil organic carbon. Forthcoming modules will bring the broader tools for quantification of measure-to-measure, robust and reliable improvements in the ecosystem metrics for these focal areas.

Each module under The Regenerative Standard is an open-access, living document that has been developed from the body of science, from peer reviewed publications, and expertise under each topical area. The core technical foundations of Version 1.1 was written, tested, and published over decades by a distinguished soil carbon team of scientists and authors of books, technical papers, and synthesis publications on agricultural system climate mitigation, including Dr. Rattan Lal, Dr. John Kimble, Dr. Curtis Monger, Dr. Ron Follett, Dr. David Hammer, Dr. Charles Rice, and others, including the AEI staff, who also co-authored and tested Verra VM0021, Soil Carbon Quantification Methodology. Testing of VM0021 occurred across the America's by the AEI team and several of the original authors from renowned universities, USDA, ARS, NRCS, national laboratories, and other research institutions. A rigorous process of engagement by more than 35 of the worlds' soil carbon scientists independently reviewed and contributed to the refinements of the VM0021 protocol. Since publication, AEI and other partners have deployed the method across USA, Canada, Chile, Peru, Costa Rica, and many other locations around the world.

AEI and partners have implemented the VM0021 protocol on tens of millions of acres of agricultural land, rangeland, and restored conservation properties, and found it can produce repeated measurements of soil organic carbon that are robust, reliable and most importantly, can support the need for trusted measurements by parties involved in soil management, carbon markets, and natural resources decision making. The Verra VM0021 Soil Carbon Quantification Methodology has been strengthened, modernized, reorganized, and streamlined, resulting in Version 1.1 of **The Regenerative Standard**.

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Introduction

The Regenerative Standard "the Standard" describes how carbon drawdown credits can be generated through nature-based, atmospheric carbon drawdown and soil carbon storage related to conservation, ecosystem restoration, and agricultural projects, as well as other projects where the management of soils directly or indirectly through management of hydrology, livestock, fertility, and plant diversity and productivity can improve soils, reduce erosion and promote soil carbon storage.

The Standard ensures the delivery of high-quality, carbon removal credits, based on rigorous soil sampling, laboratory analysis, and independent third-party verification. To meet these objectives, the Standard combines best practices, rigor, and approaches from several existing standards, including Verra, ISO, Climate Action Reserve, and BCarbon, with allowances for proven, technical, and scientific innovation to produce high-quality carbon removal credits. It is based on guidance provided in the IPCC 2003 Good Practice Guidance for Land Use, Land-Use Change, and Forestry and allows for the addition of several modules to document additionality and permanence variations as initially described in BCarbon.

Many standards describe how carbon credits from nature-based soil carbon storage can be generated. However, few standards emphasize carbon removal credit quality while also making it easier for landowners to participate in nature-based carbon storage opportunities at scale. The Standard is designed to make it easier to initiate and participate in soil carbon storage project opportunities by removing typical participation barriers.

This Standard does not focus on any particular or specific activity change and allows Land Stewards to participate and innovate activities to store and sequester additional soil carbon. These two guideposts simplify who can be involved in carbon programs. For example, undocumented, unaccounted, imported carbon materials such compost, manure, mulches, lime, or earthmoving that moves carbon (soils) around the landscape, are not allowed unless accounted for in the Project Plan.

The Standard is based on technical procedures detailed herein, in which the farmers, ranchers, or conservationists ("Land Stewards") are focused on conservation, restoration, and regeneration on grazing, agricultural, or conservation lands. The Standard also offers guidance to allow Project Proponents to address and document additionality and permanence requirements in innovative ways to increase Land Steward participation.

The Standard currently applies only to carbon removal credits and does not include any benefits from "avoided emissions" credits. Atmospheric carbon storage is determined upon measured soil organic carbon (SOC), or measure-to-measure, increase, between T0 (***Time Zero***—the initial sample date at the start of the project) and T1 (***Time One***—the subsequent sample date on average five to seven years later).

One-meter-deep (1m) soil sampling, analysis, and the generation of high-quality data is the foundation of the Standard, along with optional methods to estimate the carbon stocks and carbon stock changes over time (e.g., the rate of carbon accrual) that allow for revenue to Land Stewards in the interim years before T1 measurements are completed. This ensures Land Stewards can meet the financial challenges of implementing new management practices and therefore the quality of the credits registered through the Standard.

Forward-looking assessments for interim crediting are required to be followed by 1-meter-deep, direct soil sampling to establish the T0 baseline soil organic carbon, with subsequent 1-meter-deep sampling collected within an average of five to seven years to true-up the project soil carbon sequestration between the baseline T0 and final T1 soil sampling. Forward assessments used as the basis for interim crediting are required to be substantiated with actual field sampling results either reported in published and/or peer reviewed literature or measured by the Project Proponent using approved methods and technologies.

This document lays out the steps required to fulfill estimation, quantification, and application requirements for projects wishing to register credits under The Regenerative Registry.[1] The Standard calls on the associated modules for specific techniques and options for estimating, projecting, and measuring the GHG impacts of changes in specific pools and emissions.

Supporting References

2.1. VM0026 *Methodology for Sustainable Grassland Management (SGM), v1.1*
2.2. VM0042 *Methodology for Improved Agricultural Land Management, v2.0*
2.3. VMD0018 *Methods to Determine Stratification, v1.0*
2.4. VMD0019 *Methods to Project Future Conditions, v1.0*
2.5. VMD0020 *Methods to Determine the Project Boundary, v1.0*
2.6. VMD0021 *Estimation of Stocks in the Soil Carbon Pool, v1.0*
2.7. VMD0022 *Estimation of Carbon Stocks in Living Plant Biomass, v1.0*
2.8. VMD0023 *Estimation of Carbon Stocks in the Litter Pool, v1.0*
2.9. VMD0024 *Estimation of Carbon Stocks in the Dead Wood Pool, v1.0*
2.10. VMD0025 *Estimation of Woody Biomass Harvesting and Utilization, v1.0*
2.11. VMD0027 *Estimation of Domesticated Animal Populations, v1.0*
2.12. VMD0026 *Estimation of Carbon Stocks in the Long Lived Wood Products Pool, v1.0*
2.13. VMD0028 *Estimation of Emissions from Domesticated Animals, v1.0*
2.14. VMD0029 *Estimation of Emissions of Non-CO2 GHG from Soils, v1.1*
2.15. VMD0030 *Estimation of Emissions from Power Equipment, v1.0*
2.16. VMD0031 *Estimation of Emissions from Burning, v1.0*
2.17. VMD0032 *Estimation of Emissions from Activity-Shifting Leakage, v1.0*
2.18. VMD0033 *Estimation of Emissions from Market Leakage, v1.0*
2.19. VMD0034 *Methods for Developing a Monitoring Plan, v1.0*

[1] *The Regenerative Registry*[tm] is an independently developed, operated, and curated ledger that has been designed to work with regenerative, restorative, and conservation projects, managed by an independent organization and board of advisors.

2.20. VMD0035 *Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities, v1.0*
2.21. VT0001 *Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0*
2.22. BCarbon Soil Carbon Protocol Version 2
2.23. CAR *Soil Enrichment Protocol, Version 1.0*
2.24. ISO 14064 - *Part 2 Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements*
2.25. ISO 14064 - *Part 3 Specification with guidance for the verification and validation of greenhouse gas statements*
2.26. AFOLU Non-Permanence Risk Tool
2.27. VCS Validation and Verification Manual, v3.2
2.28. VCS Program Definitions, v4.2
2.29. VCS Risk Report Calculation Tool v4.0
2.30. VCS Standard v4.2
2.31. CDM AR-ACM0003 Afforestation and reforestation of lands except wetlands --- Version 2.

Definitions

Activity Shifting Leakage: Activities that are moved by local actors from within the project area to outside due to the project, and which result in losses of carbon in pools outside the project area.

Additionality: A criterion to determine whether emission removals and reductions are real, measurable, and in addition to what would have happened in the absence of the project.

Agent: A person or organization undertaking actions that impact the management of carbon pools and emissions.

Baseline: The total amount of carbon within the project area in absence of the project.

Baseline Scenario: The most likely sequence of events and actions which would be expected to occur within the project area in the absence of the project.

Buffer: A percentage of project carbon credits reserved by the Regenerative Registry to ensure that interim carbon credits in the forward assessment are not overstated, and a project shortfall can be addressed with the buffer.

Conservative: Tending to err on the side of reduced creditable carbon in cases where uncertainty exists as to the correct value of variables, or relationships among variables.

Coarse Fragments: Pieces of rock or cemented soils > 2mm in diameter, and therefore too large to pass through the screen used in the laboratory prior to laboratory analyses.

Crediting Period: The time period for which GHG emission reductions or removals generated by the project are eligible for issuance as Regen Credits, not including any potential crediting period renewals. Also referred to as the "Project Crediting Period."

Directly Attributable: The change or effect occurs as a result of a chain of causal events linking the change or effect to an event, or to the actions of an agent. Each of the causal events or conditions in the chain must be primarily and directly caused by the previous event in the chain. Analysis of the linkages in the chain should show that for each one, the previous event is at least 75% responsible for the next event. For this reason, the relationship between an event, or the actions of an agent, and the directly attributable effect, typically consists of not more than a few causal linkages.

Election of Option: Project Proponent selection of definitional additionality and permanence requirements under the Standard.

Ex-ante: Before the fact. Projection of values or conditions in the future.

Ex-post: After the fact. Estimation of values or conditions in the present or past.

Land Management Activity Change: Any change in crop, tillage, fertilizer, land drainage/water management, crop litter, livestock use (mass, density, stocking rate, rest-rotation), species or composition, amendment, invasive plant management technique changes (tillage, prescribed burning, herbicide or formulation, application method, flame or thermal management, smother-cropping, etc.), equipment or technical deployment, land-tenure and operations and staffing, are all accepted by definition as contributing to or resulting in a land management activity change.

Long-lived wood products: Products produced from harvested timber which is expected to persist and sequester carbon for an extended period of time – typically 100 years, unless there is a specific reason for using a different time period.

Monitoring event: The time at which monitoring of all of the relevant variables is undertaken, to determine the net change in atmospheric carbon attributable to the project.

Monitoring period: The time period specified in a monitoring report during which GHG emission removals were generated by the project.

Monitoring plan: Plan in which a monitoring schedule and methods will be documented.

Planned: Changes in the value of the variable are under the control of identified agents who are independent of the Project Proponent.

Project Boundary: The area or areas of land on which the Project Proponent will undertake the project activities.

Project Proponent: The individual or organization that has overall control and responsibility for the project, or an individual or organization that together with others, each of which is also a Project Proponent, has overall control or responsibility for the project. The entity(s) that can demonstrate project ownership in respect of the project.

Project Scenario: The resulting soil carbon pools over the project time period due to the project activity. The soil organic carbon stocks present at the next scheduled soil measurement date, calculated according to the technical procedures and methods described below. For example, a project that plans to conduct soil measurements every five years, the initial (T0) measurements are taken in year zero and the project scenario measurements are taken in years five (T1), ten (T2), fifteen (T3), and so on.

Project Start Date: The first field sampling date for any Project, also annotated as Time Zero or “T0.”

Significant: A pool or source is significant if it does not meet the criteria for being deemed de minimis. Specific carbon pools and GHG sources, including carbon pools and GHG sources that cause project and leakage emissions, may be deemed de minimis and do not have to be accounted for if together the omitted decrease in carbon stocks (in carbon pools) or increase in GHG emissions (from GHG sources) amounts to less than five percent of the total GHG benefit generated by the project.

Stratification: The division of an area into sub-units (strata) which are relatively homogenous for the value of the variable on which the stratification is based, which are repeatable in the landscape, and could reasonably be expected to be similarly identified and classified by different people.

Statum: An area of land within which the value of a variable, and the processes leading to a change in that variable, are relatively homogenous.

Uncertainty: Uncertainty is a parameter associated with the result of a measurement that characterizes the dispersion of the values that could be reasonably attributed to the measured amount

Validation: The independent assessment of the project by a validation/verification body that determines whether the project conforms with the Standard’s rules and evaluates the reasonableness of assumptions, limitations, and methods that support a claim about the outcome of future activities

Validation/Verification Body (VVB): An organization qualified to act as a validation/verification body in respect of providing validation and/or verification services in accordance with the Standard’s rules.

Verification Date: A date, at which an independent verifier audits the results of monitoring.

Verification: The independent assessment by a validation/verification body of the GHG emission reductions and removals that have occurred as a result of the project during the monitoring period. The assessment is submitted to a registry that is independent from the Project Proponent and the verifier and is based on historical data and information to determine whether the claim is materially correct, conforms with specified requirements, and is conducted in accordance with the Standard's rules.

Woody Biomass: Biomass that exists primarily in the form of lignified tissues, such as that of shrubs and trees. Typically accounting of woody biomass includes the non-woody parts (leaves, etc.) of plants that contain woody biomass.

Project Framework

Project Proponent and Verifiers interested in working with the Regenerative Standard should consult with the potential carbon registry, such as the Regenerative Registry, for Project Proponent and Verifier pre-qualification processes, and requirements.

The project crediting period is at least five (5) years with a minimum 10-year storage requirement for each credit year and can be renewed an unlimited number of times, as supported by measure-to-measure improvements on the land. This project period minimum aims to incentivize more land regeneration from Land Stewards resistant to traditional 30- to 100-year requirements but who want to engage in ecologically valuable projects.

The project start date is defined as the date of commencement of the initial (T0) set of baseline soil measurements. The project start date can be up to five (5) years prior to the project registration date if the T0 sampling measurements are consistent with this Standard.

Credit yield shall be calculated as the project scenario; the soil carbon measured in the project area after conversion to regenerative practices minus the soil carbon measured at the time of the baseline sampling.

Project registration and validation is required of an approved Project Proponent by the submittal of a Project Idea Note to an approved verifier and The Regenerative Registry for any project proposed under this Standard.

For project qualification and the issuance of credits, both interim and final, the Standard requires the Project Proponent to complete the following tasks (Figure 1) each of which is comprised of a number of sub-tasks:

- Task 1: Project Overview - Identification and Eligibility of Project Activity
- Task 2: Measurement and Reporting Plan
- Task 3: Interim Crediting Assessment (optional)

- Task 4: Project Application Submission
- Task 5: Verification
- Task 6: Registration

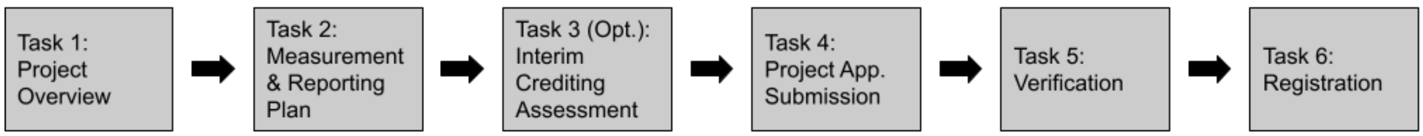


Figure 1. Overview of project framework and documentation

Project Requirements

By completing the Standard's Project Application Template, a Project Proponent shall submit responses to the following:

Task 1. Project Overview - Identification and Eligibility of Project Activity

A Project Proponent should summarize the land management activities, how data is collected, literature sources that support the project, planned project activities, and any deviations or additions to the methodologies detailed and/or referenced under the Regenerative Standard.

Task 1.1. Data confidentiality statement

A Project Proponent should list any data that is to remain confidential between the Project Proponent, Verifier, and Registry. Such data includes personal data, addresses, data related to the project properties, historical, current, and future land management techniques, livestock information, ecological assessment data, etc.

Task 1.2. Physical Address of the Properties Submitted for Certification

A Project Proponent should describe the location of the project property with an address, latitude, longitude, total land area (e.g. acres, hectares, etc.), creditable land area, and verification of ownership (e.g. tax assessors' data and vesting deed(s)).

Task 1.3. Description of Land Management Activity

A Project Proponent should document and describe landowners' historical, current, and planned future land management practices, as applicable:

- type(s) of livestock
- stocking rates
- number and size of paddocks
- average rest and recovery periods
- average rotation frequency
- forage information
- mowing/bush hog
- bale grazing
- chemical usage
- compost usage
- notable wildlife/plants
- crops/crop types
- burning
- cover crop activities
- other relevant and notable agricultural practices

For grazing projects, land management should be assessed semi-qualitatively using multiple factors that govern success in soil restoration using grazing, including:

- land management style
- number of years of regenerative or holistic management practice
- # of paddocks
- average paddock size
- stocking density
- stocking numbers
- rotational frequency
- livestock and wildlife diversity
- grazing plan documentation
- specific individual holistic practices impacting soil health

This qualitative assessment may determine how closely the reported grazing practices can correlate to a high, medium, or low impact to the site conservative estimate of soil organic carbon accrual potential.

Task 1.4. Project Eligibility

This Standard is intended for use by projects on agricultural, grazing, and other regenerative, restorative practices or conservation lands undergoing Land Use Activity Change. Planned and/or implemented land management practices must be incorporated in the project plan to ensure that the project will increase the actual measured storage of soil organic carbon within the boundaries of the project.

A Project Proponent should use this section to describe how a project meets either the mandatory or optional project eligibility criteria outlined below.

Task 1.4.1. Mandatory Eligibility Conditions

All projects using this methodology must meet the following mandatory conditions:

- **Agricultural Land Management**
  Activities that increase carbon stocks in soils and woody biomass and/or decrease CO_2, N_2O and/or CH_4 emissions from soils on croplands and/or grasslands.

  - Improved Cropland Management (ICM)
  - Improved Grassland Management (IGM)

- Cropland and Grassland Land-use Conversions (CGLC)

- **Grassland or Cropland**
As of the project start date all of the project areas consist of grasslands or croplands. Crops may include woody species grown for food products, fuel products, or timber, providing that the densities of these crops do not meet the requirements for definition of these lands as forest lands.

- **Non-forest, Non-wetland, Non-peatlands**
The project area *must* exclude and must not have been cleared of in the past 10 years forest, wetlands, or peatlands defined as:

    - Forest: Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO, or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height, and level of crown cover, and may include mature, secondary, degraded, and wetland forests.
    - Wetlands: Land that is inundated or saturated by water for all or part of the year (e.g., peatland), at such frequency and duration that under natural conditions they support organisms adapted to poorly aerated and/or saturated soil. Wetlands (including peatlands) cut across the different AFOLU categories. Project activities may be specific to wetlands or may be combined with other AFOLU activities.
    - Peatlands: An area with a layer of naturally accumulated organic material (peat) that meets an internationally accepted threshold (e.g., host country, FAO, or IPCC) for the depth of the peat layer and the percentage of organic material composition. Peat originates because of water saturation. Peat soil is either saturated with water for long periods or artificially drained. Common names for peatland include mire, bog, fen, moor, muskeg, pocosin, and peat swamp (forest).

- **Displaced**
The only baseline activities that could be displaced by the project activities are grazing and fodder production, crop production, and timber production.

- **Soil Water Regime Changes**
Project activities *must not* include changes in surface and shallow (<1m) soil water regimes through flood irrigation, drainage, or other significant anthropogenic changes in the groundwater table.

- **Termites**
The project activity *must not* cause a significant change in termite populations, as compared with the baseline scenario.

Task 1.4.2. Optional Eligibility Criteria

The following conditions do not need to be met to utilize the methodology. However, each of these conditions allows the simplification of the methodology through the elimination of the requirement for the completion of specific tasks.

Consequence if met: Project Proponent ***is not*** required to complete *Task 2.3.7 Projection of future emissions of N2O or CH4 from the soils within the project area* and *Task 2.3.26 Monitoring and estimation of soil emissions of N2O or CH4 from within the project area* described in herein.

- **Degrading Baseline Scenario**
  The activities and agents which have caused the degradation of the croplands, grasslands, rangelands, and conservation lands are expected to continue to impact the area in the absence of the project activity. On that basis, it can be demonstrated that the total carbon content of the soil organic (and often inorganic) carbon pools within the project area is highly unlikely to increase under the baseline scenario during the project crediting period.

  Consequence if met: Project Proponent may conservatively assume that soil carbon content for all future dates under the baseline scenario shall be accounted as equal to the current soil carbon content, subject to re-assessment at true-up (T1, T2, etc.), as required under the Regenerative Standard.

- **No Change in Above and Below-Ground Biomass**
  Changes in above and below-ground living biomass pools within the project area can be shown to be insignificant under either the baseline or project scenarios.

  Consequence if met: Project Proponent *is not* required to complete *Task 2.2.1 Project area stratification for biomass*, *Task 2.2.2 Estimation of the carbon content of current above-ground woody and non-woody biomass and below-ground living biomass pools*, *Task 2.2.3 Projection of future biomass pools under the baseline scenario*, and *Task 2.4.2 Estimation of the carbon content of above-ground woody and non-woody and below-ground living biomass pools* described in herein.

- **No Change in Woody Biomass**
  Woody biomass is found within the project area, but amounts of current and projected wood harvest under the baseline and project scenarios are not significant.

  Consequence if met: Project Proponent *is not* required to complete *Task 2.4.3 Estimation of the amount of wood harvest from within the project area used for the production of long-lived wood products*, and *Task 2.4.4 Long-lived wood products* described in herein.

- **No Change in Fertilizer, Manure, N-fixing Species. Flooding**
  No significant change is expected to occur in the amounts or locations of any of the following conditions or activities between the baseline scenario and the project scenario:

  - Amount or location of application of organic or inorganic fertilizers.
  - Amount or location of domesticated animal grazing and deposition of manure or urine.
  - Amount or location of areas subject to flooding, and duration of flooding.

- Amount or location of nitrogen-fixing species.

Task 1.5. Project Boundary

A Project Proponent should identify the project boundary using the module VMD0020 *Methods to Determine Project Boundary*, noting exclusion areas, project start date, and project end date. The Project Proponent should complete the following task to identify the project boundary:

Task 1.5.1. Identification of project boundary

Requirement	Required for all projects.
Goal	To determine the project boundary for baseline scenario and additionality purposes.
Method	Determine the project boundary using the module VMD0020 *Methods to Determine Project Boundary*
Comments	

Task 1.6. Baseline Scenario

A Project Proponent should follow the Baseline Scenario instructions in accordance with the above *Task 1.4 Project Eligibility*. For any project that meets the conditions in *Task 1.4.2 Optional Eligibility Criteria* above, a Project Proponent should describe which criteria are met and list any credible references, as applicable.

The **baseline scenario**, the expected soil carbon within the project area resulting from business-as-usual management practices, shall for the purposes of this Standard be assumed to be constant during the project period.

The Standard utilizes the requirement of 1-meter deep soil sampling (or to refusal) to establish a project T0 baseline. Using this actual measurement and assuming a static baseline scenario is more conservative since only atmospheric CO2 removals, (rather than both removals and emission reductions), are quantified for additionality and crediting in this standard. Emission reductions might realistically occur, but due to the challenges and uncertainties of characterizing dynamically decreasing baselines, a much more conservative short-term approach minimizes these uncertainties by simply assuming a static baseline, or no change in soil carbon during the project period.

While a truly static baseline is possible, it is a particularly safe assumption when the baseline is otherwise likely to be decreasing in the absence of the project activity (as per *Task 1.4.2 Optional Eligibility Criteria* described in the previous section), as for projects involving adaptive livestock management or regenerative/restorative land management practices, for which alternative non-adaptive management practices or traditional row crop practices are likely to result in soil carbon losses due to soil degradation stemming from the deleterious consequences of forage consumption exceeding forage production (Sanderson et al. 2020) or from the lack of cover cropping/overproduction of cash crops.

Although the more conservative approach, a stable baseline must still be evidenced through demonstration of minimal water and wind-borne soil erosion (e.g. UNFCCC/CCNUCC - Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities). Such evidence can be provided by measured percent bare soil, perennial vegetation plant cover, and/or invasive and non-native plant species percent cover using on-ground sampling and/or multi-temporal aerial photography or remote sensing which demonstrate the establishment of persistent vegetation cover for consecutive years, particularly following management conversion in degraded lands where re-establishment of healthy, diverse and productive plant communities can take many years. Ultimately, the baseline is established with a site visit evaluating strata, vegetation, and sampling to 1-meter deep and the results of the sampling event and other data collected during T0 represent the "best estimate" of the actual site baseline.

Currently, the Regenerative Standard only allows static baseline scenarios.

Task 1.7. Additionality

Any project must demonstrate additionality by passing one of the following tests. Project Proponents must note which of the following additionality definitions a project is using in the Project Plan. Option One is based on Verra's definition of additionality. Option Two is based on BCarbon's definition of additionality and is more applicable to the land use of agriculture and grazing transitioning to regenerative and restorative practices.

Per reference ISO 14064-2: A.3.3 GHG emission reductions/removal enhancements caused by a GHG project may also be described as being additional if these are greater in quantity than the volume of GHG emission reductions/removal enhancements that would have occurred in the absence of the project.

Option 1: Traditional Additionality

The project is deemed additional if it passes the four-step additionality test as summarized below and described in detail in Verra's VT0001 *Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0*

Step 1. Identification of alternative land use scenarios to the AFOLU project activity;
Step 2. Investment analysis to determine that the proposed project activity is not the most economically or financially attractive of the identified land use scenarios; or
Step 3. Barriers analysis; and
Step 4. Common practice analysis.

Option 2: Actual, Field-Measured Additionality

The project is deemed additional if it demonstrates increased soil carbon stocks based on at least two sets of measurements taken in accordance with this Standard and subject to quantitative verification. The carbon added to the soil carbon pool is additional in the sense that it has been added, per the Project Plan, subsequent to the project start date and the first set of soil measurements, or as a default period five years prior (but may be extended based on justifications[2] provided in the Project Plan Document (PDD), under the same regenerative management activity. If, for whatever reason, the baseline is found to change such that there is no measurable increase in soil carbon, then there is no additionality and no issuable credits. Atmospheric carbon drawdown and storage is considered additional when the following two conditions are met:

Condition 1

An absolute increase in soil carbon can be measured, using a static baseline. This means the absolute carbon storage in a certain time period (T0 to T1) is based on the difference in soil carbon content at T1 minus the soil carbon content at T0. No change or a decrease in SOC between T0 and T1 will result in no issuable soil carbon credits.

Condition 2

Land Stewards make continuous land management decisions and implement continuous enhancements of regenerative land management practices. Project Proponents can demonstrate (via a contractual agreement and/or other supporting documentation such as a satellite-monitored grazing management tool) that continuous implementation of additional regenerative practices is occurring.

Task 1.8. Permanence

The project must be subject to a contractual commitment by the landowner/legal custodian to maintain any carbon accrued and stored in the soil carbon pool for a minimum of ten (10) years beyond the crediting year, and this 10-year contractual commitment must renew annually during the crediting period. In other words, the minimum soil disturbance commitment must be held on the project site for ten years following the last issuance of soil carbon credits. A detailed report of contractual time commitment and baseline soil carbon stocks at the project site must be prepared as part of the PDD, which must also address a required surety need such as a buffer pool of “retained” credits (see below).

Once that minimum 10-year commitment condition is met, the number of carbon removal credits withheld in a buffer pool is determined by one of the following methods:

[2] Such as measure-to-measure projects or demonstrations conducted with intentionality for research.

Option 1: Retainage

No less than 10% of the credits issued from the project will be withheld in a buffer account and released at the end of the storage period if no shortfall during the crediting period occurs during the storage period.

Option 2: Pooling

The number of buffer credits to be contributed to the Agriculture, Forestry and Other Land Use (AFOLU) pooled buffer account can be determined by applying the latest version of the VCS AFOLU Non-Permanence Risk Tool. Pooling only applies to contracts with a greater than 25-year commitment.

Option 3: Insurance

Insurance programs that provide an alternative to, or added secure compensation for concern over permanence, can be invoked by election of the Project Proponent in coordination with The Regenerative Registry to supplement, or supplant Option 1 and 2, to ensure the minimum 10-year commitment condition is met.

An annual verification step is required to ensure reasonable progress to estimated accruals, and the Project Proponent may update the Forward Assessment to reduce the issuance of interim credits based on site conditions or land management actions. The Buffer shall serve as the vehicle to ensure that reversals on a project can be addressed.

Task 1.9. Credit Release

The Project Proponent may select a credit release after each sampling event (e.g. after T0) or, if completing the optional *Task 3. Interim Crediting Assessment*, an annual release based on verified carbon stock estimates and adjusted by the T1 or subsequent-year measurement under Verra's VMD0021 *Estimation of Stocks in the Soil Carbon Pool, v1.0* requirements. Annual releases will be certified with the submittal of the Verification Checklist, as detailed in *Task 5. Verification*, verifying that the assumptions in the original application continue as represented. It is critical that credit releases occur in a timely manner to ensure cash flow to landowners and Land Stewards, and availability of registry credits to carbon credit purchasers. See *Task 6. Registration* for more details.

Task 1.10. Contractual Commitment

A Project Proponent must describe the contractual commitment with the Land Steward and/or landowner and enforceable provisions within the contract to address topics such as non-disturbance and permanence terms, land ownership changes, double accounting prevention mechanisms, and how the Project Proponent intends to monitor contractual commitments. A Project Proponent should provide the executed contract with the landowner as proof of meeting contractual eligibility.

Task 2. Measurement and Reporting

A Project Proponent must describe the stratification and sample allocation, methods for quantifying soil carbon pools and GHG emissions for the baseline and project scenarios including laboratory and statistical analysis, and reporting.

This Standard is focused on carbon removal credits to be generated associated with increases in soil carbon stocks, provided those stocks are rigorously quantified using the procedures described above. No credit is currently awarded with Version 1.1 of this Standard for reductions in GHGs associated with reduced agricultural inputs such as fertilizers and pesticides, reduced usage of powered farm equipment, or reduced emissions from livestock or manure operations. This makes this Standard inherently conservative in terms of the number of credits issued.

However, the Standard requires a monitoring plan for leakage that offers a reasonable and sufficient assurance that the net storage of atmospheric carbon in the soil carbon pool has not been negatively impacted by increases in GHG emissions within the project area or elsewhere outside the project area resulting from the implementation of a proposed project.

Changes in carbon pools and GHG emissions related to both project activities and leakage for the project scenario shall be addressed with a two-step process:

1. A qualitative evaluation to determine if the Project Proponent can establish with reasonable and sufficient assurance that the carbon pools and GHG emissions are likely to remain unchanged during the project period (i.e. they are not expected to change by 10% on a time-weighted basis) or the potential changes are transient in nature.

2. If the changes in carbon pools and GHG emissions are not likely to be significant (i.e. less than 10% change expected) and can for all practical purposes be considered *de minimis*, a Project Proponent does not need to quantify these pools and emissions and their value may be accounted as zero for the purposes of carbon crediting.

Otherwise, the magnitude of the changes in carbon pools and GHG emissions must be quantified within the uncertainty limits following validated protocols described below, with zero reductions to carbon crediting if any change is determined *de minimis* based on application of the CDM A/R methodological *Tool for testing significance of GHG emissions in A/R CDM project activities*.

Use the decision support in Table 1, for reasonable and sufficient assurance that carbon pools and GHG emissions are not changing for the project scenario, the Project Proponent is required to determine, at a minimum, the likelihood of the project activities leading to an increase in GHG emissions either within the project area or outside the project area based on consideration of the most important GHG emissions related to operations in agricultural, grazing, and restoration and conservation lands:

Table 1. Likelihood of project activities leading to an increase in GHG emissions during the project period

Source	**Likely to increase**	**Likely to stay the same**	**Likely to decrease**	**Don't know**
Amount of animals/livestock				
Enteric fermentation				
Manure deposition				
Use of fertilizer				
Use of pesticides				
Use of hydrocarbon fuel for gas and electricity				
Use of hydrocarbon fuel for irrigation				
Export of hay				
Woody biomass (above & belowground)				
Non-woody biomass (above & belowground)				
Import of animal feed				
Export of animals and animal products				
Burning of biomass				
Use of nitrogen-fixing species				

For example, if a decline in agricultural production or significant wood harvesting is likely to occur that would change the project baseline scenario by more than 10%, *Task 2.6.1 Monitoring and estimation of emissions* *from grazing, fodder and agricultural production displacement* need to be completed since a change in carbon stocks or GHG emissions might have occurred as a result of the project. Similarly, *Task 2.6.2 Monitoring and estimation of emissions from wood harvest displacement* need to be completed only if significant wood harvesting from the project area is likely to occur, etc.

It follows that if the project does not involve a reduction of agricultural production nor a reduction in wood harvesting after the project start date, then leakage related to these factors would be zero and optional tasks related to quantitative accounting of carbon or GHG emissions do not need to be completed.

Conversely, if the magnitude of the changes in carbon pools and GHG emissions as a result of the project activities during the duration of the project are likely to change by more than 10%, optional tasks for estimation of the carbon content of current pools and the projection of carbon pools and emissions must be completed.

Task 2.1. Quantification of Soil Carbon Stocks for Baseline and Project Scenarios

These tasks relate to the quantification of soil carbon stocks and, as the core measurements for the standard, are required for all projects.

Task 2.1.1. Stratification for soil carbon sampling

The stratification process involves assembling Project Boundary, soil, hydrologic setting, and vegetation data and selecting representative locations in the Project Area for the allocation of random soil sampling points. A stratification process and sampling design, including sample point allocation, should in general follow guidance from *Task 1.6 Baseline Scenario* and Verra's modules VMD0018 *Methods to Determine Stratification* and VMD0021 *Estimation of Stocks in the Soil Carbon Pool*, to quantify the change in soil carbon stocks over time (e.g. as the difference between carbon stocks in T0 and T1) within the project area and to increase measurement precision in a cost-effective manner. This information gathered both quantifies the existing soil carbon pool and enables projections of future conditions per unit area with statistical rigor.

Requirement	Required for all projects.
Goal	To divide the project area into one or more strata within which the projected soil carbon pools and soil carbon dynamics are expected to be relatively uniform under the project scenario, given the stratification determined in Task 2.1, and the proposed treatment under the project scenario.
Method	Use module VMD0018 Methods to Determine Stratification, with soil carbon as the relevant variable X.

Task 2.1.2. Sampling and analysis for soil carbon per unit area, per stratum

The goal is to install sufficient sample locations to meet the required statistical rigor, as discussed in *Task 2.1.3 Uncertainty of soil carbon stocks*, below. For example, the Project Proponent may use a number of statistical methods to estimate the expected number of samples required, including those in the *CDM A/R Methodological Tool Calculation of the number of sample plots for measurements within A/R CDM project activities* (Version 2.0 or later).

Requirement	Required for all projects.
Goal	To sample the organic and inorganic soil carbon content in each stratum with a sampling intensity sufficient to estimate, at the required levels of statistical precision and accuracy, the amount of soil carbon per unit area.
Method	Use module VMD0021 Estimation of Stocks in the Soil Carbon Pool.

Task 2.1.3. Uncertainty of soil carbon stocks

Projects that utilize emerging technologies for interim crediting or to augment direct soil sampling to 1-meter depth (or to refusal), for example, satellite data, proximal sensing, chronosequences, eddy covariance data, shallow core sampling (for example, 30-cm depth) and/or digital soil mapping, must demonstrate that the additional methods of measurement predict SOC with sufficient accuracy to meet or exceed the requirements defined in Verra's VM0042 *Methodology for Improved Agricultural Land Management, v2.0*, Section 8.6 *Uncertainty* or VM0026 *Methodology for Sustainable Grasslands Management v1.1*, Section 8.2.9 *Unscertainty Analysis*. Projects may use emerging technologies to determine SOC content if sufficient scientific progress has been achieved in calibrating and validating measurements, and uncertainty is well-described. See Appendix 2.0 for a list of emerging technologies.

Project Proponents may meet or exceed the Verra standard confidence and uncertainty factors defined in VM0042 *Methodology for Improved Agricultural Land Management, v2.0*, Section 8.6 *Uncertainty* or VM0026 *Methodology for Sustainable Grasslands Management v1.1*, Section 8.2.9 *Uncertainty Analysis* and utilize project statistically significant factors for SOC analysis and utilize emerging technologies per Appendix 2.0. Statistical confidence and uncertainty must be demonstrated at the appropriate spatial scale of the measurement method.

If the uncertainty is above the limit defined in Verra's VM0042 *Methodology for Improved Agricultural Land Management, v2.0*, Section 8.6 *Uncertainty* or VM0026 *Methodology for Sustainable Grasslands Management v1.1*, Section 8.2.9 *Uncertainty Analysis*, a Project Proponent would reduce the carbon removal assessment by the percentage of uncertainty exceeding the uncertainty determined in the applicable Verra Standard, unless a Project Proponent resolves the uncertainty by:

1. Utilizing VMD0021 *Estimation of Stocks in the Soil Carbon Pool* Step 6.5a and VMD0018 *Methods to Determine Stratification* Step 7 or
2. Demonstrating statistically that the project falls within the uncertainty percentage for the applicable Verra Standard utilized by the Project Proponent.

Task 2.2. Quantification of Baseline Emissions from Non-Soil Carbon Sources

These tasks relate to quantification of emissions from sources other than soil carbon such as biomass carbon pools, CH_4, N_2O, etc. They are required for all projects where significant changes greater than 10% are expected for the baseline scenario at any time after the project start date; but are optional for other projects.

Task 2.2.1. Project area stratification for biomass

Requirement	Required for all projects where the difference in total above and below-ground biomass carbon between the project scenario and the baseline scenario at any time after the project start date is expected to be significant. Optional for all other projects.
Goal	To divide the project area into one or more strata within which the existing vegetation carbon pools and vegetation dynamics are relatively uniform.
Method	Use module VMD0018 Methods to Determine Stratification, with above and below-ground biomass stocks per unit area as the relevant variable X.

Task 2.2.2. Estimation of the carbon content of current above-ground woody and non-woody biomass and below-ground living biomass pools

Requirement	Required for all projects where the difference in total above- and below-ground biomass carbon between the project scenario and the baseline scenario at any time after the project start date is expected to be significant. Optional for all other projects.
Goal	To sample the above-ground biomass pools and derive the below-ground biomass pool in each stratum with a sampling intensity sufficient to estimate, at the required levels of statistical precision and accuracy, the amount of biomass carbon per unit area.

Method	Use module VMD0022 Estimation of Carbon Stocks in Living Plant Biomass.

Task 2.2.3. Projection of future biomass pools under the baseline scenario

Requirement	Required for all projects where the difference in total above and below-ground biomass carbon between the project scenario and the baseline scenario at any time after the project start date is expected to be significant. Optional for all other projects.
Goal	To determine the most likely future changes in total biomass within the project area under the baseline scenario.
Method	Use module VMD0019 Methods to Project Future Conditions, with biomass pools as the relevant variable X.

Task 2.2.4. Estimation of the amount of current wood harvest from within the project area used for production of long-lived wood products

Requirement	Required where the harvest of significant quantities (defined as greater than the amounts of woody biomass that currently die annually, and through natural decomposition release GHG quantities to the atmosphere) that are greater than the amounts of woody biomass currently occurs within the project area, or is expected to be regenerated annually in the future under the baseline scenario, and some or all of that woody biomass is used for the production of long lived wood products. Optional and not recommended in all other cases.
Goal	To estimate the current amount of woody biomass harvesting taking place within the project area.
Method	Use module VMD0025 Estimation of Woody Biomass Harvesting and Utilization.

Task 2.2.5. Projection of future wood harvest outputs

Requirement	Required where the harvest of significant amounts of woody biomass currently occurs within the project area, or is expected to occur in the future under the baseline scenario, and some or all of that woody biomass is used for the production of long-lived wood products. Optional and not recommended in all other cases.

Goal	To project the most probable amount of woody biomass harvesting, and utilization of that harvest for the production of long-lived wood products, that is expected to occur under the baseline scenario.
Method	Use module VMD0019 Methods to Project Future Conditions, with wood harvest and utilization for long-lived wood products as the relevant variable X.

Task 2.2.6. Long-lived wood products

Requirement	Required where the harvest of significant amounts of woody biomass currently occurs within the project area, or is expected to occur in the future under the baseline scenario, and some or all of that woody biomass is used for the production of long-lived wood products. Optional and not recommended in all other cases.
Goal	To project the amount of carbon which will be sequestered in long-lived wood products under the baseline scenario.
Method	Use module VMD0026 Estimation of Carbon Stocks in the Long Lived Wood Products Pool, with the outputs from *Task 2.2.4. Estimation of the amount of current wood harvest from within the project area used for production of long-lived wood products* and *Task 2.2.5 Projection of future wood harvest outputs* as the inputs.

Task 2.2.7. Estimation of current dead wood pools within the project area

Requirement	Required where there are significant amounts of dead wood in the project area at the project start date, and removals of dead wood through utilization, reduced inputs or accelerated burning as part of a management activity are expected to occur under the project scenario. Optional under all other circumstances.
Goal	To estimate the current amount of biomass contained in dead wood pools.
Method	Use module VMD0024 Estimation of Carbon Stocks in the Dead Wood Pool.

Task 2.2.8. Projection of future dead wood pools within the project area

Requirement	Required where there are significant amounts of dead wood in the project area at

	the project start date, and removals of dead wood through utilization, reduced inputs or accelerated burning as part of a management activity are expected to occur under the project scenario. Optional under all other circumstances.
Goal	To project the amount of biomass which will be contained in dead wood pools under the baseline scenario.
Method	Use module VMD0019 Methods to Project Future Conditions, with dead wood pools as the relevant variable X.

Task 2.2.9. Estimation of current average domesticated animal populations within the project area

Requirement	Required where GHG emissions from domesticated animal populations within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario at any time during the project crediting period. Optional under all other circumstances.
Goal	To estimate the average current population of domesticated animals within the project area.
Method	Use the module VMD0027 Estimation of Emissions from Domesticated Animals.

Task 2.2.10. Projection of future domesticated animal populations under the baseline scenario

Requirement	Required where GHG emissions from domesticated animal populations within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario at any time during the project crediting period. Optional under all other circumstances.
Goal	To project the future populations of domesticated animals under the baseline scenario.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with domesticated animal populations as the relevant variable X.
Comments	If at any time, within the project crediting period, the populations of domesticated animals under the baseline scenario are projected to be greater than those found at the project start date, populations at that time must be accounted as being

	equal to current levels. Conservatively, this methodology does not account for projected increases in animal populations and resulting emissions under the baseline scenario.

Task 2.2.11. Estimation of emissions of GHGs from domesticated animals within the project area under the baseline scenario

Requirement	Required where GHG emissions from domesticated animal populations within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario at any time during the project crediting period. Optional under all other circumstances.
Goal	To estimate GHG emissions from current and projected future domesticated animal populations under the baseline scenario.
Method	Use module VMD0028 *Estimation of Emissions from Domesticated Animals*, with the outputs from *Task 2.2.9. Estimation of current average domesticated animal populations within the project area* and *Task 2.2.10. Projection of future domesticated animal populations under the baseline scenario* as the inputs.

Task 2.2.12. Estimation of current soil emissions of N2O or CH4 from within the project area

Requirement	Required where emissions of N2O or CH4 from the soils within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario at any time within the project crediting period. Optional under all other circumstances.
Goal	To estimate the current emissions of N2O or CH4 from within the project area.
Method	Use module VMD0029 *Emissions of Non-CO2 GHGs from Soils*.

Task 2.2.13. Projection of future emissions of N2O or CH4 from the soils within the project area

Requirement	Required if, at any time within the project crediting period, the emissions of N2O or CH4 from the soils within the project area under the baseline scenario are projected to be greater than those found under the project scenario. Optional under all other circumstances.

Goal	To project future emissions from soils under the baseline scenario, in the case that these emissions are expected to decline.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with relevant input variable(s) from the module VMD0029 *Estimation of Emissions of Non CO2 GHG from Soils*, as the relevant variable(s) X. Then, based on the outputs from this module, use the module VMD0029 *Estimation of Emissions of Non-CO2 GHG from Soils* to estimate the projected future emissions.

Task 2.2.14. Projected emissions from use of power equipment

Requirement	Required for all projects where emissions from power equipment directly attributable to activities within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario. Not to be used in all other circumstances. Conservatively, this methodology does not account for emission reductions arising from reductions in the use of power equipment under the project scenario as compared with the baseline scenario.
Goal	To project GHG emissions for the monitoring period from the use of power equipment under the baseline scenario. Note that in this methodology emissions of GHGs due to the use of power equipment directly attributable to activities within the project area are all accounted as baseline or project emissions, whether or not the actual emissions occur within the project area.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with fuel uses in power equipment as the relevant variable(s) X. Then, based on the outputs from this module, use the module VMD0030 *Estimation of Emissions from Power Equipment* to estimate the projected future emissions.

Task 2.2.15. Estimation of current litter pools.

Requirement	Required where significant decreases in litter pools within the project area are expected under the project scenario as compared with the baseline scenario at any time within the project crediting period. Optional under all other circumstances.
Goal	To estimate the carbon content of the litter pool within the project area.
Method	Use module VMD0023 *Estimation of Carbon Stocks in the Litter Pool*.

Task 2.2.16. Projection of future litter pools

Requirement	Required where significant decreases in litter pools within the project area are expected under the project scenario as compared with the baseline scenario at any time within the project crediting period. Optional under all other circumstances.
Goal	To project emissions from future litter pools under the baseline scenario where these emissions are expected to decline under the baseline scenario.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with relevant input variable(s) from the module VMD0023 *Estimation of Carbon Stocks in the Litter Pool*, as the relevant variable(s) X.
Comments	If, at any time in the project crediting period, the litter pools within the project area under the baseline scenario are projected to be less than those at the project start date, litter pools for that time period must be accounted as being equal to levels at the project start date. Conservatively, this methodology does not account for projected decreases in litter pools under the baseline scenario.

Task 2.2.17. Summation of estimates and projections under the baseline scenario

Requirement	Required for all projects for which changes greater than 10% are expected in any non-soil carbon pool or other GHG emission, otherwise optional.
Goal	To sum current and future carbon sequestration and emissions under the baseline scenario.
Method	Use module: VMD0035 *Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*.

Task 2.3. Ex-ante Projections of Project Emissions from Non-soil Carbon Sources

These tasks relate to quantification of projected emissions from sources other than soil carbon during the project periods related to changes in biomass carbon pools, CH4, N2O, etc.

Task 2.3.1. Projection of future above-ground woody and non-woody and below-ground living biomass pools under the project scenario

Requirement	Required for all projects where significant decreases in living biomass pools are expected to occur under the project scenario, as compared with the baseline scenario. Optional in all other circumstances.
Goal	To project for the monitoring period the above-ground woody and non-woody biomass and below-ground living biomass pools in each stratum based on expected treatment regimes, and to estimate the amount of living biomass carbon per unit area based on those projections.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with live biomass as the relevant variable X and the module VMD0022 *Estimation of Carbon Stocks in Living Plant Biomass*.

Task 2.3.2. Projection of future wood harvest outputs under the project scenario

Requirement	Required for all projects where the harvest of woody biomass within the project area is expected to be significantly lower under the project scenario as compared with the baseline scenario at any time within the project crediting period and some or all of that woody biomass is used for the production of long-lived wood products. Optional but recommended in the case that harvests of woody biomass under the project scenario are expected to be significantly greater than those under the baseline scenario. Optional, but not recommended, where no significant wood harvest takes place under either the baseline or project scenario, or where no significant change in levels of wood harvest are expected under the project scenario as compared with the baseline scenario.
Goal	To project for the monitoring period the amount of woody biomass harvesting which is expected to take place within the project area under the project scenario, and the percentage of that harvest which is expected to be used for the production of long-lived wood products.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with wood harvest and wood utilization as the relevant variable X.

Task 2.3.3. Projection of carbon sequestration in long-lived wood products

Requirement	Required for all projects where the harvest of woody biomass within the project area is expected to be significantly lower under the project scenario as compared with the baseline scenario at any time within the project crediting period and some or all of that woody biomass is used for the production of long lived wood products. Optional but recommended in the case that harvests of woody biomass under the project scenario are expected to be significantly greater than those under the baseline scenario. Optional, but not recommended, where no significant wood harvest takes place under either the baseline or project scenario, or where no significant change in levels of wood harvest are expected under the project scenario as compared with the baseline scenario.
Goal	To estimate the amount of carbon which will be sequestered in long-lived wood products under the project scenario, based on the projections prepared in *Task 2.3.4 Projection of future wood harvest outputs under the project scenario*.
Method	Use module VMD0026 *Estimation of Carbon Stocks in the Long Lived Wood Products Pool*, with the outputs from *Task 2.3.2 Projection of future wood harvest outputs under the project scenario* as the inputs.

Task 2.3.4. Projection of future dead wood pools within the project area under the project scenario

Requirement	Required where significant amounts of dead wood are found on the site at the project start date, and removals of dead wood through utilization, reduced inputs, or accelerated burning as part of management activity, are expected to occur under the project scenario. Optional in all other circumstances.
Goal	To estimate the amount of biomass which will be sequestered in dead wood pools under the project scenario.
Method	Use the module VMD0019 *Methods to Project Future Conditions*, with dead wood pools as the relevant variable X.

Task 2.3.5. Projection of future domesticated animal populations under the project scenario

Requirement	Required where increases in the emissions of GHGs from domesticated animal populations are expected under the project scenario as compared with the baseline

	scenario. Not to be used in all other circumstances. Conservatively, this methodology does not account for projected decreases in emissions from domesticated animals under the project scenario as compared with the baseline scenario.
Goal	To project the future populations of domesticated animals for the monitoring period under the project scenario.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with domesticated animal populations as the relevant variable X.

Task 2.3.6. Estimation of emissions of GHGs from domesticated animals within the project area under the project scenario

Requirement	Required where GHG emissions from domesticated animal populations within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario at any time during the project crediting period. Optional under all other circumstances.
Goal	To estimate the emissions of GHGs from the current and projected future populations of domesticated animals under the project scenario the monitoring period based on the projections prepared in *Task 2.3.5. Projection of future domesticated animal populations under the project scenario*.
Method	Use module VMD0027 *Estimation of Emissions From Domesticated Animals*, with the outputs from *Task 2.3.5. Projection of future domesticated animal populations under the project scenario* as the inputs.

Task 2.3.7. Projection of future emissions of N2O or CH4 from the soils within the project area

Requirement	Required where significant increases in the emissions of N2O or CH4 from the soils within the project area are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.
Goal	To estimate future emissions from soils under the project scenario, in the case that these emissions are expected to increase.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with relevant input

	variable(s) from the module VMD0029 *Estimation of Emissions of Non CO2 GHG From Soils*, as the relevant variable(s) X. Then, based on the outputs from this module, use the module VMD0029 *Estimation of Emissions of Non CO2 GHG From Soils*, to estimate the projected future emissions.

Task 2.3.8. Projected emissions from use of power equipment

Requirement	Required for all projects where emissions from power equipment directly attributable to activities within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario. Not for use in all other circumstances. Conservatively, this methodology does not account for emission reductions arising from reductions in the use of power equipment under the project scenario as compared with the baseline scenario.
Goal	To estimate GHG emissions for the monitoring period from the use of power equipment under the project scenario. Note that in this methodology emissions of GHGs due to the use of power equipment directly attributable to the project are all accounted for as project emissions, whether or not they occur within the project boundary.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with fuel use in power equipment as the relevant variable(s) X. Then, based on the outputs from this module, use the module VMD0030 *Estimation of Emissions from Power Equipment*, to estimate the projected future emissions.

Task 2.3.9. Projection of future litter pools

Requirement	Required where significant decreases in the carbon content of the litter carbon pool are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.
Goal	To estimate future litter pools under the project scenario.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with litter carbon pools as the relevant variable X.

Task 2.3.10. Projection of biomass consumption by fire

Requirement	Required where significant burning is expected to be used for management of the project area under the project scenario. Optional but not recommended otherwise.
Goal	To project the future amounts of biomass consumed by fire during the project crediting period under the project scenario.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with biomass consumed by fire as the relevant variable X.
Comments	This step shall be done twice if biomass burning is to be done both within the project area, and outside of the project area as a consequence of displacement leakage. In that case, the results will be used for separate calculations during *Task 2.5.2. Projection of leakage due to displacement of wood harvesting*.

Task 2.3.11. Projection of non CO2 emissions from burning

Requirement	Required where significant burning is expected to be used for management of the project area under the project scenario. Optional but not recommended otherwise.
Goal	To estimate emissions of non CO2 GHGs from burning of biomass.
Method	Use module VMD0029 *Estimation of Emissions of Non CO2 GHG from Soils*.
Comments	This step shall be done twice if biomass burning is done both within the project area, and outside of the project area as a consequence of activity shifting leakage. In that case, the results will be reported and accounted for separately during *Task 2.3.12 Projection of biomass consumption by fire*, above.

Task 2.3.12. Summation of ex-ante project scenario emissions from sources other than soil carbon (e.g. biomass carbon pools, CH4, N2O, etc.)

Requirement	Required for all projects. This will be zero for projects with no projected changes in emissions from sources other than soil carbon (e.g. biomass carbon pools, CH4, N2O, etc.). If non-zero, appropriate adjustment must be made to interim crediting.

Goal	To sum current and future carbon sequestration and emissions under the project scenario.
Method	Use module VMD0035 *Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*, setting leakage variables to 0, as these will be accounted for in *Task 2.6. Ex-post Quantification of Project Leakage*.

Task 2.4. Ex-post Quantification of Project Emissions

Ex-post accounting of GHG pools and emissions must be undertaken prior to each verification event, and at least once every five (5) years during the project crediting period. Note that where leakage mitigation measures include tree planting, agricultural intensification, fertilization, fodder production, and/or other measures to enhance cropland and/or grazing land areas, then any significant increase in GHG emissions associated with these activities must be accounted for using the relevant module, whether or not they occur within the project area, unless they are deemed not significant, or can otherwise be conservatively excluded. To determine the ex-post quantification of GHG pools and emissions in the project area, the Project Proponent should use the following steps, as applicable:

Task 2.4.1. Estimation of the carbon content of current soil carbon pools per unit of area, for each stratum

Requirement	Required for all projects.
Goal	To sample the organic and inorganic soil carbon content in each stratum with a sampling intensity sufficient to allow estimation, at the required levels of statistical precision and accuracy, of the amount of soil carbon per unit area.
Method	Use module VMD0021 *Estimation of Stocks in the Soil Carbon Pool*.

Task 2.4.2. Estimation of the carbon content of above-ground woody and non-woody and below-ground living biomass pools

Requirement	Required for all projects where the above-ground woody and non-woody biomass and below-ground living biomass carbon under the project scenario is found to be significantly less than that projected under the baseline scenarios at any time after the project start date. Optional under all other circumstances. Typically completion of this task will be required where the project area before the project start date contains more than scattered woody vegetation, and where the project activities include clearance, site preparation, burning, or other activities likely to eliminate

	woody vegetation, or alternatively to enhance the recruitment of woody vegetation.
Goal	To sample the above-ground woody and non-woody biomass and below-ground living biomass pools in each stratum to a sampling intensity sufficient to allow estimation to the required levels of statistical precision and accuracy of the amount of living biomass carbon per unit area.
Method	Use module VMD0022 *Estimation of Carbon Stocks in Living Plant Biomass*.

Task 2.4.3. Estimation of the amount of wood harvest from within the project area used for the production of long-lived wood products

Requirement	Required for all projects where the harvest of woody biomass within the project area is expected to be significantly lower under the project scenario as compared with the baseline scenario at any time within the project crediting period, and some or all of that woody biomass is used for the production of long-lived wood products. Optional but recommended in the case that harvests of woody biomass under the project scenario are expected to be significantly greater than those under the baseline scenario. Optional but not recommended in the case where no significant wood harvest takes place under either the baseline or project scenario, or where no significant change in levels of wood harvest are expected under the project scenario, as compared with the baseline scenario.
Goal	To estimate the amount of woody biomass harvesting taking place within the project area during a monitoring period.
Method	Use module VMD0025 *Estimation of Woody Biomass Harvesting and Utilization*.

Task 2.4.4. Long-lived wood products

Requirement	Required for all projects where the harvest of woody biomass within the project area is expected to be significantly lower under the project scenario as compared with the baseline scenario at any time within the project crediting period, and some or all of that woody biomass is used for the production of long-lived wood products. Optional but recommended in the case that harvests of woody biomass under the project scenario are expected to be significantly greater than those under the baseline scenario. Optional but not recommended in the case where no significant wood harvest takes place under either the baseline or project scenario,

	or where no significant change in levels of wood harvest are expected under the project scenario, as compared with the baseline scenario.
Goal	To project the amount of carbon that will be sequestered in long-lived wood products derived from harvesting from within the project area during the monitoring period.
Method	Use module VMD0026 *Estimation of Carbon Stocks in the Long Lived Wood Products Pool*, with the outputs from *Task 2.4.3. Estimation of the amount of wood harvest from within the project area used for the production of long-lived wood products* as the inputs.

Task 2.4.5. Estimation of dead wood pools within the project area

Requirement	Required where dead wood is found on the site at the project start date, and significant removals of dead wood through utilization, reduced inputs, or accelerated burning as part of a management activity, are expected to occur under the project scenario. Optional under all other circumstances.
Goal	To estimate the current amount of biomass contained in dead wood pools.
Method	Use module VMD0024 *Estimation of Carbon Stocks in the Dead Wood Pool*.

Task 2.4.6. Estimation of average domesticated animal populations within the project area

Requirement	Required where increases in emissions from domesticated animals within the project area could occur in the project scenario as compared with the baseline scenario, due either to increases in populations or changes in feeding practices., Optional under all other circumstances.
Goal	To estimate the average current populations of domesticated animals within the project area during the monitoring period.
Method	Use module VMD0028 *Estimation of Emissions from Domesticated Animals*.

Task 2.4.7. Estimation of emissions of GHGs from domesticated animals within the project area

Requirement	Required where increases in emissions from domesticated animals within the project area could occur in the project scenario as compared with the baselines scenario, due either to increases in populations or changes in feeding practices. Not for use under all other circumstances, to conservatively ensure that crediting for reductions in emissions from domesticated animals does not occur.
Goal	To estimate the emissions of GHGs from the current populations of domesticated animals during the monitoring period.
Method	Use module VMD0028 *Estimation of Emissions from Domesticated Animals*, with the outputs from *Task 2.4.6.Estimation of current average domesticated animal populations within the project area* as inputs.

Task 2.4.8. Estimation of emissions from use of power equipment

Requirement	Required for all projects where emissions from power equipment directly attributable to activities within the project area could be significantly greater under the project scenario as compared with the baseline scenario. Not for use in all other circumstances. Conservatively, this methodology does not account for emission reductions arising from reductions in the use of power equipment under the project scenario as compared with the baseline scenario.
Goal	To estimate GHG emissions from the use of power equipment under the project scenario during the monitoring period.
Method	Use module VMD0030 *Estimation of Emissions from Power Equipment*.
Comments	Under this methodology emissions of GHGs due to the use of power equipment directly attributable to the project are all accounted as a project emission, whether or not they occur within the project boundary.

Task 2.4.9. Estimation of non CO2 emissions from burning

Requirement	Required where significant burning has been used for management of the project area under the project scenario. Optional but not recommended under all other circumstances.

Goal	To estimate emissions of non CO2 GHGs from burning of biomass.
Method	Use module VMD0031 *Estimation of Emissions from Burning*.
Comments	This step must be done twice if biomass burning is done both within the project area and outside of the project area as a consequence of displacement leakage. In that case, the results will be reported and accounted separately during *Task 2.5.2. Projection of leakage due to displacement of wood harvesting* and/or *Task 2.6.2. Monitoring and estimation of emissions from wood harvest displacement*.

Task 2.4.10. Monitoring and estimation of soil emissions of N2O or CH4 from within the project area

Requirement	Required where significant increases in the emissions of N2O or CH4 from the soils within the project area are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.
Goal	To estimate the emissions of N2O or CH4 from within the project area.
Method	Use module VMD0029 *Estimation of Emissions of Non-CO2 GHG from Soils*.
Comments	These estimations are expected to be based on the same models as those used during the ex-ante project study, unless improvements in models have occurred in the interim. In either case, values of variables used in the models must be updated to reflect actual conditions which have occurred during the monitoring period. If an updated model is used, and if modeling of baseline emissions was done as part of the baseline study, that modeling must be redone using the improved models.

Task 2.4.11. Estimation of litter pools

Requirement	Required where significant decreases in the carbon content of the litter pool are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.
Goal	To estimate the carbon content of the litter pool within the project area.
Method	Use module VMD0023 *Estimation of Carbon Stocks in the Litter Pool*.

Task 2.4.12. Summation of ex-post project emissions from sources other than soil carbon (e.g. biomass carbon pools, CH4, N2O, etc.)

Requirement	Required for all projects.
Goal	To sum carbon sequestration and emission impacts directly attributable to the project activity based on the monitoring undertaken during the monitoring period.
Method	Use module VMD0035 *Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*, setting leakage variables to 0.

Task 2.5. Ex-ante Projection of Leakage

If it is likely the project activities will lead to an increase in GHG emissions by more than 10% during the project period (see *Table 1. Likelihood of project activities leading to an increase in GHG emissions during the project period* above), the Project Proponent should use the following steps, as applicable.

Task 2.5.1. Projection of leakage due to displacement of grazing, fodder, and agricultural production

Requirement	Required for projects where domesticated animal grazing or fodder or agricultural production occurred within the project area at the project start date, and where these activities are projected to decline within the project area due to project activities.
Goal	To project future emissions from agricultural production, domesticated animals or fodder production displaced under the project scenario.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with displacement of domesticated animals or agricultural production as the relevant variable(s) X. Then, based on the outputs from this module, use module VMD0032 *Estimation of Emissions from Activity-Shifting Leakage*, to estimate the impacts. Depending on the results from the module VMD0032 *Estimation of Emissions from Activity-Shifting Leakage*, calculations of emissions may require the use of other modules.

Task 2.5.2. Projection of leakage due to displacement of wood harvesting

Requirement	Required for projects where displacement of wood harvest to areas outside of the

	project boundary is projected to occur.
Goal	To project future emissions from wood harvest displaced under the project scenario. Projection includes the reductions in emissions from these displaced wood harvest activities where they are expected to result in the production of long-lived wood products.
Method	Use module VMD0019 *Methods to Project Future Conditions*, with displacement of wood harvest as the relevant variable(s) X. Then, based on the outputs from this module, use module VMD0032 *Estimation of Emissions from Activity-Shifting Leakage*, to estimate the impacts. Depending on the results from module VMD0032 *Estimation of Emissions from Activity-Shifting Leakage*, calculations of emissions may require the use of other modules.
Comments	Where wood harvesting occurs outside of the project boundary as a result of activity shifting leakage, and where that wood harvesting results in the production of long-lived wood products, module VMD0026 *Estimation of Carbon Stocks in the Long Lived Wood Products Pool* must be used to estimate the amounts of carbon stored in wood products resulting from the wood harvesting.

Task 2.5.3. Projection of market leakage

Requirement	Required for projects where reductions in the production of wood, animals or agricultural products within the project area are expected under the project scenario as compared with the baseline scenario, and where *Task 2.5.1. Projection of leakage due to displacement of grazing, fodder, and agricultural production* and *Task 2.5.2. Projection of leakage due to displacement of wood harvesting* do not find that direct displacement of these activities to identifiable areas outside the project area fully replaces the production lost within the project area.
Goal	To project leakage caused by increases in prices or demand for products resulting from reduced production of these products within the project area under the project scenario
Method	Use module VMD0033 *Estimation of Emissions from Market Leakage*.

Task 2.6. Ex-post Quantification of Project Leakage

Task 2.6.1. Monitoring and estimation of emissions from grazing, fodder and agricultural production displacement

Requirement	Required for projects where domesticated animal grazing or fodder or agricultural production occurred within the project area at the project start date, and where these activities have declined within the project area due to project activities.
Goal	Estimation of emissions from domesticated animals or fodder production displaced as a result of project activities during the crediting period.
Method	Use module VMD0032 *Estimation of Emissions from Activity-Shifting Leakage*, to estimate the impacts. Depending on the results from the module, calculations of emissions may require the use of other modules.

Task 2.6.2. Monitoring and estimation of emissions from wood harvest displacement

Requirement	Required for projects where wood harvest occurred within the project area at the project start date, and where total wood harvest from the project area over the monitoring period will decline as compared with that projected under the baseline scenario.
Goal	Estimation of emissions from wood harvesting displaced as a result of project activities during the crediting period.
Method	Use module VMD0032 *Estimation of Emissions from Activity-Shifting Leakage*, to estimate the impacts. Depending on the results from the calculations of emissions may require the use of other modules. Where displaced wood harvesting results in the production of long-lived wood products, module VMD0026 *Estimation of Carbon Stocks in the Long Lived Wood Products Pool*, must also be used.

Task 2.6.3. Estimation of market leakage

Requirement	Required for projects where reductions in the production of wood, animals, or agricultural products within the project area have occurred under the project scenario, as compared with the baseline scenario, and where *Task 2.6.1. Monitoring and estimation of emissions from grazing, fodder and agricultural production displacement* and *Task 2.6.2. Monitoring and estimation of emissions from wood harvest displacement* do not find that direct displacement of these activities to identifiable areas outside the project area fully replaces the production

	lost within the project area.
Goal	To estimate leakage caused by increases in prices or demand for products resulting from reduced production of these products within the project area under the project scenario.
Method	Use module VMD0033 *Estimation of Emissions from Market Leakage*.
Comments	If market leakage has been projected in *Task 2.1 Quantification of Soil Carbon Stocks for Baseline and Project Scenarios* and *Task 2.2 Quantification of Baseline Emissions from Non-Soil Carbon Sources*, and if the input conditions remain the same ex-post as those predicted ex-ante, the projections completed in *Task 2.3.12 Summation of ex-ante project scenario emissions from sources other than soil carbon (e.g. biomass carbon pools, CH4, N2O, etc.)* may be used to satisfy the requirements of this task.

Task 2.7. Monitoring

The Project Proponent must describe following VMD0034 *Methods for Developing a Monitoring Plan* under the guidance of the VCS Validation and Verification Manual, v3.2 how "the entire project longevity must be covered by management and financial plans that demonstrate the intention to continue the management practices." The monitoring plan must also include annual proof of activity. For any Project Proponent executing *Task 3 Interim Crediting Assessment (Optional)*, any sample handling or SOC results that might have been received in the interim period must also be documented.

Task 3. Interim Crediting Assessment (Optional)

The generation of high-quality data is the foundation of the Standard. This quality is ensured through soil sampling and analysis to one meter depth (or to refusal) with a measure-remeasure approach, from baseline (T0) to follow-up (T1) timepoints spanning the duration of project. To incentivize rancher, farmer, conservationist, and project developer participation, the Standard allows for optional methods to estimate annual SOC accrual between the baseline (T0) and subsequent true-up date (T1) measurements. This forward-looking assessment of interim carbon credits aims to provide pre-T1 revenue for farmers, ranchers and other Land Stewards to overcome financial challenges to implementing improved agricultural management practices, and to incentivize the adoption of improved agricultural, conservation and restorative land management practices and enhance the quality of the carbon credits generated by the Standard.

Forward-looking assessments for interim crediting are not a replacement for direct measurement (and the measure-to-measure quantification) of SOC at the beginning and end of the project period. All forward-looking assessments for interim crediting are required to be substantiated by 1-meter deep (or to refusal), direct soil sampling to establish the baseline (T0) soil organic carbon with subsequent (T1) deep sampling collected within an average of five to seven years to true-up the project soil carbon sequestration.

Task 3.1. Projection of future soil carbon accrual rate for the project scenario

Requirement	Required for all projects applying for interim carbon credits.
Goal	To project the future soil organic carbon sequestration rate ("accrual rate") per unit area for each projected verification date within the project crediting period under the project scenario.
Method	Use module VMD0019 *Methods to Project Future Conditions*
Comments	

The module provides a step-by-step approach to assess the key factors that drive change in future soil organic carbon accrual rates, and provides a suite of methods and approaches for projecting future conditions, as well as decision criteria for choosing the most appropriate method.

The following outlines in concept the application of module VMD0019 for the estimation of soil organic carbon accrual rates for the purpose of interim crediting, *using as a particular example*, a project involving regenerative grazing management practices:

Step 1, the variable to be projected is **soil organic carbon sequestration** (i.e. the SOC accrual rate) and the geographic area is the ranch **project boundary**.

Step 2, the accrual rate is to be projected under the **project scenario**.

Step 3, the accrual rate is **location specific**, because the rate depends on the variability of the weather conditions throughout the growing season and the underlying soil conditions across the particular location of the ranch. Additionally, the accrual rate is largely **systemic**, because changes in its value depend primarily on many factors outside of local control (e.g. weather), although other aspects determining the accrual rate may be considered planned (e.g. adaptive multi paddock grazing, low intensity rotational grazing, etc.) or controlled (e.g. reduce grazing intensity by 25%), depending on the particular project scenario.

Step 4, the accrual rate is considered **intended**, because it arises as a result of the project activities under the project scenario (e.g. increasing soil health and soil carbon through regenerative grazing management).

Step 5, the steps or scenario that contribute to a future SOC accrual rate(s) include:

First – ***Primary Productivity***: Weather conditions, including rainfall (by extension, soil moisture), temperature, solar radiation and relative humidity, as well as soil nutrient availability, define the upper limit to potential rates of grassland primary productivity (i.e. biomass production) at a given location.

Second – ***Deposition***: Plant organic matter as a result of primary productivity is deposited on or within the soil, from leaf and stem litter residue deposited on the soil surface to root litter and root exudates deposited as rhizodeposition in the root zone extending near the surface to the deepest rooting depths. Aboveground versus belowground allocation of carbon by plants is influenced by the relative aboveground and belowground environmental limitations to growth (e.g. greater allocation to belowground roots in order to acquire more water if soil moisture is most limiting).

Third – ***Decomposition***: Plant residues are broken down and decomposed by soil fauna (dung beetles, earthworms, ants, etc.) and microorganisms (e.g. fungi and bacteria), with organic matter on or near the soil surface typically decomposing faster and more completely than organic matter deposited deeper in the soil profile as root litter, as conditions near the soil surface generally have greater oxygen concentrations, higher temperatures and the looser soil structure that provide a more conducive environment for decomposition. The rate of decomposition is primarily driven by temperature and soil moisture and by the chemical composition or decomposability of the organic matter. Plant organic matter is broken down into particulate organic matter (plant organic matter at various stages of decomposition) and organic matter of microbial origin (e.g. microbial necromass). Microbial efficiency for decomposition is largely determined by the soil environmental conditions during decomposition (e.g. soil temperature and moisture) as well as by the decomposability of the organic matter substrate, itself influenced by the soil environmental conditions during production (e.g. influencing the allocation to different stress-response compounds).

Fourth – ***Dispersal***: Organic matter is physically dispersed throughout the soil profile, both vertically and laterally, from its sources near the soil surface or proximal to the rhizosphere of the roots, with a rate and efficiency of diffusion that is mainly dictated by the availability of water in the soil.

Fifth – ***Stabilization***: Finally, SOC can be stored in the soil as relatively unprotected particulate organic matter (POM) or as chemically-protected mineral associated organic matter (MAOM), as well as physically-protected organic matter within soil aggregates. MAOM increases with soil clay and silt content and is nearly exclusively microbial-derived (necromass) with fungi playing a dominant role, and both physical and chemical protection make the organic matter largely inaccessible to decomposition by microorganisms, with MAOM in a more stabile form of soil organic carbon (SOC) that is more resistant to decay even after physical disturbance of the soil such as by tilling.

Step 6, Following the procedures of VMD0019 (see VMD0019 Section 5 - Procedures) for **systemic, location specific** variables, proceed to Step 7.

Step 7, the SOC accrual rate is **not directly accessible through remote sensing**.

Step 7a, collation and analysis of existing data indicate there is **no historical record of SOC accrual rates in the analysis area**, proceed to Step 13.

Step 13, lacking any existing or historical trajectory of change in SOC accrual rates, **future values are modeled by considering the integration of multiple drivers, agents and causes on the accrual rate**. This approach for forecasting accrual rates is data intensive, with the data necessary to determine casual relationships between accrual rates and the various drivers, agents and causes drawn from the **best available peer reviewed scientific literature at the time of the project**, with **clear documentation** of the methods and data, including the **risks and uncertainties** in the variables used to make the projection, to ensure **conservative estimates.**

Step 13d.1: Current conditions of driving variables drawn from published and/or reliable data sources (e.g. **gridded precipitation and temperature, digital maps of soil clay and silt content, digital elevation models and topographic data, digital maps of soil thickness**, pH, cation exchange capacity, etc.)

Step 13d.2: Correlate SOC accrual rates with driving variables based on the findings of published literature (e.g. **increasing productivity with precipitation[1], increasing microbial efficiency and SOC storage with precipitation[2], increasing decomposition and decreasing SOC storage with precipitation[3], increasing dispersal and SOC storage with precipitation[4], increasing SOC storage with decreasing temperature[5], increasing SOC storage with soil clay and silt content[6], increasing SOC storage with soil thickness[7], decreasing SOC storage with slope, increasing SOC storage with improved grazing management**[8], etc.).

[1]Del Grosso et al. 2008: *Ecology*, 89(8):2117-212; [2]Anthony et al. 2020: *One Earth*, 2:349–360; [3]Parton et al. 1993: *Global Biogeochem Cycles*, 7(4):785-809; [4]Heckman et al. 2023: *PNAS*, 120(7):e2210044120; [5]Hartley et al. 2021: *Nature*, 12:6713; [6]Georgiou et al. 2022: *Nature*, 13:3797; [7]Jobbagy and Jackson 2000, *Ecol. Appl.* 10(2):423–36, [8]Conant et al. 2017, *Ecological Applications*, 27(2): 662–668.

Step 13d.3: Model potential SOC accrual rates based on the aforementioned correlations, e.g. using a pragmatic approach, with the potential SOC accrual rate estimated as the potential net primary productivity (gC/m2/yr) and adjustment factors representing the relative probability (with a value ranging from 0-1) of SOC storage based on the most limiting factor (e.g. Law of the Minimum[8]) among a multitude of potentially limiting factors (e.g. **MAP, MAT, soil clay and silt content, topographic slope, soil thickness**, pH, cation exchange capacity, rock fragment content, C3/C4 fraction, tree cover fraction, annual/perennial fraction, fungal/bacteria ratio, etc.). [8]Lieth, H. 1972. Modeling the primary productivity of the world, 10 pp., Deciduous Forest Biome Memo Rep. 72-9, March 1972.

Step 13d.4: Review and re-parameterize the model if predictions are improbable or show discrepancies compared to actual conditions (e.g. **adjust the maximum SOC accrual rate so estimates are consistent with literature values**)

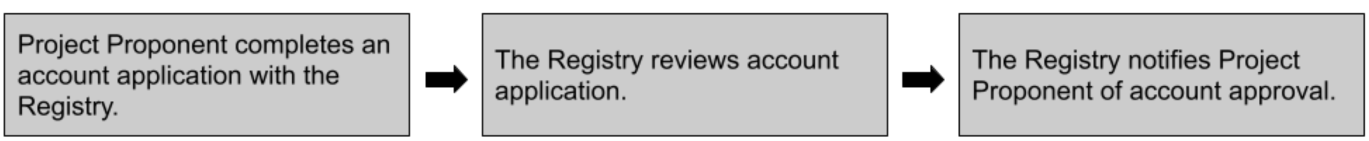
Step 13d.5: Project future SOC accrual rates using conservative estimates for model drivers or model projections (e.g. **lower quartile of range for model predictions at a given location**)

Step 13d.6: Create a time series to **predict SOC accrual rates during the years of the project**.

Task 4. Project Application Submission

A Project Proponent interacts with the Regenerative Registry to list pipeline projects, register projects, and issue carbon credits. Prior to these interactions, the Project Proponent must open an account and submit all required credentials to the Regenerative Registry in order to submit projects for pipeline listing, verification, and registration. Once the Registry approves a Project Proponent, the project application process can begin.

Figure 2: Opening a Regenerative Registry account:

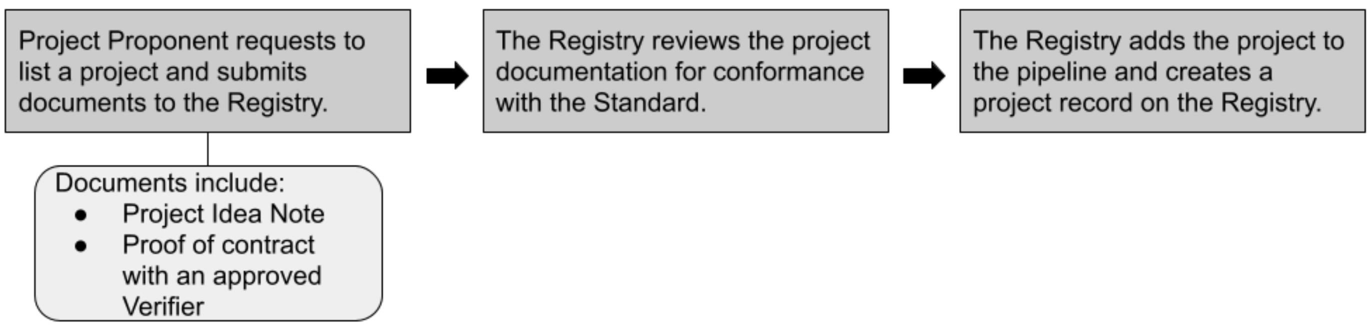


Note that all Verifiers must also complete an account application and submit all required credentials to the Regenerative Registry prior to verifying carbon projects (See Verifier Prequalification requirements, Section ___).

Approved Project Proponents must initiate the project application with the pipeline listing process by submitting to the Registry the following:

- A Project Idea Note that includes at minimum a cover page and drafts of Task 1 Project Overview - Identification and Eligibility of Project Activity and related sub-tasks.
- Proof of contract intent (such as a draft contract) or executed contract with an approved Verifier.

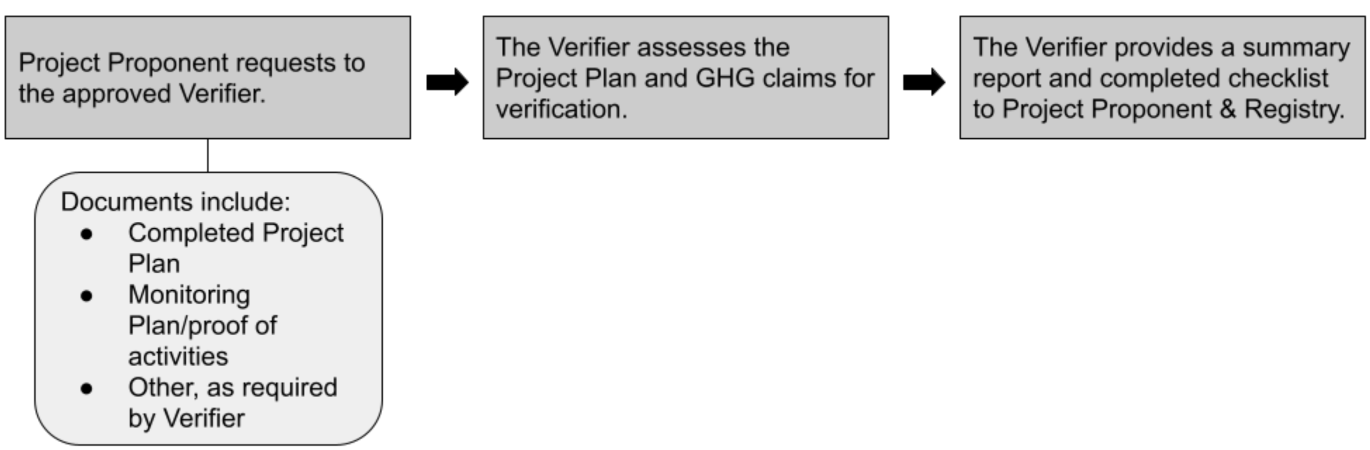
Figure 3: Listing a project on the Regenerative Registry project pipeline:



Once the project is listed with the Registry, a Project Proponent can complete the project application by submitting all documentation within a Project Plan to the approved Verifier to execute *Task 5. Verification*. A complete project application includes the Project Plan with the results from Tasks 1-3 in the Standard with accompanying documentation within appendices that may include the following:

- Site maps
- Contracts
- Proof of Legal Ownership and County Appraisal District Tax Records
- Leasee/Lessor agreements (Control of the Land-Type Contracts)
- Stratification and Sampling Maps
- Supporting documentation for land management activities (Land Steward Surveys, Communications, etc.)
- Chain of custody documentation from soil analytics laboratory
- References

Figure 4: Submitting a Project Plan for Verification:



Task 5. Verification

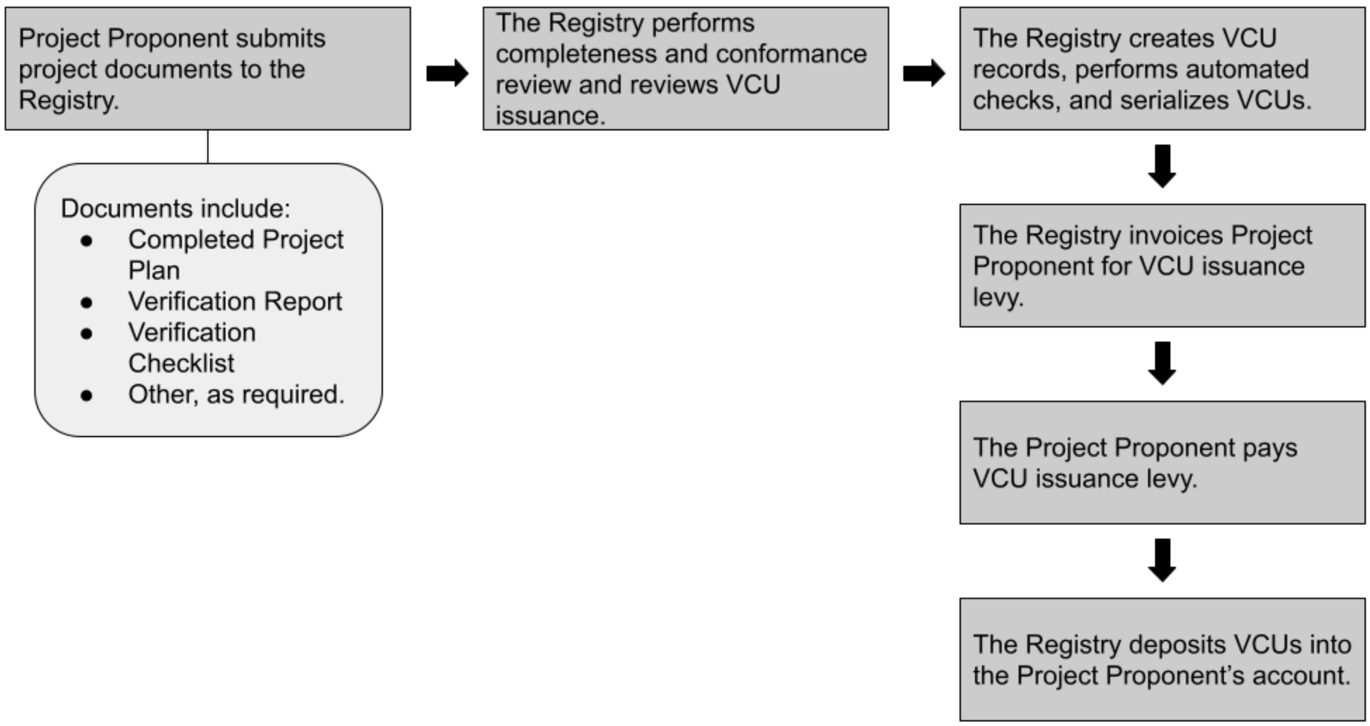
Verification of a Carbon Credit Project under the Standard is performed by pre-approved, third-party verifiers utilizing the guidance and checklists in Appendix 1.0 *Verification Guidance and Checklists* which include technical, management practice, and procedural evaluation of compliance with the Standard's requirements. Any Verifier with sufficient knowledge and experience to ensure technical review and verification of projects under the Standard must submit a Verifier Application with the Regenerative Registry. **See Appendix tk** for qualification requirements.

For Project Proponents executing the optional Task 3, annual recertification (i.e. verification of SOC changes in years between T0 and T1), utilizing the guidance and checklists in Appendix 1.0 *Verification Guidance and Checklists,* shall include a review of monitoring/proof of activities and any sample handling or SOC results that might have been received in this interim period. Examples of such documentation may include:

1. Farm records from USDA and NRCS showing acreages and confirming practices.
2. Independent on-the-ground practice confirmations.
3. Independent remote sensing practice confirmations.
4. Maps, acreages, and written explanations of any deviations from a Project Plan including soil amendments, compost, etc.
5. Financial, meteorological, marketplace, personal explanation of deviations from a Project Plan.
6. Land Steward affidavit of continuation in the Project and compliance with Best Practice principles for regenerative land stewardship as defined by literature and agreed upon by the Project Proponent and Land Steward.

Task 6. Registration

After a project has been verified, a Project Proponent may request registration and credit issuance by submitting relevant documents to the Regenerative Registry. The Registry will conduct a completeness review of the documents and an assessment of conformance of the program rules checklist. Once compliance is confirmed, the Registry will upload the documents to the public registry and issue VCUs into the Project Proponent's account.


Project Proponent submits project documents to the Registry.
Documents include:
Completed Project Plan
Verification Report
Verification Checklist
Other, as required.
The Registry performs completeness and conformance review and reviews VCU issuance.
The Registry creates VCU records, performs automated checks, and serializes VCUs.
The Registry invoices Project Proponent for VCU issuance levy.
The Project Proponent pays VCU issuance levy.
The Registry deposits VCUs into the Project Proponent's account.

Appendix 1.0 Verification Guidance and Checklists

This guide provides instruction for the verification of carbon projects for Project Proponents and Verifiers to follow. The guide and checklist is to be followed by verifiers to efficiently conduct and document their verification process. In short, verification is intended to be a streamlined, rapid, and defensible process that:

1. Allows Verifiers, Project Proponents, approving bodies, and credit purchasers to understand projects, representations, and claims by the Project Proponents.

2. Provides a clear decision pathway for all parties to understand conclusions.

3. Provides a structure for efficient internal and external auditing of projects, programs and accounts.

The verification process conclusions can be approvals and concurrence with the claims and representations by a Project Proponent. If the Project Proponent has provided an incomplete application, the verifier may request more information, clarifications, or the recognition of a fundamental problem that would not support a determination about application completeness, or support the claims and representations suggested by the Project Proponent. This verification process is intended to create a clear record to support resubmittal and completion of a review, and to encourage clear, open, and transparent communications by the Verifier, and others involved.

Fundamental to the Standard and its verification process, must be the recognition that the proof is always in comparing forward assessments for optional interim crediting with actual baseline (T0) and follow-up measurements (T1, T2, etc.). This Standard can use modeled or literature review projections early but only measured performance is used for truing the actual credit yield by a Project. This means that representations in a project plan document only have material value when the baseline and subsequent follow-up measurements document performance.

This verification guidance is focused on using a checklist process. The Standard's Checklist Templates streamline the review process to ensure that all procedures are evaluated and all Standard requirements are met for each year (T0, T1, etc. and, if applying for interim credits, the years between T0, T1, etc.).

Using the Standard's Verification Report Template, the Verifier is expected to generate a report that summarizes whether or not the claims and representations suggested by the Project Proponent are reasonably certifiable to accompany the Standard's Checklist Templates. If an application is deemed incomplete or if the checklist items do not meet the test of sufficiency, a Verifier should provide a follow-up attachment of no more than one-page in length that identifies deficiencies, discrepancies, and additional information needs.

Appendix 2.0 Guidance on Potential Emerging Technologies to Measure SOC Stocks

Projects may use emerging technologies to determine SOC content if sufficient scientific progress has been achieved in calibrating and validating measurements, and uncertainty is well-described. This appendix is adapted from the forthcoming VM0042 Version 2.0 and provides guidance on requirements for using such emerging technologies and a non-exhaustive list of potential technologies (with a focus on proximal sensing) to determine SOC content and criteria to ensure their robustness and reliability. This list of technologies may be updated in newer versions of the Regenerative Standard.

The applicability of a selected technology to measure SOC in a project must be demonstrated in several peer-reviewed scientific articles. Project Proponents should provide evidence of the ability of any emerging technologies to predict SOC content with sufficient accuracy through the development and application of adequate calibration with data obtained from classical laboratory methods, such as dry combustion. The site characteristics for the underlying calibration must match the project site conditions, including a range of SOC stocks, soil types, land use, etc. While projects may use the services of companies measuring SOC, the specificities of the applied measurement technology, including calibration methods, must be made available for review by a VVB. They must not have restricted access to intellectual property rights.

Table A.2 below presents potential emerging proximal sensing technologies that research and publications have deemed promising for streamlining SOC measurement. Although proximal sensing techniques may not be as precise per individual measurement compared to conventional analytical laboratory methods, e.g., dry combustion, proximal sensing may be more cost-efficient and provide a better balance between accuracy and cost. Hence, although each individual measurement may be less accurate, many more measurements can be made across time and space than would be feasible with conventional methods, enabling an overall estimate of carbon stock that is of similar or better accuracy than lower-density sampling that is measured with conventional analytical laboratory methods. Since many more proximal devices may be used in a project than would be used if all samples were sent to a single lab, care must be taken to demonstrate device-to-device calibration and precision.

Project Proponents must provide details to the VVB on the criteria and considerations of the emerging SOC measurement technology as specified in Table A.2. Projects should maintain adherence to these criteria over time to ensure that measurement and re-measurement are conducted under the same conditions and are thus comparable. While the focus is on proximal sensing, the Regenerative Standard is tracking developments related to remote (e.g., satellite) sensing of SOC stocks. Future revisions to this appendix may include guidance on using remote sensing for direct SOC measurement if that technology is demonstrated as scientifically credible.

Table A.2 Criteria to evaluate the use of emerging technologies based on proximal sensing to measure SOC content

Method	Criteria and considerations to ensure robustness and reliability

Inelastic neutron scattering (INS) aka neutron-stimulated gamma-ray analysis or spectroscopy	● If carbonates are present (calcareous or limed soils), inorganic C must be separately accounted for. ● Inorganic gamma scintillators (detectors based on the sodium iodide NaI(Tl), bismuth germinate BGO, and lanthanum bromide LaBr3(Ce)) are better suited due to their higher efficiency of registering gamma rays in the energy range up to 12 MeV. ● Pulsed Fast/Thermal Neutron Analysis (PFTNA) is the most suitable for soil neutron-gamma analysis. It allows separating the gamma-ray spectrum due to INS reactions from the thermal neutron capture and the delay activation reaction spectra. ● Locally adapted calibration procedures must be included in the project documentation for VVB review.
Laser-induced breakdown spectroscopy (LIBS)	● Soil samples must be dried for at least 24h at 40°C. ● If carbonates are present (calcareous or limed soils), samples must be acid-washed. ● Soil samples must be milled for homogenization and particle size reduction to facilitate the evaporation and atomization process in the plasma. ● Before analysis, soil material must be pressed to form a pellet with a flat surface. ● When measuring directly in the field (in-situ), appropriate corrections to remove soil moisture and further matrix effects must be applied. ● The configuration of the LIBS instrumental parameters should be optimized for each matrix. The laser pulse energy and the diameter of the laser beam (i.e., spot size) should be monitored simultaneously in the laser pulse fluence term (laser pulse energy per unit area, J cm-2) as well as delay time, laser repetition rate, etc. ● Projects may rely on chemometric methods for signal analysis, spectral preprocessing, and subsequent data processing and interpretation, including reducing matrix effects. ● A description of the locally adapted calibration procedures must be included in the project documentation for VVB review. Multiple linear regression has proven to be an effective calibration strategy to tackle interference in soil carbon analysis. Further "non-traditional calibration strategies" as described in Fernandes Andrade, Pereira-Filho and Amarasiriwardena, 2021 and Costa et al., 2020 may be applied, which explore the plasma physicochemical properties, the use of analyte emission lines/transition energies with different sensitivities, the accumulated signal intensities, and multiple standards to obtain a linear model or calibration curve. ● Multiple laser shots per sample may improve the measurement results.
Mid-infrared (MIR) and visible near-infrared (Vis-NIR and NIR)	● For MIR and NIR, soil samples must be air or oven-dried, crushed or sieved to a size fraction smaller than 2 mm, avoiding preferential

spectroscopy, including diffuse reflectance spectroscopy (DRS) and diffuse reflectance infrared Fourier transform (DRIFT) measurements	sieving. ● When measuring directly in the field (in-situ), appropriate corrections to remove soil moisture and further matrix effects must be applied. ● The applied spectrometer should have a spectral resolution of 10 nm or less across the visible and near-infrared range (between 400 and 2500 nm), and spectra should be recorded in this range at 1 nm intervals. ● Measurement protocols should be used when available, such as the Standard Operating Procedures of the Soil-Plant Spectral Diagnostics Laboratory of World Agroforestry Centre (ICRAF) ● Calibration through multivariate statistics or machine-learning algorithms has been performed using large spectral libraries, such as the African ICRAF-ISRIC Soil Spectra Library, the multispectral data collected in the European LUCAS topsoil database, the USDA NRCS (KSSL) National Soil Survey Center mid-infrared spectral library or the Australian soil visible near-infrared spectroscopic database described in (Viscarra Rossel and Webster, 2012), or new site-specific libraries developed with local soil samples (higher accuracy). Sub-setting or stratifying the dataset can provide better calibration results. See (England and Viscarra Rossel, 2018) and (Stevens et al., 2013) for further guidance on calibration techniques and spectroscopic model development and validation. ● Calibration procedures must be included in the project documentation for VVB review.

The following scientific publications provide more details and further guidance on the application of the above-listed technologies to measure SOC:

INS

Izaurralde, R. C. et al. (2013) 'Evaluation of Three Field-Based Methods for Quantifying Soil Carbon', PLOS ONE, 8(1), p. e55560. doi: 10.1371/journal.pone.0055560.

Kavetskiy, A. et al. (2017) 'Neutron-Stimulated Gamma Ray Analysis of Soil', in New Insights on Gamma Rays. Intech Open. Available at: https://www.intechopen.com/books/new-insights-on-gammarays/neutron-stimulated-gamma-ray-analysis-of-soil.

Yakubova, G. et al. (2019) 'Application of Neutron-Gamma Analysis for Determining Compost C/N Ratio', Compost Science & Utilization, 27(3), pp. 146–160. doi: 10.1080/1065657X.2019.1630339.

LIBS

Costa, V. C. et al. (2020) 'Calibration Strategies Applied to Laser-Induced Breakdown Spectroscopy: A Critical Review of Advances and Challenges', 31(12). doi: https://doi.org/10.21577/0103-5053.20200175.

Fernandes Andrade, D., Pereira-Filho, E. R. and Amarasiriwardena, D. (2021) ‘Current trends in laserinduced breakdown spectroscopy: a tutorial review’, Applied Spectroscopy Reviews, 56(2), pp. 98–114. doi: 10.1080/05704928.2020.1739063.

Senesi, G. S. and Senesi, N. (2016) ‘Laser-induced breakdown spectroscopy (LIBS) to measure quantitatively soil carbon with emphasis on soil organic carbon. A review’, Analytica Chimica Acta, 938, pp. 7–17. doi: 10.1016/j.aca.2016.07.039.

MIR and (Vis-)NIR, incl. DR and DRIFT spectroscopy

Barthès, B. G. and Chotte, J.-L. (2021) ‘Infrared spectroscopy approaches support soil organic carbon estimations to evaluate land degradation’, Land Degradation & Development, 32(1), pp. 310–322. doi: 10.1002/ldr.3718.

Dangal, Shree R.S., Jonathan Sanderman, Skye Wills, and Leonardo Ramirez-Lopez. 2019. "Accurate and Precise Prediction of Soil Properties from a Large Mid-Infrared Spectral Library" Soil Systems 3, no. 1: 11. https://doi.org/10.3390/soilsystems3010011

England, J. R. and Viscarra Rossel, R. A. (2018) ‘Proximal sensing for soil carbon accounting’, SOIL, 4(2), pp. 101–122. doi: 10.5194/soil-4-101-2018.

Ng, W., Minasny, B., Jones, E. and McBratney, A. (2022) ‘To spike or to localize? Strategies to improve the prediction of local soil properties using regional spectral library’, Geoderma, 406, https://doi.org/10.1016/j.geoderma.2021.115501

Nocita, M. et al. (2015) ‘Chapter Four - Soil Spectroscopy: An Alternative to Wet Chemistry for Soil Monitoring’, in Sparks, D. L. (ed.) Advances in Agronomy. Academic Press, pp. 139–159. doi: 10.1016/bs.agron.2015.02.002.

Reeves, J. B. (2010) ‘Near- versus mid-infrared diffuse reflectance spectroscopy for soil analysis emphasizing carbon and laboratory versus on-site analysis: Where are we and what needs to be done?’, Geoderma, 158(1), pp. 3–14. doi: 10.1016/j.geoderma.2009.04.005.

Sanderman J, Savage K,Dangal SRS. Mid-infrared spectroscopy for prediction of soil health indicators in the United States. Soil Sci.Soc. Am. J. 2020;84:251–261.https://doi.org/10.1002/saj2.20009

Seybold, C.A., et al., ‘Application of Mid-Infrared Spectroscopy in Soil Survey’, Soil Sci.Soc. Am. J. 2019; 83: 1746-1759. https://doi.org/10.2136/sssaj2019.06.0205

Stevens, A. et al. (2013) ‘Prediction of Soil Organic Carbon at the European Scale by Visible and Near InfraRed Reflectance Spectroscopy’, PLOS ONE, 8(6), p. e66409. doi: 10.1371/journal.pone.0066409.

Viscarra Rossel, R. A. et al. (2016) ‘A global spectral library to characterize the world’s soil’, EarthScience Reviews, 155, pp. 198–230. doi: 10.1016/j.earscirev.2016.01.012.

Viscarra Rossel, R. A. and Webster, R. (2012) ‘Predicting soil properties from the Australian soil visible–near-infrared spectroscopic database’, European Journal of Soil Science, 63(6), pp. 848–860. doi: 10.1111/j.1365-2389.2012.01495.x.