CLIMATE ACTION RESERVE

Soil Enrichment Protocol V1.0

Workgroup Meeting 1
February 6, 2020

Purpose

- To familiarize workgroup members with offset protocol development process – what we typically want in an offset protocol
- To present and solicit feedback from workgroup members on key considerations for the Soil Enrichment Protocol Version 1.0

- *In the interest of transparency, the Reserve would like to note that Indigo Ag has provided financial support for this protocol development process*

Housekeeping

- Workgroup members have the opportunity to actively participate throughout the meeting
  - Ask that you keep yourselves muted unless / until would like to speak
- We will ask and take questions throughout the session
- All other attendees/observers are in listen-only mode
- Observers are free to submit questions in the GoToWebinar question box
- We will follow up via email to answer any questions not addressed during the meeting
- The slides and a recording of the presentation will be posted online

Agenda

I. Introductions

II. Process Overview

III. Protocol Considerations:

   a) Eligibility

      a) Ownership / Permanence / Aggregation

      b) Additionality

   b) Defining GHG boundary

   c) Quantification

   d) Monitoring / Reporting / Verification

IV. Open Discussion

V. Next Steps

INTRODUCTIONS

Introductions

Reserve Staff:

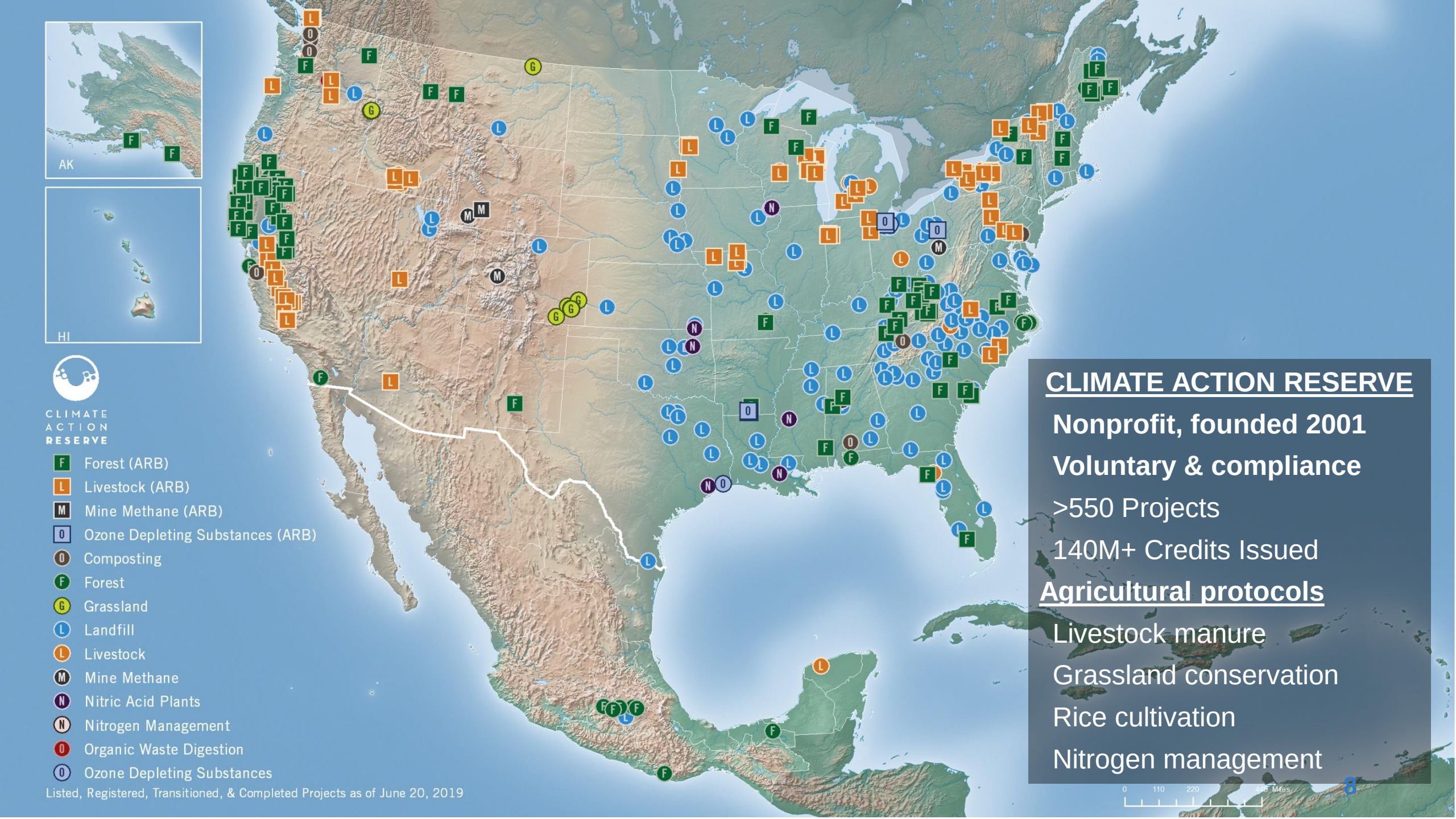
- Sami Osman, Senior Policy Manager
  - Protocol development lead
- Heather Raven, Senior Project Coordinator
  - Development process coordinator

Workgroup members

- will go through list in moment
- will not ask people to introduce themselves
- if/when anyone chooses to speak, please state your name / org

Climate Action Reserve

- Mission: to develop, promote and support innovative, credible market-based climate change solutions that benefit economies, ecosystems and society
- Develop high-quality, stakeholder-driven, standardized carbon offset project protocols across North America
- Accredited Offset Project Registry under the California cap-and-trade program
- Serve compliance and voluntary carbon markets
- Reputation for integrity and experience in providing best-in-class registry services for offset markets
- Based in Los Angeles, CA



CLIMATE ACTION RESERVE

Nonprofit, founded 2001

Voluntary & compliance

>550 Projects

140M+ Credits Issued

Agricultural protocols

Livestock manure

Grassland conservation

Rice cultivation

Nitrogen management

Workgroup Members

Name (alphabetical)	Organization
Adam Chambers	USDA Natural Resources Conservation Service
Amrith Gunasekara	California Department of Food & Agriculture
Dan Kammen	UC Berkeley
Dorn Cox	Wolfe's Neck Center for Agriculture & the Environment
Christian Davies	Shell
Jacqueline Gehrig-Fasel	TREES Consulting LLC
Grayson Badgley	Columbia University

Workgroup Members

Name (alphabetical)	Organization
Jon Sanderman	Woods Hole Research Center
Justin Allen	Salk Institute of Biological Studies
Karen Haugen-Kozyra	Viresco Solutions
Keith Paustian	Colorado State University
Ken Newcombe	C-Quest Capital
Matt Ramlow	World Resources Institute
Max DuBuisson	Indigo Ag
Mitchell Hora	ContinuumAg LLC

Workgroup Members

Name (alphabetical)	Organization
Nicholas Goeser	Alliance of Crop, Soil and Environmental Science Societies
Patrick Splichal	SES, Inc.
Robert Parkhurst	Sierra View Consulting
Stephen Wood	The Nature Conservancy
Tom Cannon	Goodson Ranch
Tom Stoddard	NativeEnergy
William Schleizer	Delta Institute

PROCESS OVERVIEW

Protocol Development Overview

- **GOAL**: To create a robust Soil Enrichment Protocol that provides best practices for GHG accounting, in particular for increases in soil organic carbon stocks, and changes in other GHGs, in order to generate Climate Reserve Tonnes (CRTs)
  - Adhere to high quality offset criteria and Reserve's principles
  - Leverage lessons learned from emerging technologies, other offset protocols and projects, other regulatory programs, other conservation programs
  - Solicit and incorporate expert stakeholder feedback

Protocol Components

- Eligibility
  - Defining the project
  - Ownership / Permanence / Aggregation
  - Additionality
    - Performance Standard Test
    - Legal Requirement Test
  - Start Date / Crediting period
  - Regulatory compliance
- Defining GHG boundary
- Quantification
  - Setting baseline
  - Quantifying project emissions
    - Biogeochemical models
    - Emission factors
    - Direct measurement
  - Sampling
  - CO_2
  - Leakage
- Monitoring / Reporting / Verification

Protocol Development Timeline

1. Scoping meeting (*January 15, 2020*)
2. Workgroup process (*Jan – Feb 2020*)
   - Formation (*Jan 2020*)
   - Meeting 1 (*today – Feb 6, 2020*)
   - Meeting 2 (*late Feb 2020*)
   - Meeting 3 *(NACW April 2, 2020 – tentative)*
3. 30-day public comment period (*Apr – May 2020*)
4. Board adoption *(Jun 10, 2020)*

~ 5 months

Timeline Process Detail

	Jan	Feb	Mar	Apr	May	Jun
Public webinar	**15th**					
Workgroup formation						
1st workgroup meeting (webinar)		**5th**				
Drafting/content development						
2nd workgroup meeting (webinar)		**~26th**				
Drafting/content development						
Deliver workgroup draft for review						
3rd workgroup meeting (in person)			**~30th**			
Workgroup review & comment on draft (1-2 wks)						
Staff revisions based on feedback						
Public comment period & webinar (~30 days)						
Staff revisions based on feedback						
Internal reviews/formatting						
Deliver Board draft						
Public Board meeting						**10th**

Workgroup members to provide input and engagement throughout the drafting process

Reserve staff role:

- Manage the development process
- Schedule and hold meetings (~2-3)
- Identify and solicit feedback on specific protocol criteria
- Produce draft protocol for review
- Revise protocol based on feedback

Workgroup role:

- Attend all (~2-3) workgroup sessions
- Be active participants: provide input and ask questions on protocol concepts and language
- After meetings, share additional input and expertise as needed
- Review draft protocol and provide written feedback to Reserve staff

Workgroup Process and Expectations

Process:

- **Consider splitting WG into specific subject matter groups**
- Hold 2-3 workgroup meetings
- Reserve staff identify and solicit feedback on specific protocol criteria
  - **Specific questions for WG will be highlighted in red**
- Reserve staff will share draft protocol with WG

Expectations:

- Review, comment on and provide recommendations on specific protocol criteria
- Participate in meetings via webinar
- Provide written comments on draft protocol
- Be constructive, collaborative, and productive

OVERVIEW OF PROPOSED APPROACH

Key Steps for Generating Agricultural Carbon Credits

1. Growers enroll in carbon offset program
2. Baseline is established
3. Farmers are supported in transitioning to regenerative practices
4. Data is collected manually and automatically
5. GHG abatement and soil carbon sequestration quantified through model
6. Emission reductions are verified & offsets issued
7. Offsets are sold
8. Value of offset is transferred to grower

Proposed program has differentiators that will enable impact at scale

CLIMATE ACTION RESERVE

Advanced technology

- **Sampling + modelling** seeking greater accuracy at lower cost
- **Aggregated strata** allows sampling only for representative growers

Universal accounting

- Methodology should cover all GHG emission **sources and sinks**

Simplified additionality

- Establishing additionality on basis of **practice change**

Scalable globally

- **Remote monitoring** allows us to collect detailed practice data

PROTOCOL CONSIDERATIONS

Protocol Components

- Eligibility
  - Defining the project
  - Ownership / Permanence / Aggregation
  - Additionality
    - Performance Standard Test
    - Legal Requirement Test
  - Start Date / Crediting period
  - Regulatory compliance
- Defining GHG boundary
- Quantification
  - Setting baseline
  - CO_2
  - Quantifying project emissions
    - Sampling
    - Direct measurements
    - Biogeochemical models
    - Emission factors
  - Leakage
- Monitoring / Reporting / Verification

ELIGIBILITY

Project Definition

Key applicability conditions

- Protocol to include a **wide range of activities** that result in sequestration and/or avoided emissions on agricultural land
- Land is either **cropland or grassland** at the start of the project
- The project activity does not decrease carbon stocks in **woody perennials**

Major practices

No or reduced tillage

Crop rotation

Cover crops

Reduced inputs

Integration of livestock

Other practices we may explore

- Biochar
- Woody biomass

Proposed Eligibility Requirements

- Location
  - Areas where the chosen model has been validated and for which there is sufficient data to generate sufficiently accurate results
- Legal requirement test
  - Project activities must not be mandated
- Regulatory compliance
  - Project activities do not violate applicable regulations
- Choice of model for quantification
- Performance standard test
  - *To be discussed in more detail in the additionality section*

Project Definition

- Eligible ***Activities / practices:*** At outset will focus primarily on various regenerative practices relating to cropping:
  - Cover crops - Tillage practices - Incorporating livestock - Fertilizer use efficiency - Irrigation practices
- Eligible ***Location(s):*** geographical areas that are eligible - At outset will focus on the US
- Eligible ***Crops:*** consider all crops at outset

Project Definition

Eligible activities / practices / locations / crops - determined by:

1. Directional certainty of positive GHG impacts (i.e., reductions or sequestration)
   - Based on literature and database reviews
2. Tests for additionality; and
3. Capabilities of an applicable quantification approach

Project Definition

- **Can or should we try to prescribe what is eligible in form of *positive list* of specifically eligible activities / practices / locations / crops?**
- Why would we want to create positive list?
  - Pros: Gives verifiers greater certainty, simplifies verification - can reduce costs
  - Cons: project developers want greater flexibility
- Could publish positive list on Reserve website – update periodically outside of formal protocol update process
- Could simply direct PDs seek confirmation from Reserve whether combination is eligible
- Could simply direct PDs to demonstrate eligibility to verifier each reporting period

Proposed Eligible Activities

Cash crop planting

- Continuous Cash Crop (Monoculture)
- Rotational Cash Crop
- Continuous Cash Crop with Cover Crop
- Rotational Cash Crop with Cover Crop
- Continuous Cash Crop planting into living cover crop
- Rotational Cash Crop planting into living cover crop
- Relay Cropping
- Companion or Intercropping of cover crop with cash crop during the same growing season

Cover crop planting

- Plant cover crops, annual
- Plant cover crops, perennial
- Plant leguminous cover crops, annual
- Plant leguminous cover crops, perennial
- Plant multi-species blend cover crops, annual
- Plant multi-species blend cover crops, perennial
- Interseeding cover crops, annual/perennial
- Interseeding leguminous cover crops, annual/ perennial
- Interseeding multi-species blend cover crops, annual/perennial

Tillage

- Moldboard (2-10”)
- Disk/chisel (2-10”), <50% residue remaining (soil armor)
- Disk/chisel (2-10”), >50% residue remaining
- Vertical tillage (1-2”), <50% residue remaining
- Vertical tillage (1-2”), >50% residue remaining
- Strip till, <50% residue remaining
- Strip till, >50% residue remaining
- No-till
- Continuous no-till (no tillage in last full year)

Incorporate livestock

- Stock pasture
- Rotational pasture
- Multi-species rotational pasture

Fertilizer

- Synthetic fertilizer without optimization
  Synthetic fertilizer: Optimize application or practice split application, surface-applied or broadcast
- Synthetic fertilizer: Optimize application or practice split application, and apply subsurface or with controlled-release (nitrogen stabilizer)
- Use non-synthetic fertilizers

Irrigation

- Flood irrigation
- Standard irrigation (defined as >X gallons/acre)
- Precision irrigation (defined as <X gallons/acre)
- No irrigation
- RICE ONLY: Minimize annual flood days (<X days/year)

This list will adapt and change as we learn and identify new practices that sequester carbon

Eligibility: Model Requirements

The protocol may not mandate the use of any specific soil biogeochemical model, but models should meet the following conditions:

- Publicly-available
- Peer-reviewed
- Validated with direct measurement data from the IPCC climate zone where the project is located

The **same model** should be used in both the project and baseline scenarios

OWNERSHIP / AGGREGATION / PERMANENCE

Ownership

Ownership = person with right to implement project = person issued offset credits

- Presume person with right to farm the land has right to implement the project
- Avoid requiring proof of title to land or permission of landholder – though proof of landholder permission / participation could lower risk
- Try use simple agreements between various parties –where possible – including landholder
- Consider other measures including insurance

Overview: Aggregation

Definition	An approach to combining multiple actors, activities, and locations into a single “project” for the purposes of monitoring, reporting, verification, and credit issuance.

Proposed approach	• “Unlimited” aggregation approach whereby a single project may contain multiple growers with multiple fields • Fields and growers may enter and leave over time

	Feature	Details
Key program features	**Scale**	Agricultural land management projects are likely not feasible on individual farms due to high costs (e.g., project development, paperwork / compliance, and verification) to return ratio
	Efficiency	A single aggregator may bring systems to bear that reduce the cost and effort required for each individual field, including reducing the number of fields that require soil sampling
	Accuracy	Aggregation may allow for more samples and more data to be used in the project modeling, improving the accuracy of the results.

Propose using an aggregated project approach vs. an individual project approach to realize scale benefits

Proposed path forward – focus on next slide

	Individual project	Aggregated project
Description	• Each participant records project activities as part of discrete projects	• Multiple participants and project activities are combined into a single project
Adding new participants	• New participants generate new, separate projects	• New participants can be added to existing projects
Quantification	• Quantification of carbon benefits is done for each participant	• Quantification done for the whole group
Credit issuances	• Credits are issued to each individual participant • Multiple monitoring reports / verifications needed	• Credits issued as a batch to the grouped project • Only one monitoring report / verification needed

Several Aggregation Approaches Considered

Aggregation approaches	*Description*	*Pros*	*Cons*
Limited aggregation approach ("cooperative" approach)	• Allow for multiple eligible fields / farms to come together as a group of projects undergoing MRV together	• Some efficiency of cost and effort • Clear serialization of offsets to individual projects • Generally preferred approach by compliance offset programs	• Every farm listed as a separate project, increasing cost and complexity • Limited achievement of potential efficiencies
Unlimited aggregation approach	• No limits on how many eligible fields / farms – different eligible crops or practices – different eligible locations – can come together in single project	• Maximum achievement of cost efficiency • Enhanced ability to manage risk • Greatest flexibility for the market	• More regulatory socialization necessary before future adoption by compliance offset programs

Proposal: Unlimited aggregation approach

Aggregation

- **Aggregation** = bringing together multiple farms for improved efficiency
  - ***Why consider aggregation?*** Transaction costs associated with developing offset projects typically make small projects cost-prohibitive – thus ***aggregation*** facilitates grouping multiple farms into more cost-effective projects
  - Spectrum of approaches available:
    - ***Traditional aggregation or cooperative approach:*** allow for multiple eligible fields/farms to come together as a group of projects undergoing MRV together – may include additional benefits
      - Reserve voluntary forest protocol – Reserve voluntary grassland protocol
    - ***Limited single-project approach:*** allow for multiple eligible fields/farms to come together in a single project with some limitations (e.g., grouped by geography or other common theme)
      - California's compliance forest protocol
    - ***Unlimited single-project approach:*** no limits on how many eligible fields/farms – different eligible crops or practices – different eligible locations – can come together in single project
      - Reserve's voluntary nitrogen management protocol

Proposed approach

Aggregation Approaches

- Traditional aggregation approach: Reserve's voluntary forest protocols
  - Forest "aggregates": multiple projects may group together for verification, with some benefits to monitoring
    - Projects must be individually eligible and maintain separate accounts with separate data
    - Limited to projects less than 10,000 acres individually
    - Fewer sample plots are required to generate an inventory of sufficient statistical certainty – allowable standard error for an individual project changes depending on the number of projects in the aggregate
      - If a project leaves the aggregate, a replacement project must be added, or the statistical target is adjusted

Aggregation Approaches

- Traditional aggregation approach: Reserve's voluntary forest protocols
  - Non-aggregated forest projects target +/- 5% at the 90 percent confidence level
  - Forest aggregate target sampling errors:

Table 2.1. Target Sampling Error at the 90 Percent Confidence Level for Projects Participating in an Aggregate

Number of Participating Projects in the Aggregate	Target Sampling Error (TSE)
2	7%
3	8%
4	9%
5	10%
6	11%
7	12%
8	13%
9	14%
10	15%
11	16%
12	17%
13	18%
14	19%
15+	20%

Aggregation Approaches

- Limited aggregation approach: Reserve's voluntary forest protocol
  - Forest "aggregates", continued:
    - Aggregator manages the projects, coordinates verification schedules, etc.
    - Projects in an aggregate have the added benefit of less-frequent site visits
      - When a site visit is required (six year intervals), the verifiers randomly select 50% of the projects, whereas - as individual - % of the projects in the aggregate would have been required to hold a site visit that year
        - » The next time site visits are required, the other 50% are chosen so that all are verified by year 12
      - Between site visits, verification bodies randomly select projects for desk audits
        - » equal to the square root of the total number of projects, or one-twelfth of the total projects, whichever is higher

Aggregation Approaches

- Traditional cooperative approach: voluntary Reserve protocols
  - Grassland “cooperatives”: administrative grouping of two or more projects that verify together, on the same schedule
    - Like forest aggregation, projects must be individually eligible with separate data
  - Nitrogen management “cooperatives”: multiple projects may be managed together as a cooperative
    - There is no functional advantage for a NM cooperative vs. an individual project with multiple fields, but Project Developers have this option for administrative purposes

Aggregation Approaches

- Unlimited single-project approach: Reserve's voluntary nitrogen management protocol:
  - a single project with a single project developer may include multiple fields with multiple owners, across multiple eligible regions, employing multiple eligible activities / practices / crops
  - no size limitations or eligible activities / practices / regions / crops

Aggregation Approaches

- Limited single-project approach: CA compliance forest protocol
  - Does not formally acknowledge ‘aggregation,’ but some market participants refer to it in this way
  - ARB did not adopt the approach in Reserve forest protocol
    - no adjusted TSE
    - no changes to the verification schedule
  - Forest protocol does allow multiple forest owners to enter into a single project together
    - All owners are liable for all parts of the project
    - This creates risk – if Owner A causes an avoidable reversal, Owner B is now equally liable to compensate – so participants must craft their contracts/project agreements carefully

Permanence

- **Permanent** = each tCO_2e of sequestered carbon must remain secured for 100 years
  - E.g., credit issued in year 10 is maintained until year 110
- **Reversals**: release of stored carbon that has already been credited
  - **Avoidable reversals**: release that is preventable (i.e., tilling, project termination)
    - Repaid by the Project Developer
  - **Unavoidable reversals**: release that is natural or otherwise out of the control of Project Developer
    - Repaid from the Buffer Pool

Permanence

- **Ensuring permanence – various approaches:**
  - ***Ongoing monitoring*** – project continues to monitor and report to the Reserve for 100 years following credit issuance, demonstrating that the carbon is still sequestered
  - ***Buffer pool contributions*** – each time credits are issued, place % in central pool – pool used to replace unavoidable reversals
  - ***Legal agreements*** – an agreement to the terms of replacing the credits in the case of a reversal, or an agreement to maintain a certain level of sequestered CO_2, often with restrictions registered on title to land (e.g., Project Implementation Agreements, conservation easements)
  - ***Tonne-year accounting*** – issue fewer credits in return for shorter commitment, based on radiative forcing of the GHG (e.g., a 20-year commitment gets 1/5 of credits)
  - ***Insurance*** – a financial product based on an actuarial analysis of project risk that considers circumstances such as the region, threats, and mitigating factors
- Proposed approach: combination of buffer pool contributions – legal agreement with aggregator – ongoing monitoring

Permanence: Buffer Pool

- Reversals may be insured against through a mandatory buffer pool
  - Contributions made based on calculated level of risk
- Buffer pool
  - Identify reversal risk for soil carbon tonnes (% of credits)
  - Shared pool among all soil enrichment projects
  - Contributions not returned to projects
- What are the areas of risk/nature and likelihood of risk for these projects?
- What size buffer pool contributions would be appropriate?
- Discount for geographically dispersed projects?
- Reducing buffer pool contribution over time?

Permanence / Ownership

- *Required for Forest and Grassland projects*
- Project Implementation Agreement (PIA): An agreement between the owner of the emission reductions (Project Operator – forest – or Project Owner - grassland) and the Reserve to maintain the permanence of the project
  - Covers entire project area
  - Recorded with the deed for the property and transfers to subsequent owners (forest or grassland projects); may also be in the form of an executed contract that is not recorded (grassland projects only)
    - An abbreviated “PIA Amendment” is signed each time the project is issued new credits to reaffirm the terms of the original PIA
  - Grasslands – single owner of ERs gets issued credits, and indemnifies Reserve against claims from any other owners
  - Can we avoid encumbrance on land title?
  - Can we have PIA style agreement with single aggregator instead of multiple farmers?

Permanence: Tonne-year Accounting

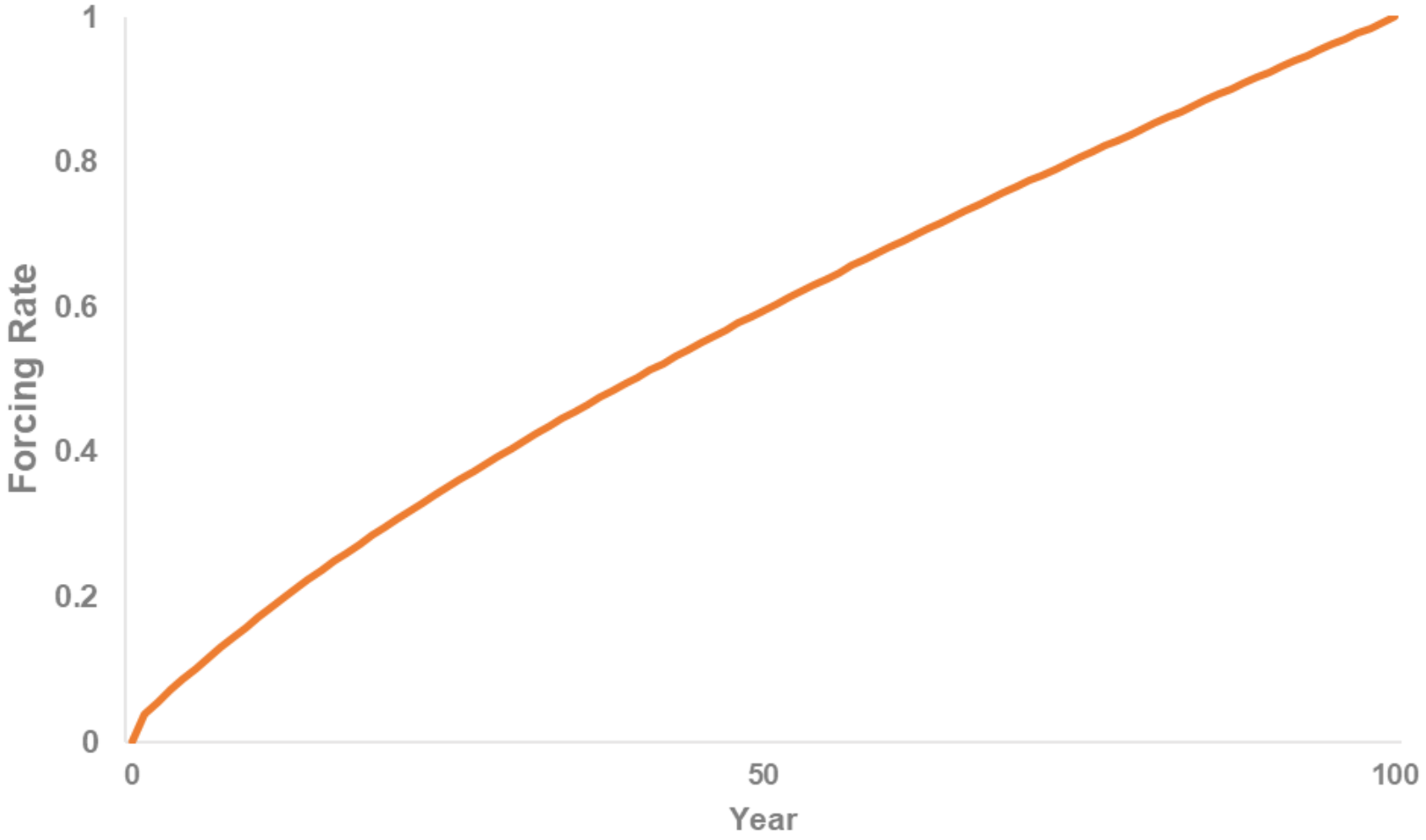
- **"Tonne-tonne" approach**: One CRT emitted for each tCO_2e removed/reduced from the atmosphere for a period of 100 years

- **"Tonne-year":** tCO_2e securely removed/reduced from the atmosphere for a period of time less than 100 years → ***credited based on their atmospheric impact proportionate to the 100 year period***

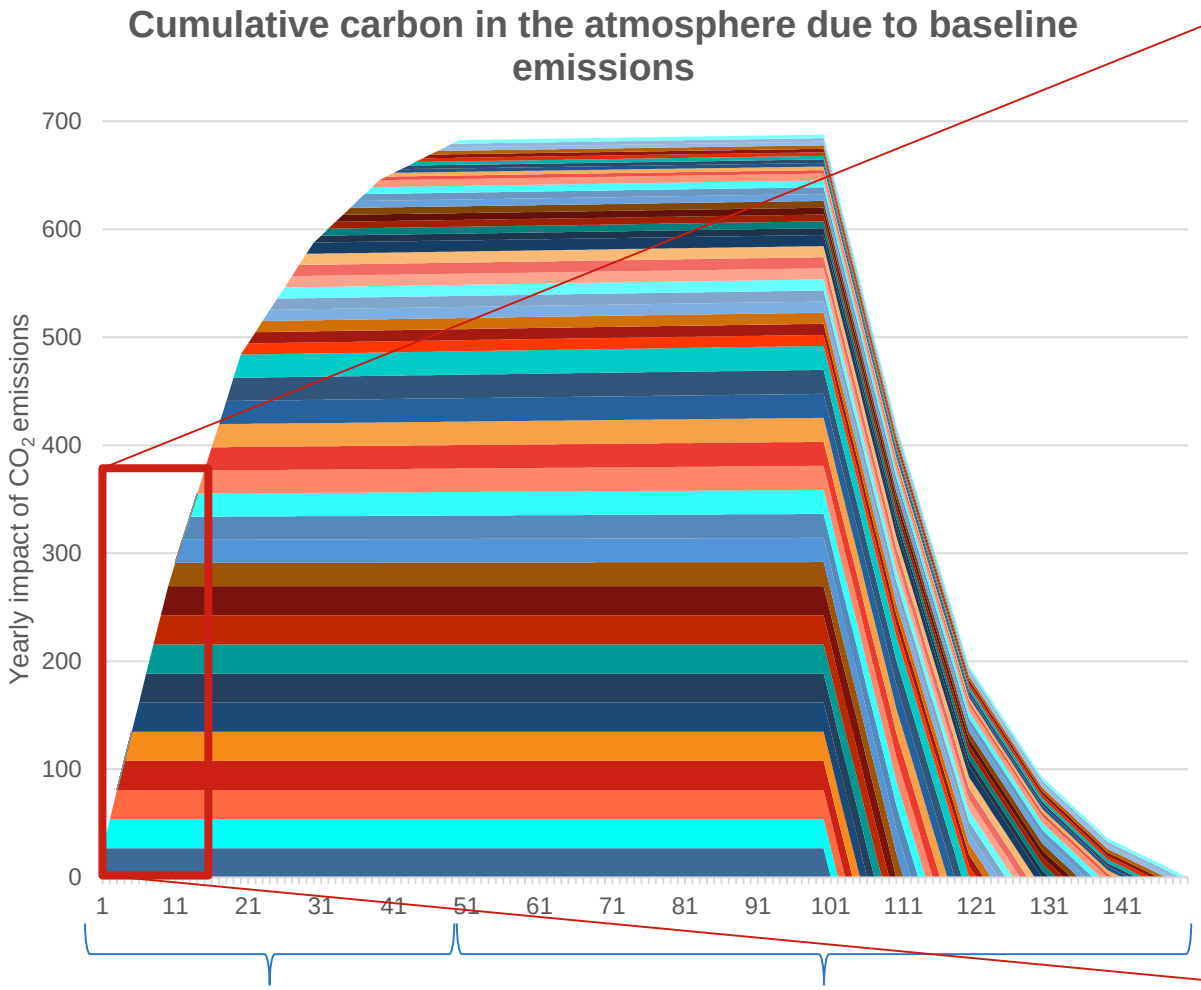
- **Reserve's "Tonne-year" approach:** each tCO_2e removed/reduced from the atmosphere credited roughly 1% per year secured

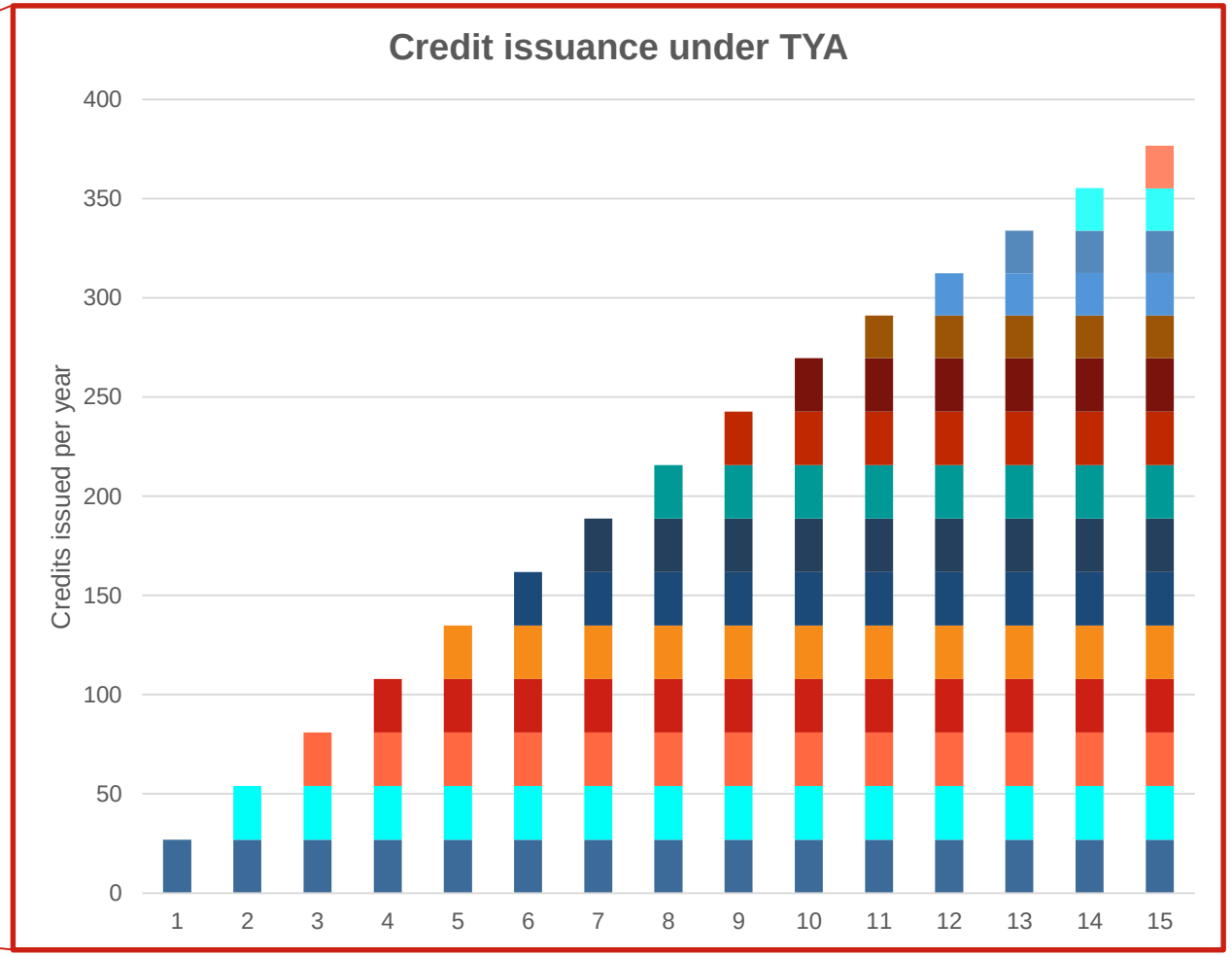
Permanence: Tonne-year Accounting

Radiative forcing of 1 tCO_2e



Tonne-year Accounting Example:
impact of grassland conversion over time





Crediting period Permanence monitoring period

Permanence: Tonne-tonne vs. Tonne-year Accounting

Tonne-tonne	Tonne-year	Hybrid approach
• *Requires long term commitment (PIA)* • *Receive 100% value at time tCO_2e is removed or reduced* • *Regular monitoring and verification costs* • *Credits sent to buffer pool*	• *No long-term commitment from land owner* • *Less credits at beginning of CP* • *Shorter period for monitoring permanence* • *Verification cost only at time of credit issuance*	• *Shorter contracts with tonne-year (commitment determined by landowner)* • *Receive % (proportional to contract length) at time tCO_2e is removed or reduced* • *Regular monitoring and verification costs*

Proposed approach

Permanence: Evaluating Risk

- Are there significant risks of unavoidable reversal with respect to SOC on farms/ranches? Exactly what are they?
- Should we consider eminent domain and/or mining activities unavoidable? Is it reasonable to expect third parties causing such impacts to pay for reversal?
- Is SOC sequestered in deeper layers more stable?
- Do geographically clustered projects represent greater risk?
  - Should we ascribe higher risk rating (i.e., higher buffer pool contributions) for clustered projects? Should we mandate some form of geographical dispersion or allow a lower buffer pool contribution for dispersed projects?
- Does risk of reversal drop over time, as regenerative practices become entrenched?
- Depending on nature of such risks, can also perhaps consider insurance as means to mitigate

START DATE & CREDITING PERIOD

Project Start Date and Crediting Period

- ***Start date*** = date new eligible activities first undertaken
  - Delineates when first credits issued & sets overall *crediting period*
  - Need to balance excluding non-additional actions, whilst not unduly disadvantaging early adopters
  - Can set start date to coincide with development of this protocol – i.e., projects can set start date as early as 2019
  - Perhaps set start date based on the earliest date of the newest eligible activity used to demonstrate additionality
  - Consider giving each project but also each field own start date
    - Fields coming into project after project start date could be given full crediting period

Project Start Date and Crediting Period

- ***Crediting period*** = total period for which project is eligible to receive credits
  - Reserve - typically 10 years per crediting period – renewable once (if still eligible)
    - Typically apply additionality screen again at start of new crediting period – we ask would that project still be considered eligible if submitted as new project at start of 2nd CP
  - Given slow build up of SOC – could consider longer periods
  - Consider conversion of project over to avoided conversion at end of project
    - Estimates for GHG emissions per hectare of urban land in Yolo County are >70 times greater than for irrigated cropland
  - Consider allowing each field to have crediting period, as well as each project to have crediting period

REGULATORY COMPLIANCE

Regulatory Compliance

- Projects must demonstrate no laws broken at/by the project
  - focus on laws relating to environmental & social responsibility
  - focus on formal determinations by regulators – we don't interpret laws
  - focus on substantive problems – not admin failures such as late filing
  - violations of law may result in credits being withheld
- Reserve approach
  - PD must report all regulatory violations to VB – VB reports to Reserve
  - Do violations have sufficient nexus to offset project – agency – causality?
  - Do violations have clear start / end dates?
  - Balance explicit guidance re exactly which laws are relevant with flexibility

Regulatory Compliance

- Questions we typically ask:
  - Has a regulator deemed there to be a violation?
  - Is the violation merely administrative in nature?
  - Did the project equipment or activities directly contribute to the violation?
  - Can this violation be limited temporally?

ADDITIONALITY

Performance Standard Test

- ***Additionality*** – projects must go beyond business as usual
- Reserve favors ***standardized approaches*** to assessing additionality
  - No comprehensive additionality screens applied by PD for each project
  - Instead we do analysis as part of protocol development – reduce burden for projects
- Could develop specific ***positive list*** of eligible practices / activities / crops / locations - based on data on what's common practice in that region
- Alternative – if PD applies one/more new regenerative activity from eligible list – they are deemed additional
  - **Do we have sufficient data to support this simplified contention?**

Legal Requirement Test

- Project activities must not be mandated by laws
- If/when projects mandated by law – either get no more credits – or can only get credited for going beyond what law requires
- Can be applied:
  - Once per crediting period – typically for capital intensive projects
  - Each reporting period
- Few examples in cropping context – typically relate to water quality
  - Nutrients - nutrient management plans mandated in some circumstances – e.g., applying manures from CAFOs, threatened waterways
  - Sediment limits – TMDL – more common in forestry – but also see it in some cropping contexts
  - Riparian buffers

Credit / Payment Stacking

- Where project is able to receive either credits or payments for the same activities for which they receive offset credits – considered *stacking*
- Generally Reserve ok with stacking unless credit / payment is specifically for GHG benefits
- Reserve typically does extensive research to identify potential stacking risks – identify complementary programs – research program rules – identify specific risks either our program or other program will prohibit stacking
- Simple alternative is not to do that – simply point out to other parties PD/VB needs to report such instances to Reserve and where there is risk of stacking related to GHG benefits – may not get offsets

GHG ASSESSMENT BOUNDARY

The GHG Assessment Boundary

SSR	Description	Included Gas(es)	Baseline (B) or Project (P)	Quantification Method*
1	Soil organic carbon	CO_2	B, P	Soil measurements; Biogeochemical model
2	Soil respiration	CO_2, CH_4, N_2O	B, P	Biogeochemical model
3	Manure deposition	CH_4, N_2O	B, P	Biogeochemical model Default emission factors
4	Nitrogen inputs	N_2O	B, P	Biogeochemical model Default emission factors
5	Biomass burning	CO_2, CH_4, N_2O	B, P	Default emission factors
6	Fossil fuel use	CO_2	B, P	Default emission factors

*proposed

- Are any SSRs missing from this table that should be included?
- Are any SSRs included in this table that should *not* be included?

QUANTIFICATION

Overview: Quantification

Definition	Quantification describes the approach by which the project measures the carbon benefit over the business as usual scenario

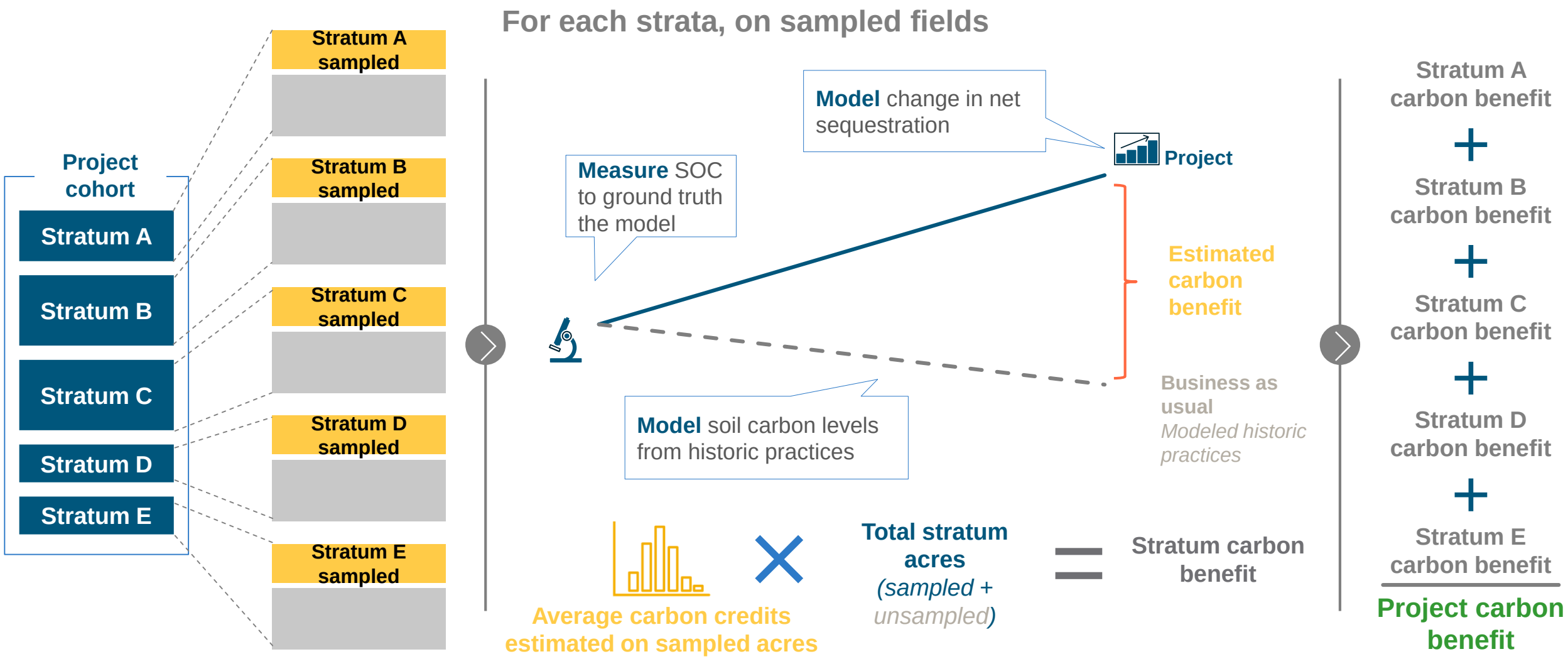
Proposed approach	• Measure + model approach that credits a wide range of practices

	Feature	Details
Key program features	**Modeling approach with measured "true-ups"**	Monitoring can be performed using either a model or a soil measurement; direct measurements required every 5 years to ensure accuracy
	Comprehensive data collection	Growers are asked to provide detailed current and historical management data; participation is maximized by allowing for many forms of evidence
	Project stratification	Acres grouped by common characteristics in order to reduce variability and reduce uncertainty while allowing for scalability
	Soil sampling	Soil sampling performed using a randomized approach

Typical Reserve Quantification Approach

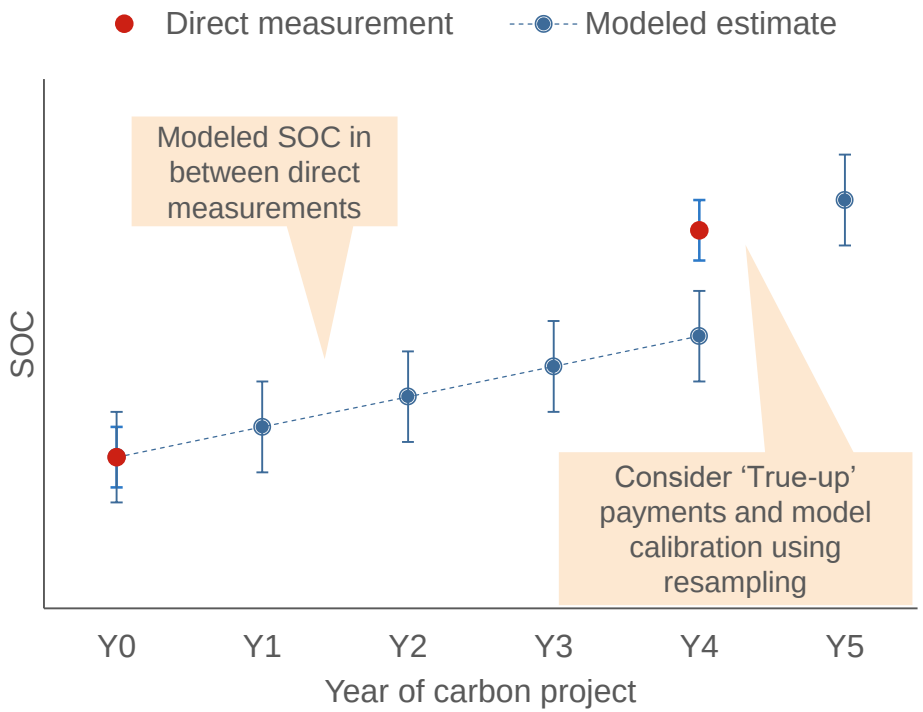
- Estimate baseline emissions
- Estimate project scenario emissions
- Emission reductions = baseline minus project

Quantification: Overview of Approach



Quantification: Direct soil measurements could be used to "true up" modelled results

Proposed soil carbon quantification protocol



Measure baseline	○ **Measure SOC** within first enrolled year ○ **Collect management practices** for use in forecasts
Model sequestration	○ **Identify target practices** to be implemented in project ○ **Predict annual changes** to enable annual crediting
Verify sequestration	○ **Resample** SOC at least every *5* years ○ **Consider 'True-up'** crediting where model underestimated ○ **Calibrate predictions** using sample results

Baseline Setting

- Several approaches used across existing SOC methods & other protocol types

IA's preferred approach

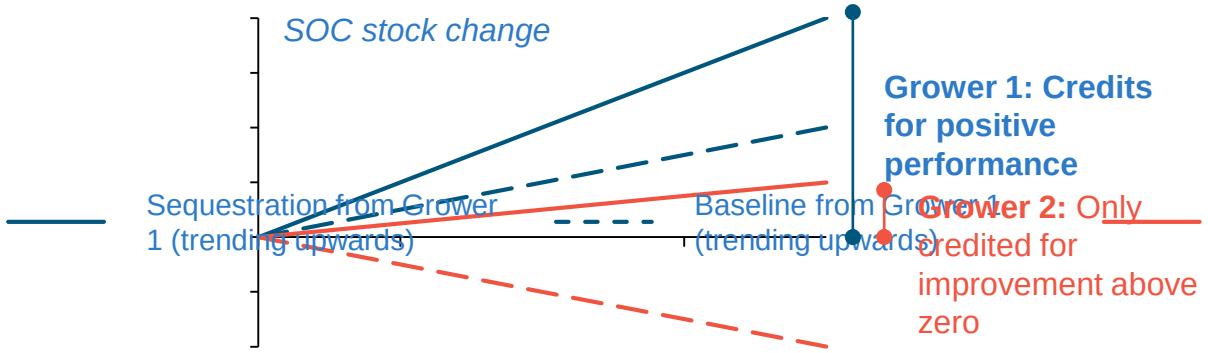
  - Single point-in-time measurement of pool at project start
  - Detailed modelling of baseline SOC pool for crediting period based on baseline management practices

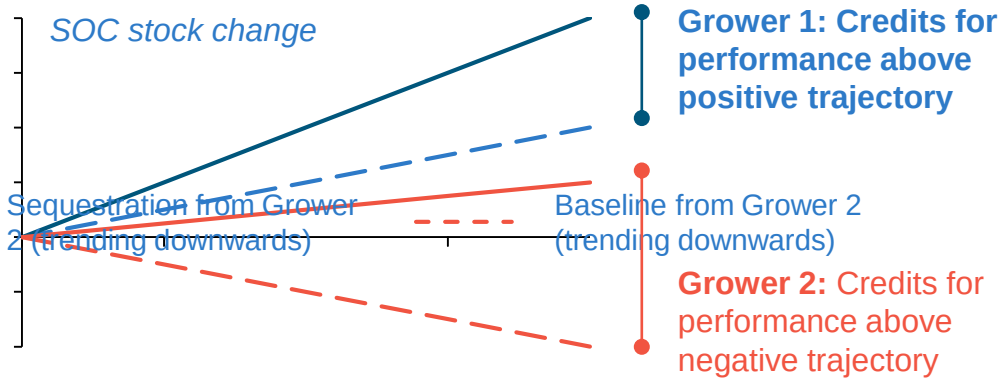
  - Establishment of baseline SOC trend based on measurement at two points in time
  - Paired SOC measurement at "control" properties as proxy for baseline conditions in project area

- Is point-in-time approach only suitable where given field not already using regenerative practices at field start date?
- Typically Reserve protocols requires at least 3 years of average data for given parameter if developing single point-in-time estimates

Options for Individual Baseline

	Point in time measurement	BAU baseline
Description	• Carbon sequestration credited on each sampled field relative to a baseline of carbon stocks at project start	• Business as usual modelled for each sampled field **based on their own historic practices** • Incremental sequestration credited over counterfactual sequestration in absence of practice adoption





CO_2 Emissions

- Must account for increases in CO_2 emissions from increased energy usage (fuels / electricity) – ***unless they are expected to be* de minimis**
  - Could possibly also *optionally* credit for decreases in CO2 emissions
- **Can we ignore CO_2 emissions for being *de minimis*? If no, can we create some standardized assumptions?**
  - Nitrogen management protocol quant for CO_2 and all others SSRs needs to be done for each field
  - ***Conservative* assumptions could streamline:** PD assumes all energy use in project = energy used in baseline;
  - Can we automate data capture – can we do so in way verifier need not worry about accuracy of data?
    - Validated or 3rd party tools – 3rd party corroboration
  - Livestock protocols = relatively hands-off approach – VB asks for available data – if VB convinced of no significant increase in CO_2 – verifiers will say so – programs defer to verifiers

Other GHG Increases?

- Any other increases in GHGs (CH_4 / N_2O) to be expected?
- If changes expected to be insignificant – may be appropriate to ignore – otherwise need to estimate or measure
  - How can we efficiently / conservatively estimate them?
- Another option – exclude the combination in question
  - E.g., adoption of no-till in short term can cause increase in N_2O
  - If can identify specific combinations of region / activity / soil etc. – where expect increase of GHGs – can exclude projects with such combinations

Sampling

- Sampling is employed where full quantification is not feasible due to time or cost
  - Plots are established to take measurements of a subset of the desired pool, and those measurements are expanded based on plot size (and stratum size, if applicable)
- Protocol will typically dictate the standards for sampling:
  - Measurement parameters (e.g., carbon pools, precision, etc.)
  - Size of sample/target sampling error
  - Sampling technique (e.g., equipment, training, etc.)
  - Guidelines around verification of the sample
- In some cases, project developers have latitude to decide on many of the inventory parameters (e.g., for the forest protocol, projects decide: plot size, fixed vs variable radius plots, whether to monument plot center, etc.)

Direct Measurement

- Best way to measure SOC changes = extract samples & lab test
  - Dry combustion = most accurate approach
- ***Challenges:***
  - Time consuming to take samples
  - Need precision re: taking / storing / shipping samples
  - Costly to have lab analyze samples – time consuming
  - Need to minimize number of samples – extrapolate results across homogenous conditions (stratification)

Direct Measurement

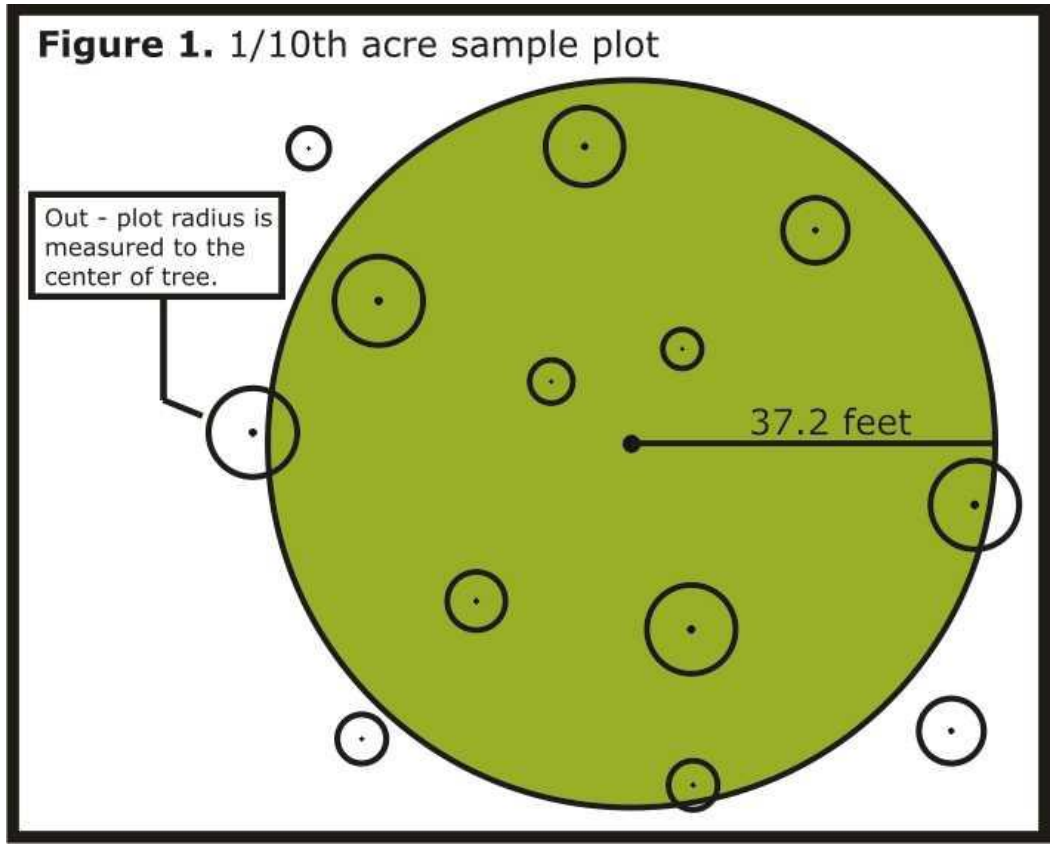
- Typically we'd look to specify and approve specific technologies/approaches
- ***Lab testing methods*** *– Should we prescribe methods or provide guidance for suitable lab analysis for SOC / bulk density testing?*
- ***Approaches other than lab testing*** - Portable spectroscopy / reflectometers / NDVI / other?
    - Yale Quick Carbon portable reflectometers reporting initial accuracy results +/- 0.5% in California – requires pairing analysis with bulk density analyses
- ***Stratification / sampling:***
    - *Minimum accuracy standards?*
    - *Mandated sampling frequency? What triggers the need for new samples (e.g., periodic verifications)?*
    - *Mandated techniques? Requirements or recommendations for establishing plots (e.g., random locations, monumenting plots, etc.)?*
    - *How do we confirm stratification done properly? Do VBs need expertise in cropping / SOC to confirm stratification appropriate?*

Stratification

- *Should there be any minimum stratification requirements?*
- Grassland approach:
  - Strata based on three factors: geography/climate, soil texture, and previous land use, all of which affect baseline emissions
  - Each stratum has its own default emission factors
- VM0032:
  - Stratification may be based on vegetation, management practices, topography, and soil texture
  - Used to help achieve desired confidence for measured approach to SOC (should have reduced variability within strata)

Direct Measurement (FPP V5.0 approach - trees)

- Forest projects employ a randomized or systematic sampling design to measure a selection of trees at plots placed throughout the project area
- If the center of the tree falls within the plot, it is measured for:
  - DBH, height, species, defect/decay
  - Protocol defines which trees are included:
    - Mandatory: “Tree” = > 5 in DBH
    - Optional: “Sapling” => 1 in DBH
    - Mandatory: Dead trees must be at least 15 ft tall



Direct Measurement (FPP V5.0 approach - trees)

- Currently, ground-based sampling is required
- Plots must be no older than 12 years
  - Inventory data maintained by project developer in databases
  - Models grow plots forward until remeasured
- Target sampling error +/- 5% at the 90 percent confidence level
  - Projects that cannot meet this have to take a confidence deduction
  - +/-20% at the 90 percent confidence level = minimum for eligibility
- Verifiers use sequential sampling to check the inventory
  - Taking direct re-measurements on a subset of randomly selected plots
- The Reserve has a Standardized Inventory Methodology with suggestions for best practices in establishing a forest carbon inventory

Direct Measurement (FPP V5.0 approach - soil)

1. Sample for soil organic matter and bulk density
    1. Identify plot locations (randomly, or systematically with a random starting point)
    2. Does not identify number of plots – desired confidence is +/- 20% at the 90 percent confidence level
    3. Eight samples are taken at each plot (4 for soil organic matter, and 4 for bulk density)
    4. Sample depth and other details described in protocol
2. Lab analysis
    1. Requires they be sent to a lab (with experience analyzing soil carbon and physical properties) within 106 hours of sampling
    2. Samples are to be heated to over 1000 degrees Celsius for soil organic matter
    3. Bulk density samples are to be dried at 105 degrees centigrade for at least 48 hours

Direct Measurement (VM0032 Approach)

1. Sample for soil organic matter and bulk density
    1. Permanent sampling stations (plots) within strata
    2. Number of plots calculated using CDM methodological too
        1. desired confidence is +/- 15% at the 95 percent confidence level
    3. 3 or more samples per plot
    4. Sample depth and other details described in protocol
    5. Sufficient time must pass between verifications to detect changes in SOC (at least 5 years, depending on productivity of project area)
2. Lab analysis
    1. Lab may determine SOC and bulk density through combustion or multi-spectral diffraction with a calibrated infrared spectrometer

Direct Measurement: Verification Process

- Determining whether the project estimates are sound (within specified tolerances of the verifier's sample plots)
- T-test or sequential sampling:
  - Paired t-test; paired or unpaired sequential sampling
  - Randomly selected plots (paired s.s.) or placed plots (t-test, unpaired s.s.)
  - The minimum number of plots varies by project size:

Test	Number of Strata Verified	Project Acres				
			<100 – 500	501 - 5,000	5,001 – 10,000	>10,000
Paired/Unpaired	3		3	4	5	6
	2		4	6	8	10
	1		8	10	12	12

Direct Measurement: Verification Process

- Sequential sampling continues until the verifier's and project sample data agree
  - Testing until a stopping rule is reached, rather than a fixed sample size
  - Stopping rules indicate to the verifier to:
    - continue to the next plot(s) since the results do not indicate either a bias or an agreement and further testing is required,
    - stop as the testing indicates a bias, or
    - stop as the testing indicates agreement
- Test applied independently for each carbon pool (e.g., SOC, woody biomass), unless combined pools have a common plot location

Direct Measurement: Verification Process

CLIMATE ACTION RESERVE

Step 1: Ensure Data to be Verified will be a Paired Comparison.

This worksheet is designed for cases in which verifiers can compare their measurements directly to project data. Plots must be relocated for this comparison. Refer to the verification guidelines for details in selecting plots for measurement. If plots cannot be relocated, verifiers must use the Unpaired Unknown-Project worksheet. The worksheet must be used for each carbon pool independently, or combined where allowed, according guidance in the verification section.

Sequential Sampling Worksheet for Verification Inventory where Project Plots are Monumented

Allowance:	10%
Alpha:	0.05
Beta:	0.2
Project/Stratum Mean:	150
Number of Strata Verified:	3
Project Acreage:	5,001 - 10,000
Minimum Number of Passing Plots Needed in Sequence:	5

*or 1st passing plot after 12 measured plots

D0:
D1:
Mean_Diff0:
Mean_Diff1:
Zalpha:
Zbeta:
K:

Plot Pair (n)	Plot Data: Project	Plot Data: Verification	Running Examination/Plot Success	Number of Passing Plots in Sequence	Status of Verification	Y(n)	-K	K	Running Mean	Running SD	n_Threshold
1	140	135	Pass(H0)	1	Verification not Satisfied	5	-9.92	9.92	5.00		
2	100	110	Inconclusive	0	Verification not Satisfied	-10	-9.92	9.92	-2.50	10.61	3.09
3	170	180	Pass(H0)	1	Verification not Satisfied	-10	-9.92	9.92	-5.00	8.66	2.06
4	160	155	Pass(H0)	2	Verification not Satisfied	5	-9.92	9.92	-2.50	8.66	2.06
5	180	170	Pass(H0)	3	Verification not Satisfied	10	-9.92	9.92	0.00	9.35	2.40
6	165	160	Pass(H0)	4	Verification not Satisfied	5	-9.92	9.92	0.83	8.61	2.04
7	115	112	Pass(H0)	5	Verification Successful	3	-9.92	9.92	1.14	7.90	1.72
8							-9.92	9.92			
9							-9.92	9.92			
10							-9.92	9.92			

Modeling: Two approaches to model carbon benefits in the project

	Biogeochemical model	Default factors
Usage:	Soil carbon, potentially NH_4 and N_2O emissions	Potentially NH_4 and N_2O emissions
Description:	• Computer simulation of carbon biogeochemistry in soils that can predict soil sequestration, soil carbon, and nitrogen emissions (e.g., DNDC)	• Default factors from published sources (e.g., IPCC, published literature) • Potential to develop new default factors to simplify accounting
Pros / cons:	✓ Capable of analyzing complex relationships in living systems ✗ Complex, time consuming to operate with a high learning curve ✗ Conservative / inaccurate relative to direct measurement	✓ Reduces transaction costs due to simplification of quantification ✗ Limited defaults ✗ Conservative / inaccurate relatively to direct measurement

Note: Soil carbon models can be ground-truthed using direct measurements

Biogeochemical soil carbon models work by simulating classical laws governing carbon storage

CLIMATE ACTION RESERVE

Two categories of inputs into a soil carbon model

1 **Ecological drivers**

- Climate
- Soil
- Crops / vegetation
- Management practices

2 **Soil environmental factors**

- Temperature
- Moisture
- pH
- Redox potential
- Soil substrates

Quantification through equations that parametrize reactions in soil

Daily photosynthesis, respiration, carbon allocation, etc. simulated for plant growth

Multiple carbon pools (e.g., microbial activity, active / passive humus) simulated; each carbon pool has different properties and impact on carbon storage

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Equations used in quantification taken from classical laws of physics, chemistry, and biology, as well as equations from laboratory studies

Key outputs of a soil carbon model

1 **Soil properties**

- Soil carbon dynamics and storage
- Soil temperature
- Soil moisture

2 **Trace gas emissions**

- Nitrous oxide
- Methane
- Carbon dioxide emissions from soil

Models

- **Biogeochemical models***:* Several used to estimate ERs for many activities would like to include - DNDC – COMET-Farm - DAYCENT
- **Challenges**: **– *very limited use in offset programs to date*** - likely lack data to parameterize model for all desired combination of practices / crops / regions – could be relatively resource intensive to run models (expertise, computing, licensing etc.,)
- Typically Reserve very prescriptive re exactly which models & how they must be parameterized - then provide guidance on MRV for requisite data
  - Can we instead prescribe minimum accuracy requirements?
  - What do we need to see re parameterizing the models? Tied to stratification?
  - Can we defer to 3rd parties to parameterize – to run the model?
  - Can we minimize verification requirements by:
    - Using third parties to parameterize and/or run models?
    - Automating data inputs/outputs and 'locking' the model GUIs?

Data Sources

- SSURGO: soil texture
- NRI: land use status, condition, trends over time
- CTIC: tillage practices
- ERS: crop and livestock management practices
- NASS: crop area and yields (for QC)
- From VM0032:
  - EPIC, SNAP, Hurley Pasture
- Others?

Emission Factors

- Utilize as many existing EFs as we can
  - As conservative default – in cases where PD may lack data for more accurate project-specific approach
- Will it be just as cost-effective to use biogeochemical models to develop new EFs, periodically, as would cost to run model each RP?
- Can we build protocol to allow for updating of EFs without update to protocol?
  - Do we need any specific process for approving such updates?

Nitrogen Management

- Overview of Reserve's Nitrogen Management Project Protocol
  - standard EFs developed by CSU using COMET-Farm + USDA Blue Book
  - Custom Excel-based quant tool developed – plug in very few variables – get estimated % reduction in synthetic N usage – plug that into protocol equations
- Could allow parties to simply use NMPP– possibly with single project using multiple protocols
  - Could refine how use NMPP – such as using sampling / stratification
- Alternatively could use biogeochemical model to estimate emissions directly each time seeking credits

Use of Sensors

- Likely could be employed remotely – or onboard farm machinery – or handheld
- Likely primarily useful for streamlining MRV
  - I.e., employ satellites to gather operational data such as planting / irrigation / harvest dates – corroborate other operational activity data
  - Can potentially decrease need for site visits
- IA's 'Turbo-Tax of agriculture' a useful example
  - How do we minimize work verifier does to confirm appropriate tool use?
  - 3rd party validation and/or Reserve approval of tools?
  - Can we automate capture, transfer, integrity of data gathered using such tools?

Leakage

Activity shifting leakage:

- When GHG emissions are unintentionally changed or moved from one source to another due to project activities
- E.g., if crop yield declines due to project activities, production may increase outside the project area to compensate for this loss

How Best to Address?

- Evaluate yield impacts and make adjustments accordingly
  - E.g., ACR and Reserve nitrogen fertilizer protocols require increases to project fertilizer rates if yield drops (3% or statistically significant, respectively) below historical levels
- Add default deduction
  - E.g., Reserve's GPP V2.0 assumes a 20% leakage effect from grassland projects
- Assume risk is low and ignore
- Recommendations / data to set thresholds?
- Other options?

MONITORING / REPORTING / VERIFICATION

Monitoring, Reporting, and Verification

- Monitoring, reporting, and verification (MRV) rules dictate how project data are collected, organized, submitted to the registry, and checked by third-party verifiers
- Will consider questions around:
  - Data types and sources
  - Monitoring methods
  - MRV frequency
  - Use of Reserve developed templates
  - Use of existing systems, complementary programs with existing oversight, automation, technology and 3rd parties to streamline

Monitoring

Monitoring

Requirements can vary greatly regarding volume/ complexity / frequency of data required to be monitored

Associated transaction costs can also vary significantly

Historically, many farms lack rigorous data collection systems

We will look to reduce transaction costs by:

- Standardizing / streamlining / simplifying - reducing requirements - using detailed & standardized guidance - using templates
- Making use of any existing data gathering and reporting efforts
- Making use of new technologies such as remote sensing
- Facilitating consolidated reporting for aggregates

Monitoring

- *What data points are needed, how often must they be monitored?*
  - *Protocol required information (eligibility, QA/QC, etc.) Delineation of fields, acreage, entities involved, etc.,*
  - *Project emission data: fertilizer use, fossil fuel and electricity use, etc.,*
  - *Other operational activity data: planting / harvest / fertilization dates etc.,*
- *What methods are available, affordable, accessible, and accurate?*
  - *Direct measurement*
  - *Remote sensing*
  - *Objective third parties – existing regulatory programs – others?*

Reporting

Reporting

We will require a comprehensive monitoring report summarizing monitoring results, raw data, quantification results, qualitative descriptions, etc.

We will look to reduce transaction costs by:

- Standardizing / streamlining / simplifying - limiting requirements - using detailed & standardized guidance - using templates, automating data systems
- Making use of any existing data gathering and reporting efforts
- Facilitating consolidated reporting for aggregates

Reporting

- Within Reserve program this refers to report by project developer to verifier
- *How often should we require reporting?*
  - Typically every 12 months – allow parties to defer to 24 months (but only get issued credits at 24 months – up to every 6 years for Reserve forest projects – *longer periods desirable here?*
  - Longer periods between reporting, greater risk of lack of sufficient data – greater risk of losing ERs
  - Should we prescribe standard reporting template – i.e., both monitoring plan / report template & verification report template?

Verification

Verification

Requirements and associated costs vary

- Site visits are typically largest contributor to cost
- Large volumes of raw data will need to be sampled
- Use of models / tools should be replicated by verifier

We will look to reduce transaction costs by:

- Standardizing / streamlining / simplifying - reducing requirements - using detailed & standardized guidance - using templates
- Making use of any existing data gathering and reporting efforts
- Facilitating consolidated verification for aggregates

Verification Considerations

- *Systematic, independent and documented process for the evaluation of a GHG assertion against agreed criteria*
- *Are there any minimum requirements we should consider for the verification team?*
  - Any need to require an agronomic expert or certified soil scientist? Will this be necessary to confirm stratification done properly?
- *What data sources at a minimum should be reviewed by the verification team?*
  - Records, receipts, soil sample results, time-stamped photographs, etc.
  - Other ideas?

Verification Considerations

- *Are site visits necessary?*
  - Grassland projects may forego a site visit provided they include a higher buffer pool contribution
  - Nitrogen management projects
    - undergo a risk-based selection of fields for site visits (at a minimum, at least 5% of the fields), and randomly sample the remaining fields to select fields for desk reviews (at a minimum, 2 times the square root of the total number of fields in the project)
    - a project with 100 fields will have a site visit verification for 5 fields, and a desk review for 20 fields
  - Can we instead rely on combination of:
    - objective third-party proxies such as local extension staff or NRCS officers
    - sensors

OPEN DISCUSSION – FEEDBACK AND SUGGESTIONS

NEXT STEPS

Workgroup Sub-Committees

- Please identify your interest and availability to engage in additional, small-group discussions on one or more of the following topics
  - Group 1: APPLICABILITY & ELIGIBILITY
  - Group 2: QUANTIFICATION & MODELING
  - Group 3: MONITORING & DATA COLLECTION

Next Steps

- Email us to nominate yourself to work on specific protocol considerations we discussed today
- **Submit comments/feedback by Feb 14th**
- Protocol drafting by Reserve staff – *ongoing*
- ***Share protocol draft with workgroup***
- ***Workgroup Meeting 2 – Late-Feb 2020***
  - Review DRAFT protocol, section by section
  - ~2-4 hour session via webinar

Key Contacts

Protocol development lead:

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