MONITORING FOR FOREST CARBON UNDER THIRD PARTY-VERIFIED CARBON OFFSET PROGRAMS

Northwest Natural Resource Group

NORTHWEST CERTIFIED FORESTRY™

Prepared by Swedeen Consulting
for Northwest Natural Resource Group

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Northwest Natural Resource Group (NNRG) specializes in working with non-industrial forest landowners, conservation organizations and public entities interested in conservation-based forest stewardship. Northwest Certified Forestry is a non-profit membership and services program developed by NNRG to assist small forest landowners in Oregon and Washington with optimizing the economic and ecological potential of their forestlands. Visit www.nnrg.org for more information.

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Introduction

Forest carbon is perhaps the best developed and monetized ecosystem service associated with forest ecosystems in the world. The ability of forests to accumulate and store carbon over time is recognized as an essential part of the global carbon cycle, and as crucial to mitigating the overall impacts of climate change. Both voluntary and regulatory markets have developed which can result in payments to forest landowners for avoiding emissions and increasing sequestration of CO_2 by changing their forest management practices or agreeing to perpetuate practices that maintain high carbon stocks which are not otherwise required by law or considered business as usual for the landowner. The unit of measure is a metric ton of CO_2e, and usually conceptualized as an "offset" credit that can be sold to another entity to counter otherwise unavoidable emissions of CO_2, usually from burning fossil fuels.

The three major third-party verified forest offset programs in the U.S. that are available for forest landowners in Washington and Oregon are reviewed here: the **California Air Resources Board/Climate Action Reserve (ARB/CAR: these will sometimes be discussed separately), the Verified Carbon Standard (VCS), and American Carbon Registry (ACR)**. This paper addresses forest data requirements and other monitoring requirements used in these programs. It is important to note however that monitoring is only one aspect of project development and maintenance. Other related aspects of carbon protocols are discussed as appropriate. After describing basic monitoring requirements, the paper describes how Northwest Natural Resources Group can better integrate its monitoring program for FSC certification with these carbon offset programs.

Common elements of all three protocols

Forest carbon offset projects are built on high quality forest inventory data. The basic aspects of forests measured in carbon projects are the species, diameter, and height of standing live trees; diameter, height and decay class of standing dead trees; and the length, diameter, and decay class of lying dead wood. Below-ground carbon associated with standing live trees is calculated using allometric equations and is thus not directly measured or sampled. Standing dead and lying dead wood are optional in the ACR protocol. Lying dead wood is conditional in the VCS protocol. Lying dead wood is necessary for natural forest management portion of the CAR and ARB protocol, but at this time is excluded from the carbon accounting portion of the protocols.

Soil carbon is required under some conditions in CAR and VCS but no specific direction for sampling soil carbon is provided. The CAR protocol has undergone a recent revision that requires the use of models and proposed management to ascertain the impact of a carbon project on soil carbon stores in some circumstances. This will not require collection of additional field data.

All three protocols require an accuracy of forest carbon inventory data of between +/- 5% to +/-10% at the 90% confidence interval for combined data on live and dead tree carbon pools across the project area. If these accuracy levels are not attained, discount factors are applied that reduce the number of credits awarded to the project. The ARB/CAR protocol has a cut-off of +/- 20% beyond which credits are not awarded at all.

Aggregation is allowed (more discussion below) which can result in landowners not needing to meet this accuracy standard individually because the "project" is considered an aggregate of several land holdings. However, the basic requirement for accuracy necessitates putting in more inventory plots than would otherwise be required for standard timber cruising, and for basic checks required for FSC monitoring under Northwest Certified Forestry. Table 1 includes a summary of the elements of forests measured in carbon inventories. Specific measurement parameters are described in the spreadsheet attachment in Appendix 1 (data collection matrix).

Inventory data on standing live and dead trees and lying dead wood is used to calculate the carbon stocking of the project forest at the beginning of the project. Standardized calculations for converting tree measurements into volume, biomass, and finally carbon are specified by the protocol in question and can be built into spreadsheets and database programs.

The ARB and CAR protocols require tracking of tree species composition and both standing dead and lying dead wood density (tons per acre or stems per acre) for natural forest management purposes (promotion of forest biodiversity). This information can be derived from the original inventory data, so does not add to the basic information gathering requirements.

Other basic elements of project description are required in monitoring reports. A monitoring report template from CAR is included as Appendix 2. Once this information is filled out the first time, it is only the change in carbon stocks and documentation of management activity from the prior year that changes from year to year.

Finally, all protocols require calculation of carbon in harvested wood products. This information is gathered both from the base forest inventory data but also requires record keeping of trees actually harvested and sold for wood products so that the carbon content of harvested wood products can be calculated.

Table 1: Carbon Pools Requiring In-Forest Measurement in Carbon Offset Protocols

	Carbon Pool				
Protocol	Live Trees	Standing Dead	Lying Dead	Soil Carbon	Wood Products
California Air Resources Board	Required	Required	No	Conditional	Required
Climate Action Reserve	Required	Required	Optional	Conditional	Required
American Carbon Registry IFM	Required	Optional	Optional	Optional	Required
Verified Carbon Standard	Required	Required	Conditional	Conditional	Required

Beyond basic data: Tracking carbon over time

All three protocols require filing annual monitoring reports, regardless of whether the project owner elects to verify credits for registration and sale in a particular year. Annual monitoring reports require a description of management activities on the property over the prior year and changes in carbon stocks that results from annual growth and harvest or natural disturbance that occurred that year. Monitoring reports must be overseen and signed by a registered professional forester. Changes in carbon stocks are calculated by running forest and growth models and then using the output (cubic foot volume of woody biomass) to calculate carbon stocks. This method is preferable to having to go out and re-measure trees on an annual basis. However, it still requires tracking carbon stock changes through models, maintaining inventory data, and filing reports. Such requirements usually mean that a consultant needs to be retained unless the landowner is a forester with the technical capacity to run growth models and manage inventory data. An alternative to this need is for a central service provider, like the aggregator, to take on these tasks.

Aggregation

All three protocols/programs allow aggregation (or will soon). The Climate Action Reserve protocol has the most explicit set of guidelines on how to conduct aggregation. It should be noted that the California Air Resources Board intends to allow aggregation in its regulatory protocol, based on the CAR guidelines. Incorporation will occur the next time the regulations governing offsets are updated.

The basic premise of aggregation is that individual land ownerships can be pooled for the purposes of calculating error rates on carbon stocks and for frequency of conducting field verification thereby reducing the overall carrying costs of maintaining carbon projects over time. The CAR protocol allows individual landowners to have lower accuracy rates of carbon inventories, depending on the number of landowners within an aggregate, which reduces the number of inventory plots required by up to 70% compared to an equivalent area as a stand-alone project. The protocol also allows field verifications to occur every 12 years rather than every six years. Desk audits occur randomly from the pool of participating landowners. Thus, these are likely to be less frequent than annually, but the actual frequency is not determinate.

These three changes can decrease overall costs of project maintenance significantly over the 100 or more year life of a carbon project, thereby improving access to smaller forest landowners. Individual landowners cannot have more than 5,000 acres in an aggregated project. Verification costs will be at least 50% less under aggregation than doing a stand-alone project. The savings here may be higher if desk audits do not occur on annual basis through random sampling. Depending on the number of projects in an aggregate, inventory costs can be reduced by between 20 and 70 percent compared to doing a stand-alone project. Other cost savings may come, depending on the aggregator's fee structure and services, from sharing costs on filing monitoring reports and conducting forest growth and yield modeling.

The ACR protocol allows aggregation but does not provide specific guidance on how aggregation is to be accomplished. A major difference with aggregation under CAR however is that ACR contracts with an aggregator as the project proponent, while CAR requires contracts with individual landowners even if they are part of an aggregate. The approach taken by ACR may provide some cost savings, as individual landowners would not need to pay account fees and a sliding scale of fees to cover verification may mitigate the fixed cost issue. For example, a landowner with 200 acres could pay a lower fee to be part of aggregate than a 1,000 acre landowner because the entire aggregate would be verified, not necessarily each individual landholding. This is difficult to parse out at this point in time however because the manner in which verification is carried out for an aggregate is not specifically detailed in the protocol. In addition, other costs may accrue to individual landowners as they would likely be asked to help defray the cost of risk that the project aggregator assumes under this type of approach. The most concrete form of cost reduction likely is that plot intensity would be lower on individual landholders, likely similar to CAR.

VCS allows aggregation but the specifics are not delineated in program documents or in the protocol that could be applied in Washington and Oregon forests. In addition, given that only one VCS project has been completed in the U.S., and it is not an aggregate, it is difficult to assess the benefits of aggregation compared to standard individual project development.

Two things should be noted about these potential cost savings. The first is that because carbon credit calculations are based on forest growth and yield modeling with inventory data as the input, individual landowners may not want to decrease their statistical accuracy as much as the aggregation guidelines allow because low accuracy could result in errors in carbon projections through time. Second, there are no examples of aggregates yet in existence to derive actual cost savings data. The CAR guidelines however do offer the most quantifiable potential savings of the three protocols.

Barriers to entry for small forest landowners

The expense of intensive inventory and monitoring are not necessarily in and of themselves barriers to participating in carbon markets, though this will depend on the price of voluntary or compliance offset credits and the carbon density and growth rate of the land. **Full carbon inventory costs approximately $45/plot.** If a landowner is not considering entering a carbon project, this is not an expense that they would otherwise need to incur, and a viable carbon project would cover these costs several fold (see below). If a landowner is unsure but would otherwise conduct a timber cruise for commercial forest management, the marginal additional cost of doing a carbon inventory versus a timber inventory may be worthwhile.

Running growth and yield models adds cost to monitoring beyond field data collection as this requires the use professional consulting skills. However, this cost can be reduced by having a professional forester on staff that can serve all members in an aggregate as part of the membership fee.

By far the largest expense of conducting carbon offset projects is third-part verification. Verifications for individual landowners under CAR and ACR run around a minimum of $15,000 for initial field verification, regardless of size. Large projects (more than 3,000 acres, for example) will cost more due to more time in the field checking inventory measurements. Interim desk verifications (years in-between required field verifications) cost $4,000. Even under an aggregation scheme like what is allowed under CAR, verification costs will account for 10 times the project maintenance costs of updating inventory data in the field. Projects conducted under ARB's regulatory protocol will cost more to verify: a minimum of $25,000 for field verification and $8,000 to $10,000 for desk verifications.

Carbon projects therefore need to generate enough revenue to cover these and other transaction costs over time. The smaller the project size, the less revenue there is to defray these fixed costs. Thus, a floor for project size emerges that eliminates very small properties. A mature well-stocked forest (e.g., 60-70 years or older) on 500 acres might be viable, but if prices drop to below $10 per metric ton CO_2, the project could be vulnerable to cost overruns. Properties that are at least 1,000 acres are recommended for ARB projects and 750 acres for other voluntary protocols.

Integration with NCF monitoring

Monitoring for carbon offset projects requires specific annual tracking of management activities, growth and yield modeling, and carbon calculations on an annual basis. If an NCF member landowner is going to pursue a carbon project, the requirements of the protocol/program of choice will dominate monitoring activities and supplant standard NCF procedures due to their intensity. In this situation, the question is more a matter of how to combine monitoring of FSC requirements with carbon projects in order to produce cost efficiencies, not the other way around.

If however, an NCF member is thinking about a carbon project but has not yet decided, there are ways to change the basic monitoring data collection template and inventory guidelines for FSC monitoring that could make it easier and cheaper for a landowner to enter into the carbon market at some future point in time. These changes are as follows:

1. Establish a grid for plots as if a full carbon inventory was going to be conducted. While a sensitivity analysis from a less intensive cruise should be run if possible, a general guide to adequate plot intensity for Westside forests in an aggregate is likely around 1 plot per 5-10 acres.

2. Stratify the forest by stand type and age if possible. Not every stand in an ownership will need plots if stratification is possible. This can further reduce inventory costs.

3. Install a few plots at a time, depending on what the landowner can afford, and the fee structure NCF charges for this service.

4. Install plots in a distributed manner throughout the grid so preliminary carbon estimates that cover the full range of conditions on the property can be calculated prior to a full inventory.

5. Schedule the addition of new plots over time until the full grid has established plots.

6. Monument plots for ease of re-location (e.g., re-bar or plastic pipe).

7. Change minimum diameter from 5.9 inches dbh to 5.0 inches dbh.

8. Add data collection for standing dead wood by height, diameter, and decay class for snags at least 15 feet tall and 5 inches in diameter.

9. Consider collecting data on down wood, but this element can be added later if necessary.

These changes should allow a plot system to be developed that even when not yet fully populated can help a landowner decide whether they have enough carbon to make an offset project worthwhile. If it takes a full decade to populate the plot grid – i.e., to get full inventory data, it may be necessary to conduct a full re-sampling to enter into a carbon project due to the difference in dates among all the plots. However, the data collected in the first round will help the landowner decide whether the payoff will be financially advisable.

If a landowner is moving ahead with a carbon project, data required for FSC certification as per the NCF data collection form could easily be collected when a carbon inventory is conducted at little extra cost given the time already spent on the ground and the fact that the full extent of the subject property would be surveyed for carbon data.

Additional cost savings could be achieved by having an FSC audit conducted simultaneously with a third-party carbon offset field verification visit. At the very least, this would eliminate duplicate travel costs and contract administration costs.

Finally, it should be noted that the ACR program may consider prior FSC certification to indicate business as usual practice. This would require FSC standards to be part of the baseline rather the project. Baselines are constructed differently for CAR/ARB (Ruddell, personal communication). FSC certification is considered voluntary (unless part of a conservation easement) and would thus not be part of the baseline.

Appendix 1

A matrix of specific measurement parameters for collecting forest carbon inventory data.

Sampling Methodology	Sample Measurement (s)
SCALE of APPLICATION	
Min/Max size of assessment area	Extent of project boundary except for sustainable harvest demonstration, which is ownership-wide. The stand is the basic area unit for measurement.
Use of Plots	Yes - fixed or variable radius; transects for lying dead wood; monumenting plots for ease of re-location in the field is highly recommended.
Sampling approach	Stratified based on vegetation type acceptable in all methodologies; use when more efficient; otherwise calculate statistics on all plots over entire project area. Small owners not likely to need stratification. Protocols require accuracy of a standard error of +/- 5 (CAR) to 10% (VCS) at the 90% confidence interval of combined carbon pools. The per project sampling error goes down in CAR aggregates from +/- 7% for 2 projects to +/- 20% for aggregates with 15 or more projects.
UNITS	
Pools:	Live trees, standing dead trees, lying dead trees, soil, harvested wood products
Outputs:	Metric tons of CO2e per acre
DATA COLLECTION	
Tools/Techniques	Standard forestry field equipment: large tape, dbh tape, prism, relascope, lasers; GIS for stand and project boundary delineation; FVS or other forest and growth models
Needed expertise	Forest mensuration, inventory data management, forest and growth modeling, GIS
Time	Plot data collection will depend on size of property, variability of the forest, and difficulty of the terrain. Modeling for annual project maintenance can be done in a few days.
Cost	Inventory: Higher cost for more inaccessible terrain or highly variable forest types: ave = $10/acre or $45/plot for inventory data collection; total number of plots pr project area is less for CAR aggregates depending on the number of projects within an aggregate. Costs can be reduced by half or more. ACR and VCS allow aggregation but guidelines are vague.
When Data Collection is Required	
TRIGGERS	Initial establishment of project and baseline carbon stocks; monument plots for 3rd party verifiers; re-do field inventory every 10 years (ACR,VCS) or 12 years (CAR/ARB); use growth and yield models for intervening years; need to re-sample stands that have been harvested; monitoring reports require updating on-site carbon stocks every year. Done through modeling of plot data.

Carbon Pools	*Measurement Requirements*
Live trees	dbh of trees >= 5"; height to a 4" top or total; species; defect
Standing Dead	dbh of standing dead trees >=5", total height with a minimum of 15 feet, decay class; where total height not available, method to determine how volume is derived by decay class from Harmon et al., 2008.
Lying dead	(not counted in CAR/ARB, but conditionally required in VCS): line transect: 2 50 m lines bisecting each plot, measure diameter of each piece 10 cm and greater that intersect lines.
Harvested wood products	Based on actual harvested volumes converted to metrics tonnes of CO2e; need to follow tree records from database into a harvested pool to calculate carbon and decay according to protocol.
Soil	CAR will start requiring soil carbon pool to be accounted for this spring. They will use a standardized approach based on soil type and harvest practice, so direct measurement will not be necessary.
Calculations	Each protocol has specified equations for calculating biomass from cubic foot volume of live and dead trees. These can be programmed into spreadsheets or databases, using output from forest and growth models.
Documentation	All protocols require submission of inventory data collection plans, including plot layout, how plot intensity was calculated, inventory management plan, and a data modeling plan. ARB requires these plans to be submited at intial verification.
Natural Forest Management	*(Part of CAR requirements but not VCS or ACR).*
Natives	95% native species composition required; assessed based on inventory data by stems per acre or volume
	Stands cannot be dominated by one or a few species; requirements by vegetation type for maximum composition of any one species are listed in an appendix to CAR/ARB protocol. Measured based on inventory data, again based on stems or volume by species.
Age class distribution	<= 40% of project area younger than 20 years old: use inventory data - assessed at project initiation and each subsequent verification
Down wood	1% of standing live carbon stocks in standing dead wood or 1 ton C per acre whichever is higher if no salvage; 2% of live stocks or 2 tons per acre whichever is higher if recent salvage: use inventory data for standing dead wood.
Sustainable harvest	Demonstrate harvest is sustainable in perpetuity through certification (FSC) management plan, or use uneven-aged management
Leakge	
Harvest volume records and management plans	ACR requires documentation of proof that no internal leakage has occurred on the project owner's property. CAR uses certification and a requirements of sustained yield to demonstrate no activity shifting leakage, thus does not require additional monitoring data. ACR and CAR have stardard formulas for calculating market leakage, and thus does not require data beyond harvest records already kept for calculating carbon in wood products.

ACR Activity-shifting leakage requirements	If the project decreases wood product production by >5% relative to the baseline then the Project Proponent and all associated land owners must demonstrate that there is no leakage within their operations. Such a demonstration must include one of the following: Historical records covering all Project Proponent ownership trends in harvest volumes paired with records from the with-project time period showing no deviation from historical trends over most recent 10-year average; or Forest management plans prepared ≥24 months prior to the start of the project showing harvest plans on all owned/managed lands paired with records from the with-project time period showing no deviation from management plans; or Entity-wide management certification that requires sustainable practices (programs can include FSC, SFI, or ATFS). Management certification must cover all entity owned lands with active timber management programs.

Appendix 2

The Climate Action Reserve monitoring report template.

Revised 07/29/2013

Forest Project Monitoring Report

The Monitoring Report must be completed for every reporting period after project registration. It is also required that the Forest Project Calculation Worksheet be submitted with this report. The Forest Project Calculation Worksheet is available at:
http://www.climateactionreserve.org/how/protocols/adopted/forest/resources/

Forest Owner	
Project Number	
Project Name	
Name of Individual Completing Report	
Date of Form Completion	
Current Reporting Period	
Initial Reporting Period	
Completion date of last site visit verification	
Date of next planned site visit verification	

I. Ownership

1. Has the Forest Owner changed since the last reporting period?

☐ No.

☐ Yes. Please explain, including the nature of the ownership interest, new Forest Owner's full legal name and contact information. Please include recorded copies of relevant documents demonstrating any change of Forest Owner as well as any assignment and assumption agreement. (See Section 7 of the Restrictive Covenant and Project Implementation Agreement)

2. Has the Forest Owner acquired additional landholdings within the project's Assessment Area?

☐ No.

☐ Yes. Please explain how these landholdings demonstrate sustainable long-term harvesting practices:

II. Natural Forest Management

1. Specify how the project currently meets (or is in progress of meeting) the following requirements under "Natural Forest Management" (Refer to Section 3.10.2 of the Forest Project Protocol for additional information):

a. *Native species:* Does the project currently consist of at least 95% native species based on the sum of carbon in the standing live pool? ☐ YES ☐ NO

If no, provide evidence that demonstrates the project is making continuous progress toward this requirement.

b. *Composition of Native Species:* Does any one tree species currently exceed the 'Composition of Native Species' percentage in the Assessment Area Data File?
☐ YES ☐ NO

c. If yes, please provide evidence that demonstrates the project is showing continuous progress towards native species requirements:

d. *Sustainable Management:* Indicate how the project meets this requirement:

☐ Third party certification. Please provide certificate identification

☐ Operating under a renewable long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency. Please provide documentation.

☐ Employment of uneven-age silivicultural practices and canopy retention. Please explain and provide documentation.

☐ Not applicable, no commercial harvesting is occurring within the Project Area

e. *Structural Elements (Standing and Lying Dead Wood)*:

i) *Standing Dead Wood*: What is the estimated tonnes per acre of standing dead wood (in units of CO2e metric tonnes)?

Does this meet the minimum requirements? ☐ YES ☐ NO

If not, provide evidence that demonstrates the project is making continuous progress toward this requirement.

ii) *Lying Dead Wood*: Explain how is the project ensuring that lying dead wood exists within the project at levels required by the protocol?

f. *Distribution of Age Classes:* Does the project incorporate even-aged management as a predominant silviculture method? ☐ YES ☐ NO (No further action is needed)

If the answer is yes, provide evidence that demonstrates the project has met or is showing continuous progress toward meeting the required distribution of age classes.

III. Carbon Stocks

1. **Please provide an updated estimate of the current reporting period's carbon pools.**

Carbon Pool	Previous Reporting Period - Gross CO2e per Acre	Previous Reporting Period – Total CO2e	Current Reporting Period - Gross CO2e per Acre	Current Reporting Period – Total CO2e
Standing Live Trees				
Standing Dead Trees				
Soil carbon (optional)				
Net Onsite Carbon Stocks (CO2e)				
Confidence Deduction				
Sequential Sampling Adjustment Factor (if applicable)				
Final Reported Onsite Carbon Stocks (CO2e)				

2. **Has the inventory methodology been modified since the project was registered?**

☐ No.

☐ Yes. Please explain and provide evidence that this modification has been approved by the Reserve.

3. **What is the confidence deduction for the forest carbon inventory (this should not change between site visit verifications)?**

IV. Permanence

1. **If you suspect that a reversal may have occurred during the current reporting period, please explain the nature of the suspected reversal.**

☐ Avoidable Reversal, please respond to question #2.

☐ Unavoidable Reversal, please respond to question #3.

2. **Unavoidable Reversals. Please explain the nature of the reversal or suspected reversal:**

a. When did the reversal or suspected reversal occur (month, day, year)?

b. What is the estimated quantity of the reversal or suspected reversal (in units of CO_2e metric tonnes):

c. When will carbon stocks be verified (month, day, year)?

3. **Avoidable Reversals. Please explain the nature of the reversal or suspected reversal:**

a. When did the reversal or suspected reversal occur (month, day, year)?

b. What is the estimated quantity of the reversal or suspected reversal (in units of CO_2e metric tonnes):

c. When will carbon stocks be verified occur (month, day, year)?

4. **Has this project been terminated due to the reversal or suspected reversal?**

☐ No. Please explain:

☐ Yes. Please explain:

5. **Has the project's reversal risk rating changed since the last verification?**
   - ☐ No.
   - ☐ Yes.
     A. Please explain:

B. **Summarize the reversal risk rating by category:**

Risk Category	Contribution
Financial Failure	
Illegal Forest Biomass Removal	0% (Default Value)
Conversion	
Over-harvesting	
Social	2% (Default Value)
Wildfire	
Disease or Insect Outbreak	3% (Default Value)
Other Catastrophic Events	3% (Default Value)
Additional Contribution Per the Project Implementation Agreement	

C. **Project reversal risk rating:**

	Previous Reporting Period	Current Reporting Period
Reversal Risk Rating		

D. **If the reversal risk rating has increased, have additional contributions been made to the Buffer Pool?**
   - ☐ Yes.
   - ☐ No. Please explain:

VI. GHG Reductions and Removals

Is this monitoring report being verified through a desktop verification for issuance of CRTs?

☐ No. When is the next planned verification date for this project (month, day, year)?

☐ Yes.

I have completed this form and believe it contains the most accurate data and information possible.

Forest Owner Signature _____

Name:

Title:

Organization:

Date: