



Forest Landowner – Carbon Sequestration Inventory October 2009

Goals and Objectives

Forest Landowner has been targeted for Carbon Sequestration project. This primary goals and objectives are to address the following requirements as outlined in the Climate Action Reserve (CAR) Forest Project Protocol (FPP) Version 3.0.

1. *Project Types* – Three project types are accepted under FPP Version 3.0; Reforestation, Improved Forest Management, and Avoided Conversion. This cruise design is aimed at addressing the Reforestation and Improved Forest Management activities within the forest ownership. The avoided conversion option is not applicable to this project, but may be addressed on future project areas.
2. *Carbon Pools* – The intent in addressing carbon pools is twofold; transform current forest owner inventory into an applicable GHG project and update the existing inventory to address deficiencies such as statistical shortages, gap analysis between historical inventory measurements compared to minimum CAR inventory measurements, and inventory carbon pools that have not been accounted for. All mandatory and optional carbon pools outlined under FPP Version 3.0 will be inventoried including; Standing Live, Shrub and Herbaceous Understory, Standing Dead, Lying Dead, Litter and Duff, Soil Carbon, and Carbon in Forest Products.
3. *Estimating Baseline Onsite Carbon Stocks* – Utilizing vintage inventory data, the project start date is targeted for 20xx when the initial inventory commenced. Based on where the average live standing carbon was in 20xx compared to the “Common Practices” or FIA baseline, the project will settle into one of two scenarios. If the project falls above FIA baseline proceed to model the data based on growth and expected harvest over the next 100 years. The average results over a 100 year time frame will be the addition of carbon that is sequestered per year. If the project falls below FIA, the highest carbon stocks must be determined on the project area within the last 10 years of the project start date (19xx – 20xx). Once the highest carbon stock is established the “Highest Stocking Reference” is calculated by taking 80 percent of that number. Unlike before where only one model is required, this scenario involves modeling not only the current project carbon stock levels (that are under FIA baseline) based on growth and harvest from 20xx – 21xx but also model the “Highest Stocking Reference”. The average stock over a 100 year period between the two models is the established baseline for the project. The average amount of carbon sequestered over 100 years modeled under the “with carbon project” scenario from the 20xx – 21xx over the established baseline (average of the two models) is the addition of carbon that is sequestered per year. Once the baseline is established under one of the two scenarios, baseline estimates for all additional pools for the project need to be aggregated and added to the live standing baseline. Note: Due to statistical shortages and live standing carbon stocks within the forest ownership the project start date may change.



Inventory Intensities by Strata

Based on statistical shortages in historical data within the Forest ownership (Standard Error xx% @ 90% Confidence Interval), Forester's Co-Op re-stratified the project area based on standing live carbon stocks. Three dates have been modeled and re-stratified; 20xx Strata – initial inventory was completed, 20xx Strata – following tractor harvest, and 2009 Strata - current standing live carbon stocks following 20xx harvest and grown to 20xx. Each year contains two strata based on natural classification breaks within the inventory data – Low Carbon Stocks and High Carbon Stocks. The 20xx live tree carbon stock strata is used for the purpose of this inventory.

Plot Location

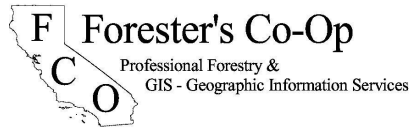
1. All Plots will be navigated to using GeoXH GPS, with pre-loaded plot locations automated in FCO GIS database.
2. Establish the plot center utilizing GPS to determine closest approximate location. Plot center shall be monumented with ¾" PVC Piping, a large metal bolt placed inside PVC pipe, and GPS point taken.
3. Hang two yellow attention flags at or above eye level at the nearest available location to plot center. Plot number, date, and cruiser initials shall be written on flagging with an indelible black ink felt tip marker.
4. Proceed with plot measurements.

Data Collection

Data shall be recorded using a Field Data Recorder and the FCO Forest Landowner template. Data shall be backed up each day to prevent loss of data. The electronic data shall load successfully into Forsee Inventory Program and run through the edit program without fatal errors. A minimum of one site tree for every species will be taken within every strata. The following will be measured; DBH to the 10th of an inch, total height, crown ratio, age at breast height (do not add on additional years), no defect on site tree.

Carbon Pool Measurements and Procedures:

- I. ***Lying Dead Carbon Stock (Optional Pool):*** The down woody material data shall be collected on every plot visited utilizing a 1/50th acre fixed area plot (16.7' Radius). As per CAR FPP specifications of dead woody any piece(s) of dead woody material from a tree, e.g. dead boles, limbs and large root masses, on the ground with a minimum average diameter of 5" and length of 8' that fall within the fixed area plot will be recorded. The scaling end of the log must fall within the 1/50th acre plot to be counted "in". Once it is determined that dead woody material fall within the plot the following measurements will commence;
 - Record species of lying dead material
 - Measure small and large end diameter of down woody material.
 - Measure total length of chunk with minimum of 8'.
 - Determine decay condition ranging from 1 to 5 - See Appendix A



II. *Shrub and Herbaceous Understory Carbon Stock (Optional Pool in Forest Management and Required in Reforestation Projects):* At every plot the appropriate photo series picture number will be recorded using the “Stereo Photo Series for Quantifying Natural fuels: Volume VII: Mixed Conifer with Shrub Types in Western United States”. These estimates are ocular (Shrub and Herbaceous Carbon Stock) and should be representative on average of the acre in which the plot is located.

III. *Litter and Duff Carbon Stock (Optional Pool):* Litter is the dead plant material that can still be identified as leaves, grasses and small branches. The largest material that can be considered litter is the minimum diameter stated in the Forest Project’s approved methodology for lying dead wood. The duff layer is the organic material layer at the soil surface under the litter layer. The duff layer consists of dead plant materials that cannot be identified as leaves, grasses, and small branches. At every plot the litter and duff carbon stock will be inventoried utilizing two methods;

1. The appropriate photo series picture number will be recorded using the “Stereo Photo Series for Quantifying Natural fuels: Volume VII: Mixed Conifer with Shrub Types in Western United States”. Based on an ocular estimate of the litter and duff that is representative on average of the acre in which the plot is located.
2. There will be four (4) samples in each of the N, S, E, and W quadrants of the plot approximately 20’ from plot center. The sampling will consist of a 12” x 12” square sample frame. At each location, all litter and duff within the sample frame is collected. These samples will then be taken back to the lab for analysis.

IV. *Soil Carbon Stock (Optional Pool unless Site Preparation exceeds 25%of Project Area):* XX soils types have been identified within the Project Area. To obtain an accurate inventory of organic carbon stocks three variables must be measured; soil depth, soil bulk density, and organic carbon. Two soil samples within each of the xx soil types will be taken see Table 1 below;

<i>Soil</i>	<i>Soil Depth (NRCS)</i>		<i>Acres</i>
<i>Sample Soil</i>			
<i>Sample Soil</i>			
<i>Sample Soil</i>			
<i>Sample Soil</i>			
<i>Sample Soil</i>			

The sampling methodology and protocols follow the same sampling methodology prepared by Brown, Schoch, Pearson, & Delaney (2004). To take conservative estimates a fixed soil depth for the A horizon as outlined in Table 3 (based on NRCS data).



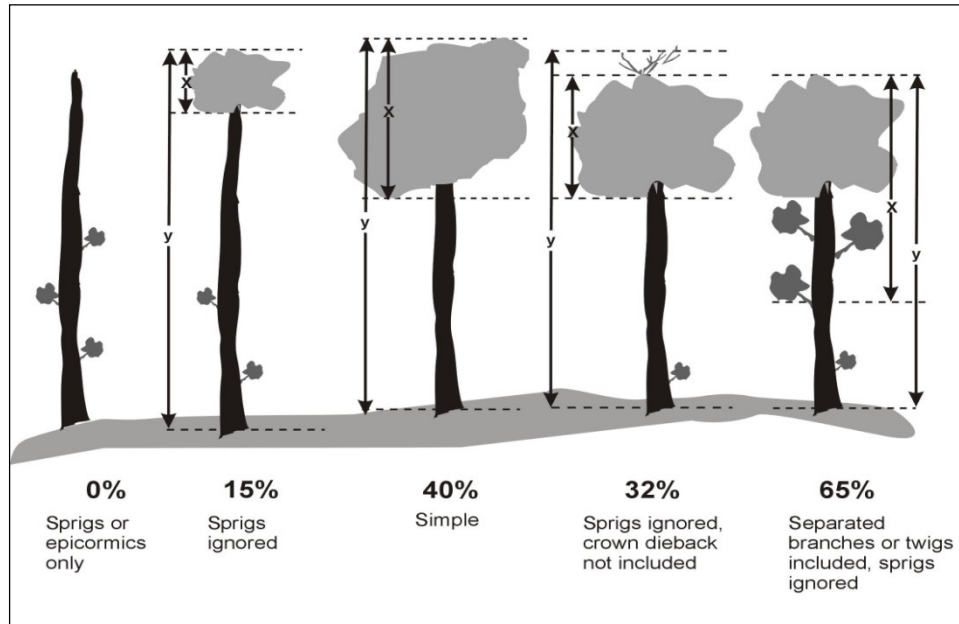
Composite sampling will be done by aggregating a pre-determined number of samples from each collection site in the field, from which one sample is derived for analysis. The resulting *composite* sample captures more of the range of inter-microsite variability in soil carbon. The first 12 x 12" frame sampled for the litter and duff for the above plots will be sampled for soil carbon. Using the core sampler method, mineral soil samples are collected from within the area of the sampling frame. When taking cores for measurements of bulk density, care should be taken to avoid any loss of soil from the cores; if any material is lost, the sample needs to be taken again.

- V. ***Standing Live Carbon Stock (Required Pool):*** The standing live tree estimate includes carbon in all portions of the tree, including the bole, stump, bark, branches, leaves, and roots. Three types of plots will be sampled to measure the standing live trees on plot;
1. All Trees greater than or equal to 10" DBH will be counted in a variable radius prim plot utilizing a basal area factor of 20. On all trees the following will be measured; Species, DBH to the nearest 10th Inch, Total Height, Crown Ratio to the nearest 5% (See Appendix A), Defect in 10% increments by 16ft log (non merch, Cull, Missing).
 2. A 1/50th acre fixed radius plot (16.7') will account for all trees less than 10" DBH and greater than or equal to 4.5' height. Tree species, DBH to the nearest 10th Inch, Total Height, Crown Ratio will be record and measured for each sapling.
 3. A 1/100th acre fixed radius plot (11.8') will account for a regeneration plot trees < 1" in DBH and <4.5' Total Height. Trees will be tallied by species.
- VI. ***Standing Dead Carbon Stock (Required Pool):*** All standing dead trees with a minimum DBH of 5" and 15' height will be targeted for measurement. A variable radius prim plot utilizing a 20 basal area factor will determine if a dead tree is measured. Tree species, DBH to the nearest 10th Inch, Total Height and the following codes for the Browns decomposition state will be documented;
1. Trees with branches and twigs and resembles a live tree
 2. Tree with no twigs but with persistent small and large branches
 3. Tree with large branches only
 4. Bole only no branches



Appendix A

Crown Ratio Guide:



Lying Dead Wood Guide:

