Supplemental Guidance

To: **ALL PROJECT DEVELOPERS AND VERIFIERS**
Date: July 03, 2012
Re: Updated Guidance for Accounting for Soil Carbon for Avoided Conversion Projects

On March 4, 2011, the Climate Action Reserve (Reserve) issued a Policy Memorandum disallowing crediting of optional carbon pools for forest carbon projects until standardized guidance for accounting of these optional carbon pools was developed.

The Reserve has developed the following standardized guidance for accounting of the soil carbon pool for Avoided Conversion Projects. This guidance also serves to clarify how soil carbon emissions are to be calculated associated with forest project management activities, such as harvesting and site preparation activities.

The following guidance is supplemental to any guidance in versions 3.1 and 3.2 of the Forest Project Protocol, and should be used in lieu of the supplemental guidance previously issued on October 21, 2011. This guidance will be incorporated into version 3.3 of the Forest Project Protocol, and will allow avoided conversion projects to include soil carbon as a credited carbon pool. Version 3.3 will also include guidance for projects of all types to account for soil carbon emissions associated with management activities. Project Developers may submit 3.1 and/or 3.2 projects using the guidance for calculating benefits associated with Avoided Conversion projects. The guidance for soil emissions accounting associated with management activities will not be required until Version 3.3 is approved. This supplemental guidance includes the following:

1. Guidance for quantifying net reductions and removals (baselines) for Avoided Conversion projects that include soil carbon accounting
2. Guidance for project soil carbon accounting (for Avoided Conversion projects and emissions reporting)
3. Guidance for verification of soil carbon stocks

1. Guidance for quantifying net reductions and removals for Avoided Conversion Projects that include soil carbon.

The following guidance is modified from the FPP Version 3.2 guidance (Estimating Baseline Onsite Carbon Stocks – Section 6.3) to allow for soil carbon emissions to be included in the baseline quantification.

1.1 Estimating Baseline Onsite Carbon Stocks

The baseline for Avoided Conversion Projects is a projection of onsite forest carbon stock losses that would have occurred over time due to the conversion of the Project Area to a non-forest land use. Estimating the baseline for Avoided Conversion Projects involves two steps:

1. Characterizing and projecting the baseline.
2. Establishing the baseline based on conversion risk.

Step 1 – Characterizing and Projecting the Baseline
Forest Owners must characterize and project the baseline by:

1. Clearly specifying an alternative highest-value land use for the Project Area, as identified by an appraisal (as required by the Forest Project Protocol).

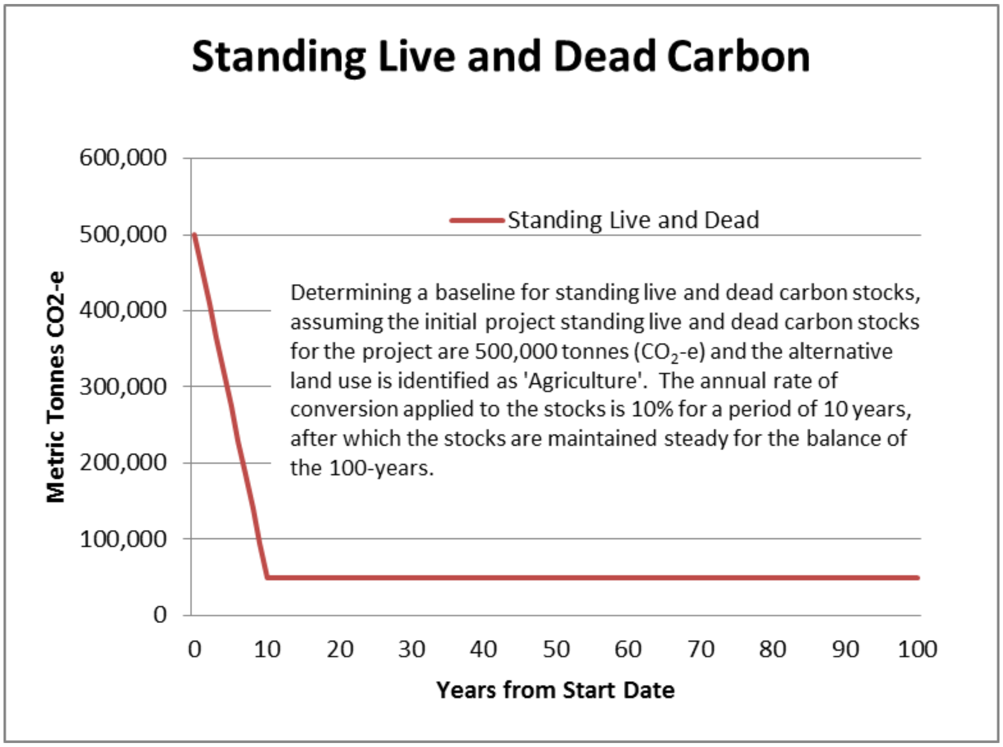
2. Estimating the rate of conversion and removal of onsite standing live and dead carbon stocks. The rate of conversion and removal of onsite standing live and dead carbon stocks must be estimated by either:
    a. Referencing planning documentation for the Project Area (e.g. construction documents or plans) that specifies the timeframe of the conversion and intended removal of forest cover on the Project Area; or
    b. In the absence of specific documentation, a default annual conversion rate for carbon in standing live and dead carbon stocks must be identified from Table 1.

Table 1. Default Avoided Conversion Rates for Standing Live and Dead Carbon Stocks

Type of Conversion Identified in Appraisal	**Total Conversion Impact**	**Annual Rate of Conversion**
	This is the assumed total effect over time of the conversion activity on standing live and dead carbon stocks. (The total conversion impact is amortized over a 10-year period to determine the annual rate of conversion in the next column.)	This is the assumed annual rate of the conversion activity on standing live and dead carbon stocks. The percentages below are multiplied by the initial standing and dead carbon stocks for the project on an annual basis for the first 10 years of the project.
Residential	Estimate using the following formula: $TC\% = (\min(1,(P*3) / PA))$ Where: TC = % total conversion (TC cannot exceed 100%) PA = the Project Area (acres) identified in the appraisal P = the number of unique parcels that would be formed on the Project Area as identified in the appraisal. * Each parcel is assumed to deforest 3 acres of forest vegetation	Estimate using the following formula: $ARC = TC / 10$ Where: ARC = % annual rate of conversion TC = % total conversion
Mining and agricultural conversion, including pasture or crops	90%	9.0%
Golf course	80%	8.0%
Commercial buildings	95%	9.5%

    c. A computer simulation must be conducted to project changes in onsite standing live and dead carbon stocks over 100 years. The computer simulation of the onsite standing live and dead carbon stocks must approximate the identified rate of conversion over time to estimate changes in standing live and dead carbon stocks, beginning with the Project Area's initial onsite standing live and dead carbon stocks. If the projected conversion rate does not result in a complete removal of onsite standing live and dead carbon stocks, the baseline projection must account for any residual forest carbon value as a steady condition for the balance of a 100-year projection. See Figure 1 for an example of a projected decline in standing live and dead carbon stocks for a hypothetical project that avoids agricultural conversion, using an appropriate conversion rate from Table 2.

Figure 1. Example of an Avoided Conversion Project Baseline for Onsite Standing Live and Dead Carbon Stocks.



3. Estimating the rate of soil carbon emissions (optional):

Soil carbon can only be quantified for conversion to agriculture at this time. The amount of soil carbon and the rate of soil carbon emissions are dependent upon the soil type (Order) and the conversion activity. Emissions from soil carbon are estimated by applying the default emissions estimators from Table 2 below to the estimates of soil carbon in the project area. Table 2 provides an estimated percentage emitted as the result of conversion and presents the rate of emissions associated with each soil order.

Table 2. Soil carbon emissions estimators by soil order

Soil Order		***Alfisol***	***Andisol***	***Inceptisol***	***Mollisol***	***Spodosol***	***Ultisol***	***Histosol***
Estimated Emissions Associated with Conversion Activity	Agriculture	30%	30%	30%	30%	30%	30%	80%
	Residential/ Commercial/ Industrial	0%	0%	0%	0%	0%	0%	80%
Rate of Estimated Emissions		100% in first 10 years.	100% in first 10 years.	100% in first 10 years.	100% in first 10 years.	100% in first 10 years.	100% in first 10 years.	22 tonnes per acre per year (up to 80% loss) for till-based agriculture and Residential /Commercial/Industrial. 7.5 tonnes per

							acre per year (up to 80% loss) for conversion to grazing.

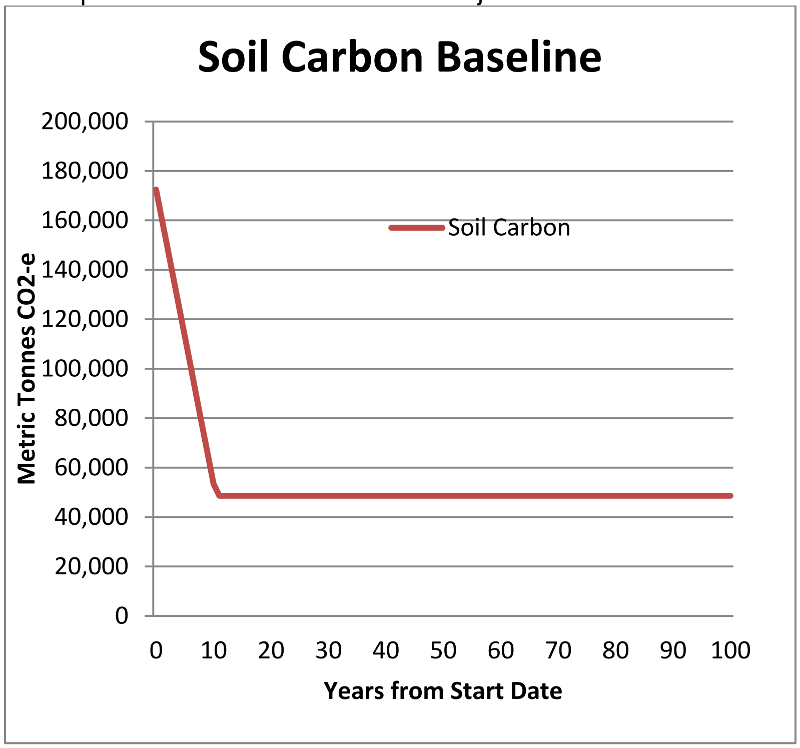
A weighted estimate of emissions must be conducted where more than one soil order is found in the project area.

Table 3. Example of the computation of weighted soil carbon estimates.

					Years															
Project Acres	**Estimated Soil CO_2-e (metric tonnes) per Acre**	**Rate of Emissions**	**Total Emissions**	**Soil Carbon Inventory and Emissions**	**Project Start Date**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
500	285	Histosols 22 tonnes per acre per year (Conversion to till-based agriculture)	80%	CO2-e Metric Tonnes Total	142,500	131,500	120,500	109,500	98,500	87,500	76,500	65,500	54,500	43,500	32,500	28,500	28,500	28,500	28,500	28,500
				Annual Emissions	NA	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	4,000	0	0	0	0
				Cumulative Emissions (%)	NA	8%	15%	23%	31%	39%	46%	54%	62%	69%	77%	80%	80%	80%	80%	80%
500	60	Alfisols 3% of inventory estimate per year	30%	CO2-e Metric Tonnes Total	30,000	29,100	28,200	27,300	26,400	25,500	24,600	23,700	22,800	21,900	21,000	20,100	20,100	20,100	20,100	20,100
				Annual Emissions	900	900	900	900	900	900	900	900	900	900	900	0	0	0	0	0
				Cumulative Emissions (%)	NA	3%	6%	9%	12%	15%	18%	21%	24%	27%	30%	30%	30%	30%	30%	30%
1,000	287.5			CO2-e Metric Tonnes Total	172,500	160,600	148,700	136,800	124,900	113,000	101,100	89,200	77,300	65,400	53,500	48,600	48,600	48,600	48,600	48,600
				Annual Emissions	NA	11,900	11,900	11,900	11,900	11,900	11,900	11,900	11,900	11,900	11,900	4,000	0	0	0	0

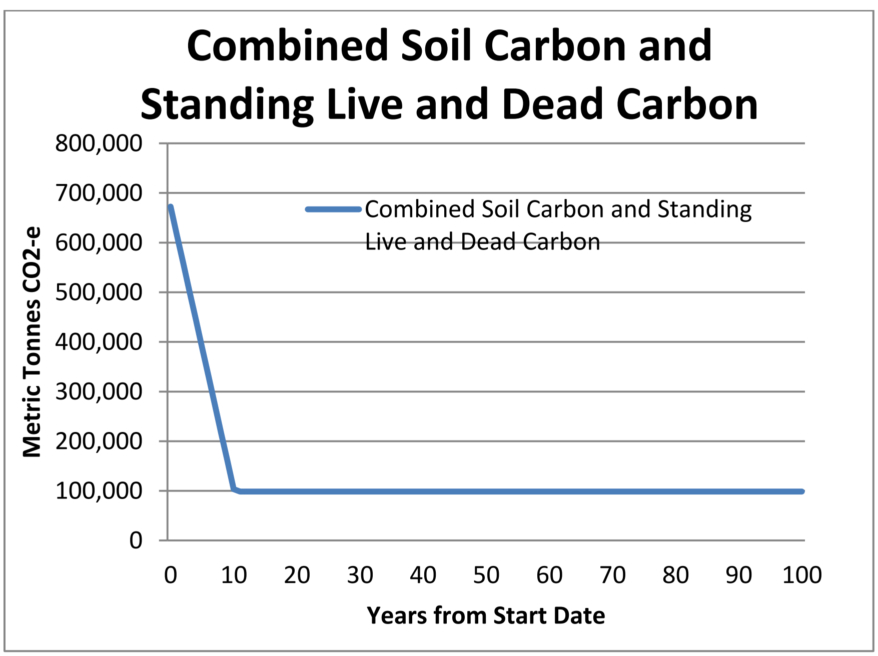
The baseline trend of soil carbon stocks must be graphed to display the soil carbon stocks on an annual basis. Figure 2 displays the baseline trend of soil carbon using the example presented in Table 3.

Figure 2. Example of an Avoided Conversion Project Baseline for Soil Carbon Stocks.



The carbon stock trends for standing live carbon, standing dead carbon, and soil carbon are added together to determine a project baseline for the onsite carbon stocks. Figure 3 displays the baseline trend of soil carbon and standing live and dead carbon, using the example data provided above.

Figure 3. Example of an Avoided Conversion Project Baseline for the total Onsite Carbon Stocks.



Step 2 – Discount for Uncertainty of Conversion Probability

If the fair market value of the anticipated alternative land use for the Project Area (as determined by the appraisal required in the Forest Project Protocol) is *not more than 80 percent greater* than the value of the current forested land use, then a discount must be applied each year to the project's quantified GHG reductions and removals. If quantified GHG reductions and removals for the year are positive (i.e. $[(\Delta AC_{onsite} - \Delta BC_{onsite}) + (AC_{wp,y} - BC_{wp,y}) \times 80\% + SE_y] > 0$ in **Equation 6.1** of the Forest Project Protocol) then use Equation 1 (below) to calculate the appropriate Avoided Conversion Discount (ACD) factor. If quantified GHG reductions and removals for the year are negative, then ACD must equal zero.

Equation 1. Avoided Conversion Discount Factor

If $0.4 < ((VA / VP) - 1) < 0.8$, **then** $ACD = [80\% - ((VA / VP) - 1)] \times 2.5$
If $((VA / VP) - 1) > 0.8$, **then** $ACD = 0\%$
If $((VA / VP) - 1) < 0.4$, **then** $ACD = 100\%$

Where,

ACD	=	The Avoided Conversion Project discount factor (used in **Equation 6.1** of the Forest Project Protocol)
VA	=	The appraised fair market value of the anticipated alternative land use for the Project Area
VP	=	The appraised fair market value of the current forested land use for the Project Area

1.2 Determining Actual Onsite Carbon Stocks

Actual carbon stocks for Avoided Conversion Projects must be determined by updating the Project Area's forest carbon inventory. This is done by:

1. Incorporating any new forest inventory data obtained during the previous year into the inventory estimate. Any plots sampled during the previous year must be incorporated into the inventory estimate.
2. Using an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Approved growth models are identified in Appendix B of the Forest Project Protocol of the Forest Project Protocol. Guidance for projecting forest inventory plot data using models is also provided in Appendix B.
3. Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year.
4. Applying an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the guidance in Appendix A, Section A.4 of the Forest Project Protocol.

1.3 Estimating Baseline Carbon in Harvested Wood Products

Harvesting is assumed to occur in the baseline over time as the Project Area is converted to another land use. To estimate the baseline carbon transferred to long-term storage in harvested wood products each year:

1. Determine the amount of carbon in standing live carbon stocks (prior to delivery to a mill) that would have been harvested in each year, consistent with the rate of reduction in baseline standing live carbon stocks determined in Section 6.3.1 of the Forest Project Protocol. This projection is determined at the project outset, using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project.
2. On an annual basis, determine the amount of harvested carbon that would have remained stored in wood products, averaged over 100 years, following the requirements in Appendix C of the Forest Project Protocol.

1.4 Determining Actual Carbon in Harvested Wood Products

Perform the following steps to determine actual carbon in harvested wood products:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to delivery to a mill) harvested in the current year (based on harvest volumes determined in Section 6.3.3 of the Forest Project Protocol).
2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements in Appendix A, Section A.4 of the Forest Project Protocol.

1.5 Quantifying Secondary Effects

1. Significant Secondary Effects for Avoided Conversion Projects can arise if the type of land use conversion that would have happened on the Project Area is shifted to other forest land.

2. To quantify Secondary Effects for Avoided Conversion Projects, Forest Owners must quantify Secondary Effect emissions using Equation 2. The value for Secondary Effect emissions will always be negative or zero.

Equation 2. Secondary Effects Emissions

$$SE_y = (-1) \times 3.6\% \times (\Delta AC_{onsite} - \Delta BC_{onsite})$$ or **0**, whichever is lower

Where,

SE_y	=	Secondary Effect GHG emissions caused by the project activity in year y (Equation 6.1 of the Forest Project Protocol)
ΔAC_{onsite}	=	Annual difference in actual onsite carbon (CO_2e) as defined in Equation 6.1
ΔBC_{onsite}	=	Annual difference in baseline onsite carbon (CO_2e) as defined in Equation 6.1

2. Guidance for Project Soil Accounting

All projects must estimate the soil carbon emissions associated with project management practices. Certain conversion activities associated with Avoided Conversion projects are eligible (optional) to report the baseline soil carbon stocks the project activity is avoiding. This section provides guidance for estimating soil CO_2-e within the project boundaries, and quantifying emissions associated with project activities.

No direct sampling of soil carbon is required for projects that are reporting soil carbon emissions only. Rather, the estimate of emissions is based on soil carbon estimates from United States Geological Survey (USGS) data for project sites and comparing the data to standardized guidance to assess emissions based on management activities

For Avoided Conversion projects, the project benefit is determined by comparing the project soil carbon estimate (from sampling) to the standardized estimate of emissions associated with the activity. Currently, only Avoided Conversion projects that demonstrate a risk of conversion to agriculture (grazing not included) are eligible to report soil carbon benefits associated with the avoided conversion activity. Conversion risks to housing, development, golf courses, etc. are not currently eligible.

To summarize, Table 4 provides the two different approaches to quantifying soil carbon benefits and/or emissions.

Table 4. Soil Carbon quantification methods by Project Type

Project Description	Project Type Identification	Method to Estimate Project Soil Carbon (CO_2-e) Stocks	Method to Estimate Project Effects on Soil Carbon (CO_2-e)

<table>
<tr><td rowspan="4">Project will provide benefits by avoiding soil carbon emissions associated with conversion to agriculture (Avoided Conversion).</td><td rowspan="4">1</td><td rowspan="2">Soil carbon sampling required at project initiation</td><td>Initial avoided conversion effects estimated through standardized guidance.</td></tr>
<tr><td>Follow guidance in 2-2</td></tr>
<tr><td rowspan="2">Follow guidance in: 2-1a, 2-1d, 2-1e, 2-1f</td><td>Ongoing project effects estimated through default estimates of soil carbon emissions.</td></tr>
<tr><td>Follow guidance in: 2-1a, 2-1d, 2-1e, 2-1f</td></tr>
<tr><td rowspan="2">Project is reporting management-related emissions</td><td rowspan="2">2</td><td>Use of United States Geologic Survey data</td><td>Project effects estimated through default estimates of soil carbon emissions.</td></tr>
<tr><td>Follow guidance in 2-1a, 2-1b, 2-1c, 2-1f</td><td>Follow guidance in 2-2</td></tr>
</table>

Step 2-1: Developing an Estimate of Soil CO_2 –e within the Project Boundaries

Step 2-1a. Identify soil orders present within project (**Project Types 1 and 2**)

Forest Owners must determine the soil orders present in their project area and the area each soil order represents. Where Natural Resource Conservation Service (NRCS) soil data is available on the NRCS website (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx), projects must use this data. Where NRCS data is either unavailable or believed to be in error at the project site, Forest Owners may present the soil orders and area represented by each order with an official letter from a local NRCS representative stating that the portrayal of the soil orders by the Forest Owner is accurate. The letter must state why existing data is either absent on the NRCS website or why the data is not accurate.

On the NRCS website mentioned above, users must create an Area of Interest (AOI), using the website tools, that approximates the project boundaries. To determine the soil order, users select the soil reports tab, select land classifications, and select “Taxonomic Classification of Soils”. This report provides a taxonomic classification of each of the soils in the AOI. The last four letters of the soil descriptions correspond to the soil order. For example, a soil classified as Xerochrepts is in the Inceptisol order. Table 5 below displays the soil orders associated with the last four letters in the soil descriptions:

Table 5. Soil Orders

Soil Order	Last Four Letters in Soil Description
Alfisol	-alfs
Andisol	-ands
Inceptisol	-epts
Mollisol	-olls
Spodosol	-ods
Ultisol	-ults
Histosol	-ists

Step 2-1b. Obtain Soil Organic Matter Values (**Project Type 2**)

Select the tab entitled ‘Soil Properties and Qualities’, then select ‘Soil Organic Matter’ and within the advanced options, select ‘Weighted Average. For the aggregation method, select ‘Higher’ as the tie break rule, and designate ‘0-30 cm’ for the soil depth. Next, click ‘View Ratings’ to review the organic matter percentage for each soil type in the AOI. Convert the number from the rating to decimal percent by dividing by 100.

Step 2-1c. Obtain the Soil Bulk Density Values (**Project Type 2**)

Soil bulk density estimates are determined by first selecting the 'Soil Properties and Qualities' tab, the 'Bulk Density' tab next, followed by the 'On-third Bar'. Specify the 'Weighted Average' method and soil depth (0-30cm, unless otherwise noted). Select 'View Ratings. The ratings will provide bulk density values for each soil type in the AOI. If the bulk density values are not available in the database, determine whether the soil orders are qualified as sandy, loamy, or clay using the 'Surface Texture' value in the Soil Properties and Qualities tab and then apply default values of 1.2 g/cm^3 for clay soils, 1.6 g/cm^3 for sand soils, and 1.4 g/cm^3 for loam soils.

Step 2-1d. Sample for Soil Organic Matter (**Project Type 1**)

Soil carbon estimates are based on sampling soil organic matter for the project. Materials needed include:

- Rubber Mallet
- Square spade (for removing organic material from core site)
- Soil Probe
- Compass
- Trowel and/or sturdy knife (for cleaning soil off of outside service of probe)
- Plastic bags (1 bag for each soil core)
- Marking Pen
- Measuring Tools (meters and centimeters)

Step 2-1di. Identifying the Plot Locations

Plots must be located randomly or systematically with a random start in each of the soil orders that occur on the project site. An adequate number of plots is needed to ensure the overall estimate of soil carbon meets or exceeds the minimum confidence levels stated in the FPP (+/- 20% @ 90% confidence interval). It is acceptable to use the same, or a subset of, plot locations as used for biomass sampling, so long each soil order is sampled and the overall soil carbon estimate achieves the confidence standards stated above

Step 2-1dii. Identify Four Random Locations at each Plot and Extract Soil Organic Matter Samples

2-1dii-1. Select a random number by glancing at a watch's second hand (or digital version). Multiply this number by six to derive a compass bearing to use for the soil sample locations. Following the determined compass bearing, measure 10 meters from the plot center and establish each of the four soil sample locations. Minimal spatial adjustments (<2 meters) can be made to avoid rocks and roots from impacting the ability to sample. If obstacles cannot be avoided within 2 meters, an additional sample location must be selected using the method described above.

2-1dii-2: For each sample location, insert a soil core probe (minimum diameter ½") into the soil at the sample location to a depth of 30cm. A rubber mallet may be used to facilitate penetration. If the probe will not penetrate to the required depth, the probe must be removed, wiped free of soil, and inserted in an alternate location with a 2m radius from the sample location. If repeated efforts result in difficulties achieving full penetration, an additional sample location must be chosen as described in 2-1dii-1. If full penetration is not achieved within two efforts to locate a satisfactory sampling location, the sample must be taken from the initial sample location and the depth recorded.

2-1dii-3: Soil must be extracted carefully from the probe to avoid losing any of the soil collected. Should any soil be lost, the sample must be rejected and a new sample location selected as described above. The extracted soil is placed in a sealable plastic bag. Label the bag with the plot number followed by the letter "SOM", indicating the sample is a 'Soil Organic Matter sample (not a bulk density sample).

2-1dii-4: The soil organic matter samples must be sent to a laboratory with expertise in analyzing soil carbon and physical properties within 106 hours of the acquisition of the samples from the plot sites. The laboratory must receive instructions that the samples are to be heated to over 1000 degrees Celsius. This heat will burn off the carbon and a detector is to be used to measure the amount of carbon dioxide produced and reported as a percent of the volume sampled.

Step 2-1e. Sample for Bulk Density (**Project Type 1)**

Sampling for soil bulk density must be conducted on the project site. Materials needed include:

- Rubber Mallet
- Piece of wooden 2x4 approximately 1' to 2' in length
- Square spade
- Soil Core/Ring with known volume
- Trowel and/or sturdy knife
- Plastic bags (1 bag for each soil pit)
- Marking Pen
- Measuring tools (meters and centimeters)

Step 2-1ei. One random location 4 meters from each plot center must be selected for soil data collection to dig a soil pit to a depth of at least $30cm^3$. The measure of depth must be below the organic layer (branches, leaves, moss, etc.). The sides of the pit can be made straight using the trowel or the study knife. Random selection is achieved through the use of the second hand method described in Step 2-1dii-1. Adjustments to the location of the pit can be made using the adjustments allowed for difficulties associated with inserting soil probes described in 2-1dii-2.

Step 2-1eii. Two samples will be taken from the soil pit. The sample is taken by centering the soil ring at a depth of 7.5cm and the second is taken by centering the ring at a depth of 22.5cm. The ring is inserted perpendicular to the pit face. The location of each insertion must be into undisturbed soil, as occurs during the process of extracting the soil rings. The soil pit can be expanded to ensure that undisturbed soil is sampled.

2-1eii -1: For each of the samples the sharp end of the ring is pushed in, without twisting, as far as possible with the hands.

2-1eii -2: The piece of wood is placed over the ring and gently hammered evenly into the soil. If strong resistance is encountered, an alternate location may be found within the pit, or a new pit located using the guidance described above.

2-1eii -3: Using the trowel or sturdy knife, soil is removed around the outside of the ring to allow for extraction of the ring without losing soil. The surfaces of the ring should be cleaned and cut flus to the surface of the ring. Small losses during extraction and cleaning (up to 2 cm^3) can be restored by filling the void with soil from the pit site and smoothing. Samples must be rejected if soil losses from the ring occurring during extraction and cleaning are greater than $2cm^3$.

2-1eii -4: The soil from both ring samples is placed in one sealable plastic bag and labeled with BD and the plot number.

2-1eii -5: The bulk density samples must be sent to laboratory with expertise in analyzing soil carbon and physical properties within 106 hours of the acquisition of the samples from the plot sites. Bulk density instructions sent with the samples shall describe that the samples are to be dried at 105 degrees centigrade for at least 48 hours and that all portions of the sample are to be retained (including rocks). The laboratory shall present the results of the analysis of bulk density estimates as g/cm^3, displaying dry weight over total sample volume.

Step 2-1f. Calculate the Total Soil CO_2 per Acre (**Project Types 1 and 2)**

Use Equation 2 (below) to calculate the soil CO_2 per acre:

Equation 2. Soil CO_2-e per acre

$$\text{Soil } CO_2e = \text{Organic Matter Value (Steps 1b or 1d)} \times 0.58 \text{ (Conversion of Organic Matter to Carbon)} \times \text{Bulk Density Value (Steps 1c or 1e)} \times \text{SoilDepth Sampled (30 cm)} \times 40{,}468{,}564.224 \text{ (Conversion of } 1\text{cm}^2 \text{to 1 acre)} \times 10^{-6} \text{ (Conversion of 1 gram to 1 metric ton)} \times 3.67 \text{(Conversion of Carbon to } CO_2\text{)}$$

An example is provided in Table 6 below.

Table 6. Example Calculation

Organic Matter from Steps 2-1b or 2-1d	Conversion of Organic Matter to Carbon	Bulk Density (g/cm3) from Steps 2-1c or 2-1e	Soil Depth Sampled 30 cm	Conversion of 1 cm^2 to 1 acre 1 acre = 40,468,564.224 cm2	Conversion of 1 gram to 1 metric ton Carbon	Conversion of 1 Metric Ton Carbon to 1 Metric Ton CO_2	Estimated Metric Tons CO_2 per Acre
	*	*	*	*	*	*	=
0.05	0.58	1.2	30	40,468,564.224	0.000001	3.67	155.05

Step 2-2. Quantify the project effects on soil CO_2-e (Project Types 1 and 2)

Project effects are calculated using the standardized guidance below. Avoided Conversion projects must use the standardized guidance for purposes of estimating project benefits. Soil carbon emissions resulting from management activities are determined where the activity, or set of activities, leads to a net loss of soil carbon across the entire project. Net emissions can occur across the project area in a sustainably managed forest where emissions from management activities are not restored during the rest, or growth cycle, of the stand. The default values provided are derived from scientific literature and address the high-end estimates of net emissions associated with management activities, except in the case of conversion where it is more conservative to underestimate the emissions associated with the avoided activity. The background documentation for the default values is found on the Reserve’s website under ‘Forest Resources’.

Default emission values are provided as percentages for each soil order, based on harvesting intensity, site preparation intensity, and the frequency of disturbance. Forest Owners must report their soil carbon emissions by grouping the total acres in each permutation, or class of soil order, harvesting intensity, site preparation intensity, and frequency of disturbance, rather than reporting on an individual stand basis. An example of reporting classes of management activities is provided below, following the descriptions of the management activities.

Net carbon emissions are estimated as the difference between soil carbon stocks (CO_2-e) in the soil prior to the management activity and the soil carbon stocks (CO_2-e) in the soil immediately prior to the subsequent harvest event for each harvested stand. Index values are provided for both harvesting intensity and site preparation intensity that, when combined, classify the harvesting intensity for the stand. The index value for harvesting intensity is derived from both the amount of biomass removed during harvest and the soil disturbance associated with the biomass removal. The index value for site preparation is based on the amount of soil disturbance associated with site preparation activities.

For each stand harvested in a given reporting year, Forest Owners must determine the harvesting intensity using the guidance below. For Avoided Conversion projects, the guidance is used below to assist in determining baseline conditions and applied to the project rather than individual stands. First, the index value is determined for the stand based on the amount of biomass removed during harvest, based on guidance in Table 7.

Step 2-2a. Harvesting Intensity

The Harvesting Intensity value is calculated using a factor for the amount of biomass removed and the amount of soil disturbance that occurs removing the biomass. Both values are added together to calculate the harvesting intensity. The value for disturbance related to biomass removal is determined using Table 7 below:

Table 7. Determination of Biomass Removal Index

Biomass Affected by Harvest		
Percentage Pre-Harvest Above-Ground Biomass Removed	Silviculture Activities Generally Associated with Level of Biomass Removed	Biomass Removal Index
<10%	Sanitation Salvage	0
10 – 50%	Selection, Thinning	0
51% - 80%	Rotation harvest with biomass remaining in tree tops, seed/shelterwood and/or leave trees, and dead wood	1
> 80%	Rotation harvest with whole tree harvesting and little retention	2
Not a Silvicultural Activity- There is no intent to follow up with efforts to regenerate forested conditions		
100%	Conversion – only relevant to assessment of Avoided Conversion baseline	10

Step 2-2b. Soil Disturbance from Harvesting Activities

The second value considered for determining the harvest intensity is based on the level of soil disturbance associated with biomass removal. Soil disturbance within the harvested stands boundary may be the result of skidding logs, tree falling, and harvesting equipment. The disturbance may be extensive or minimized, depending on site-specific conditions and care taken during harvesting operations. The soil disturbance index is based on the amount of mineral soil (below the organic layer, including litter and duff) exposed due to harvest activities. The determination of the amount of mineral soil disturbance is from ocular inspection of harvested stands. Table 8 below is used to determine the Soil Disturbance Index from harvesting

Table 8. Determination of Soil Disturbance Index.

Percent of Mineral Soil Exposed during Harvest	Soil Disturbance Index
<5%	0
5-20%	2
20-40%	3
40-60%	4
>60%	5

Step 2-2c. Determining the Harvesting Intensity Class

The values for the biomass removal index and the soil disturbance index are summed together to determine the Harvesting Intensity Class. Table 9 below displays the Harvesting Intensity Classes for the sum of the biomass removal and soil disturbance indexes.

Table 9. Harvesting Intensity Classes based on Summing the Biomass Removal and Soil Disturbance Indexes

Harvesting Intensity Classes	
Harvesting Intensity Class	Sum of Biomass Removal and Soil Disturbance Indexes
Light - Medium	<3
High	3-4
Very High	5-7
Conversion	>7

Step 2-2d. Determining Site Preparation Classes

For each stand harvested the Forest Owner must determine the Site Preparation Index using the guidance in Table 10.

Table 10. Site Preparation Classes and Descriptions of Management Activities

Site Preparation	
Site Preparation Class	Description
Very Light	Less than 5% surface area disturbance of soil below litter and duff due to ripping, grading, raking, etc.
Light	5% to 24% surface area disturbance below litter and duff due to ripping, grading, raking, etc.
Medium	25% to 59% surface area disturbance below litter and duff due to ripping, grading, raking
Heavy	60% to 100% surface area disturbance below litter and duff due to ripping, grading, raking
Conversion	Soils cleared of trees, stumps and other forest vegetation and prepared for agriculture, grazing, and/or development. No return to forest vegetation.

Step 2-2e. Determining the Frequency of Disturbance

The frequency of disturbance is determined as the time between harvest activities associated with the specific silviculture event that is being evaluated for soil carbon emissions. This value must indicate the number of years until the next harvest event will occur.

Table 11. Frequency of Disturbance Classification

Frequency of Disturbance	Years
Short	< 15
Medium	16 - 30
Long	31 - 45
Very Long	>45

Step 2-2f. Determining Emissions Associated with Management Activities

For each class of harvested stands, or stands that have received site treatment, a value is determined for each combination of Harvest Intensity, Frequency of Disturbance, Site Preparation, and Soil Order. A percent value is derived from Table 12 below based on the combination of the various classes.

Table 12. Estimated Net Carbon Loss

Harvesting Intensity	Frequency of Disturbance	Site Treatment	Estimated Net Carbon Loss by Soil Order						
			Alfisol	*Andisol*	*Inceptisol*	*Mollisol*	*Spodosol*	*Ultisol*	*Histosol*
Light - Medium	Short	Very Light	0%	0%	0%	0%	0%	0%	80%
	Medium		0%	0%	0%	0%	0%	0%	80%
	Long		0%	0%	0%	0%	0%	0%	80%
	Ex-Long		0%	0%	0%	0%	0%	0%	80%
High	Short	Very Light	Conifers 0% Hardwoods 20%	0%	8%	0%	10%	9%	80%
		Light	Conifers 5% Hardwoods 20%	5%	8%	5%	10%	9%	80%
		Medium	Conifers 10% Hardwoods 20%	10%	10%	10%	20%	11%	80%
		Heavy	Conifers and Hardwoods 20%	20%	20%	20%	41%	22%	80%
	Medium	Very Light	Conifers 6% Hardwoods 20%	0%	0%	0%	33%	24%	80%
		Light	Conifers 6% Hardwoods 20%	5%	5%	5%	33%	24%	80%
		Medium	Conifers 10% Hardwoods 20%	10%	10%	10%	33%	24%	80%
		Heavy	Conifers and Hardwoods 20%	20%	20%	20%	41%	24%	80%
	Long	Very Light	Conifers 0% Hardwoods 20%	0%	0%	0%	31%	0%	80%
		Light	Conifers 5% Hardwoods	5%	5%	5%	31%	5%	80%

			20%						
		Medium	Conifers 10% Hardwoods 20%	10%	10%	10%	31%	11%	80%
		Heavy	Conifers and Hardwoods 20%	20%	20%	20%	41%	22%	80%
	Very Long	Very Light	0%	0%	0%	0%	5%	0%	80%
		Light	0%	0%	0%	0%	10%	5%	80%
		Medium	0%	0%	0%)	0%	20%	11%	80%
		Heavy	0%	0%	0%	0%	41%	22%	80%
Very High	Short (<10 years)	Very Light	Conifers 6% Hardwoods 20%	6%	28%	6%	1%	6%	80%
		Light	Conifers 6% Hardwoods 20%	6%	28%	6%	10%	6%	80%
		Medium	Conifers 10% Hardwoods 20%	10%	28%	10%)	20%	11%	80%
		Heavy	Conifers and Hardwoods 20%	20%	53%	20%	41%	22%	80%
	Medium (11-30 years)	Very Light	Conifers 6% Hardwoods 20%	6%	6%	6%	0%	5%	80%
		Light	Conifers 6% Hardwoods 20%	6%	6%	6%	10%	6%	80%
		Medium	Conifers 6% Hardwoods 20%	10%	10%	10%	20%	11%	80%
		Heavy	Conifers and Hardwoods 20%	20%	20%	20%	41%	22%	80%
	Long (31-45	Very Light	Conifers 6%	5%	6%	6%	0%	6%	80%

	years)		Hardwoods 20%						
		Light	Conifers 6% Hardwoods 20%	6%	6%	6%	10%	6%	80%
		Medium	Conifers 6% Hardwoods 20%	10%	10%	10%	20%	11%	80%
		Heavy	Conifers and Hardwoods 20%	20%	20%	20%	41%	22%	80%
	Ex-Long (>45 years)	Very Light	Conifers 6% Hardwoods 6%	6%	6%	6%	0%	6%	80%
		Light	Conifers 6% Hardwoods 6%	6%	6%	6%	10%	6%	80%
		Medium	Conifers 6% Hardwoods 6%	6%	6%	6%	20%	6%	80%
		Heavy	Conifers 6% Hardwoods 6%	6%	6%	6%	41%	6%	80%
Conversion	Conversion	Agriculture	30%	30%	30%	30%	30%	30%	80%
		Residential-commercial	0%	0%	0%	0%	0%	0%	80%

This percentage is multiplied by the soil carbon (CO_2 –e) estimate on a per acre basis and multiplied by the stand's acres to determine the emissions to report for each stand. The stand emissions are summed to determine the soil carbon emissions (CO_2 –e) reported annually. An example of the calculation is provided in Table 13 below.

Table 13. Example of Calculations for Annual Soil Carbon Reporting

Reporting Year			2012						
A	B	C	D	E	F	G	H	I	J
Stand ID	Soil Order	Soil Carbon (CO_2-e) Tonnes per Acre	Acres	Stand Soil Carbon (CO_2-e) Tonnes	Harvesting Intensity	Disturbance Frequency	Site Preparation	Estimated Soil Carbon Loss %	Stand Soil Carbon Loss (CO_2-e) Tonnes
	From Step 2-1	From Step 2-1		D*C	From Step 2-2	From Step 2-2	From Step 2-2	Table 12	I*E
1	Alfisol	85	595	50,575	Very High	Very Long	Heavy	6%	3,035
2	Alfisol	85	683	58,055	Light-Medium	Short	Very Light	0%	-
3	Alfisol	85	2,232	189,720	High	Long	Light	5%	9,486
Sum of Soil Carbon Emissions (CO_2-e) Tonnes									12,521