Public Workshop on Forest Project Protocol White Papers Introduction

March 2011

Purpose of White Papers

- ✓ Commissioned the development of white papers in Winter of 2010 to gather up-to-date research to ensure protocol accounting is accurate and conservative and to inform modifications where appropriate.

White Papers Explored
Two Key Themes

- ✓ Are carbon accounting activities accurately accounting for emissions/benefits from project activities?
  - ✓ Are there practical approaches to measurement?
- ✓ Are there adequate safeguards for sustainable forest management and natural forest management ?

White Paper Topics

- ✓ Carbon Accounting and Management of Lying Dead Wood
- ✓ Accounting for Carbon in Soils
- ✓ Sustainable Forest Management Certification
- ✓ Carbon Dynamics Associated with Even-Aged Management

Public Comment Period

- ✓ Now open for public comment until March 25, 2011.
- ✓ Submit written comments in Word or PDF format to: policy@climateactionreserve.org.
- ✓ Following the 45-day public comment period, the Reserve will respond to all comments received in writing and propose further steps as necessary to amend the FPP based on its findings.
- ✓ Public Workshops in Durham and Sacramento to further solicit public input.

Public Workshop Agenda

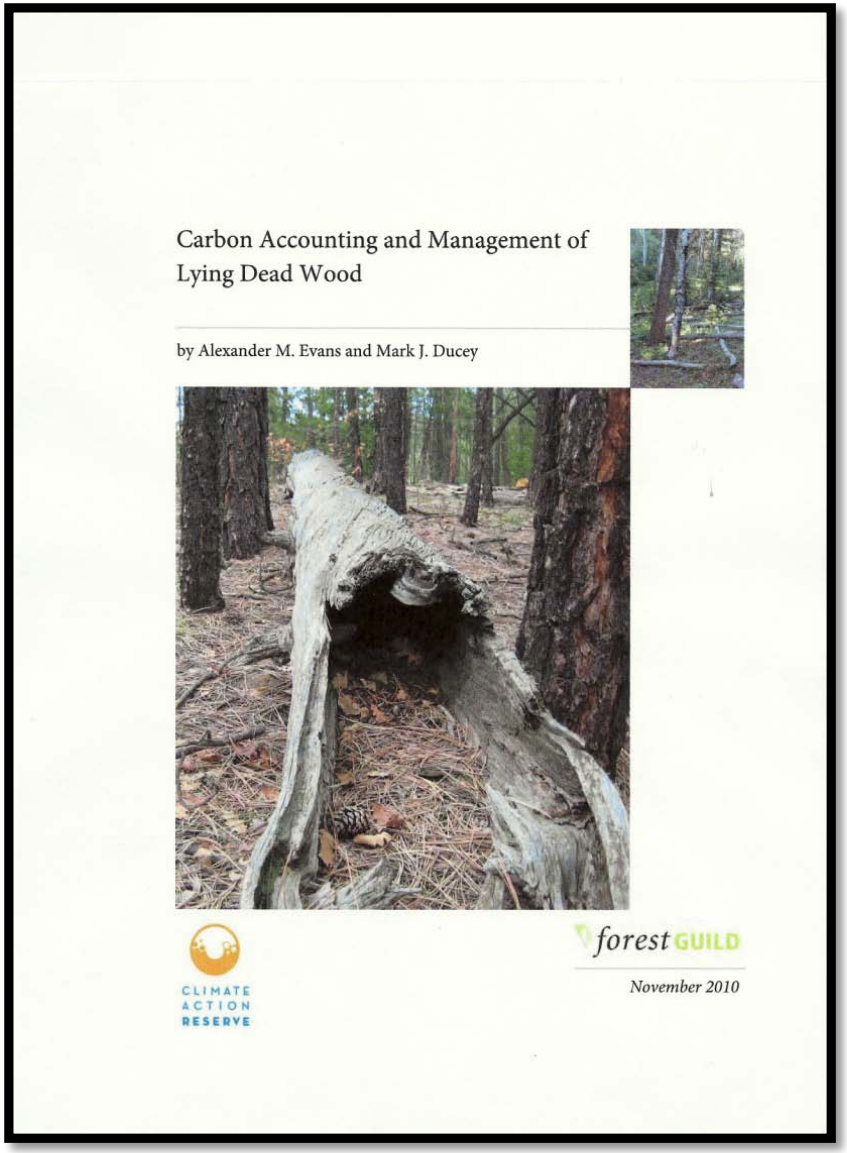
- ✓ Introduction – 15 minutes
- ✓ Carbon Accounting and Management for Lying Dead Wood (LDW) – 45 minutes
- ✓ Accounting for Carbon in Soils – 45 minutes
- ✓ Break – 15 minutes
- ✓ Carbon Dynamics Associated with Even-Aged Management – 45 minutes
- ✓ Examining Carbon Accounting and Sustainable Forestry Certification – 45 minutes

CLIMATE ACTION RESERVE

Public Workshop on Forest Project Protocol White Papers

Carbon Accounting and Management for Lying Dead Wood (LDW)

March 2011



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Completed:

November 2010

Current Reserve Guidance for LDW Accounting

- ✓ Inclusion is optional for all project types.
- ✓ The protocol requires retention of lying dead wood as a structural element as a criterion of Natural Forest Management (Section 3.10.2).
- ✓ Assurances of adequate LDW are focused on measurement of standing dead wood, since all lying dead wood originates as standing dead wood and standing dead wood lends itself to standard forest inventory sampling practices.

Questions Addressed in White Paper

- ✓ What is the magnitude and importance of carbon in lying dead wood for different forest types?
- ✓ How are the levels of carbon in lying dead wood impacted by forest management projects and land use changes?
- ✓ How accurate and feasible are different methods for quantifying lying dead wood?

Magnitude of LDW

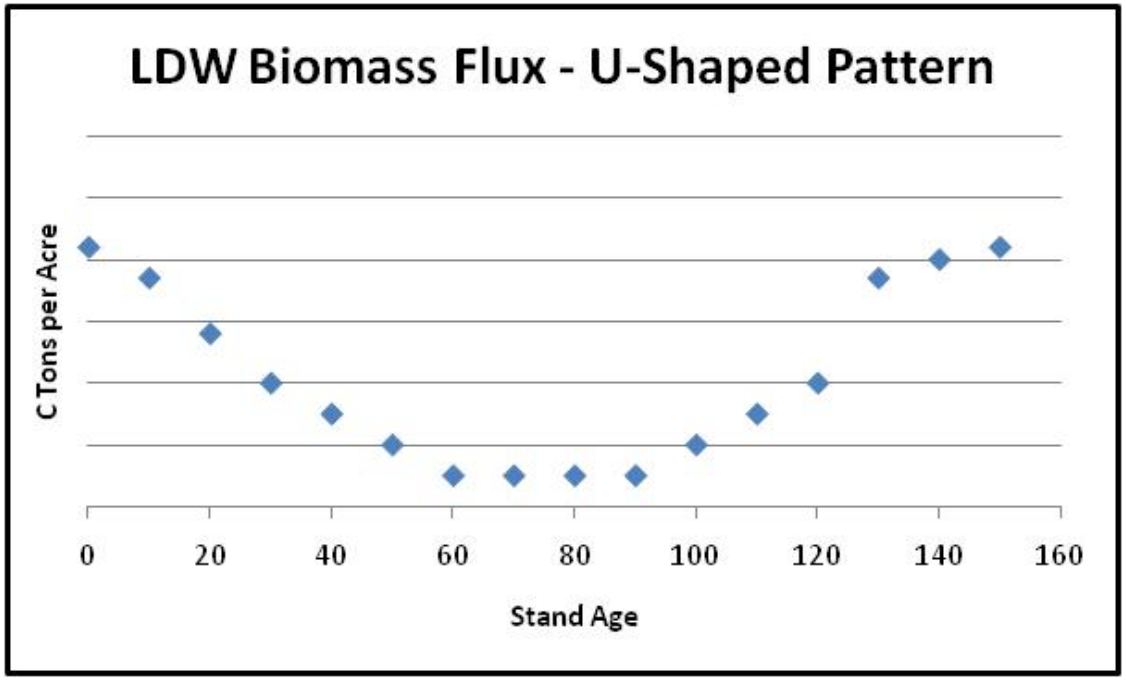
- ✓ Across U.S., regions average 3.2 to 16.9 tCO2e of LDW per average forest acre which represents a range of 1.7% to 4.6% of total forest carbon.

AVERAGE BY REGION FOREST TYPES	tCO_2e per acre	LDW as a % of total forest carbon
Northeast	6.3	2.3%
Northern Lake States	6.8	1.9%
Northern Prairie States	5.5	2.4%
Pacific Southwest	8.5	2.9%
Pacific Northwest	16.9	4.4%
Rocky Mtns. (North)	10.6	4.6%
Rocky Mtns. (South)	4.1	2.7%
South Central	3.2	1.9%
Southeast	4.1	1.7%

Estimates of LDW by region from Woodall et al. (2008), and LDW as a % of total forest carbon (EPA 2010 Table A-216) Region Tons of LDW

Flux in volumes of LDW

- ✓ Dead wood accumulation in forest stands is constantly in a state of flux – in general, stands have the most LDW when they are very young and very old depending on nature of disturbances and decomposition rates .



Ecological Benefits of LDW

- ✓ In addition to storing carbon, LDW plays other important roles in ecosystem:
  - ✓ Wildlife Habitat.
  - ✓ Erosion Protection.
  - ✓ Water Storage.
  - ✓ Nutrient Cycling.

Ecological Tradeoffs of LDW

- ✓ Potential negative ecological impacts of increasing LDW retention for carbon storage:
  - ✓ Insect outbreaks.
  - ✓ High severity fire.
- ✓ LDW retention requirements should be as ecologically specific as possible.

Benefits of Forest Carbon Projects

- ✓ Eligible projects under the FPP are likely to increase LDW compared to baseline conditions due to:
  - ✓ Increasing tree stocking.
  - ✓ Protection of existing LDW.
  - ✓ Increasing rotation ages.
  - ✓ Thinning diseased and suppressed trees.
  - ✓ Managing competing brush.

Impacts of Forest Management Activities on LDW

- ✓ Forest management activities associated with decreasing LDW:
  - ✓ Reducing the number of potential snags. (Snags eventually become LDW).
  - ✓ Removal of existing LDW.
- ✓ These activities are unlikely with FPP projects:
  - ✓ FPP accounting currently includes snags.
  - ✓ LDW is low quality wood with low economic value.

Measurement Challenges

Measurement Challenges

- ✓ Measuring LDW is more challenging than standing forest inventory:
  - ✓ Number of LDW pieces per acre can be high, but overall contribution to total carbon is low.
  - ✓ Accuracy issues with sparse and patchy distribution.
  - ✓ Consistency issues with breakage, orientation and assignment of decay classes.
  - ✓ Visibility can be obscured by understory vegetation, moss and litter.

Measurement Challenges

- ✓ Issues with available sampling methods:
  - ✓ Time consuming and inefficient (Fixed Area Plots, Perpendicular Distance Sampling).
  - ✓ Risks of non-detection (Point Relascope Sampling and Prism Sweep Method).
  - ✓ Little field testing to date (Transect Relascope Sampling, Prism Sweep Method, Line Intersect Distance Sampling).

Modeling Challenges of LDW

- ✓ Modeling approaches also have challenges.
  - ✓ Application of available look-up tables and on-line estimators are based on FIA data - require field–based calibration and adjustment and not intended for uneven-aged stands.
  - ✓ Application of growth and yield models could account for LDW by modeling trees post-mortem, no widespread validation studies to date.

Seeking Further Input

- ✓ If standing dead wood provides a good surrogate for future levels of LDW, can the measurement of standing dead wood continue to be used instead of a sampling or modeling requirement for measuring LDW with some level of statistical confidence?
- ✓ Are the recruitment/retention goals stated in Table 3.2 of the FPP (1 to 4 Metric Tons of Carbon per acre in standing dead wood) appropriate?
- ✓ Should the recruitment/retention goals be tailored to each Assessment Area?

Seeking Further Input

- ✓What are guidelines for a verifier to determine that the "…quantity of lying dead wood is not commensurate with recruitment from standing dead trees…" as stated in Table 3.2 of the FPP?
  - ✓More LDW is not always better.
  - ✓Recognize "Forest projects designed to increase carbon storage under the Climate Action Reserves Forest Project Protocol are unlikely to have a negative impact on long-term LDW."

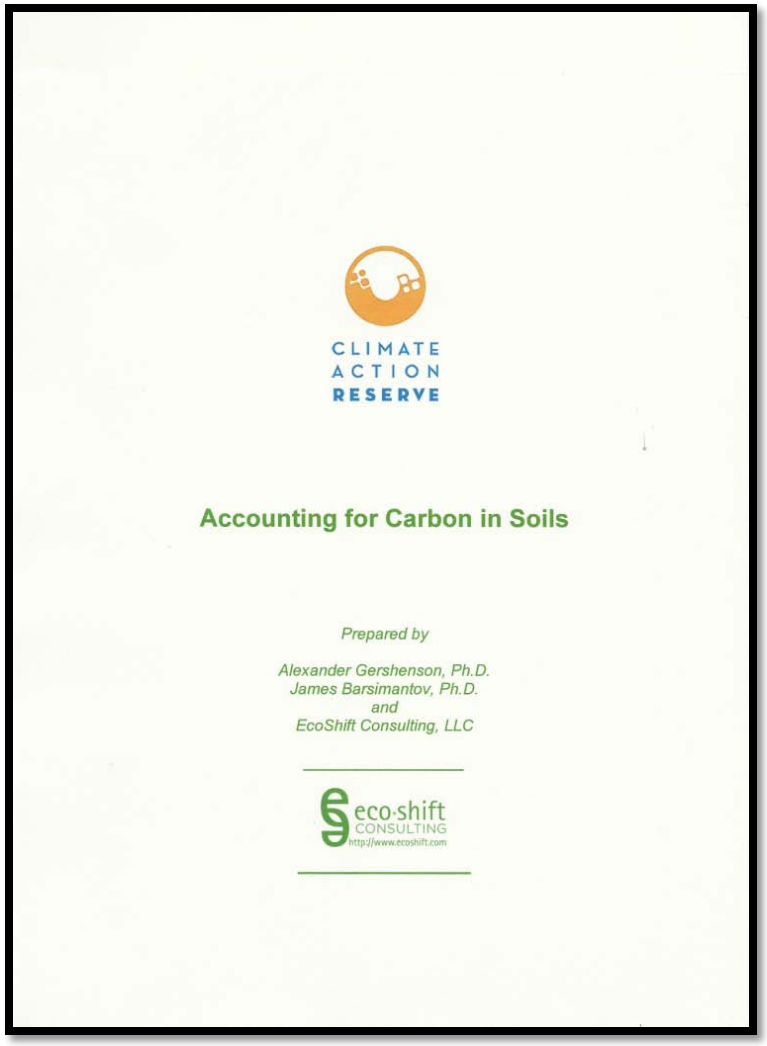
Seeking Further Input

- ✓ What are best approaches to additional accounting of LDW?
  - ✓ Set minimum thresholds by assessment areas (e.g. 5 C tonnes/acre in Coast Redwood Forest)?
  - ✓ Debit project activity if minimum not met/maintained?
  - ✓ No project credit for levels exceeding minimum?
  - ✓ Call for measurement/monitoring methodology that exceeds simple ocular estimates, but keeps accuracy levels realistic?

Public Workshop on Forest Project Protocol White Papers

Accounting for Carbon in Soils

March 2011



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Completed:

November 2010

Current Reserve Guidance for Soil Carbon Accounting

- ✓ Soil Carbon is an optional carbon pool except to account for biological emissions when:
  - Site preparation activities including deep ripping, plowing, furrowing, etc. exceed 25% of the project area, or
  - Mechanical site preparation activities are not conducted on contours.

Questions Addressed

- ✓ What is the magnitude and importance of soil carbon for different forest types?
- ✓ How are the levels of soil carbon impacted by forest management and land use changes?
- ✓ How accurate and feasible are different methods for quantifying soil carbon?

Magnitude and Dynamics of Soil Carbon

- ✓ Soil carbon accounts for 50%-75% of all forest carbon in temperate and boreal regions.
- ✓ Carbon enters the soil pool through litterfall (decomposing woody and leafy material) or rhizosphere processes (decomposing root material).
- ✓ Carbon is lost through microbial decomposition, which is largely dependent on temperature, moisture, and substrate availability .

Impacts of Forest Management Activities on Soil Carbon

- ✓ Forest management activities have the potential to significantly increase or decrease soil carbon.
- ✓ Impacts are highly uncertain due to dependence on a complex array of interrelated factors.
  - ✓ Site characteristics (soil type, dominant tree, etc.)
  - ✓ Organic material left on site (charcoal, slash, etc.)
  - ✓ Increased productivity (fertilization, thinning, etc.)
- ✓ Factors affect soil carbon differently under different conditions.
- ✓ Studies to date show conflicting information.

Pre-Harvest Activities: Fertilization and Vegetation Control

- ✓ Pre-harvest activities such as fertilization and control of competing vegetation can increase soil carbon by contributing fresh litter and increasing primary plant production.
- ✓ On the other hand, these activities can decrease soil carbon by removing vegetation and stimulating microbial decomposition.
- ✓ The primary variable that controls this is the amount of soil carbon present before the treatment

Pre-Harvest Activities: Thinning Operations

- ✓ Thinning which removes diseased or suppressed trees, can decrease soil carbon by stimulating microbial activity (allowing more light) and a reduction in litter input and fine root biomass.
- ✓ Thinning effects on soil carbon can be mitigated by lengthening intervals between thinning and by leaving biomass residues on site.

Harvest Activities: Biomass Removed

- ✓ Whole tree harvests can reduce soil carbon by as much as 20%.
- ✓ Sawlog (bole only) harvests that leave residues (bark, branches) on site can cause gains in soil carbon by over 30% in conifer forests while showing no changes in soil carbon in hardwood and mixed forests.
- ✓ Increases in harvest intensity (number of stems removed) show higher decreases in soil carbon in the short term, particularly on surface horizons.

Harvest Activities: Rotation

- ✓ Rotation length is a more important factor for determining soil carbon gains/losses than harvest intensity.
- ✓ Intervals between rotations shorter than 50 years resulted in significant losses in soil carbon regardless of forest type.
- ✓ Longer rotation lengths has a positive effect on overall soil carbon accumulation. (>50 years for pine and aspen; >100 years for spruce).
- ✓ Important to allow soil carbon to return to pre-harvest levels before subsequent harvest.

Harvest Activities: Variable Effects

- ✓ Harvest effects can result in immediate declines in soil carbon as high as 60%.
- ✓ For most harvest sites, soil carbon returns to previous levels within 50 years or less.
- ✓ Conifer-dominated systems exhibit smaller losses in soil carbon due to decomposition dynamics.
- ✓ Most important factor for potential soil loss from harvest is soil type.
  - ✓ (Inceptisols and Ultisols show higher average losses; Spodosols and Alfisols not significantly affected)

Post Harvest Treatment: Debris Management

- ✓ When post-logging debris remains onsite, soil carbon increases in the short term after harvest by incorporation of organic matter into the forest floor.
- ✓ The cover of debris lowers bulk soil and microbial respiration and lowers decomposition rates.
- ✓ Slash burning can retain a large % of slash carbon in the forest floor and carbon in charcoal is more resistant to decomposition.

Post Harvest Treatment: Site Preparation

- ✓ High disturbance site preparation such as disking and plowing can decrease soil carbon as much as 30% .
- ✓ High levels of disturbance results in mixing top soil horizons increasing decomposition and exposing soil carbon to erosion risks.
- ✓ The new CDM guidelines for soil carbon management specify that such disturbance shall not exceed 10% of the project area.

Measurement and Monitoring

- ✓ Soil carbon monitoring techniques are imprecise or very expensive and time consuming.
- ✓ Soil sampling is destructive and due to soil heterogeneity, high numbers of samples must be obtained per sampling interval to achieve confidence in estimates.
- ✓ Costs of precise measurements can run hundreds of thousands of dollars per plot.

Modeling Approaches

- ✓ Modeling approaches can be used for estimating soil carbon dynamics.
- ✓ Input assumptions include climate, region, soil types, disturbance effects.
- ✓ Ultimately models could be improved with new research incorporating additional effects of management and contributing environmental factors.

Seeking Further Input – Accounting for Emissions

- ✓ Should the threshold criterion for accounting for soil carbon be modified?
- ✓ Should accounting of soil carbon be expanded beyond site preparation activities?
- ✓ What timescale should be applied to determine important impacts on soil carbon?

Seeking Further Input – Developing a Standardized Approach

- ✓ Would modeling approaches to develop standardized soil carbon accounting be acceptable?

Concept entails:

- ✓ Retain a qualified consultant to model project activities on a variety of soils, dominant tree species, and other environmental conditions.
- ✓ Develop a standardized look-up table for project activities in different assessment areas.
- ✓ Prioritize accounting to project activities that likely to have associated soil carbon emissions over project life.

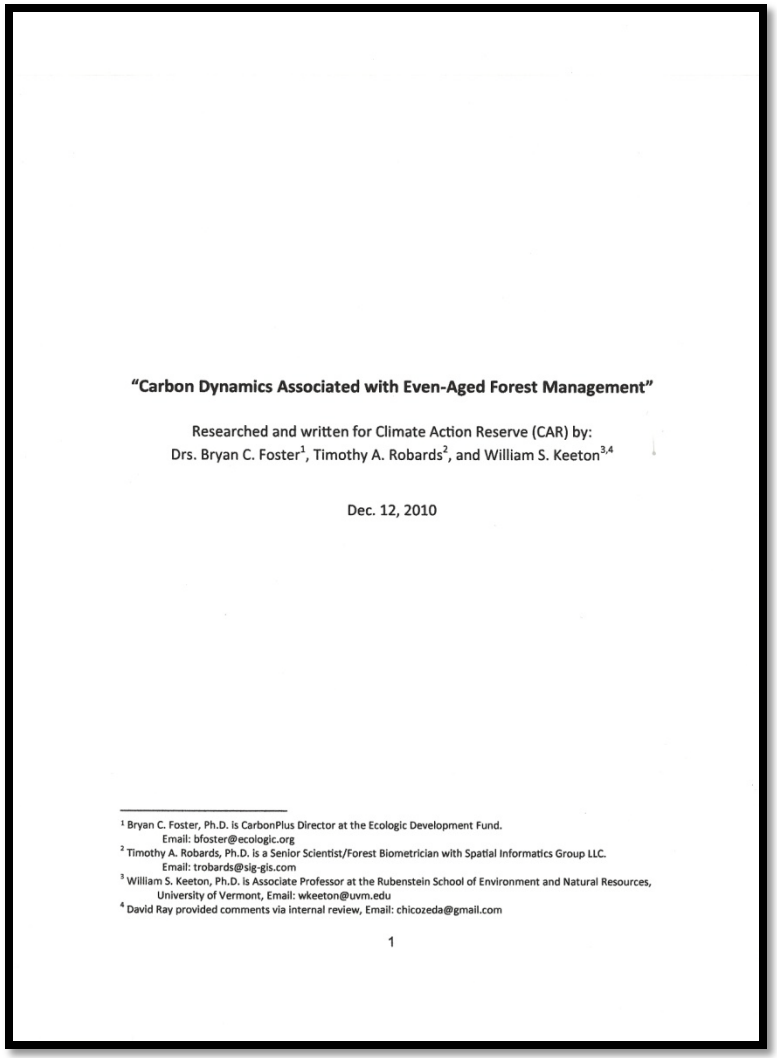
Seeking Further Input – Crediting versus Emissions Accounting

- ✓ Should changes in soil carbon pools be allowed to create a positive flow of credits from a project?
  - ✓ Potentially high amount of soil carbon reductions from avoided conversion projects.
- ✓ Limit project credits due to changes in soil carbon but assess project debits based on a conservative, standardized methodology for any negative impacts.

Public Workshop on Forest Project Protocol White Papers

Carbon Dynamics Associated with Even-Aged Forest Management

March 2011



"Carbon Dynamics Associated with Even-Aged Forest Management"

Researched and written for Climate Action Reserve (CAR) by:
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Dec. 12, 2010

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Completed:

December, 2010

Current Guidance Related to Even-Aged Management in the FPP

- ✓ Current Reserve requirements for use of even-aged management include requirements for:
  - ✓ 40 acre maximum openings with adjacency restrictions.
  - ✓ Non-declining inventory over a 10-year period.
  - ✓ No more than 40% of the age classes can be less than 20 years old.
- ✓ The latter two points above will lead to a minimum 50 year rotation age limitation.

Questions Addressed in White Paper

- ✓ What is even-aged management and why is it applied in different forest types?
- ✓ How do even-aged management practices affect carbon dynamics in forests over project lifetimes?
- ✓ What are the magnitudes of impacts from even-aged management on optional and required carbon pools?

Even-Aged Forest Management Definitions

- ✓ Even-aged management practices generally refer to treatments that remove overstory trees either in total (clearcutting) or with some retention of mature trees for short periods of time (seed tree/ shelterwood).
- ✓ The results are stands of trees that are generally uniform in composition and age class.
- ✓ An “age class” is typically used to refer to a 10-20 year aggregation of trees originating from a single natural disturbance or silvicultural regeneration treatment.

Even-Aged Treatments and Natural Disturbance

- ✓ Rationale for natural disturbance-based forest management is that it limits forest management within the historic range of variability thereby more likely to maintain ecosystem values.
- ✓ Even-aged management practices can mimic natural disturbance in forest types with crown fire history.
- ✓ Even-aged treatments depart from natural disturbance patterns if uniformly low in retention (<10% basal area) or lack retention of large live trees, snags and LDW.

Many Areas Identified as Having Natural Stand Replacing Disturbances

- ✓ Loblolly and Shortleaf Pine - SOUTHEAST
- ✓ Oak-pine, Oak-hickory, Oak – MID-ATLANTIC AND GREAT LAKES
- ✓ White and red pine - NEW ENGLAND, MID-ATLANTIC, AND GREAT LAKES
- ✓ Douglas-fir – PACIFIC COAST
- ✓ Jack pine – GREAT LAKES
- ✓ Aspen – GREAT LAKES AND ROCKY MOUNTAINS
- ✓ Lodgepole pine – ROCKY MOUNTAINS
- ✓ White and black spruce – UPLAND ALASKA
- ✓ Sitka spruce and western hemlock – COASTAL ALASKA

Barriers to Replicating Natural Disturbances

- ✓ Temporal intervals between natural disturbances are inconsistent across the landscape (e.g. ridgetop burns more frequent than midslope burns).
- ✓ Length of intervals between stand-replacing natural disturbances can be more variable and longer than commercial rotations.
- ✓ Fires and windthrows can be much larger scale (e.g., 5000-10,000 Ha) than typical of forest management.
- ✓ Natural disturbances have high variability of intensity and retention which has not necessarily been replicated in harvest treatments.

Harvest Retention and Rotation Impacts on Overall Carbon Storage

- ✓ Carbon storage potential determined by species composition and site quality.
- ✓ In Northern hardwood forest types, higher live tree retention of large diameter trees shown to have positive impact on carbon storage.
- ✓ In Western and Southern softwood forests, extending harvest rotations rather than retention is the more significant variable for carbon storage.

Harvest Retention and Rotation Impacts on Lying Dead Wood (LDW)

- ✓ Decreased LDW quantities depends on retention policies for both live and dead trees as well as use of slash treatments that reduce LDW immediately after harvest.

Harvest Retention and Rotation Impacts on Litter and Duff

- ✓ Includes non-woody plant parts and partially decomposed woody material; may constitute up to 40% above-ground carbon storage.
- ✓ Even-aged forest management can disturb the forest floor which results in reduction of litter and duff through increased decomposition.
- ✓ Can be offset by contributions from logging slash.
- ✓ Variables in logging techniques have greater impact on litter and duff than choice of even-age vs. uneven-age forest management .

Harvest Retention and Site Preparation Impacts on Soil Carbon

- ✓ Soil carbon is not anticipated to change substantially as a result of most project activities including choice of even-age management.
- ✓ The exceptions are in cases of direct soil disturbance associated with site preparation after harvest, such as plowing, ripping, furrowing, and subsoiling which reduce forest ecosystem carbon.

Seeking Further Input

- ✓ Can historical natural disturbances provide guidelines to incorporate the following factors in the Forest Project Protocol?
  - ✓ Harvest retention of live trees, snags and LDW.
  - ✓ Targets for maintaining large diameter trees.
  - ✓ Rotation limitations.
  - ✓ Spatial limitations for disturbance.

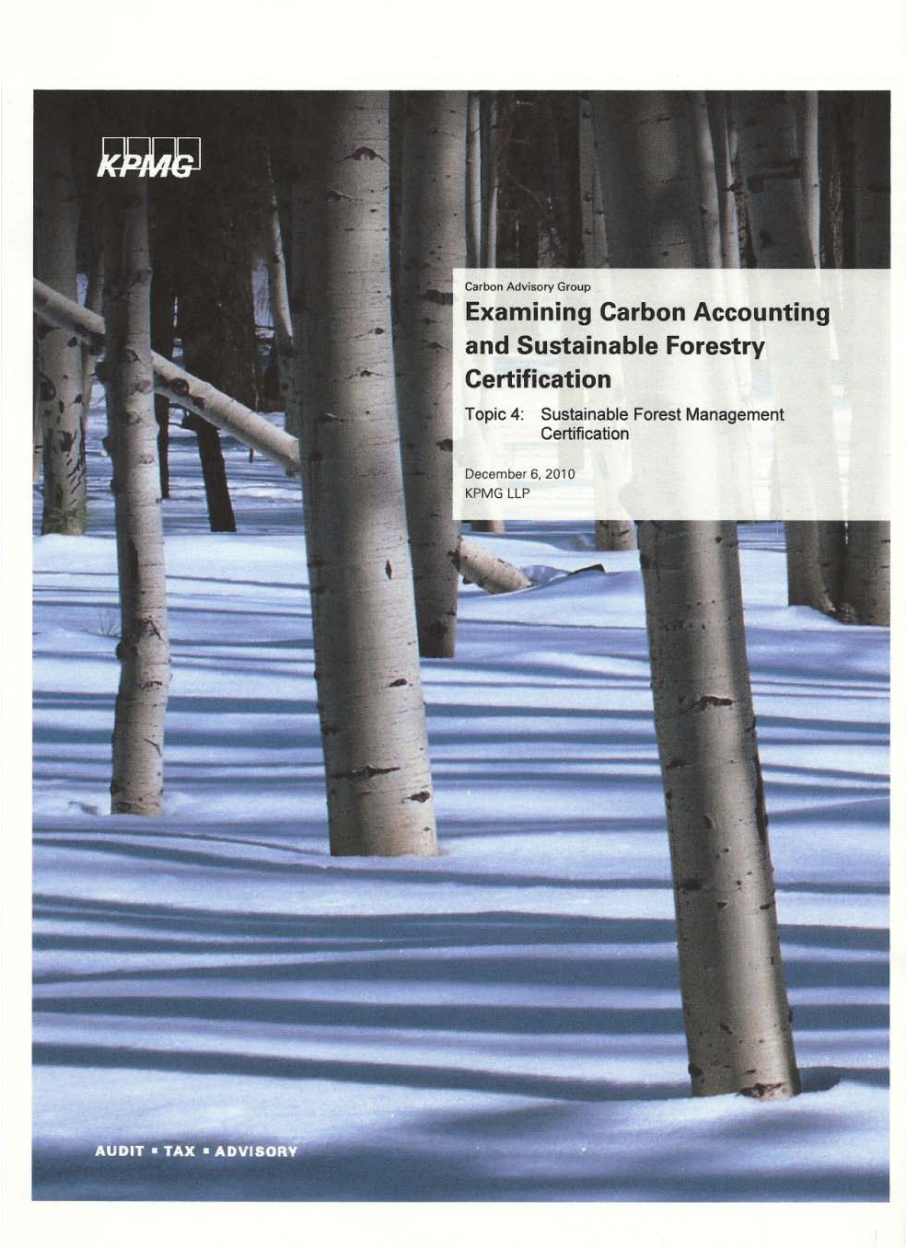
Seeking Further Input

- ✓ Should modifications to issues of rotation and retention be tailored to forest types and regions?
- ✓ Should localized guidance be included in consideration of any revisions to these limitations in the protocol?

Public Workshop on Forest Project Protocol White Papers

Examining Carbon Accounting and Sustainable Forestry Certification

March 2011



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Completed:

December, 2010

Current Role of Certification in the Forest Project Protocol

- ✓ First of three options to demonstrate required sustainable long-term harvest practices on all forest holdings:

  "The Forest Owner must be certified under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System certification programs. Regardless of the program, the terms of certification must require adherence to and verification of harvest levels which can be permanently sustained over time."

  (FPP, Section 3.10.1)

Other Options to Demonstrate Sustainable Harvest Practices in FPP

- ✓ Second Option: Adherence to a renewable long-term management plan that is sanctioned and monitored by a state or federal agency.

- ✓ Third Option: Use of uneven-aged silvicultural practices and maintenance of canopy cover >40 % on any 20 acres within landholdings.

Questions Addressed in White Paper

- ✓ Describe and compare the three forest certification systems – Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI) and American Tree Farm System (ATFS).
- ✓ Do these certification systems adequately ensure sustainable harvest levels across ownerships?
- ✓ Are there other forest certification programs that could be used as part of the eligibility criteria for the Reserve's Forest Project Protocol?

Additional Value of Certification Considered

- ✓ Can/should certification through ATFS, FSC, and/or SFI be used to replace the Natural Forest Management criteria currently listed in the Forest Project Protocol?

U.S. Forest Certification

- ✓ Forest certification is primarily conducted in the U.S. by these three (ATFS, FSC, SFI) market-based, non-governmental schemes designed to demonstrate well-managed forests and sustainable harvests.
- ✓ Approximately 25% of the total non-federal forest land in the U.S. is currently certified by one (or more) of these systems.

Common Requirements of Certification Systems

- ✓ Attention to a broad set of environmental, economic, and social factors reflecting broad range of stakeholders.
- ✓ Development of a long-range forest management plan that develops data on sustainable harvest levels.
- ✓ Comprehensive audit process which includes documentation, and field evidence.
- ✓ Transparent public summaries and investigation of stakeholder issues.
- ✓ Requirements for continuous review and improvement.

Major Differences Between Systems

- ✓ The FSC program has more rigorous and broad social and environmental criteria with application in countries where laws are lacking or poorly enforced. Audit includes more stakeholder involvement.
- ✓ The ATFS and SFI programs emphasize water quality and biodiversity standards which respond more directly to public concerns in the U.S.
- ✓ The ATFS and SFI standards based on a widely tested ISP 17021 certification platform while FSC is has its own customized certification process.

Risks to Inadequate Assessment of Sustained Harvest Levels

- ✓ Shift of climate impact from project area to other forest holdings (leakage).
- ✓ Impacts on long-term soil and forest productivity.
- ✓ Impacts on ecological integrity.
- ✓ Excessive harvest to address forest health or stand objectives.

Risks to Inadequate Assessment of Ecological Services and Functions

- ✓ Impacts to:
  - ✓ water quality.
  - ✓ soil productivity.
  - ✓ air quality.
  - ✓ biological diversity/wildlife and aquatic habitat.
  - ✓ nutrient cycles.
  - ✓ climate regulation.
  - ✓ recreation and aesthetic value.
- ✓ Reduced commercial opportunities for Non-Timber Forest Products.

Assurances Provided by Certification Systems

- ✓ All standards build on the existing regulatory framework for forestry.
- ✓ All standards contain a suite of indicators and a range of additional processes that will address most, if not all, of the risks to sustainability and maintenance of ecosystem services and functions.
- ✓ Certification systems review sustainability of harvest levels throughout all Forest Owner's landholdings.

Qualifications of Assurances

- ✓ Ongoing levels of assurance will depend on quality of audit process and appropriate technical skills of auditors.
- ✓ Since the period encompassed by long-term sustainability and/or the length of time harvest can exceed growth are not explicit, will depend on recalculation of harvest levels and updating of management plans (which are required).
- ✓ Certification covers ownership level sustainability and leakage issues, but may not address all risks at a project level .

Strengths of Certification Compared to Other Options

- ✓ *Option 2: State or Federal Agency Sanctioned Plan*
- ✓ *Option 3: Employ Uneven-Aged Management*

- ✓ Certification has clearer and more consistent criteria for determining sustainable harvest levels.
- ✓ Certification has audit monitoring process in place.
- ✓ Certification criteria applied to full ownership.
- ✓ Certification utilizes a broader range of indicators to assess ecosystem function and services.

Use of Other Forest Certification Systems

- ✓ Very few recognized certification standards beyond ATFS, FSC, and SFI.
- ✓ Reviewed logger certification systems, Green Tag certification, ISO14001, CSA Z809, and CCBA. All currently lack the scope and criteria necessary to meet sustainable harvest tests.
- ✓ Currently no additional certification standards within the U.S. applicable at the ownership level for the Reserve's intended use.

Seeking Further Input

- ✓ Can Forest Owners with Certification from ATFS, FSC, and/or SFI be excluded from the other criteria of Natural Forest Management in the protocol?

- ✓ Should all Forest Owners with forest carbon projects that involve commercial harvesting be required to obtain certification from ATFS, FSC, or SFI?

Seeking Further Input

- ✓ In the case when Forest Owners rely on one of the other options to demonstrate sustainable harvest levels, are the current evaluation criteria for Natural Forest Management adequate to provide assurances?

- ✓ How can the assurances provided by Options 2 and 3 be strengthened?

Bonus Slides Below

American Tree Farm System (ATFS)

- ✓ Program of American Forest Foundation.
- ✓ Standards developed in wide-range public process and formally adopted in 2004.
- ✓ Currently has certified 25.7 MM acres held by over 95,000 family forest owners in 43 states.
- ✓ Annual auditing and 3-yr full accreditation by accredited ANSI-ASQ qualified certifiers.

Forest Stewardship Council (FSC)

- ✓ World-wide independent non-profit established in 1993.
- ✓ Standards and Criteria adopted in 1994, latest U.S. version in 2010.
- ✓ Currently has over 300 MM acres certified in 50+ countries, 32 MM acres in the U.S.
- ✓ Emphasizes transparent performance specifications and outcomes (e.g. prescribed riparian buffers).
- ✓ Annual audit process with full recertification assessment every 5 years.

Sustainable Forestry Initiative (SFI)

- ✓ Independent , non-profit launched in 1995 by the American Forest & Paper Association.
- ✓ Current independent Board of Directors represents broad-based environmental and academic concerns.
- ✓ Latest compliance standards published in 2010.
- ✓ Emphasizes process based indicators and assessment of system implementation.
- ✓ Currently has certified 56.5 million acres in the U.S.
- ✓ Recertification required every 3 years with annual certification audits.