Description of how Net Present Value (NPV) calculations were derived for Columbia Carbon's new ACR IFM methodology

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July 11, 2011

Introduction

The objective of this document is to describe our process for deriving discount rate values to be used in Net Present Value (NPV) calculations for the qualified forestland ownerships within Columbia Carbon's proposed Improved Forest Management (IFM) methodology under consideration by the American Carbon Registry (ACR).

The development of this methodology is due to a current lack of IFM pathways under ACR for non-federal forestland owners other than private industrial ownerships greater than 1,000 acres in size. While private industrial ownerships are an important part of the forestland base in the U.S., they only represent 21% of the approximately 747 million acres of forestland in the country. Family forestland ownerships account for about 35% of the nation's forestland base, while public lands represent approximately 42% of the U.S. forestland base. We therefore wanted to expand carbon program opportunities for these other significant non-federal landowner groups for two key reasons:

1) If forestry offsets are to have an impact on lowering the buildup of greenhouse gases in the atmosphere, than the largest segments of the non-federal forestland base should be eligible to participate in the ACR carbon program; and

2) The capacity to store more carbon by these other non-federal forestland owner groups is greater than typical industrial lands due to longer-term management time horizons and more flexible management objectives.

The key to generating participation in a carbon program is to incentivize these landowners to modify their management behavior in favor of less intensive management over time through carbon payments. For many, receiving annual income for reducing or delaying harvest is an attractive option that is consistent with their values and objectives of forestland ownership.

Calculating carbon benefits from IFM projects is challenging because it requires long-term forecasting (for decades into the future) of carbon stock dynamics under a with-project versus a without-project baseline scenario. For private industrial ownerships that practice intensive management of their wood fiber resources, predicting harvest behavior is less challenging than predicting family forest landowner and other non-industrial ownership harvest decisions over time.

To address this challenge, we use Net Present Value (NPV) as a proxy for predicting baseline management decisions. This approach is supported extensively in the literature. NPV is a consistent, transparent, replicable, and verifiable metric that can be applied across major forestland ownership

groups. We believe this approach will attract participation by these other non-federal landowner groups in the carbon markets (see public comments received prior to peer review).

Statistical data on NPV rates for public and private landowners proposed in this methodology is mostly absent from the scientific literature. However, the U.S. Forest Service FIA data system covers all types of land ownerships in the country. For example, data is collected on private corporate (hereafter labeled Private Industrial (PI)) and private non-corporate (hereafter labeled Private Non-industrial (PNI)) and reported in their periodic assessment of United States Forest Resources (Smith et al. 2009). The PI category consists of forest industry and forest management companies, timber investment management organizations, and other companies. The PNI category consists of individuals, couples, estates, trusts, nongovernmental organizations, clubs, associations, and other unincorporated groups.

In the following sections of this document, we describe the existing baseline determination approach used under an existing ACR IFM methodology. We then briefly discuss the literature related to PNI harvesting patterns. We follow that with a graphical presentation of the age class structure of PI, PNI, and other non-federal forest owners from FIA data. Finally we present a description of the steps used to derive NPV values used in our proposed ACR IFM methodology (Table 1).

Table 1. NPV values by ownership class

Ownership	Annual Discount Rate
Private Industrial	6%
Private Non-Industrial	5%
Tribal	5%
Non-governmental organization	4%
Non-federal public lands	4%

Existing ACR IFM Methodology

The current accepted ACR Improved Forest Management Methodology developed by Finite Carbon Corporation dated September 2010 is applicable to privately owned US forest land exceeding 1,000 acres in size. That methodology takes a Faustmann approach to baseline determination using net present value (NPV) maximization with a 6% discount rate on future cash flows. The literature is strong supporting Faustmann's original 1849 work which forms the basis for modern optimal rotation/investment decisions and forest economics. See Newman (2002) for a discussion of the development of the optimal forest rotation literature including over 313 works including book and journals.

One of the reasons there is such an extensive literature base is that the Faustmann approach to forest investment and optimal rotation is not perfect. Like the basic economic model of supply and demand, while these underlying theorems go far to predict how agents will act, they do not correctly account for all situations. In the current ACR IFM methodology, the 6% discount is an assumption of how a common forest landowner with over 1000 acres would make his/her forest management decision. As an assumed average, 6% will be lower than half the landowners' true discount rate, and higher than the

other half's. The basic Faustmann approach is also a stand level investment analysis tool and does not account for the complexities of a forest or entity wide investment constrained optimization problem. That said, the 6% NPV maximization determination of the baseline level of emission and sequestration is appropriate in that it gives a common transparent metric by which landowners, project developers, verifiers, and offset purchasers can base their assessment of an ACR IFM carbon project.

PNI Harvesting Literature Review

The omission of PNI ownerships of less than 1,000 acres is most likely based on the assumption that the NPV maximization baseline does not apply to the way PNI landowners manage their forest lands. Given that PNI forest landowners control a majority of the forestland base, determination of harvesting behavior of PNI timberland has been the subject of a plethora of peer reviewed studies in the literature. These studies can be broadly grouped into two classes; one that looks to use statistics to determine the harvesting decision from one period to the next, and another that takes an optimal control approach to determine the rotation length.

Amacher et al. (2003) and Beach et al. (2005) both provide excellent reviews of the literature base focused on econometric studies of PNI harvesting decisions. These studies typically present the harvesting decision as a function of a range of variables including timber price, interest rate, reforestation cost, presence of cost-share program, household income, tract size, education and owner age among other things. While these studies are numerous, they are perhaps not helpful in an application such as this where we undertake to determine the management level and rotation decision in the absence of a carbon project.

Here we are not concerned with the decision to harvest or not in any one period, but rather on the long term silvicultural planning decision of the PNI landowner and therefore it is the second set of studies which are of interest. To do this, researchers began with the most basic Faustmann approach with harvest allocated over time to maximize returns. This theory did not explain the age class structure difference between PI and PNI lands and the basic model was amended to include an amenity value where the standing trees had value.

Hartman (1976) was the pivotal study in this arena as he presented the fundamental adaption of the basic Faustmann formula to include value for standing timber. This amenity value associated with standing timber stock has the impact of lengthening rotation ages and much better simulated behavior seen in the forest. Several investigations to empirically determine if this relationship holds include the notable Newman and Wear (1993) article where they show that PI and PNI owners both demonstrate behavior consistent with profit maximization, yet the determinants of profit differ with the PNI owners deriving significant non-market benefits associated with their standing timber.

Pattanayak etal. (2002) revisit the problem as they study timber supply and find joint production of timber and non-timber values and better describe the objective as utility maximization in the absence of market derived prices for the amenity values associated with standing timber. The fundamental problem associated with the inclusion of amenities in the forest decision making framework is that there are no

such values established in the marketplace as well as the fact that the actual amenity varies by individual owner including a wide range of attributes such as habitat, recreation, and hunting. Gan et al. (2001) showed that the impact of a reduced discount rate actually had the same impact as the addition of an amenity value. This concept frees the optimal management/rotation analysis from needing explicit non-market amenity values and allows economists instead to investigate lower discount rates for PNI owners.

NPV Determination

We can get an idea about the relative weights different ownership groups place on standing timber by looking at the age class structure of their associated timberland bases. Figure 1 is derived from Smith et al. (2009) accompanying CD containing RPA Data Wiz 2007 1.1. It shows the acres by five-year age class by owner group for three broad classes; Private, State, and National Forest.
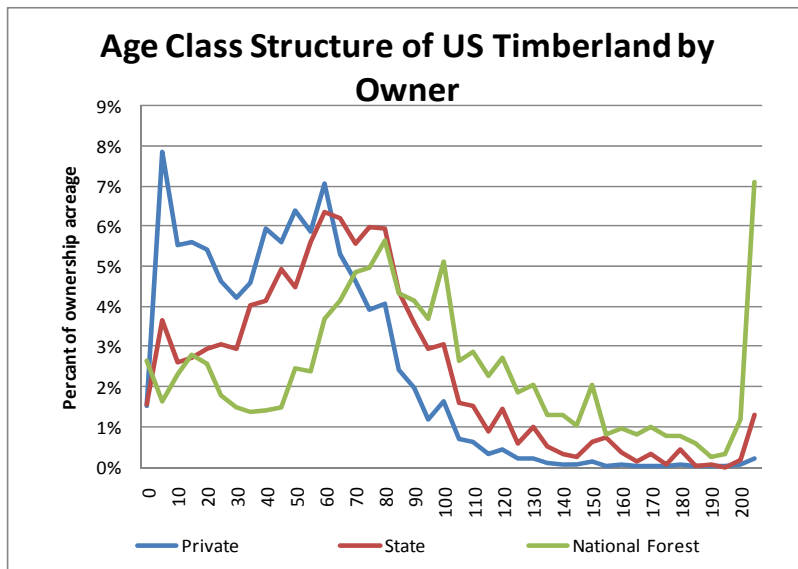

Figure 1. US forest acres by five-year age class and owner group.

It shows the relative differences on standing forest age class, with private lands placing the lowest amenity value on older age classes and National Forest lands placing the most amenity value associated with older forests. Based on the data presented above, we believe private owners have a higher discount rate than either Federal or State ownerships.

While the publicly available FIA data does not include any further breakdown of the private ownership group, we were provided with the twenty-year age class data from USDA FIA research foresters (Figure 2) divided by private corporate and private non-corporate classes.
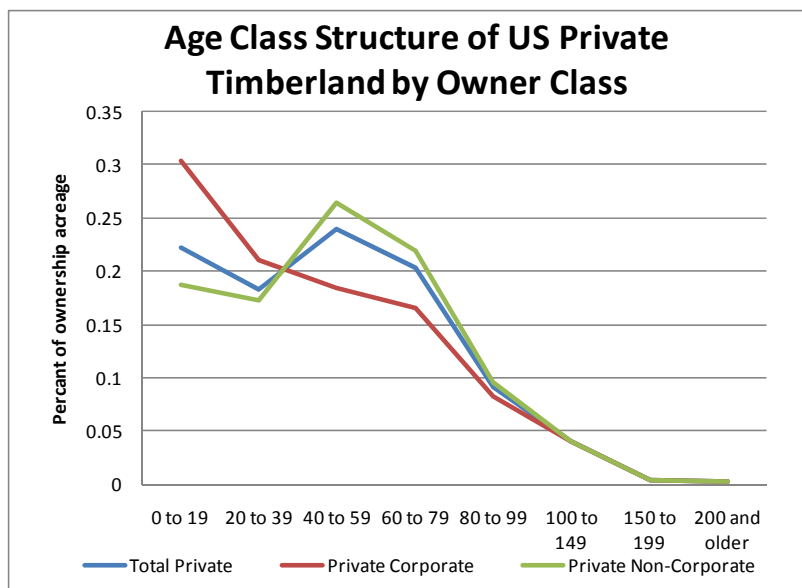
Figure 2. Age class structure of US Private timberland by owner group.

Figure 2 demonstrates that while US private forest landowners may not operate using the same profit maximization objective as PI ownerships, they do in fact display an age class structure indicating a slightly longer rotation. This is consistent with either joint optimization of timber and non-timber values per Pattanayak et al. (2002) or equivalent profit maximization optimization with a lower discount rate per Gan et al. (2001). With these results we concluded that a lower discount rate value for non-PNI ownerships was justifiable as compared to PI ownerships.

Private Industrial

For the private industrial ownership group, the existing ACR IFM methodology NPV value of 6% is used, which is consistent with values in the literature. According to recent timber market reports from the end of 2010, a market survey indicated that NPV rates varied from 6.0% to 7.5% for private forestland in the U.S. (See Appendix 1). Since the higher the NPV rate the more aggressive the harvesting pressure, we concluded that continued use of 6% for the PI ownership class was appropriate for purposes of conservatism.

Private Non-industrial

FIA data (displayed in Figure 2 above) indicates that PNI ownerships are typically managed less intensively than PI ownerships, as indicated in the age class distribution in the FIA data. As illustrated in Figure 1, private lands are harvested more aggressively as compared to public lands. PI discount rate values of 6% to 7.5% were identified in the literature and literature values for state lands indicated discount rates of 4%. Thus, by analyzing FIA data and consulting with forest economists, experienced natural resource professionals and a range of PNI forestland owners, we concluded that a Private Non-Industrial ownership NPV value of 5% is rational and reasonable (which is halfway between PI of 6% and Public land values of 4%).

Tribal

Tribal owned lands fall into two broad categories: lands owned fee-simple (for example Native Corporations) and those that are owned in Trust or managed with the oversight of Federal agencies (for example the Bureau of Indian Affairs). In published reports and in the FIA system, Tribal lands are categorized as private lands. While some Tribal lands are managed in an identical fashion as Private Industrial ownerships, others are managed in a manner similar to Public lands. We therefore determined that a NPV of 5% was a reasonable value to use for Tribal ownerships since it is halfway between PI of 6% and Public land values of 4%).

NGO

Discount values for NGO owned lands were not available in the literature, and are not part of FIA classifications. However, based on discussions with forest economists and experienced natural resource professionals, we assigned a discount rate value of 4% for Non-Governmental Organizations, since NGOs typically manage with a conservation, habitat, or land preservation objective in mind. Timber production is often a secondary objective and typically not part of an NGO's core business. However, since as part of the applicability conditions in our proposed methodology, lands must be subject to commercial timber harvesting. Lands that have an existing easement that are not subject to commercial harvesting would not qualify under our methodology unless the easement was placed for purposes of GHG mitigation. Therefore, our baseline discount rate value of 4% was derived since conservation-based forestry practiced by NGOs most closely resembles harvest and management of non-federal public land ownerships (for example State owned lands).

Non-federal public lands

Based on values in the literature (see Appendix A and Excel file), examination of the FIA data (Figure 1 and 2) as well as discussions with state government officials, a discount value of 4% was derived for non-federal public land ownerships.

References

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Amacher, G.S., Conway, M.C., and J. Sullivan. 2003. Econometric analyses of nonindustrial forest landowners: is there anything left to study? Journal of Forest Economics 9, 137–164.

Beach, R.H., Pattanayak, S.K., Yang, J.C., Murray, B.C., and R.C. Abt. 2005. Econometric studies of non-industrial private forest management a review and synthesis. Forest Policy and Economics, 7(3), 261-281.

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Pattanayak, S., Murray, B., Abt, R., 2002. How joint is joint forest production? An econometric analysis of timber supply conditional on endogenous amenity values. Forest Science 47 (3), 479– 491.

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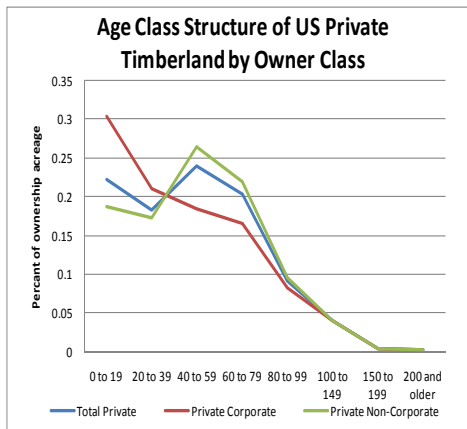**Appendix 1. NPV values and sources (also see attached excel file)**

Private Industrial

Ownership class:		Private Industrial
	Reported	
Source	**NPV**	**Context**
8	6.00%	Existing Approved ACR IFM methodology by Finite Carbon
9	6.40%	Timberlands Research Report
Average	6.20%	
Citation		
8		American Carbon Registry. Improved Forest Management Methodology by Finite Carbon (2010)
9		Brookfield Timberlands Management LP, Q4 2010 Global Timberlands Research Report

Citation	
8	http://www.americancarbonregistry.org/carbon-accounting/improved-forest-management-methodology-for-increased-forest-carbon-sequestration-on-u.s.-timberlands
9	http://www.industryintel.com/Corporate/downloads/4QBrookfield2010.pdf

Private non-industrial

Age Class Structure of US Private Timberland by Owner Class

While US private forest landowners may not operate
using the same profit maximization objective, they do in fact display an age class structure
indicating a slightly longer rotation which is consistent with either joint optimization of timber and
non-timber values per Pattanayak et al. (2002) or equivalent optimization of profit maximization with
a lower discount rate per Gan et al (2001).

Tribal

In published reports and in the FIA system, Tribal lands are categorized as private lands. While some Tribal lands are managed in an identical fashion as Private Industrial ownerships, others are managed in a manner similar to Public lands. We therefore determined that a NPV of 5% was a reasonable value to use for Tribal ownerships since it is halfway between PI of 6% and Public land values of 4%).

Ownership class:		Tribal lands
Source	Reported NPV	Context
10	none	Discussion of volume removals as a percent of growing stock on MN tribal ownerships
11	none	Harvest pattterns of WA tribal ownerships
12	none	Volume and acreage of Tribal ownerships in the US

Citation	
10	Impacts of increased timber harvesting on timber management activities
11	Washington's forests, timber supply and forest-related industries
12	Changing timberland ownership in the Northern forest and implications for biodiversity

Citation	
10	http://iic.gis.umn.edu/download/geis/econ/lund_3.pdf
11	http://www.dnr.wa.gov/Publications/em_fwfeconomiclow1.pdf
12	http://www.postcom.org/eco/sls.docs/Manomet%20Ctr-NE%20Timberland%20Changes%20Report.pdf

Non-governmental organization

An NPV value of 4% was used since NGOs typically manage with a conservation, habitat, or land preservation objective in mind, with timber production often a secondary objective.

Non-federal public lands

Basis for Discount rates used by Columbia Carbon in their new IFM methodology under consideration by ACR

Ownership class:			State owned, public lands
Source	State	Reported Discount Rate	Context
1	ID	4.00%	For state land harvest decisions
2,3	WA	5.00%	Forestry state agency in Washington State (Department of Natural Resources)
4	MN	3.00%	Forestry state agency in Minnesota (Department of Natural Resources)
5	OR	4.50%	Forestry state agency in Oregon (Department of Forestry)
6	PA	4.00%	Forestry state agency in Pennsylvania (Department of Conservation & Natural Resources)
7	MT	3.75%	Forestry state agency in Montana (Montana Department of Natural Resources & Conservation)
Average		4.04%	

Citation		Page
1	Legislature of the State of Idaho, Sixty First Legislature First Regular Session (2011) House Bill No. 11 by Revenue an	2
2	Washington Department of Natural Resources. Forest Management Modeling. Appendix C.	52
3	Sustainable Harvest Calculation for Forested State Trust Lands in Western Washington (2007). WA DNR	9
4	Forest Management Lease Pilot Study Report. (2009) Report ot the House and Senate Natural Resources Policy Fina	13
5	Northwest Oregon State Forests Management Plan (2006) Appendix 1. Decadal Analysis of Alternatives	5
6	State Forest Resource Management Plan (2003)	web
7	State Forest Land Management Plan (1996). Final Environmental Impact Statement. Record of Decision.	19

Citation	Web link
1	http://www.legislature.idaho.gov/legislation/2011/H0011.pdf
2	http://www.dnr.wa.gov/ResearchScience/Topics/SEPANonProject/Pages/amp_sepa_nonpro_flp_southpuget.aspx
3	http://www.dnr.wa.gov/Publications/lm_sh_may07_bnr_present.pdf
4	htttp://www.dnr.state.mn.us/aboutdnr/reports/legislative/forest_mgt_leasing_09.pdf
5	http://www.oregon.gov/ODF/stateforests/docs/management/FMP2010_rulemaking/nwfmp/NWFMP_I_2010rulemaking.pdf?ga=t
6	http://www.dcnr.state.pa.us/forestry/sfrmp/silviculture.htm
7	http://www.dnrc.mt.gov/trust/pdfs/SFLMP.pdf