Economic Viability of Ownerships in the Deerfield River Watershed

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ACKNOWLEDGMENTS

This study was made possible through the generous support of the Kohlberg Foundation, through the New England Forestry Foundation.

Several people have provided invaluable contributions to this study to which we are very grateful. These people include: David Kittredge, UMass; Keith Ross, LandVest; Nathaniel Best, LandVest; Scott Sylvester, Consulting Forester; Whitney Beals, NEFF.

In addition, we would also like to thank the Harvard Forest for sharing with us their Ch. 132 Forest Cutting Plan data.

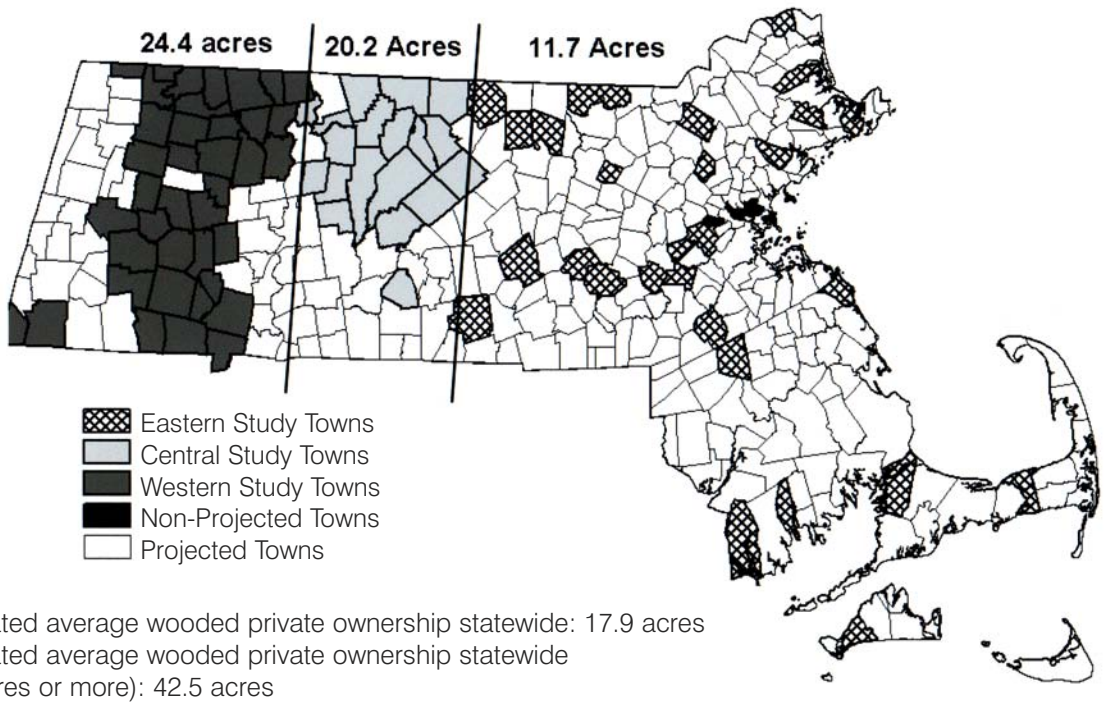
ABSTRACT

The mostly forested landscapes of Massachusetts are owned primarily by tens of thousands of family forest owners. Every day, landowners make decisions about the future of their land. Often times these decisions arise suddenly and are made without the benefit of knowing their full suite of options. We developed a net present value (NPV) analysis over a 30-year period for ownerships of 15, 30, 60, and 150 acres for the Deerfield River Watershed for four forest conservation tools: timber management, timber management plus current use, timber management plus current use plus the sale of a conservation restriction, and the sale of a conservation restriction only. We then compared the NPV of the scenarios to the estimated property taxes to provide landowners information on the potential financial impacts of these programs and to learn more about the effectiveness of these tools. With the exception of the timber management only scenario, all the tools provided NPV greater than the property tax liability. We also summarized research on Massachusetts landowner demographics, the nature of their decisions, and program participation. Recommendations on developing new tools based on the NPV analysis and landowner research are made.

SITUATION STATEMENT

With 3.1 million forested acres, Massachusetts is 62% forested, making it the eighth most forested state, by percentage, in the country. More than 75% of the state's forests are owned by over 212,000 private families and individuals. We estimate that there are over 46,500 landowners with 10 acres or more with an average acreage of 42.5. When considering ownerships of 3 acres or more, the average parcel size moves to 17.9 and shows an increase in size as you move from eastern to western Massachusetts, as shown in Figure 1. These are highly parcelized landscapes.

Figure 1.
Massachusetts private forest ownership, 2005 for ownerships 3 acres and larger



Estimated average wooded private ownership statewide: 17.9 acres
Estimated average wooded private ownership statewide (10 acres or more): 42.5 acres

Ownership data compiled and analyzed by UMass-Amherst, Kittredge et al., 2006.

Kittredge, D.B., A. D'Amato, P. Catanzaro, J. Fish, and B.Butler. *In review.* Estimating ownerships and parcels of non-industrial private forest in Massachusetts. *Northern Journal of Applied Forestry.*

In landscapes dominated by small, private nonindustrial forest ownership, a vast array of important ecosystem services, such as clean water and carbon sequestration, are provided free of charge to the general public. In addition, private forests provide a wealth of additional public benefits: a buffer from development, a scenic backdrop for rural tourism, habitat, outdoor recreation, and a source of wood products and employment.

Processes of conversion, fragmentation, and parcelization are reducing the number of acres, increasing the number of owners, and complicating the future of these landscapes. These ecosystem services and public benefits are best ensured by resilient forested landscapes with intact ecological patterns and process, such as nutrient and hydrologic cycling, natural disturbance, migration, biodiversity, and exchange of genetic material.

Massachusetts Audubon estimates that Massachusetts loses over 40 acres of open space every day, 65% of which is converted to low-density, large-lot construction. The success of forest conservation efforts in Massachusetts is largely dependent on the independent decisions of these thousands of family forest owners and the hundreds of communities they live in across the state. To safeguard the future sustainability of public benefits from these private forest landscapes, it is imperative that forest owners make informed decisions about their land and that communities understand the impacts of their decisions on landowners. To successfully expand conservation to a large scale (e.g., Wildlands and Woodlands), we must better understand private landowners, the nature of their land decisions, and the financial realities of their ownerships.

RESEARCH PROJECT DESCRIPTION

This project is divided into two related parts. In the first part of the study, we use a NPV analysis to determine the financial impacts of several forest conservation tools. In the second part of the study, we summarize research on Massachusetts landowners.

Part One The Deerfield River Watershed is the most rural region of Massachusetts, with forest cover as high as 93% and population densities as low as 10 people per square mile. Our analysis of assessors' data indicates that the Deerfield watershed has some of the largest land ownerships in Massachusetts. Due to the large ownerships and high amount of forest cover, this region offers perhaps the greatest potential for maintaining viable working forest landscapes in Massachusetts; however, this window of opportunity is closing as development pressures continue to rise.

The intent of this study is to help inform landowner decisions by providing landowners with information about the likely financial impacts of several forest conservation tools—forest management, current use, and conservation restrictions. Helping landowners understand the financial circumstances surrounding landownership also allows us to shape outreach efforts and craft conservation programs and policy that will be effective.

The results of this project are based on numbers (e.g., appraisals, assessments, tax rates, forest types) that are specific to the study area of the Deerfield watershed. Use of these results in other areas should be used with caution.

Part Two Research on forest landowner demographics, attitudes, and program participation is summarized. Based on the NPV analysis and the landowner research, recommendations are made to increase the effectiveness of forest conservation participation.

PART ONE | LITERATURE REVIEW

A literature review was done at the start of the project in order to determine existing knowledge on this subject. We identified several studies that seek to understand the valuation of forestland. Vrooman sought to understand the valuation of vacant forested parcels in the Adirondack Park using sales data 1971-1993 (Vrooman, 1978). He identified the key variables influencing price per acre and used multiple regression analysis to determine how they affected land values. Kilgore and MacKay (2007) analyzed real estate market trends in Minnesota from 1989 to 2003 (Kilgore & MacKay, 2007). They gathered publicly available real estate sales records of forestland 20 acres or greater with no structures and looked for trends in the real estate market and what those trends might mean for the future of forestland uses. They found a number of changes in the forestland market since 1989, including a decreasing size of forestland tract, suggesting parcelization, and an increasing rise in the median forestland prices. Their findings are pertinent to our study in two ways. First, because the majority of Minnesota's forestland owners are not trying to generate money from timber production on their land, they may be pressured to sell their parcels as the cost of owning land increases as prices for forestland continue to rise (Cervantes, 2003) in (Kilgore & MacKay, 2007). Second, Kilgore and MacKay found that the cost of protecting forestland through fee simple title or easement is approximately five times greater in 2003 than in 1989 based on the calculated median sales prices. One way to compensate for this reduced purchasing power, they suggest, is focusing on larger parcels. These trends are likely to be seen in western Massachusetts as well, where land values and development pressures are increasing.

Another study done in Hawaii looked at various economic scenarios and business strategies for landowners as options for land conservation. The study of Koa plantations in Hawaii acknowledges the public benefits provided by private landowners and suggests that various scenarios must be tried to address the financial pressures on landowners who act as a barrier to conservation (Goldstein et al., 2006). Goldstein et al. suggests that addressing these challenges may make conservation a viable option for private landowners. To do this, they created five business strategies and used an 8% discount rate to calculate the mean net present value (NPV) in dollars per acre to test the various conservation tools. Because this study seeks to test conservation tools for landowners, in order to encourage conservation on private lands, we used it as the model for our analysis.

RESEARCH METHODOLOGY

Building the Research Scenarios

The land ownerships in the Deerfield River Watershed come in a range of sizes (Figure 2) and are primarily private, nonindustrial (Figure 3). Different ownership sizes bring different costs and opportunities. Segmenting ownerships by size allows the opportunity to evaluate the appropriateness of a tool to the ownership size. In addition, segmenting ownerships also maximizes the outreach value of this research by allowing landowners to look at scenarios that most closely fit their own ownership size.

We have taken assessors' data and combined individual parcels into ownerships, allowing us to see the range of ownership sizes in our project area (see Table A).

Table A. Summary statistics for forest parcel and ownership acreages within the Deerfield River Watershed, MA.

	N	Mean(SE)	Median	Minimum	Maximum
Ownerships	5124	27.2 (0.6)	10.1	2.4	729.0
Parcels	6264	23.2 (0.5)	9.2	2.4	729.0

Figure 2.
Size Distribution of Parcels and Ownerships within the Deerfield River Watershed, MA

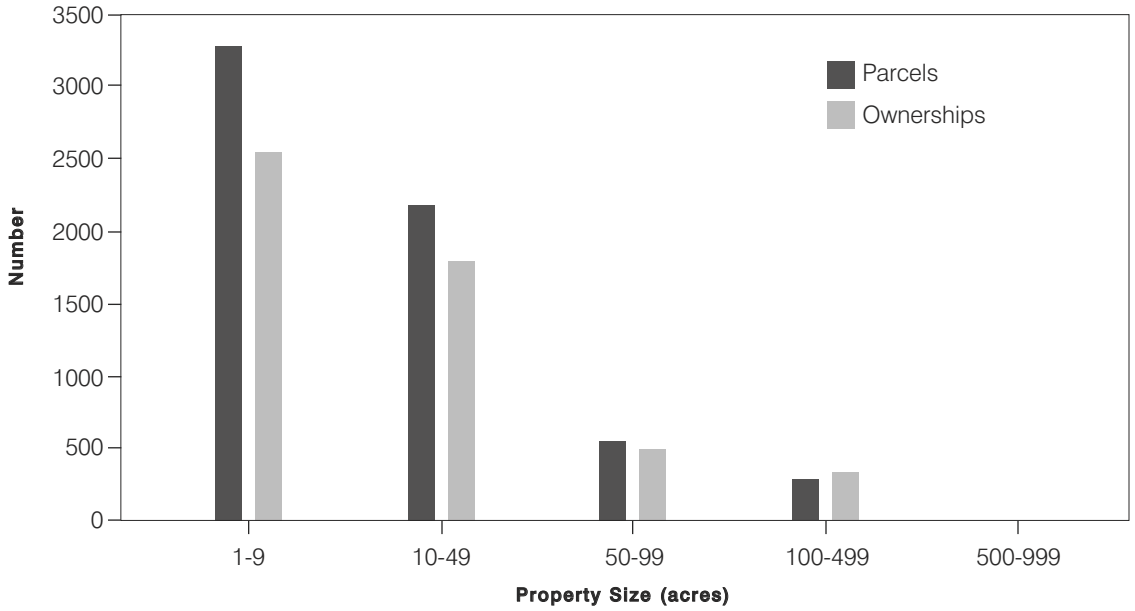
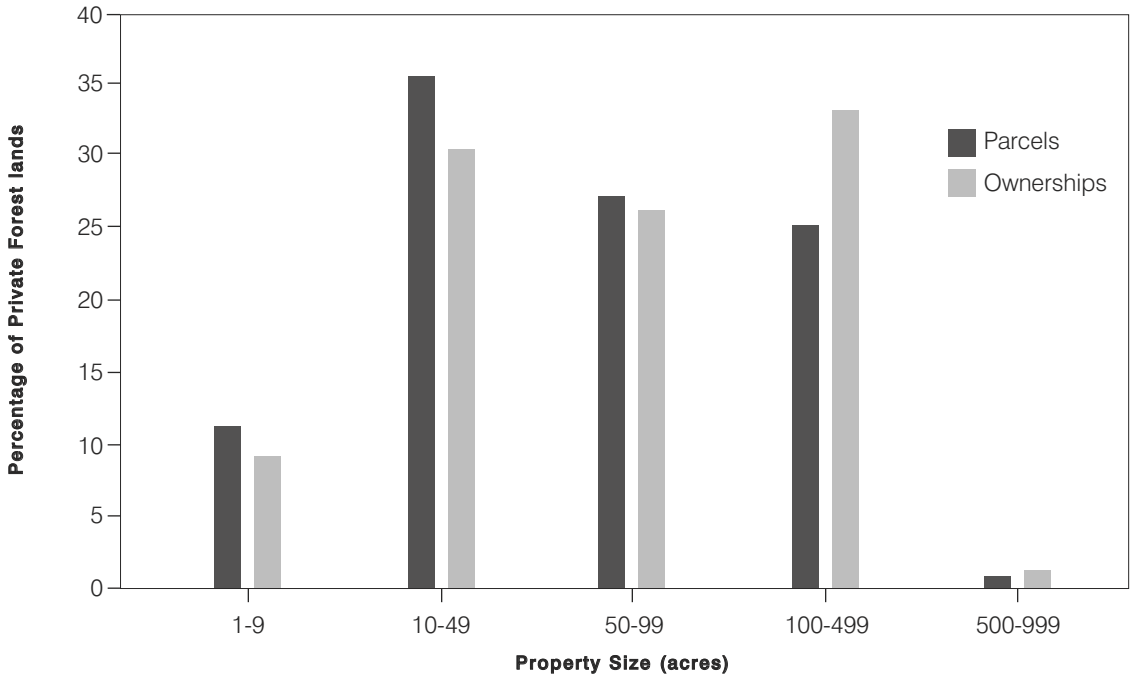


Figure 3.
Proportion of Private Forestland in Property Size Classes within the Deerfield River Watershed, MA



Based on this analysis, we have focused on the four different quartile ownership sizes as examples:

- 15 acres *25% of the ownerships are 15 acres or less*
- 30 acres *50% of the ownerships are 30 acres or less*
- 60 acres *75% of the ownerships are 60 acres or less*
- 150 acres *99% of the ownerships are 150 acres or less*

Within each of the above ownership sizes, we have developed estimates for the tax burden of these lands and three scenarios of real estate values over time (no change, 5% increase, and 10% increase). The example ownerships were analyzed for the financial impact of four scenarios to the land's tax burden and compared to the development value.

Status Quo | Property Taxes
The four scenarios are listed below:

Scenario 1 *Timber Management Only*
Scenario 2 *Timber Management and Current Use (Ch. 61) Tax Reduction*
Scenario 3 *Timber Management, Current Use, and the Sale of a Conservation Restriction*
Scenario 4 *Sale of a Conservation Restriction Only*

The average age of forest landowners in Massachusetts is 62. We built the scenarios based on a 30-year time horizon because it is reasonable for current landowners to live 30 more years, therefore seeing the impacts of their decision. We feel longer time frames (e.g., 50 or 75 years) will likely be seen as beyond their lifetime and therefore someone else's decision.

REAL ESTATE VALUE MODELING

We collected data for 239 "arm's-length" forestland property sales—117 of which were greater than 10 acres—in the Deerfield River Watershed for the period 1997–2006. Land sales from $1,000 to $10,000,000 were searched to prevent inter-family and family trust transactions from being listed in the search. Land transactions were first identified through the Banker and Tradesman (B & T) Web site. All property transactions were searched, not just land sales, because sales may have been incorrectly categorized (i.e., forestland assessed as developed land) and would not be included in a raw land search. We reviewed each sale transaction to determine whether there was a structure on the land prior to being removed from the search.

The sales of land parcels greater than 10 acres were aggregated by parcel size and averaged to per-acre sales prices to gauge the land value for our sample parcel sizes as shown in Table B. The results of this simple averaging indicate a per-acre land value that is inversely proportional with parcel size. We hypothesize that this may be due to the relative proportions of "house lot" land that abuts road frontage and is highly valued for its development potential compared to "back lot" land that is considered less accessible and less valuable. Applying the per-acre values from Table B directly to the sample acreages yields the questionable result of the 60-acre parcel having a lower value than the 30-acre parcel. Vrooman (1978) analyzed the effect of 18 variables in determining forestland value in the Adirondack Park region of New York. His best model indicated 11 of these variables to be significant in determining land value, including:

- Date of sale
- Parcel size
- Accessibility by dirt, gravel, paved and state roads
- Amount of open land
- Amount of waste land
- Measure of location
- Potential intensity of land use

Even with this level of analysis, Vrooman determined that his model suffered from omitted variables. Our segregation of property values by parcel size is not expected to explain all of the variation in actual property sales. The purpose of this study is to explain the impacts of forestland management decisions on representative samples of forest properties. Actual properties will vary greatly in their actual values due to the many variables that explain those values.

To proceed with our calculation of sample values, the example per-acre average values presented in Table B were smoothed with a log regression fit resulting in the per-acre and total property values shown in Table C. The smoothed price-per-acre values resulted in very close total property values for the 60-acre and 150-acre parcel sizes. A second "high" value 150-acre parcel case was added to illustrate sensitivity to differences in property values for same sized parcels.

Table B. Sales of land parcels > 10 acres, aggregated by parcel size and averaged to per-acre sales price

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	$/Ac.
15-acre range number of sales	$6,555 5	$1,958 1	$1,975 3	$1,607 3	$5,722 4	$1,894 6	$1,735 5	$3,590 1	$1,631 6	$5,267 3	$3,178 37
30-acre range number of sales	$234 1	$3,058 3	$2,120 7	$2,184 1	$2,957 3	$741 3	$2,230 2	$251 4	$3,504 3	$7,484 2	$2,361 29
60-acre range number of sales	$1,800 1	$646 1	$641 7	$410 2	$655 9	$571 1	$1,206 9	$624.29 2	$1,015 2	$4,729 2	$1,050 36
150-acre range number of sales	$230 1	$756 1	$0 0	$1,719 3	$942 3	$591 1	$1,092 1	$660 4	$0 0	$1,343 1	$976 15

We analyzed the scenarios described above over a 30-year time horizon, and it was necessary to factor in the price inflation for land. The data collected from town sales were analyzed for price inflation over time. Data limitations, specifically the inability to collect a sufficient number of explanatory variables (a la Vrooman above), yielded insignificant results. The literature, however, does give us some information regarding forestland price inflation. Vrooman (1978) found that forestland in the Adirondacks rose at an annual rate of 12% over the period 1971–1973. Kilgore and MacKay (2007) found a similar mean annual rate of forestland inflation of 13% over the period 1989–2003 in Minnesota. However, the annual rates varied over time with a mean annual rate of only 3% for the period 1989–1995 and a rate of 21% for the period 1995–2003. The rate of inflation in land prices might be due to a large number of factors such as trends in population and the general economy.

Three land inflation rates were modeled in this study: 0%, 5%, and 10%. Using the 30-acre sample parcel size as an example, the estimated property value was calculated at approximately $69,000 in Table C. Using the 0%, 5%, and 10% inflation rates, this value grows to $69K, $97K, and $134K respectively in our Year 1 of 2008. Figure A shows these

Table C. Sample property values (2001).

Property size	Smoothed price/acre	Total property value
15 acres	$3,004	$45,055
30 acres	$2,300	$68,995
60 acres	$1,596	$95,760
150 acres low	$666	$99,839
150 acres high	$1,200*	$180,000

* $1,200 chosen to represent high value larger acreage parcel at approximate mid-point between smoothed price/acre values calculated for 60 acres and 150 acres

FUTURE PROPERTY TAX LIABILITY MODELING

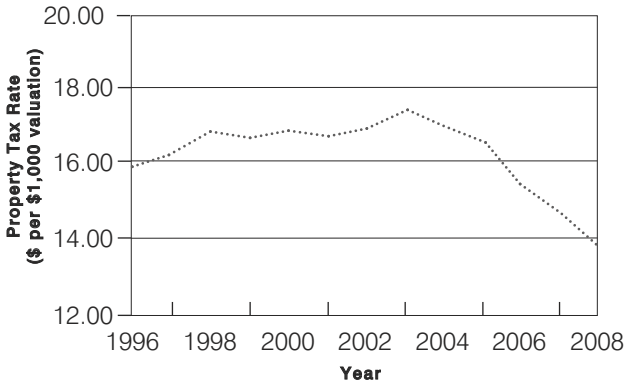
To measure the savings experienced by landowners by participating in programs such as current use, the normal property tax must first be calculated. Annual tax rates, measured in dollars-per-thousand valuation, were gathered for 15 towns in the Deerfield Watershed study region (MA Department of Revenue, 2007). Data were collected for the period of 1996–2007. One of these towns, Rowe, was excluded from the analysis due to the low property tax rate, about one-third of the rate of surrounding towns. This low rate is due to the presence of the Rowe Nuclear Power Plant and its contribution to the town tax base. The remaining rates ranged from a low of $7.14 per thousand in Florida in 2007 to a high of $24.20 per thousand in Heath in 2002. Figure 4 shows the average annual property tax rates for 14 towns. Note that the figure indicates a relatively steady tax rate over the period of 1996–2003 followed by a downward trend in 2003–2007. We hypothesize that this downward trend in tax rates was due to the steeply rising real estate values over the past few years.

Due to the variance in tax rates, for the purposes of this study a single rate was chosen of $16 per thousand, which matches the overall average across years and towns of $16.07, to be applied to the real estate values.

TIMBER MANAGEMENT MODELING

Timber projections were developed using the U.S. Forest Service Northeast Vegetation Simulator forest growth model, NETWIGS. This model is a part of the Landscape Management System (LMS) application, which is designed to assist in landscape-level analysis and planning of forest ecosystems by automating the tasks of forest stand growth projection, graphical and tabular summarization, stand visualization, and landscape visualization. To use LMS, we developed several virtual forest stands based on inventory data collected within the project area. The following discussion describes our approach for creating these stands.

Figure 4 *Average Annual Property Tax Rates (1996-present)*



Building the virtual stands

Forest stands used in the harvest simulations were developed to reflect the species composition and size structure of forest stands within the Deerfield River Watershed. We focused on three main cover classes (northern hardwood, oak, and white pine), since these are the predominant forest types in this region based on U.S. Forest Service Forest Inventory and Analysis (FIA) data for Franklin County. The landscape-level proportions we employed for these cover types are summarized in Table D (see Proportion of Landscape column).

We created virtual forest stands by selecting MA Bureau of Forestry Continuous Forest Inventory (CFI) plots within the Deerfield watershed that were classified as either northern hardwood, oak, or white pine cover types. We combined these points to create an average stand condition (i.e., stocking, size-class distribution, and composition) for each of the cover types.

In Table D, percent unacceptable growing stock (UGS)—those trees that are not economically worth growing as timber—and site quality distributions are based on the MA Bureau of Forestry CFI plots within the Deerfield watershed. Numbers in parentheses for site quality percentages represent the 25, 50, and 75 percentiles for site index in that cover type.

Table D. Percent unacceptable growing stock and site quality distributions within the Deerfield River Watershed.

		Cover types	Site Quality		
Stand	% UGS	Proportion of Landscape	% Low	% Medium	% High
NHW	63.1	63.5	25.3 (53)	49.3 (59)	25.4 (66)
Oak	57.5	11.0	35.6 (47)	38.6 (55)	25.8 (60)
Pine	62.8	25.5	30.5 (56)	42.1 (64)	27.4 (82)

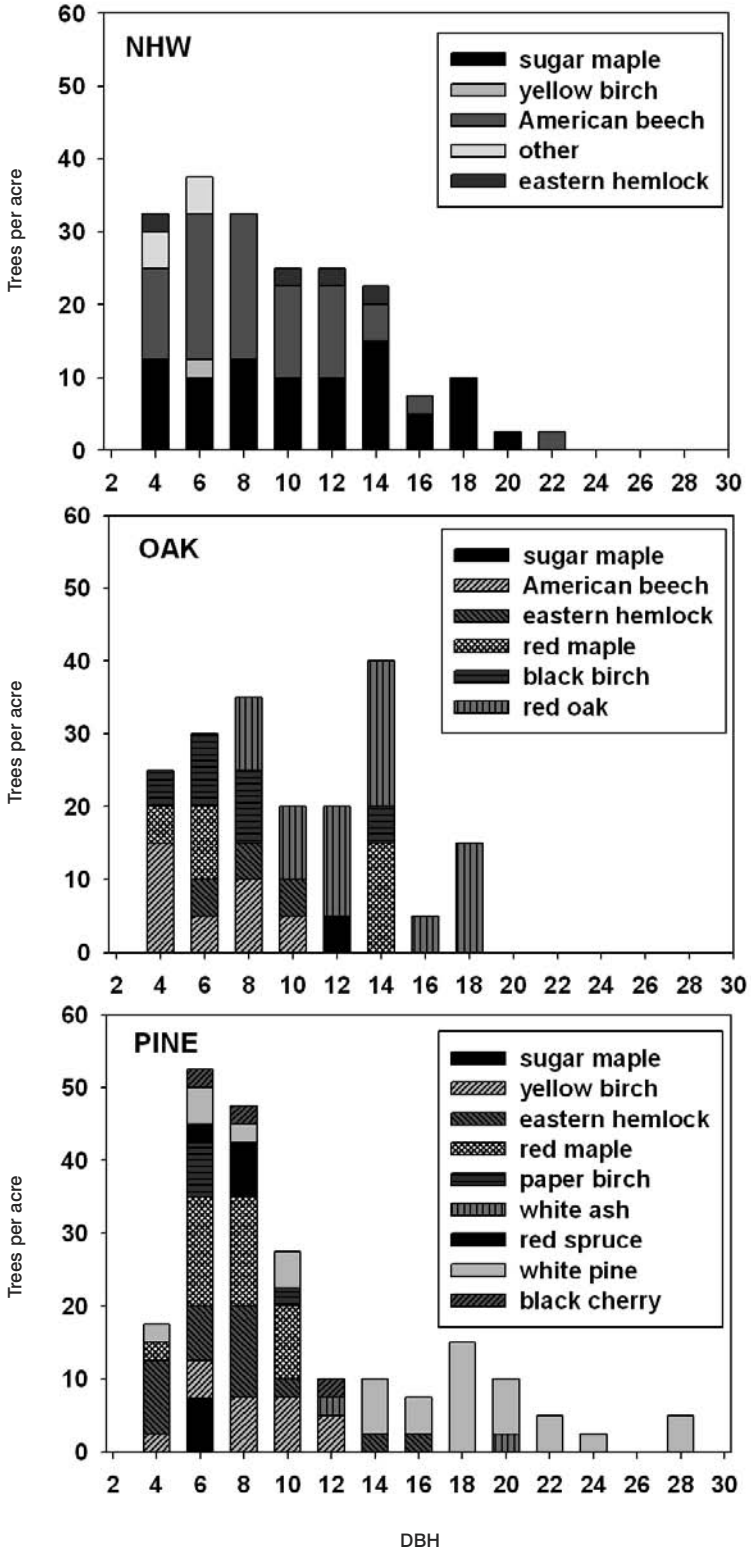
The species composition of the stands used for our forest harvesting modeling exercise was summarized in Table E using species importance values, calculated as $\frac{\text{(Relative Density + Relative Basal Area)}}{2}$.

Table E. Species composition of the stands.

	Stand		
Species	NHW	OAK	PINE
Sugar maple	50.2	2.9	2.2
Red oak		50.4	
White pine			47.1
American beech	40.7	12.7	-
Red maple		15.4	14.3
Eastern hemlock	5.1	6.2	13.2
Black birch		12.5	
Yellow birch	1.0		10.2
White ash			3.5
Red spruce			3.3
Paper birch			3.2
Black cherry			2.8
Other	3.2		

The diameter distribution of the stands was built using inventory data from the CFI plots, as shown in Figure 5.

Figure 5. *Diameter Distribution of Stands*



The virtual forest, including information on cover type, species composition, quality and diameter distribution, was built in LMS and was now ready for virtual management and revenue projection.

Management

The intent of the forest management was to maximize revenue from timber harvesting over a 30-year time horizon. We chose a 30-year time horizon so that landowners—whose average age is 60—would likely see the benefits of their forest management decisions.

Based on the work to build forests typical in the Deerfield River Watershed, we knew we were working with largely even-aged stands. We made the assumption that the stand was of good enough quality to manage, as cutting the stand to regenerate it would likely postpone timber revenue for decades.

We calculated the average per-acre volume for harvests in the Deerfield watershed (2.1 MBF/acre) over a 20-year period using the Forest Cutting Plan data provided by Harvard Forest. We used the average volume per acre as a target for our simulated per-acre harvest volumes to ensure the harvests were producing enough volume to be commercial harvests. Using LMS, we harvested each stand (northern hardwood, mixed oak, and white pine) three times, once in 2007, 15 years later in 2022, and 15 years after that in 2037.

Entry 1: Concentrate on removing the poorest quality trees first in order to increase the value of the forest. On the first entry, we removed two-thirds of the UGS, reducing the stand to around 90 sq. ft., between A and B stocking lines.

Entry 2: Harvest the remaining one-third UGS. Again, we reduced stand to 90 sq. ft.

Entry 3: Remove 10% UGS—we assume there was 10% mortality (insect, disease, wind, ice). Based on the age of the stands, we regenerated them using a shelterwood like harvest, reducing the basal area to 60 sq. ft., leaving a residual stand comprising primarily good quality dominant and co-dominant trees.

Our projections show that the per-acre volume and value of these stands increased, despite being harvested three times in a 30-year period. Table F shows the initial (before the first harvest) and final (left standing at the end of the last harvest) volumes and values.

Table F. The initial and final volumes and values of the stands.

Stand	Entry	BdFt/Acre	Cds/Acre	Stumpage
NHW	Initial	3.3	3.3	$565
	Final	4.4	0.3	$1,062
Oak	Initial	3.8	3.3	$803
	Final	4.9	0.4	$930
Pine	Initial	8.4	9.3	$745
	Final	7.7	0.6	$694

After each entry, we increased the percentage of high-quality, grade-one logs and reduced the amount of lower-quality, grade-3 logs, based on research for the grade increases through silviculture in northern hardwood stands, as shown in Table G

Table G. Basal area and grade changes for each entry and the volumes produced.

Stand	Entry	Initial BA (ft^2/ac)	Resid. BA (ft^2/ac)	% GR1	% GR2	% GR3	BdFt/Acre	Cds/Acre	Stumpage
NHW	1	127.6	94.6	24	24	53	1.6	0.7	$170
	2	108.6	86.6	24	39	37	2.0	0.4	$358
	3	94.5	59.7	48	29	24	2.3	0.2	$559
Oak	1	128.0	93.0	20	40	40	1.6	0.5	$392
	2	109.2	85.1	20	55	25	2.0	0.3	$646
	3	95.7	61.5	36	41	23	2.8	0.2	$1,000
Pine	1	167.5	126.4	49	11	40	4.0	1.9	$318
	2	141.4	116.2	49	14	36	4.4	0.8	$387
	3	127.7	66.1	45	20	35	8.0	0.6	$696

Calculating timber values

After calculating the volume and quality for each species in each forest type, we calculated stumpage values for species harvested at each entry in harvest simulations. Stumpage prices are the average of the quarterly prices in each given year (Entry 1, 1994; Entry 2, 2000; Entry 3, 2006). The years used represent the longest species specific time series collected for southern New England (http://forest.fnr.umass.edu/snestumpage.htm). In Table H, grades 1, 2, and 3, represent the 25th, 50th (median), and 75th quartiles, respectively. The 25th and 75th quartiles were used to limit the effect of outlier timber prices.

Table H. Stumpage prices used to calculate the stumpage value of each entry.

		Stumpage ($)		
Species	Entry	Grade 1	Grade 2	Grade 3
American beech	1	53	40	10
Black cherry	1	364	269	67
Eastern hemlock	1	46	34	8
Paper birch	1	77	46	11
Red maple	1	73	49	12
Red oak	1	505	382	95
Black birch	1	105	69	17
Sugar maple	1	266	179	45
White ash	1	256	185	46
White pine	1	89	61	15
Yellow birch	1	136	76	19
Cordwood	1	-	6	-
Pulp	1	-	5	-
American beech	2	52	39	10
Black cherry	2	630	463	116
Eastern hemlock	2	37	30	8
Paper birch	2	120	50	13
Red maple	2	168	60	15
Red oak	2	566	394	99
Black birch	2	216	91	23
Sugar maple	2	493	306	77
White ash	2	201	178	45
White pine	2	99	81	20
Yellow birch	2	220	115	29
Cordwood	2	-	6	-
Pulp	2	-	5	-
American beech	3	27	25	6
Black cherry	3	536	406	102
Eastern hemlock	3	29	21	5
Paper birch	3	34	26	6
Red maple	3	72	42	11
Red oak	3	323	297	74
Black birch	3	82	70	18
Sugar maple	3	498	373	93
White ash	3	249	94	23
White pine	3	103	72	18
Yellow birch	3	98	72	18
Cordwood	3	-	5	-
Pulp	3	-	3	-

Once timber values were applied, a per-acre value was calculated. This value was applied to each of our scenario property sizes (15, 30, 60, 150) to estimate the revenue from the sale of timber from well-managed forests over 30 years for each respective property size. A 15% reduction in the stumpage was applied to recognize the use of a professional forester in managing the forest. The median value reported from 30 foresters surveyed for marking and administering timber sales was 15% (Hersey and Kittredge 2005). It is very possible that the percentage may be higher for the smaller sized 15- and 30-acre properties because of the increased set-up costs (e.g., abutters' notices, boundary line issues, neighbor concerns).

Ownership-level stumpage revenues, shown in Table I, from the operations described above applied across entire forest ownership. Values are based on proportion of land base in each site index class (proportions derived from 234 CFI plots within Deerfield Watershed) and forest cover type (based on FIA projections for Franklin County, Massachusetts).

Table I. Ownership-level stumpage revenues.

Ownership Size (acres)	Entry 1 (stumpage)	Entry 2 (stumpage)	Entry 3 (stumpage)	Total revenue
15	$2,958	$5,066	$8,197	$16,221
30	$5,915	$10,132	$16,395	$32,442
60	$11,831	$20,264	$32,789	$64,884
150	$29,577	$50,660	$81,973	$162,211

In recognition that not every acre of land in the scenario properties will likely be suitable for management due to operational constraints, we reduced the calculated acreage of each scenario property by 7%. Although there has not been any analysis of percent of private lands with steep slopes (>35% slope) and wetlands, we chose 7% based on the analysis of lands classified as steep slope and wetland at the 53,987-acre Quabbin Reservoir (steep slopes, 1,712 acres; wetlands, 2,272 acres).

The 7% is likely a conservative reduction as the project area is likely to have a greater percentage of steep slopes than the Quabbin region. In addition, the percentage does not account for additional regulatory restrictions, such as endangered species, as well as landowner objectives, abutter concerns, and buffering around boundary lines.

Ground truth

Finally, we interviewed a consulting forester with over 30 years of experience managing woodlots in the Deerfield River Watershed as a way to "ground truth" our numbers. The consulting forester agreed that the numbers were an accurate representation of what a landowner may expect from forest management in the target area.

The consulting forester did raise concerns over our use of the smaller ownerships. It has been his experience that the 15-acre, and increasingly the 30-acre, ownerships are becoming uneconomical to harvest. He attributed this to higher service costs to set up the harvest and manage concerns of an increasing number of abutters, as well as the higher operational costs associated with moving equipment on to smaller ownerships.

An analysis of harvests in the Deerfield watershed for the periods of 1984–2003 indicated that over 20% of cutting plans filed under the state's Forest Cutting Practices Act were for harvests of 3–15 acres (Figure 6), although these plans made up less than 10% of the total acreage harvested (Figure 7). We question the validity of the cutting plan data and posit that for a number of years, cutting plans were being filed for changes of land use, specifically house lots. As a result, numerous harvests on small acreages were likely filed under the Forest Cutting Practices Act; however, many of these operations were not actually forest management. The individual cutting plans would need to be investigated to know for certain. It is very possible that timber harvesting may not be an available conservation tool for the 15-acre scenario property, removing approximately 25% of the ownerships from timber production in the target area. If the 30-acre ownerships are not economically viable to manage, then the percentage of ownerships where timber management is not economical is closer to 50% and approximately 20% of the land.

Figure 6. Number of Cutting Plans Filed 1984-2003

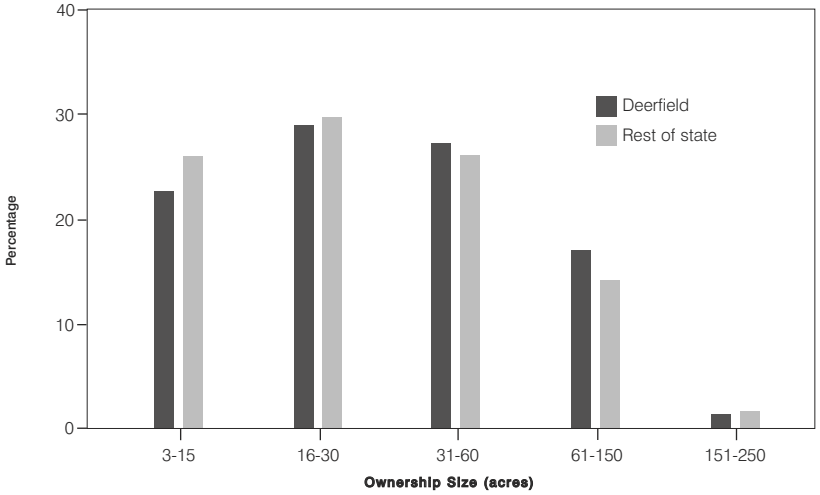
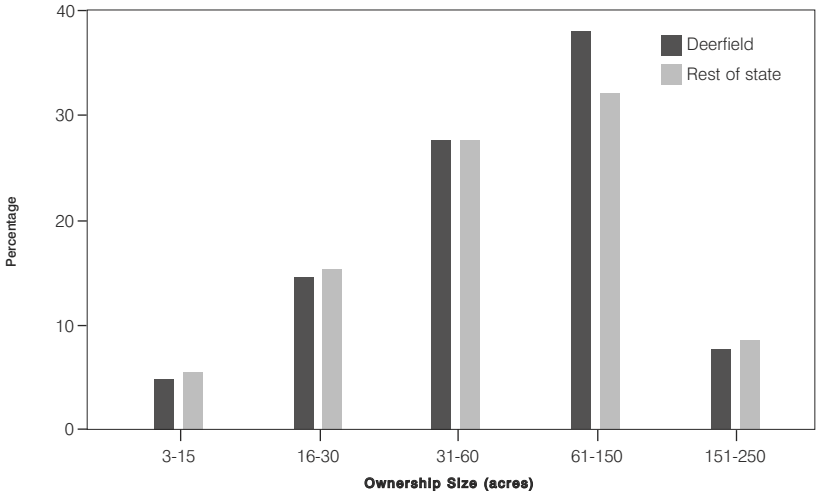


Figure 7. Acreage of Cutting Plans Filed 1984-2003



Final stumpage values

We feel our harvest scenarios and revenues represent a realistic approximation of the economic returns from timber management that can be derived from the project area over a 30-year time frame. Table J lists are the final stumpage values.

Table J. Final stumpage values.

Ownership size (acres)	Entry 1 (stumpage)	Entry 2 (stumpage)	Entry 3 (stumpage)	Total revenue
15	$2,751	$4,711	$7,623	$15,086
30	$5,501	$9,423	$15,247	$30,171
60	$11,003	$18,846	$30,494	$60,342
150	$27,507	$47,114	$76,235	$150,855

CURRENT USE (CHAPTER 61) MODELING

A number of states, including Massachusetts, have a form of "current use" tax law. The intent of current use is to provide rural landowners of either agricultural or forested property with an incentive to maintain their property in either agriculture or forest as opposed to conversion to some other use. This is accomplished by creating a more favorable property tax based on the land's current agricultural or forest use. These laws are enacted for a variety of reasons, including the following:

- To preserve community character
- To maintain scenic beauty or other aesthetics
- To maintain an agricultural or forest products economy
- To maintain wildlife habitat and preserve ecosystems
- To ensure other ecosystem benefits such as clean water

Current use programs are designed in a number of ways. We modeled two different methods: current use assessment and ad valorem tax reduction. The current use assessment method assigns a per-acre "productive use" value to the land. New Hampshire provides an example of this type of program (UNH Cooperative Extension, 2005). The stated purpose of New Hampshire's program is to preserve open space. Land covered under this program is taxed based on its productivity in its current use (timber management or farming are examples) as opposed to its highest and best use. This estimate can be based on productivity of the land based on soil and site conditions.

Table K. Scenario 2b calculation of current use assessment rate.
Range of Current Use Assessments (Effective April 1, 2005)

Forestland		Mid-point
White pine	$73–$130/acre	$101.50
Hardwood	$15–$44/acre	$29.50
All Other	$49–$94/acre	$71.50

Average of three forest types	$67.50/acre
Unproductive Land	$15.00/acre

Not all forest land is harvestable/productive assuming 90% productive and 10% unproductive.
Calculated rate = .90 * $67.50 + .10 * $15.00 = $62.25/acre

Source: Overview of Current Use Assessment, RSA 79-A, UNH Cooperative Extension, 2005

The second method modeled was a simple reduction in the assessed value of the property as determined by individual town assessors. Massachusetts Chapter 61 provides a 95% reduction in the assessed value of forestland that is enrolled in the program.

Two valuation rates were modeled for the current use scenarios. Scenario 2a applied an $80 per-acre valuation (MA Department of Revenue, 2007). For comparison and to gauge sensitivity to the assessed value rate, a blended average rate of $62.25 was used for Scenario 2b. This was based on the published ranges of the New Hampshire current use assessments. Table K, page 12, outlines this calculation.

A third scenario, Scenario 2c, is also presented that models a simple 95% reduction in the assessed value of forestland.

For all current use scenarios, the cash flow effects are modeled as a positive cash flow equal to the reduction in taxes resulting from participation.

SALE OF CONSERVATION RESTRICTION MODELING

One increasingly popular method of protecting land while maintaining ownership is to sell its development rights and place a conservation restriction on the property. Details of this process for Massachusetts landowners can be found in the publication "Land Conservation Options: A Guide for Massachusetts Landowners" (Trustees of Reservations, 2001).

Data from appraisals for land conservation deals were collected on 44 conservation easements in 11 towns within the Deerfield River Watershed from current conservation deals. Data included the assessed value prior to application of the conservation easement, the value of the easement, and the remainder value (Ross, 2007). We then sorted the results by acreage, and calculated summary per-acre values. Table L shows no apparent pattern in the per-acre values or easement values when compared across acreage groupings. The average assessed value was $1,866/acre, and the average calculated value of the conservation easement totaled $1,323/acre or 70% of the assessed value. 75% of the 70% value—or 53% of the total assessed value—was used as an example of landowners forgoing 25% of their CR value as a match for funding the other 75%. This 53% value is used as an estimate of conservation easement value in the analysis.

Table L. Deerfield River Watershed CR value analysis 44 appraisals in 11 towns, August 2007.

Size (acres)	Number of properties	Per acre before value	Per acre after value	Per acre CR value	% of appraised
13–18	3	$2,972	$637	$2,335	79%
19–39	5	$1,415	$530	$885	63%
40–60	4	$2,563	$685	$1,878	73%
61–150	15	$1,850	$519	$1,331	72%
151–250	7	$1,796	$522	$1,274	71%
251–700	10	$1,553	$515	$1,038	67%
Total	44				
Weighted Averages		$1,866	$543	$1,323	70%

Source: Ross (2007)

NET PRESENT VALUE ANALYSIS

Net present value (NPV) analysis is used to compare the value of investing in different projects that have differing costs, revenues, and perhaps risks over time (Copeland & Weston, 1983). NPV accounts for the time value of money, by discounting future cash flows at a given "discount rate" to reflect those future values in present dollar terms. NPV analyses are commonly used in businesses to compare business decisions. NPV incorporates both the positive and negative cash flows of a scenario and brings them back to today's dollars so that a comparison of each scenario can be made. A positive NPV means the cash flow exceeds the money loss and the risk (represented as the discount rate) of the scenario. NPVs represent both money made and money saved.

A key variable in conducting any NPV is the choice of discount rate. Storey (1991) discusses some of the issues concerning the choice of discount rate for use in benefit-cost analysis of environmental policy. Some argue for the discount rate to reflect the risk level associated with the investment, whereas others argue for a low rate when projects have a social benefit. Storey concludes that most rates used for environmental analyses range between 2% and 10%. This analysis and most results are reported for a 6% discount rate with sensitivity done at 4% and 8%.

RESULTS

Real Estate Value

Below are real estate values over time for three different inflation rates and the NPV of the land if it were sold, using discount rates of 4%, 6%, and 8%.

Table M. NPV of land sale.

15 acres, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$45,060	$45,060	$45,060
2008	$45,060	$63,404	$87,809
2037	$45,060	$260,979	$1,392,925

30 acres, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$69,000	$69,000	$69,000
2008	$69,000	$97,090	$134,461
2037	$69,000	$399,635	$2,132,975

60 acres, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$95,760	$95,760	$95,760
2008	$95,760	$134,744	$186,609
2037	$95,760	$554,624	$2,960,198

150 acres low, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$99,900	$99,900	$99,900
2008	$99,900	$140,569	$194,677
2037	$99,900	$578,602	$3,088,177

150 acres high, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$180,000	$180,000	$180,000
2008	$180,000	$253,278	$350,769
2037	$180,000	$1,042,527	$5,564,282

15 acres, NPV

	Land inflation rate		
Discount rate	0%	5%	10%
Sell 2008	$0	$18,344	$42,749
4%, 2037	($29,434)	$19,499	$345,033
6%, 2037	($34,664)	($14,376)	$159,684
8%, 2037	($37,244)	($32,772)	$57,120

30 acres, NPV

	Land inflation rate		
Discount rate	0%	5%	10%
Sell 2008	$0	$28,090	$65,461
4%, 2037	($45,072)	$29,859	$528,346
6%, 2037	($53,081)	($22,014)	$244,522
8%, 2037	($57,032)	($50,183)	$87,468

60 acres, NPV

	Land inflation rate		
Discount rate	0%	5%	10%
Sell 2008	$0	$38,984	$90,849
4%, 2037	($62,552)	$41,440	$733,253
6%, 2037	($73,667)	($30,551)	$339,354
8%, 2037	($79,150)	($69,646)	$121,390

150 acres, low NPV

	Land inflation rate		
Discount rate	0%	5%	10%
Sell 2008	$0	$40,669	$94,777
4%, 2037	($65,257)	$43,231	$764,953
6%, 2037	($76,852)	($31,872)	$354,025
8%, 2037	($82,572)	($72,657)	$126,638

150 acres, high NPV

	Land inflation rate		
Discount Rate	0%	5%	10%
Sell 2008	$0	$73,278	$170,769
4%, 2037	($117,580)	$77,894	$1,378,294
6%, 2037	($138,471)	($57,427)	$637,884
8%, 2037	($148,779)	($130,913)	$228,177

Status Quo – Property Taxes

Below are NPV for three different real estate inflation rates, using discount rates of 4%, 6%, and 8%.

Table N. NPV for three different real estate inflation rates.

Status Quo–Taxes–Net present value results

15 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$12,467	$33,735	$102,561
6%	$9,924	$25,109	$71,586
8%	$8,116	$19,292	$51,567

30 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$19,090	$51,657	$157,050
6%	$15,196	$38,449	$109,619
8%	$12,429	$29,541	$78,964

60 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$26,494	$71,691	$217,958
6%	$21,090	$53,360	$152,133
8%	$17,249	$40,998	$109,588

150 acres (low)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$27,640	$74,791	$227,381
6%	$22,002	$55,667	$158,710
8%	$17,994	$42,770	$114,326

150 acres (high)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$49,801	$134,758	$409,696
6%	$39,643	$100,301	$285,963
8%	$32,422	$77,064	$205,993

Scenario 1 *Timber Management*

The timber management scenarios described above yielded positive cash flows at each of the three harvests in years 1, 15, and 30. Though the later harvest yields the highest cash flow, the discounted values are dominated by the cash generated in the Year 1 harvest. Table O shows the NPV results for the 15-, 30-, 60-, and 150-acre properties for the range of discount rates: 4%, 6%, and 8%. At the 6% discount rate, the 15-acre parcel yielded an NPV of $5,888. Due to the assumption of linearity, the other property size results scale proportionately by acreage.

Table O. NPV results, Scenario 1: Timber management.

		15 acres	30 acres	60 acres	150 acres
NPV	4%	$7,612	$15,223	$30,446	$76,114
NPV	6%	$5,888	$11,776	$23,553	$58,882
NPV	8%	$4,790	$9,579	$19,159	$47,897

Scenario 2 *Timber Management and Current Use Program Participation*

Timber management plus participation in a current use program was designed to measure the combined cash flows from active forest management with the tax savings accruing from participation in a current use program. Timber revenues were identical to Scenario 1 with the additional cost of developing a formal forest management plan in years 1, 10, and 20. Table P shows the assumed costs for developing a written management plan based on 2007 100% cost share rates from the MA Forest Stewardship program, which reimburses $700 for management plans less than 36 acres and $700 plus $11/acre for every acre over 36. Based on these rates, the management plans ranged from $700 for the smaller parcel sizes to $1,954 for the 150-acre parcel. Rates were not changed for years 10 or 20.

Table P. Forest management plan costs.

Property size	Management plan costs
15	$700
30	$700
60	$964
150	$1,954

Three sub-scenarios, 2a, 2b, and 2c, were run to analyze the impact of current use as follows:

- 2a: Used the current published rate of $80 per acre average valuation for Massachusetts Woodland Productive and Christmas Trees (MA Department of Revenue, 2007)
- 2b: Blended average rates for New Hampshire Current Use $62.25 per acre
- 2c: A simple 95% reduction in taxes similar to the current Massachusetts Chapter 61 program

Adding a current use tax incentive has a significant positive effect on NPV when compared to the Scenario 1 timber management case. Table Q shows results of Scenario 2a NPV analysis. Analyzing these results, looking at the 30-acre parcel, we can see the mid-point NPV of $47,957, assuming 5% land value inflation and a discount rate of 6%. This compares with $11,776 for the 6% discount rate 30-acre property in Scenario 1, more than quadrupling the management only NPV.

Dropping the discount rate to 4% yields a 34% increase in NPV to $64,074. Raising the discount rate to 8% reduces NPV by 22% to $37,231. The NPV is also sensitive to land value inflation rates. Assuming no increase in land values over the 30-year planning horizon reduces the NPV by 52% to $25,174. If land appreciates in value at a 10% rate compared to the mid-point estimate of 5%, then the NPV increases by 146% to $117,974.

Table Q. Scenario 2a: NPV results

15 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$18,281	$39,210	$107,165
6%	$14,278	$29,228	$75,129
8%	$11,568	$22,576	$54,459

30 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$32,183	$64,074	$167,724
6%	$25,174	$47,957	$117,974
8%	$20,453	$37,231	$85,870

60 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$53,594	$97,437	$240,219
6%	$41,837	$73,169	$169,633
8%	$33,997	$57,078	$124,101

150 acres (low)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$96,343	$140,110	$283,987
6%	$74,697	$106,015	$203,287
8%	$60,597	$83,700	$151,338

150 acres (high)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$118,504	$200,078	$466,302
6%	$92,338	$150,649	$330,540
8%	$75,025	$117,994	$243,005

Table R shows the overall results for Scenario 2b, using a current use valuation rate of $62.25 per acre, which is a reduction from the $80 used in Scenario 2a. The net result, again looking at the 30-acre mid-point, yields an NPV of $48,179, slightly higher than in Scenario 2a. This is the expected result given the modest reduction in taxes derived from the lower current use value rate.

Table R. Scenario 2b: NPV results.

15 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$18,355	$39,359	$107,507
6%	$14,337	$29,339	$75,368
8%	$11,616	$22,661	$54,631

30 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$32,331	$64,371	$168,408
6%	$25,292	$48,179	$118,451
8%	$20,549	$37,401	$86,214

60 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$53,888	$98,032	$241,587
6%	$42,072	$73,611	$170,588
8%	$34,189	$57,418	$124,788

150 acres (low)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$97,079	$141,598	$287,408
6%	$75,283	$107,122	$205,674
8%	$61,076	$84,551	$153,058

150 acres (high)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$119,241	$201,565	$469,723
6%	$92,924	$151,756	$332,928
8%	$75,504	$118,844	$244,725

Scenario 2c looks at the effect of a 95% tax reduction on forestland similar to the current implementation of Chapter 61 in Massachusetts. Results, shown in Table S, are very close to the other two scenarios. The 30-acre mid-point case yields an NPV of $47,033, slightly lower than in Scenario 2a. However, the different tax reduction formula combined with the interaction of varying land value inflation and discount rates yield differing results when compared with 2a or 2b. For example, the 150-acre low land value case has slightly higher NPV estimates when comparing Scenario 2c to Scenario 2a, while most of the other results are slightly lower. We caution the reader not to rely on these results too heavily in their decision-making process. They are presented to provide an example of what might be expected and to illustrate the impact of changes in property characteristics such as acreage or risk and price inflation assumptions.

Table S. Scenario 2c: NPV results

15 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$17,990	$38,194	$103,579
6%	$14,047	$28,472	$72,626
8%	$11,378	$21,994	$52,656

30 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$31,893	$62,832	$162,955
6%	$24,943	$47,033	$114,645
8%	$20,264	$36,521	$83,472

60 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$53,597	$96,534	$235,488
6%	$41,840	$72,496	$166,331
8%	$33,999	$56,561	$121,722

150 acres (low)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$98,281	$143,075	$288,036
6%	$76,240	$108,222	$206,112
8%	$61,858	$85,396	$153,373

150 acres (high)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$119,334	$200,044	$461,235
6%	$92,999	$150,624	$327,003
8%	$75,565	$117,974	$240,457

Scenario 3 *Timber Management, Current Use, Sale of a Conservation Restriction*

Table T presents the summary results for the effect of timber management combined with a conservation restriction. The estimated NPVs are significantly higher than in the prior scenarios. This is due to the initial revenue resulting from the Year 1 sale of the CR. This provides a large lump-sum payment of approximately 53% of the land value at that time. For the 30-acre mid-point case, the calculated NPV is $94,409 in the CR scenario. This scenario clearly provides the highest calculated NPV as a result of the CR sale.

Table T. Scenario 3: NPV results.

15 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$41,353	$70,128	$148,038
6%	$36,915	$59,563	$115,230
8%	$33,785	$52,349	$93,818

30 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$67,513	$111,418	$230,312
6%	$59,837	$94,409	$179,381
8%	$54,474	$82,822	$146,140

60 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$102,625	$163,144	$327,080
6%	$89,943	$137,635	$254,855
8%	$81,212	$120,350	$207,745

150 acres (low)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$147,493	$208,657	$374,604
6%	$124,883	$173,269	$292,193
8%	$109,853	$149,708	$238,598

150 acres (high)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$210,668	$323,586	$629,575
6%	$182,762	$271,826	$490,733
8%	$163,775	$236,927	$400,231

Scenario 4 *Sale of a Conservation Restriction Only*

For illustration purposes, Scenario 4 analyzed the case of a forest property with a CR and no timber management. This might represent a case where the landowner wants the land to be left wild. In this scenario, there is no income from timber management, there is lower tax savings than land under a current use program, but there is still that large lump sum income from the initial CR sale. As shown in Table U, this yields NPV estimates between the CR plus timber management scenarios and the current use plus timber management scenarios. For the 30-acre mid-point case, the estimated NPV is $78,960.

Table U. Scenario 4: NPV results.

15 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$33,463	$60,662	$134,673
6%	$30,908	$52,473	$105,573
8%	$28,983	$46,783	$86,521

30 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$50,270	$91,021	$202,118
6%	$46,556	$78,960	$158,798
8%	$43,748	$70,568	$130,425

60 acres	Land inflation rate		
Discount rate	0%	5%	10%
4%	$67,225	$121,436	$269,780
6%	$62,589	$105,946	$212,898
8%	$59,060	$95,143	$175,615

150 acres (low)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$58,040	$103,433	$230,398
6%	$55,670	$93,220	$186,473
8%	$53,741	$85,959	$157,542

150 acres (high)	Land inflation rate		
Discount rate	0%	5%	10%
4%	$121,214	$218,362	$485,370
6%	$113,549	$191,777	$385,013
8%	$107,663	$173,177	$319,174

SELLING THE PROPERTY

Table V illustrates the NPV of a simple sale of the property. The left hand set of tables shows the property values estimated for 2001 from the data, and 2008 and 2037 assuming 0%, 5%, and 10% land value inflation rates. The right hand set of tables lists the price appreciation from 2001-2008, and the NPV for a sale of the property in year 30 (2037) at the different discount rates. It is not surprising to see negative NPV for all the cases with 0% land value appreciation and the majority of the 5% land value appreciation. NPV will grow quickly only when land values inflate at rates higher than the assumed discount rate.

For the 30-acre mid-point case, assuming 5% land inflation and a 6% discount rate, the NPV is negative at ($22,014). Even though the nominal price has inflated to over $399,000 in year 30, the 6% rate of discount deflates that future value to $22,014 below the 2008 property value of $97,090. However, if the land value inflation was 10% annually, the NPV at a 6% discount rate becomes a positive $244,522 for the 30-acre case.

Table V. NPV of land sale.

15 acres, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$45,060	$45,060	$45,060
2008	$45,060	$63,404	$87,809
2037	$45,060	$260,979	$1,392,925

30 acres, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$69,000	$69,000	$69,000
2008	$69,000	$97,090	$134,461
2037	$69,000	$399,635	$2,132,975

60 acres, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$95,760	$95,760	$95,760
2008	$95,760	$134,744	$186,609
2037	$95,760	$554,624	$2,960,198

150 acres low, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$99,900	$99,900	$99,900
2008	$99,900	$140,569	$194,677
2037	$99,900	$578,602	$3,088,177

150 acres high, land value

	Land inflation rate		
Year	0%	5%	10%
2001	$180,000	$180,000	$180,000
2008	$180,000	$253,278	$350,769
2037	$180,000	$1,042,527	$5,564,282

15 acres, NPV

	Land inflation rate		
Discount rate	0%	5%	10%
Sell 2008	$0	$18,344	$42,749
4%, 2037	($29,434)	$19,499	$345,033
6%, 2037	($34,664)	($14,376)	$159,684
8%, 2037	($37,244)	($32,772)	$57,120

30 acres, NPV

	Land inflation rate		
Discount Rate	0%	5%	10%
Sell 2008	$0	$28,090	$65,461
4%, 2037	($45,072)	$29,859	$528,346
6%, 2037	($53,081)	($22,014)	$244,522
8%, 2037	($57,032)	($50,183)	$87,468

60 acres, NPV

	Land inflation rate		
Discount Rate	0%	5%	10%
Sell 2008	$0	$38,984	$90,849
4%, 2037	($62,552)	$41,440	$733,253
6%, 2037	($73,667)	($30,551)	$339,354
8%, 2037	($79,150)	($69,646)	$121,390

150 acres, low NPV

	Land inflation rate		
Discount Rate	0%	5%	10%
Sell 2008	$0	$40,669	$94,777
4%, 2037	($65,257)	$43,231	$764,953
6%, 2037	($76,852)	($31,872)	$354,025
8%, 2037	($82,572)	($72,657)	$126,638

150 acres, high NPV

	Land inflation rate		
Discount Rate	0%	5%	10%
Sell 2008	$0	$73,278	$170,769
4%, 2037	($117,580)	$77,894	$1,378,294
6%, 2037	($138,471)	($57,427)	$637,884
8%, 2037	($148,779)	($130,913)	$228,177

SUMMARY RESULTS OF NPV ANALYSES

When compared to the projected property tax liability over 30 years, our NPV analysis of forest conservation tools shows that with the exception of timber management alone, all the scenarios all provide positive NPV. The sale of a conservation restriction had the greatest impact on NPV followed by enrollment in current use. Scenario 3, the combination of timber management, current use, and the sale of conservation restrictions provided the highest NPV.

Figure 8 (below) and Table W (page 20) show the NPV contributions of the various conservation tools for the 30-acre parcel, mid-point case. For the largest NPV case, Scenario 3, timber management accounted for 11% of the total, with tax savings contributing 40% and sale of the conservation restriction 49%.

Figure 8.
30-Acre Parcel, Mid-Point, NPV Contributions

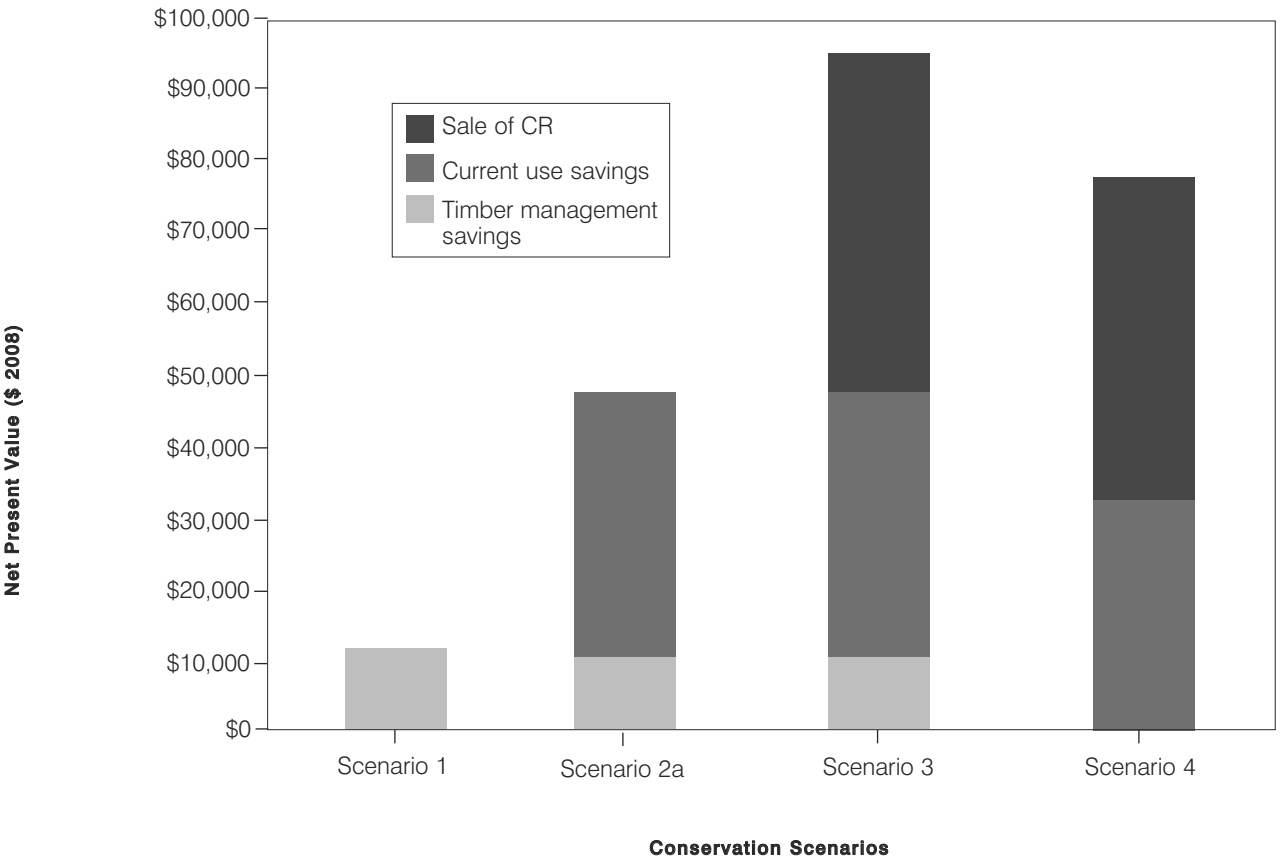
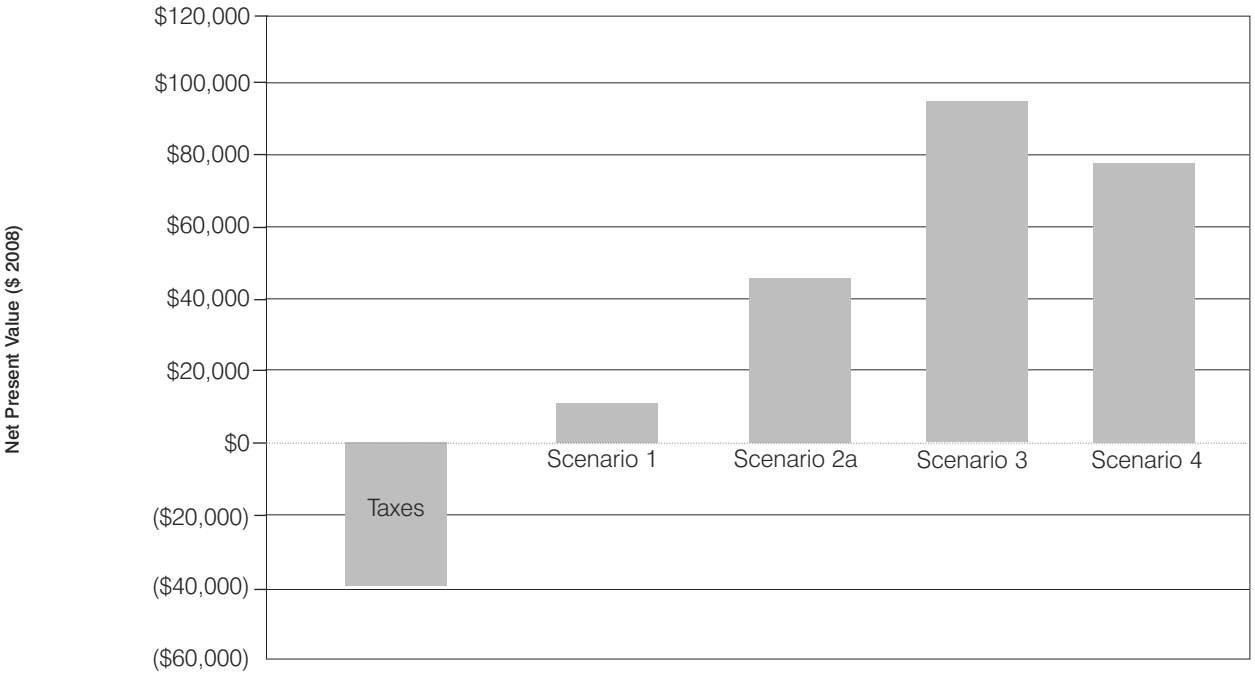


Table W.
NPV contributions of the various conservation tools for the mid-point values of the 30-acre parcel scenario.

Status Quo - Property Taxes	15 $25,109	30 $38,449	60 $53,360	150 low $55,667	150 high $100,301
Scenario 1					
Timber management	$5,888	$11,776	$23,553	$58,882	$58,882
Tax savings	$0	$0	$0	$0	$0
Sale of a CR	$0	$0	$0	$0	$0
Total NPV	$5,888	$11,776	$23,553	$58,882	$58,882
Scenario 2					
Timber management	$4,618	$10,506	$21,805	$55,338	$55,338
Tax savings	$24,610	$37,451	$51,364	$50,677	$95,311
Sale of a CR	$0	$0	$0	$0	$0
Total NPV	$29,228	$47,957	$73,169	$106,015	$150,649
Scenario 3					
Timber management	$4,618	$10,506	$21,805	$55,338	$55,338
Tax savings	$24,612	$37,450	$51,363	$50,677	$95,312
Sale of a CR	$30,333	$46,452	$64,467	$67,254	$121,177
Total NPV	$59,563	$94,408	$137,635	$173,269	$271,827
Scenario 4 CR, ONLY					
Timber management	$0	$0	$0	$0	$0
Tax savings	$22,140	$32,508	$41,479	$25,966	$70,600
Sale of a CR	$30,333	$46,452	$64,467	$67,254	$121,177
Total NPV	$48,162	$78,960	$105,946	$93,220	$191,777

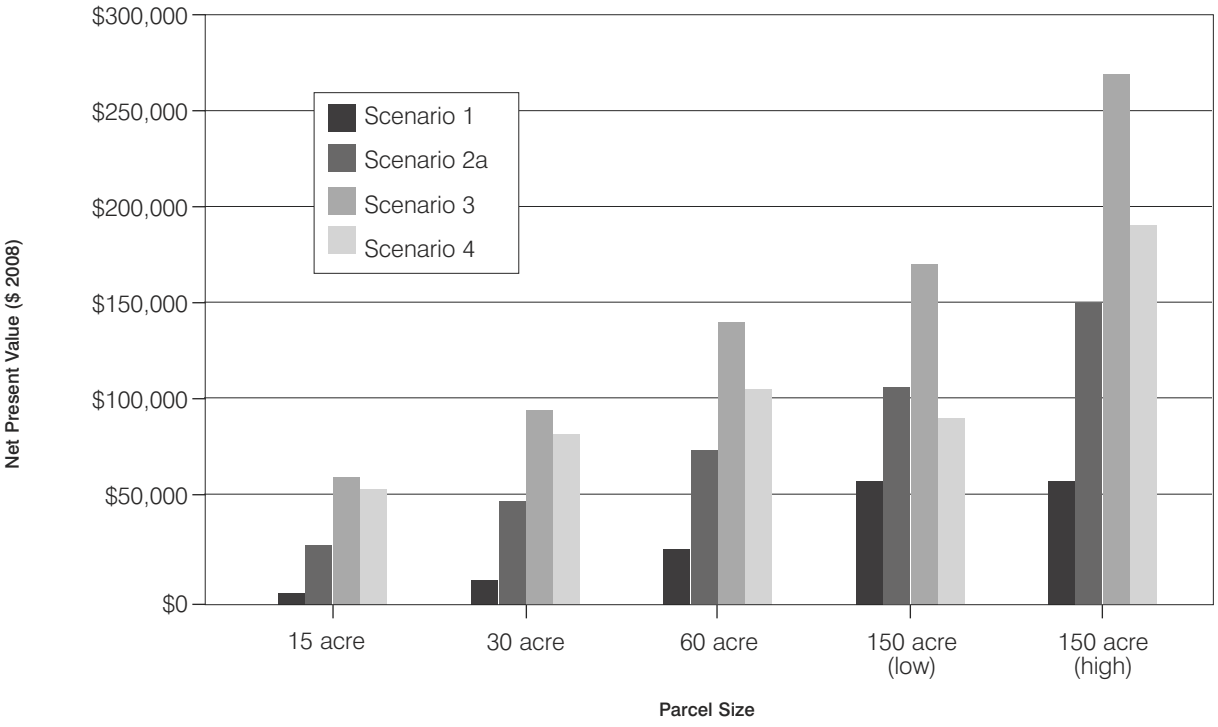
Figure 9 summarizes the various scenarios showing the relative impacts of property taxes, timber management, current use, and CRs on the 30-acre mid-point example. Timber management alone provides some benefit to landowners but taxes outstrip income from timber sales. The only scenarios that result in cash flows that exceed taxes are those that involve either participation in a current use tax reduction program or sale of a CR. Scenario 3 involving both timber management and a CR provides the highest NPV, in this case exceeding the tax outflows by more than 2:1.

Figure 9.
30-Acre Mid-Point NPV Estimates (5% Land Value Inflation, 6% Discount Rate)



The effect of parcel size on NPV is illustrated in Figure 10. NPVs are increased for larger parcels through several mechanisms. Greater revenues from timber management accrue to the larger parcels. Larger parcels tend to be more actively harvested (Alig et al., 1990), and our assumption of linearity in returns from timber management may be conservative. One can argue that larger parcels offer economies of scale in production and therefore the returns per acre would be higher for larger parcels. Other effects of parcel size flow through its effect on total property value. More valuable properties will carry a greater tax burden. The effects of tax reductions from current use program and CR value are expected to be greater for larger parcels as shown.

Figure 10.
Mid-Point Examples, NPV(Land Value Inflation 5%, Discount Rate 6%)

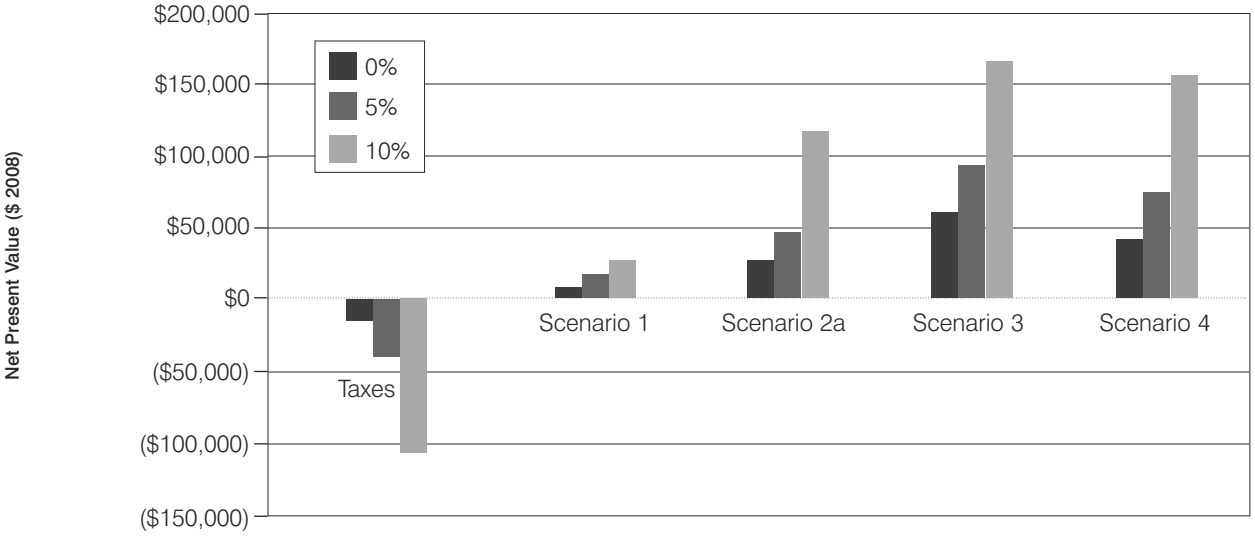


NPV analyses provide the opportunity to compare financial options to determine the best strategy by discounting the financial impacts to today's dollars in order to provide an "apples-to-apples" comparison. A positive NPV indicates a positive net cash flow or a good financial decision.

FURTHER RESEARCH NEEDS FOR NPV ANALYSES

One of the most significant factors in determining the NPV for forest management planning decisions is the assumed rate of inflation in land values. The literature shows a wide variance in rates that have been shown, and the factors that affect appreciation and depreciation in land values are complex. Figure 11 illustrates the magnitude of this effect on the 30-acre parcel example. In this figure, the discount rate of 6% is held constant, and the estimated NPV for 0%, 5%, and 10% land value inflation rates are shown. For Scenario 3, CR plus timber management, we see a near tripling of the NPV when comparing 0% inflation versus 10%. With no changes in land over the 30-year period, the NPV was estimated at $59,837. This rose to $179,381 when land values appreciate at a 10% rate.

Figure 11.
30-Acre Parcel–Land Value Inflation Rate Sensitivity

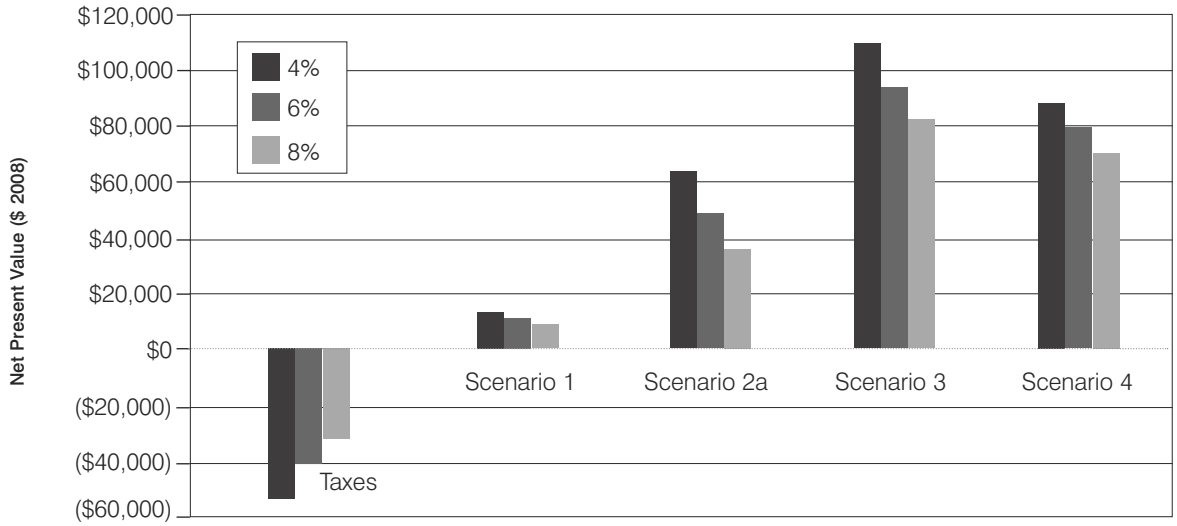


More research, particularly through developing a more comprehensive multi-variable regression model, would yield more insight into the land value factors affecting Massachusetts and perhaps other Northeast NIPF lands. Completing an analysis of land value appreciation over time across the state would better inform forest conservation outreach and programs as NPV analyses would show where programs were effective.

As noted earlier, the assumed discount rate in calculating the NPV has a large effect. Figure 12 shows the effect over different scenarios for the 30-acre parcel example, holding the land value inflation rate at 5%. For scenario 3, the difference in NPV is $28,596 when comparing the NPV calculated at 4% versus 8%. The higher discount rates reflect a lower value in present terms for cash flows in the distant future. This typically results from recognizing a higher risk associated with one investment when compared with another.

Additional research, including more extensive literature review/meta-analysis of other study's discount rate assumptions, would shed light on this issue. New primary research to discover stakeholder assumptions regarding the risk of forestland investment over varying time horizons would lead to a better understanding of the appropriate discount rate to use in forest management decisions.

Figure 12.
30-Acre Parcel—Discount Rate Sensitivity



Although the financial impact of a decision is important, it is typically not the only factor. Certainly, social factors also play a role in landowners' reasons for owning, managing (or not managing), and conserving their land. Therefore, knowing more about landowners and their motivations can increase the effectiveness and efficiency of our conservation efforts. Below are the results of several studies that help characterize Massachusetts landowners.

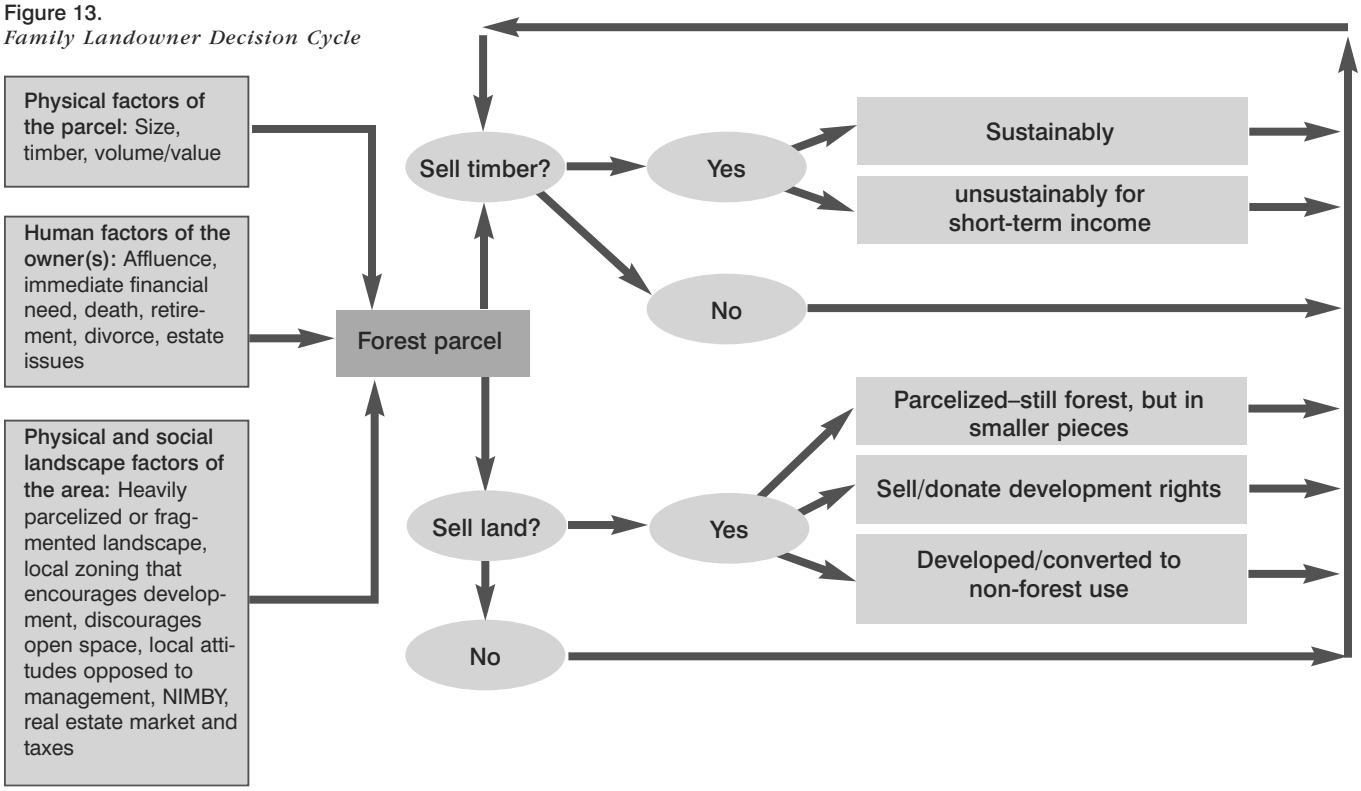
General Demographics for Massachusetts Landowners (White 2001)
- Gender 68% male, 32% female
- Average age is >61
- Income: >$100,000, 33%; >$60,000, 58%
- Well educated—63% have at least a college degree
- 75% have primary residence on the land
- Estimated average length of ownership is 21 years (Belin et al., 2005)

Top five concerns of MA landowners (NWOS, 2006)
- Insects or plant diseases
- Misuse of woodland (e.g., dumping)
- High property taxes
- Keeping land intact for heirs
- Air and water pollution

Future plans (5 years) of Massachusetts family forest owners (NWOS, 2006)
- Harvest firewood 39%
- Minimal activity 38%
- Leave it as is 28%
- Harvest timber 20%
- Pass land on to heirs 19%

Top family forest ownership objectives (NWOS, 2006)
- Scenery
- Privacy
- Residence
- Protect environment
- Wildlife habitat

Figure 13.
Family Landowner Decision Cycle



LANDOWNER DECISIONS

Most forest landowners don't often think about selling or sub-dividing their land. It is usually when a situation arises in the life of a landowner that the "sell land?" decision point is triggered (see Figure 13, Kittredge, 2004).

Instead of planning forest management, most landowners simply enjoy their woodlots for their privacy and aesthetics on a daily basis, giving little or no thought to management until something triggers a "sell timber?" decision point. In most cases, landowners are not prepared to make an informed decision about their land (either its management or conservation) when it arises suddenly in their life. **It is at these decision points that our outreach and conservation programs need to inform landowners about their alternatives.** Landowners with full knowledge of their alternatives—and a better understanding of how their parcel is situated and affects the broader surrounding landscape—are more likely to make educated decisions.

Where do landowners get information when decision points arise? (HCI Survey, 2007)

When asked, "Where do you generally turn for advice regarding decisions about your land?" the top response at 64% was "Family members" or "Friends/neighbors."

Chapter 61 as a Conservation Tool

Only 2% of landowners who enrolled in Chapter 61 went on to permanently protect land with a conservation restriction during the study period of 1980–2004 in 62 towns (880 owners in 61) (Kittredge, 2005).

Interest in Timber Management within the Project Area

A recent survey of landowners in the Deerfield and Westfield watersheds done by UMass asked landowners about their interest in timber management, and only 8.8% of respondents said "Very" or "Extremely important" (Kittredge, 2007).

Income from the Land

In the same survey as above, landowners were asked, "Over the last five years, what percentage of your yearly income came from your woodland (e.g., timber)?" 96% of respondents indicated "10% or less" (Kittredge, 2007).

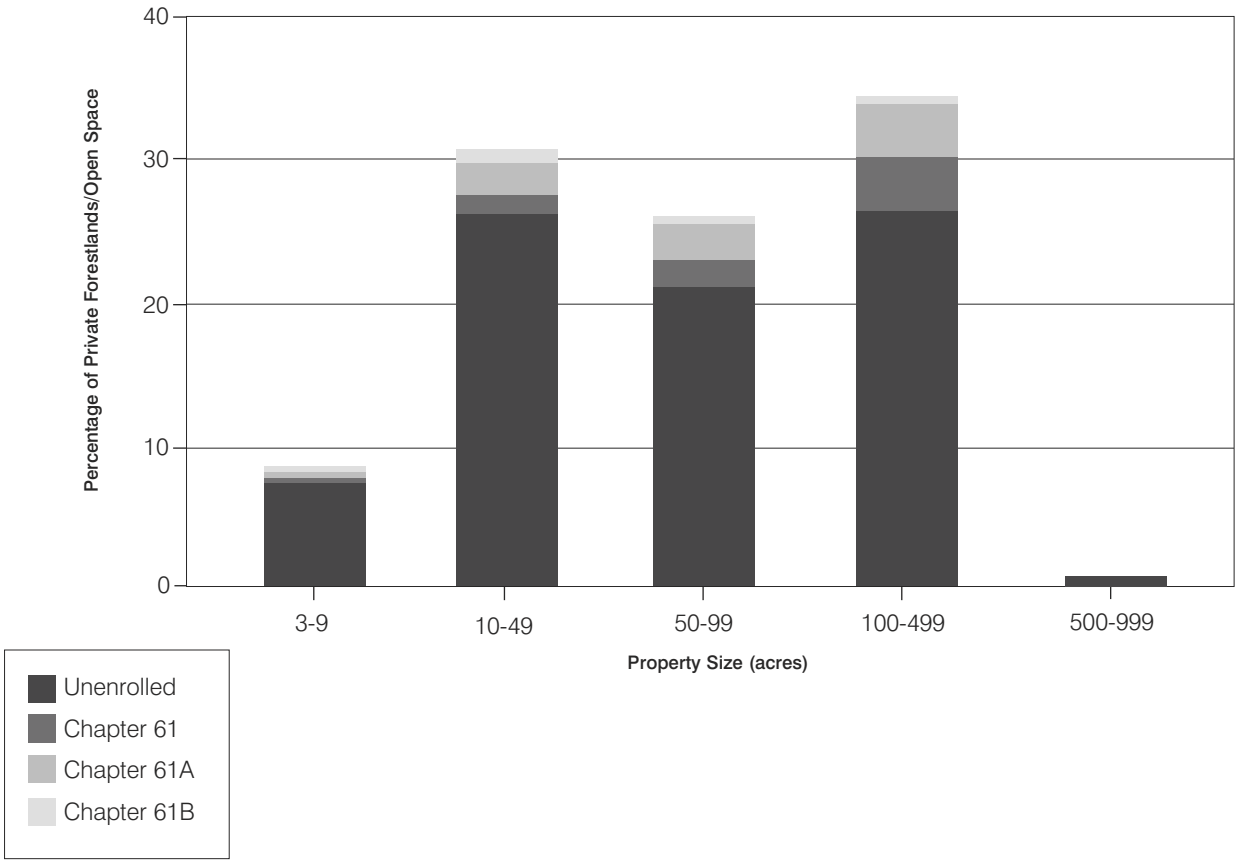
DISCUSSION

As noted in the "Timber Management Modeling" section, smaller acreages (<30 acres) are becoming increasingly less viable to manage. Continuing to mandate forest management on these ownerships will greatly reduce enrollment as landowners of smaller ownerships are often less likely to have a timber sale. In the Deerfield River Watershed, approximately 50% of the ownerships are 30 acres or less, making up approximately 20 percent of the land base. These numbers are likely higher in most other parts of the state, which have smaller ownerships than the Deerfield.

The NPV analysis shows the value of current use programs in reducing the property tax burden, making keeping land open more financially appealing. However, the Chapter 61 program has low participation rates—approximately 15% of landowners are enrolled in the program—despite decades of existence and millions of dollars of cost-share to develop management plans (see Figure 14).

Given the results on landowner attitudes from the research cited above, one strong possibility for low participation rates is that there does not seem to be a strong interest from landowners to engage in long-term forest planning and management. Planning the future of their forest's management and income from timber are not prime motivators for the majority of forest landowners and may even be seen as competing with their top landowner objectives (i.e., scenery, privacy, residence, environment protection, and wildlife habitat). For the majority of landowners, forestry is a "back-burner issue." Their landowner objectives are being met by "doing nothing" to the land. Their needs for information arise only periodically when a decision about their land must be made.

Figure 14.
Proportion of Private Forestland/Open Space Enrolled in Chapter 61 within the Deerfield River Watershed, MA



It is important to note that not only are landowner objectives often being met by "doing nothing," but many public benefits are also being met as these landowners are "doing nothing." Clean water, carbon sequestration, wildlife habitat, scenic backdrops, rural character, etc., all continue to be provided from forestland with no or only sporadic management. Forest management provides us the opportunity to diversify or enhance these benefits, but many continue to be provided in its absence.

Despite the above research findings, programs targeting forest landowners (e.g., forest management plan cost-share, green certification of private lands, forest viability program) revolve around timber management, economic objectives, and long-term forest planning. Combined, the Chapter 61 programs, forest stewardship program, and tree farm involve less than 20% of Massachusetts landowners. To engage the 80% we aren't reaching, we must plan outreach and conservation programs based on the research findings to ensure they will be in sync with landowner goals and the sporadic nature of their decisions (see Figure 13).

Paradoxically, despite ranking timber low as a landowner objective, between the years of 1997 and 2001 in Massachusetts, family forests were responsible for 83.2% of all harvest operation, 83.9% of all harvested acres, and 78.0% of all harvested MBF. Although timber management may not rank high, there is no doubt that family forestlands account for the overwhelming majority of Massachusetts' annual volume and acreage. When the "sell timber?" decision point arises, many landowners—most of them not in current use—choose to implement a harvest. **Mandating active management as a part of current use to help ensure a supply of wood products may hinder enrollment numbers and ultimately make little difference to the overall amount of wood being harvested.**

Given the research, elements that will likely make up successful outreach and programs to attract landowners to forest conservation are likely to

- allow landowners to "do nothing" to their land;
- recognize the value of land that is not being managed under a long-term plan and compensate forests for the public benefit they provide (e.g., carbon sequestration, water quality);
- maintain forest management as a right—rather than mandating it—should the decision cycle arise.

RECOMMENDATIONS

1. Given the NPV analysis, CRs appear to have a greater influence on landowner returns than either participating in a current use program or timber management alone. Currently, landowners are only offered options that include current use (temporary protection) and conservation restrictions in perpetuity. There is no middle ground. Creating a program with a 30-year easement would offer an opportunity for landowners to choose an option greater than current use, but not in perpetuity, giving their kids options. A 30-year easement would also help bridge the inter-generational transfer and give families an opportunity to get their feet under them before making a decision about the land and help extend our conservation window of opportunity on those lands with easements. A program of this nature should be sure to include in it the elements listed above likely to attract landowners.

   We recommend creating a Forest Reserve Program (FRP) modeled after the NRCS Wetlands Reserve Program (WRP). WRP is a voluntary program. It provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. Landowners can choose either a 30-year easement or a permanent easement. Historically, landowners in the WRP were not mandated to implement active management of the resource as the public good they provided through their wetlands was seen as enough to justify the public dollars paid for the easement. Recently, the program has moved to requiring restoration work to restore wetland functions and values. This work is eligible for cost-share.

   A new FRP could be targeted to areas of high public value such as public water supplies, endangered species core habitat, and large forest blocks. A 30-year easement could be offered to provide landowners income for the public benefits they will provide over the next 30 years. The time frame will help get families through the inter-generational transfer, while still maintaining options for heirs. Like the WRP, the FRP can be structured to not mandate active management, but allow for optional management done in a way that is consistent with the high conservation value landscape. Monies could be provided for enhancement of the values, e.g., invasive/exotic control, restoration of old-growth characteristics, stream bank stabilization.

2. Another option would be to create a program to purchase the Right of First Refusal (ROFR) from landowners in key landscapes. A program of this type avoids having to "sell" long-term forest management to landowners and instead allows landowners to manage, or not manage, as they would like. The land continues to provide public benefits and at the time of conversion, the state would have a ROFR. Again, a program of this nature helps extend the conservation window of opportunity.

3. Our interviews with assessors showed a variety of methods used to assess CRs. Assessors were doing the best they could with their limited understanding of CRs and their limited knowledge of the value of CR land. It would be beneficial to communities and landowners to work toward a standard assessment of CRs.

4. Like Kilgore and MacKay (2007) found in Minnesota, the per-acre price of conservation is lower on larger parcels, and therefore concentrating on those parcels is the most cost-effective. Now is the time for cost-effective conservation. In addition, larger parcels hold the greatest potential for maintaining working landscapes as the service, and operational costs of setting up and implementing harvests are lower.

5. Focus on peer-to-peer outreach to place in each community respected citizens that have a greater chance of being there when decisions are being made with credible local information and experiences to share. Friend and neighbors are trusted and are often consulted when decisions arise.

6. Research into the demographics and attitudes of those that have already conserved their land would help focus on what information, policies, or programs had the largest influence and therefore should be increased.

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