

Net Present Value Analysis for Leasing Taps vs. Managing for Sawtimber Production
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Please read the following document before operating the Net Present Value (NPV) calculator. This document describes the key variables in the decision of whether or not to lease a maple tree for tapping, harvest the tree immediately, or manage the tree for long-term commercial sawtimber production. There are 26 variables that a user must input values for in order to conduct the analysis. The website defaults to a typical value one might expect to find in an average maple tree. What makes this spreadsheet useful is that a user can change the value of any of the variables and then immediately see how the NPV analysis changes. The possible ranges for each of the variables is presented in red next to the name of the variable (with the default value appearing in parentheses).

Initial tree diameter (ITD) 6 – 36 (12) inches (dbh)

A user can enter any value for the diameter of the tree at breast height (inches). At very small sizes (<6" dbh) the analysis will not make much sense, so it is best to consider trees that are ≥ 6 " dbh.

Height of tree affected by tapping (HTTap) 3-12 (8) ft

Enter in the height at which the butt log would be affected by tapping (in feet). The default value is set to 8, as one can reasonably predict that the first 8 ft butt log will contain all of the tapholes and staining. This is due to tapping higher in years of heavy snow depth with tubing systems. Also, with a typical lateral line height of 4 ft and a 30" dropline extended to maximum capacity, most of the holes wind up being approximately 5-6 ft above the ground. However, if a sugaring operation only used buckets in an area without excessive snow depths, it is possible that only the bottom 3-5 ft would contain tapholes and staining.

Initial Merchantable height growth rate Untapped (IMHGU) 0 – 3 (.5) ft/year

Enter the height at which the bole of the tree reaches a point where it can no longer be used for a sawlog. This generally occurs where the diameter of the tree inside the bark equals 8". It can also be to the point where there are many large branches spreading out in to the crown of the tree or where a serious defect occurs that would negate any potential sawlog value.

Initial Diameter Growth Rate Untapped (DGRU) 0 – 1 (.15) inches/year to dbh

Individual tree growth rates will vary based on many factors, including soils, genetics, age, crown position. etc. Typical growth rates range anywhere from .02-.08 in/yr for a slow growing tree vs. .25-.50 for a very fast growing tree. An average tree growing in a northeastern forest would grow at about .15 in/yr. The following table is taken from

Richard M. Teck and Donald Hilt. 1991. Individual-Tree Diameter Growth Model for the Northeastern United States. USFS Northeastern Forest Experiment Station Research Paper NE-649. It shows the average potential growth rate for a sugar maple tree based on tree diameter and site index (a measure of site quality). Given that the average potential growth rate is .15 in/yr, this is set as the default growth rate.

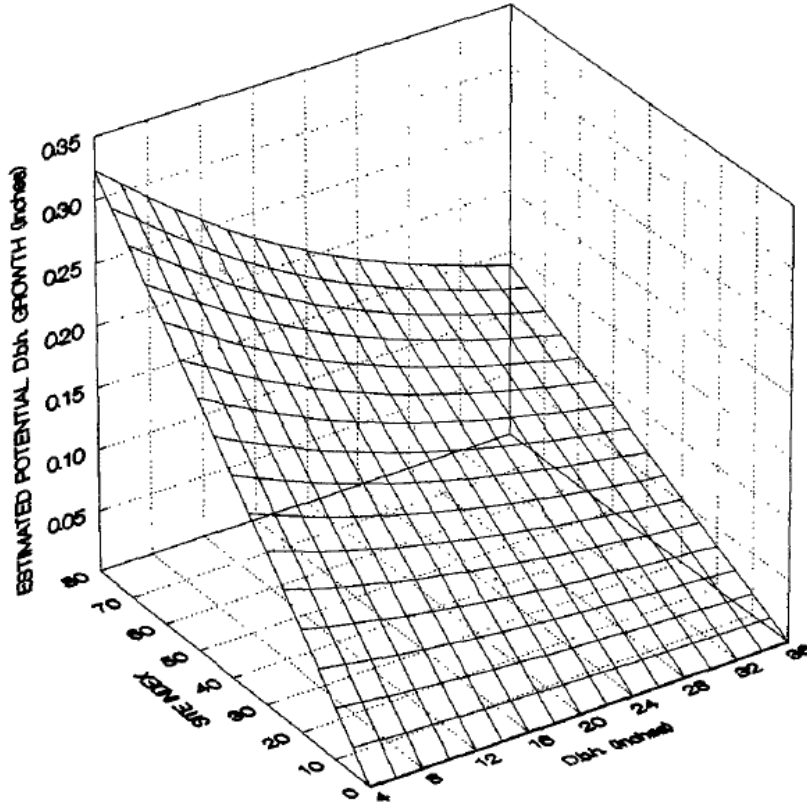


Figure 6.—Predicted potential diameter growth (in inches) for sugar maple.

Initial Merchantable height growth rate Untapped (IMHGU) 0 – 3 (.5) ft/year

Users can enter the rate at which the height of the bole that could be sold for sawtimber is increasing at an annual rate (in feet). This could be 0 if the tree form and quality is such that it can no longer add additional height in merchantable logs. This could be the case for trees with serious defects, crotches, or large limbs that occur at a certain height in the tree. For tall straight trees that can still add merchantable height growth, the growth rate may vary anywhere from 0- 3 ft/yr, with the default value set to .5 ft/yr.

Sawtimber Delivered Log Prices (SDLP) 0-2,000 \$/MBF

The user can obtain a price sheet from a local sawmill to input the delivered log prices for sugar and red maples of a given size (assuming no grade defects). The spreadsheet is set up such that users can enter prices for sugar and red maple logs with a diameter inside bark at the small end of 10-11.9", 12-13.9", 14-15.9", and ≥ 16 ".

Sawtimber Delivered Log Prices (SDLP)

DBH Range	Untapped Sugar Maple (SDLPUSM) SRC	Untapped Red Maple (SDLPURM) SRC
less than 10" dbh		
Between 10 and 12" dbh	0-2,000 (325) \$/MBF	0-2,000 (160) \$/MBF
Between 12 and 14" dbh	0-2,000 (400) \$/MBF	0-2,000 (160) \$/MBF
Between 14 and 16" dbh	0-2,000 (475) \$/MBF	0-2,000 (250) \$/MBF
greater than 16" dbh	0-2,000 (625) \$/MBF	0-2,000 (300) \$/MBF

Veneer Delivered Log Prices (VP) 1,000-12,000 \$/MBF

The user can obtain a price sheet from a local sawmill to input the delivered log prices for veneer sugar maples of a given size. The spreadsheet is set up such that users can enter prices for sugar maple veneer logs with a diameter inside bark at the small end of 14, 15, 16, 18, and 20".

Veneer Prices (VP)

DBH Range	Untapped Sugar Maple Veneer (USMV)
between 14 and 15"	1,000-12,000 (3,100) \$/MBF
between 15 and 16"	1,000-12,000 (3,600) \$/MBF
between 16 and 18"	1,000-12,000 (4,600) \$/MBF
between 18 and 20"	1,000-12,000 (5,600) \$/MBF
greater than 20"	1,000-12,000 (6,100) \$/MBF

Real Annual % increase/decrease in stumpage rate (% Δ SR) -10 to 10 (4.5) %

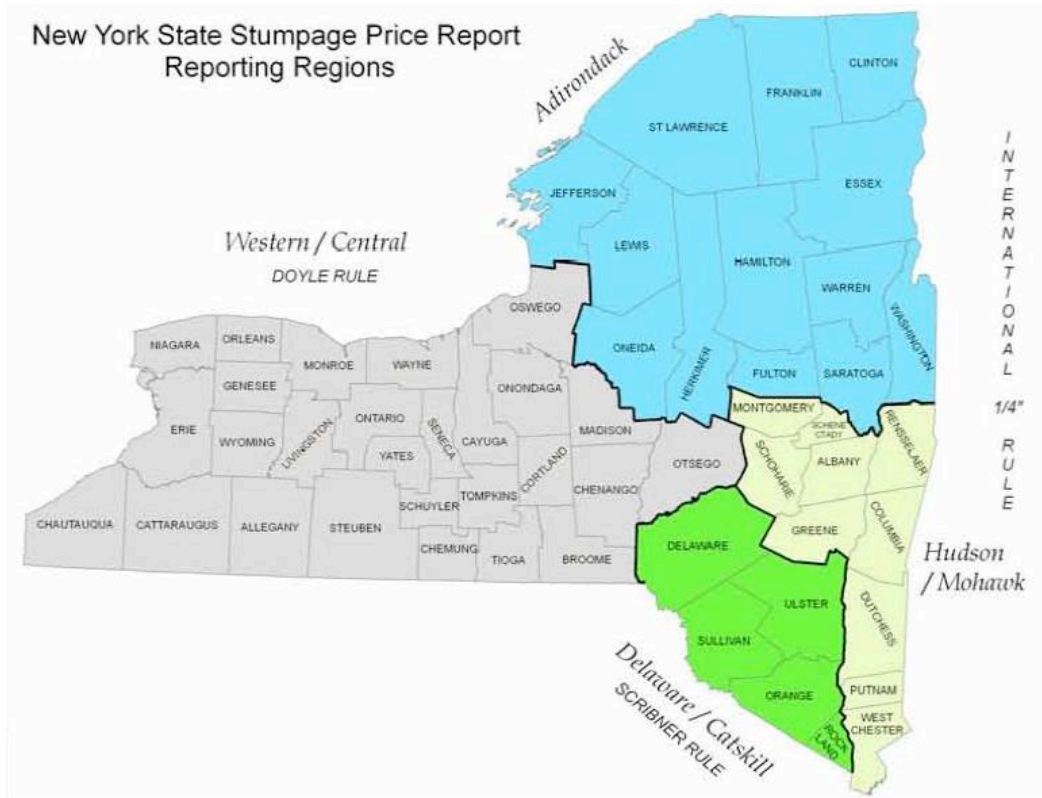
Users can estimate the annual percent increase in the real (nominal - inflation) stumpage prices for maple sawtimber. In *Northeastern Regional Timber Stumpage Prices: 1961-1991*, USDA Forest Service Research Paper NE-683, Sendak (1994) estimated over a 30 year period (1961-1991) that real hardwood stumpage prices in the northeast increased at an annual rate of 4.5%. Based on this analysis, the default value is set to 4.5, however users can change this to whatever value they feel anticipate for the future.

Species (Sp) sugar or red maple

A user can type in 'sugar' or 'red'. The only difference this will make is in the stumpage prices, although since sugar maple sells for much more than red maple the change in NPV will be quite significant.

Log Scale (LS) Doyle or Scribner or International scale

The three commonly used log scales in NY are Doyle, Scribner, and International. Doyle is used primarily in central and western NY, Scribner is used in a small portion of the Catskill region, and International is used in the Adirondacks and Hudson Valley regions. Please refer to the following map, taken from the NYSDEC Stumpage Price Reports, to determine the log scale appropriate for your region.



Initial Annual Lease Payment (ALP) 0 – 2 (.50) \$/tap/year

The user can enter the annual payment he/she expects to receive per tap. This usually varies anywhere from \$.25 to \$1 per tap. If the compensation is in syrup rather than a direct cash payment, the user can determine the cash equivalent according to the following formula.

$$\text{Lease Payment} = \frac{\text{Gallons received} * \text{\$/Gallon (if landowner had to purchase the syrup)}}{\text{\# of taps leased}}$$

Real Annual % Increase/Decrease in Lease Payment (% Δ LP) -10 to 10 (0) %

This can range anywhere from -10 to 10%, depending on the level of inflation and terms of the lease contract. It is determined according to the following formula:

(% Δ LP) = % annual increase in lease payment (nominal value) – annual rate of inflation.

For example, lease contracts are often developed such that the lease payment is set at a determined rate such as \$.50/year for a certain time period. Given that there is no annual increase in the lease payment, if inflation was 3% and then the real annual decrease in lease payment would be -3%. Now imagine another common scenario in which the contract provides an initial lease payment of \$.50 with a \$.01 (2%) increase each year. If inflation was still at 3%, then the real annual decrease would be $2 - 3 = -1\%$. If a contract is written such that the annual lease payment increases at the rate of inflation each year, then the % Δ LP would be 0. Since this is a recommended practice, the default value for this variable is set to 0.

Diameter at which the tree can be tapped (D1T) 6-12 (10) inches (dbh)

The spreadsheet is currently set at 10" but in reality, this could range anywhere from 6-12", depending on the mutually agreed upon desires of the maple producer and landowner. It should be noted that conservative tapping guidelines do not permit the tapping of a tree until it reaches 10 or 12" dbh. However, it is common practice for maple producers to tap trees much smaller than 10" dbh, especially if the stand is crowded and a silvicultural thinning is not scheduled to take place.

Diameter at which to add a second tap (D2T) 12-36 (18) inches (dbh)

Following conservative tapping guidelines, the spreadsheet defaults to 2 taps being placed in a tree once it reaches 18" dbh. However, many maple producers will put a second tap in before the tree reaches 18". The spreadsheet is not set up to include more than 2 taps in a tree, as this is not an acceptable practice according to conservative tapping guidelines. If a user would like to explore the financial implications of adding a 3rd tap, then he/she could simply increase the lease payment by 50%. For a 4th tap, the user can increase the lease payment by 100%.

Discount Rate (DR) 0-16 (4) %

This is one of the most important variables, especially when comparing future revenues for leasing and/or timber harvesting vs. harvesting a tree immediately. As seen in 'Discount rate for long-term Forest Service investments', *Journal of Forestry*, 79(6): 367-369, 376., Row, C., Kaiser, H.F. and Sessions, J. (1981) explain how the US Forest Service used a discount rate of 4% to evaluate long term investments. Therefore, based on the USFS guidelines, 4% is the default discount rate used in the spreadsheet. However, the discount rate can vary greatly based on the desires of the landowner, so user can change it to reflect their own situation. In order to set a discount rate, one should

first ask themselves “What is the annual rate of return (interest payment) that I could expect to get over the long-term if I invested the money that I would receive by harvesting the tree immediately?”

Regular taxes per acre (RTPA) 0-1,000 (20) \$/acre/year

A user can look at his or her tax bill and assessment to determine the amount of taxes he/she is paying on a per acre basis for the forestland. The following equation is useful for determining this value:

$$\text{RTPA} = \frac{\text{Total Tax Payment} * (\text{Value in land}/\text{Total assessed value})}{\text{Acres in sugarbush}/\text{Total acres on property}}$$

Ag assessment taxes per acre (AgTPA) 0-1,000 (5) \$/acre/year

In New York State (and possibly others), landowners can receive an agricultural assessment, thereby reducing their property tax payments, by producing syrup themselves or leasing taps to another producer. For a brochure explaining the details of this program, please refer to the following website.

A user can determine what the annual taxes would be on a per acre basis if his or her land qualified for an agricultural assessment. This will be based on the assessed value of the land (as determined by the soil type provided from the Soil & Water Conservation District) as well as the tax rate for a given town.

Number of trees per acre (TPA) 30-500 (100) # trees/acre

This variable is used to determine the amount of taxes per tree that a landowner must pay each year. Although taxes are paid on a per acre basis, in order to conduct the analysis on an individual tree basis, one must divide the total taxes per acre by the number of trees per acre. A young, dense sugarbush could have upwards of 400-500 trees per acre whereas an older, established sugarbush that has been managed may only have 30-50 trees per acre. This is one of the most difficult and time consuming variables to determine the value for, especially if the data is collected scientifically and systematically (which it should be). Furthermore, assessing taxes on a per tree basis is not a fair assessment of real-world conditions, as landowners will pay the same amount of taxes no matter how many trees are growing on a specific acre. The exception to this is where assessors utilize a “tree tax”, essentially taxing landowners at a higher rate based on the quality and quantity of timber present.

Time Horizon of the Investment Period (THIP) 2-40 (10) years

A user can enter between 2 and 40, depending on either (1) the number of years the user is planning to own a particular piece of land, or (2) the number of years until which the landowner is planning on harvesting the tree in question.

Reduction in diameter growth due to tapping (% Δ DGT) 0-50 (10) %

A user can enter the expected % reduction in diameter growth rate if the tree was to be tapped. This can range anywhere from 0-50%, depending on the assumptions of the user. Based on personal communication with Brian Chabot, who has done research on the effect of tapping on diameter growth rate, the default setting has been set to 10%.

Reduction in height growth due to tapping (% Δ HGT) 0-50 (10) %

A user can enter the expected % reduction in height growth rate if the tree was to be tapped. This can range anywhere from 0-50%, depending on the assumptions of the user. The default setting is 10%, based on personal communication with Brian Chabot regarding the effect of tapping on diameter growth rate. Since merchantable height is strongly correlated with diameter growth of the upper logs, one can assume the same reduction in height growth due to tapping as diameter growth. However, no formal research has ever been done on this subject, so a user can input whatever value he/she feels is appropriate.

% Decline in annual diameter growth rate (% Δ ADGR) 0-5 (1) %

Unless trees are growing at an increasing rate, the amount of annual diameter growth will decline as trees get larger. This is due to the fact that if a tree puts on the same amount of wood volume, by having to distribute that same volume over a larger surface area, the annual diameter growth will be reduced by a certain amount. The percentage reduction is what the user must input for this variable, and the default setting is 1%. This figure was devised according to the following graph, taken from Richard M. Teck and Donald Hilt. 1991. Individual-Tree Diameter Growth Model for the Northeastern United States. USFS Northeastern Forest Experiment Station Research Paper NE-649. This shows the potential diameter growth for five species (sugar maple is the 2nd one from the bottom) as a function of tree diameter. The authors develop a series of complicated formulas to derive this graph, but they require information on basal area and relative density that would be difficult and time consuming for a user to obtain. Thus, for the purposes of this analysis, a user can assume that a 1% reduction in annual growth rate for maples, which closely approximates the graph below.

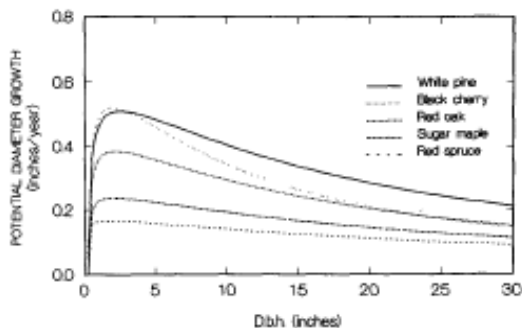


Figure 3.—Predicted potential diameter growth rates for several important species groups (species specific site index equivalent to SI = 50 for red spruce).

% Decline in annual height growth rate (% Δ AHGR) 0-5 (1) %

Given that merchantable height growth is strongly correlated with annual diameter growth, the default setting for this variable is also set to 1.

Number of Grades reduced by defects in butt log (#GRBL) 0 – 4 (1) grades

A user should assess the condition of the butt log (on the standing tree) and grade it according to the following specifications, taken from the A. Johnson Company's spec sheet acquired in December 2009. Note that the size and extent of the heartwood has a significant impact on grade, yet this can not be determined until the tree has been cut down. Therefore, the amount of heartwood must be estimated by examining the outer features of the tree and making an educated guess based on previous experience.

HARDWOOD LOG GRADE SPECS

Prime	16" & up, 1 defect/13 ft of length	ACCEPTABLE LENGTHS: 8' 4" -16' 4" ft. Odd lengths are accepted in hardwood. Pine & Spruce even lengths only Please mark length on the small end of the log. Please keep 8' logs to a minimum. MAXIMUM DIAMETER Sawlogs: 30" - either end Diameter includes sweep, crook & large knots and flare
Clear	14" & up, 1 defect /10 ft of length	
Select	12" & up, 1 defect /4 ft of length	
#1	10" & up, 1 defect/3 ft of length 9" butt logs, 1 defect - HM & RO	
#2	10" & up, 1 defect/2ft length	
Cord Wood	Maximum 20" dia, 20' length	

¹ Hard Maple - Logs with more than 1/3 diameter in heart are reduced 1 grade
Logs with more than 2/3 diameter in heart are reduced 2 grades.

LONG LOGS PAY A BONUS

² HARD MAPLE, RED OAK, ASH & YELLOW BIRCH earn a 7% price bonus for length.
Long logs are 13' 4" & longer in the grades of Prime, Clear & Select.

FACTORS AFFECTING GRADE AND SCALE

Log diameter and length, size and location of defects. Defects include:

Sweep: 1" per 4' of length maximum. Rot, Crook, Heart size (Hard Maple only), Black heart, Mineral stain, Dry logs, Worm holes, Ingrown bark, Checking, Frost cracks, Shake, Cat faces, Knots (especially knots larger than 1/4 of log diameter), Seams (especially spiral seams). Excess gum in Cherry.

Hard Maple (or any other species) with signs of tapping may not be scaled.

Number of Grades reduced by defects in upper logs (#GRUL) 0 – 4 (1) grades

The same process that is undertaken to determine the number of grade reductions for the butt log must also be done to determine the amount of grade reductions in the upper logs. Often times there will be several logs in the upper portion of the stem, yet this analysis

assumes that all of the logs have the same number of defects. Therefore, an overall average number of defects (and associated grade reductions) must be assumed for all of the upper logs in a given tree.

Butt Log Market (BLM) sawlog or cordwood or veneer

As seen in this specification sheet from A. Johnson Company, it clearly states that “hard maple (or any other species) with signs of tapping may not be scaled”. However, it does not state that tapped logs *will* not be scaled, it only states that they *may* not be scaled. Different sawmills have different policies and guidelines for buying and scaling tapped logs and this will change based on the quality of the logs and market forces. If a tapped log will be bought as a sawlog, then the user should enter “sawlog”. If not, then the tapped log will be used for either firewood or pulpwood, so the user should enter “cordwood”. This variable also presents an opportunity for the user to enter “veneer” if the butt log is of sufficient size and quality to be sold to a veneer mill. This drastically increases the stumpage price for the log, though readers should note that only a small fraction of all sawlogs will be sold as veneer.

Percentage of Delivered Log Price that the landowner receives (%DLPLR) 10-100 (50) %

This will vary based on many factors, including but not limited to timber quality, volume to be harvested, terrain and accessibility, market demand, distance to market, season of year, costs of harvesting, landowner knowledge, and the terms of the contract.

Value of Tapped Logs as a % of Untapped Logs (TL%UT) 10-150 (33) %

If a tapped log is to be sold as a sawlog, this variable allows the user to specify the price that will be paid to the landowner as a fraction of the untapped price. The default price is set to 33%, meaning that a tapped log will sell at 33% of the price of an untapped log of the same size and number of defects. The figure may actually be much higher, depending on the buyer, market conditions, and other factors. Also note that by inserting a value above 100, the price for a tapped log can actually be higher than that of an untapped log. While this is rarely the case, there are situations where niche markets for taphole maple lumber will drive the prices up for relatively rare tapped logs.

Stumpage rate for Cordwood (SRC) 0-50 (20) \$/MBF

Although cordwood stumpage is usually based on a per cord basis, the nature of this spreadsheet requires that stumpage prices for cordwood be described on a bd ft basis. If one assumes that there are 2 cords in 1,000 bd ft (MBF), and the stumpage rate for cordwood is \$10/cord, then the user should input $2 * 10 = \$20$ for this variable.