

# NE-TWIGS Update: *Incorporating Tree Quality*

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## ABSTRACT

A method to distribute tree quality was incorporated into the NE-TWIGS individual-tree growth and yield simulator. The program uses potential tree grade to allow changes in actual tree grade over time. Volume is reported by grade and value is calculated using tree grades. Example screens are shown.

## INTRODUCTION

Eastern tree grades for white pine, southern pine, eastern hemlock, and all hardwood species indicate the present quality of the tree, which is useful in improving the assessment of value. Although standard tree grades can be used to assess growing stock, they give little indication of the future value of trees and stands. With the exception of PROQUAL (Lyon and Reed 1987) and OAKSIM (Yaussy 1991b), current growth and yield simulators do not account for present or future tree quality. Potential grade (Yaussy 1991a), defined as the USDA Forest Service grade that a tree will attain when it grows to 16 inches dbh, accounts for the change in tree quality over time.

NE-TWIGS (Teck and Hilt 1990) is an interactive simulation program that allows the user to impose a variety of management alternatives at various times within the life of a northeastern forest stand. These alternatives can then be evaluated economically given user cost and value input. Yaussy describes a method to estimate the probability that a tree would be in one of four potential tree-grade classes. This method has been included in the NE-TWIGS individual-tree growth and yield simulator to improve estimates of value. The

additions to NE-TWIGS are presented here.

## METHODS

The NE-TWIGS program has been modified to include a method for estimating the probability distribution of potential grade as a function of species group, site index, and dbh described. Equations were developed for 20 species groups found in age-indeterminate stands in the northeastern United States. The differences in how potential grade is applied to hardwoods and softwoods are described in the section that follows.

### Hardwoods

USDA Forest Service hardwood tree-grading standards include minimum dbh restrictions of 16 inches for a grade 1 tree and 13 inches for a grade 2 tree (Hanks 1976). Potential grade disregards these dbh restrictions as well as surface defects that will disappear as the tree grows. Potential grade is defined as the actual Forest Service tree grade that a tree should attain if allowed to grow into the 16-inch diameter class. When a tree enters that class, potential grade and actual tree grade will be identical. Potential grade is a discrete variable with four categories: grade 1, grade 2, grade 3, and below grade. Actual tree grade for hardwoods can be determined di-

rectly from potential grade and dbh. For example, a tree with potential grade of 1 and dbh of 12.4 inches would have an actual grade of 3. As dbh increases beyond the 12.6- and 15.6-inch thresholds, the actual grade would change to 2 and then to 1.

### White pine

Tree grades for white pine used by the Forest Service's Forest Inventory and Analysis unit require four full-length clear faces for a tree to be considered grade 1 unless the dbh is larger than 16 inches. This restriction is relaxed for potential grade determination. Actual tree grade cannot be determined from white pine potential grade since there can be a grade one tree less than 16 inches dbh if it has four full-length clear faces.

### Other pines

All other pines are graded using the southern pine tree-grading system which has no diameter restrictions. Therefore, potential grade is identical to actual tree grade.

### Other conifers

Minimum merchantability standards are used to sort spruce, fir, tamarack, and hemlock trees into two classes: merchantable and cull. The only diameter restriction imposed is that 3 inch knots are acceptable if the small end of the grading section is 13 inches or larger

(inside bark); otherwise, the knots must be 2 inches or less.

**NE-TWIGS operation**

The use of the updated version of NE-TWIGS differs little from version 3.0, and the user's manual written by Miner and others (1988) for the north-central United States version remains the main document to be referenced. To use NE-TWIGS, a data set must be prepared by the TREEGEN program. The individual-tree data-entry portion of this program has been modified to allow the optional entry of potential tree grades (Figure 1). If potential grades are not collected in the field, the user should set them to zero using the option provided to set constants (Figure 2). Data sets created with the Normal or Weibull distribution options of the TREEGEN program have potential tree grades set to zero by default.

Running the data set through NE-TWIGS allows the user to see a list of the trees before setting any options. This list will include either the potential grades as entered in the TREEGEN program or those assigned by the program for trees over the sawlog dbh threshold if zeros were entered during the TREEGEN program (Figure 3).

Type values for sample tree # 1:

- (1) Enter USFS code : 802
- (2) Enter tree diameter (1.0" - 30.0") : 14.3
- (3) Enter crown ratio (0.0 - 9.9, 0.0=not measured) : 0
- (4) Enter tree status (1=live,2=cut,3=dead) : 1
- (5) Enter tree class (20=acceptable,30=undesirable,40=cull): 20
- (6) Enter potential tree grade (0 - 4, 0 = not measured) : 2

How many sample trees have these characteristics? 1

**Figure 1.** Example of TREEGEN data-entry screen.

ITEM	CURRENT VALUES FOR TREE # 1	
1)	802	USFS Species Code.
2)	14.3	Tree Diameter.
3)	.0	Crown Ratio.
4)	1	Tree Status.
5)	20	Tree Class.
6)	2	Potential Tree Grade.
7)	.4	Trees Per Acre.

Type item number to be changed or  
 Type C to accept these values and set the parameter constants or  
 Type 0 to accept these values and add another entry or  
 Type Z to accept final tree on list:

**Figure 2.** Example of TREEGEN screen with option to set constants.

16 Trees will be read for property "STUDY 21", STAND "PLOT 1"  
 YEAR= 1992, AGE= 61, SITE INDEX FOR WHITE OAK = 72.0

SEQ NUM	STEMS CODE	USFS CODE	STEMS GRP NAME	CROWNTREE DBH	TREE RATIO	TREES/AC	POT. STATUS	CLASS	GRADE
1	23	802	WHITE OAK	8.3	3.7	39.8	1	20	0
2	23	802	WHITE OAK	11.4	3.9	25.2	1	20	4
3	23	802	WHITE OAK	15.3	4.1	5.7	1	20	2
4	23	802	WHITE OAK	18.0	4.1	.9	1	20	1
5	27	837	BLACK OAK	7.5	4.1	29.6	1	20	0
6	27	837	BLACK OAK	11.1	4.3	19.3	1	20	3
7	27	837	BLACK OAK	16.9	4.6	4.5	1	20	3
8	27	837	BLACK OAK	19.6	4.7	.9	1	20	1
9	24	806	SCARLET OAK	7.9	3.8	13.4	1	20	0
10	24	806	SCARLET OAK	12.3	4.1	9.2	1	20	1
11	24	806	SCARLET OAK	16.8	4.5	1.6	1	20	4
12	17	400	HICKORY	7.8	3.8	11.7	1	20	0
13	17	400	HICKORY	11.0	4.0	6.8	1	20	1
14	17	400	HICKORY	15.2	4.3	1.7	1	20	2
15	25	832	CHESTNUT OAK	8.9	1.2	1.7	1	20	0
16	25	832	CHESTNUT OAK	12.3	1.5	1.4	1	20	4

TREE LIST HAS 16 TREES, TPA= 173.4, BATOT= 99.6, DBH = 9.9

**Figure 3.** Example of NE-TWIGS tree-list screen.

The major visual difference between this version and version 3.0 of NE-TWIGS is the reporting of sawlog volumes by actual tree grade (Figure 4). Potential tree grade is used for tabulating volumes for the conifers; for hardwoods, volumes are tabulated by actual tree grades calculated from dbh and potential tree grades.

The addition of tree grades to NE-TWIGS allows the user to consider the quality of the trees to be removed by intermediate cuttings and thinnings. This is accomplished in the management section of the program with the option of cutting individual trees (Figure 5). No other management option uses tree grade to influence cutting decisions. Thinning routines that consider tree size and quality, like those contained in OAKSIM, may eventually be incorporated into NE-TWIGS.

<u>STAND VOLUME</u>								
SPECIES	GR.	<u>SAWLOG</u>		<u>PULPWOOD</u>		<u>TOTAL</u>	<u>RESIDUE</u>	
		CUFT	BDFT	CUFT	CORDS	MERCH. CUFT	CUFT	TONS
HICKORY		110	611	122	1.6	233	119	3.6
GRADE 1		0	0					
GRADE 2		46	268					
GRADE 3		64	344					
BELOW GR		0	0					
WHITE OAK	4192075		397	5.0	816	425	12.3	
GRADE 1		31	163					
GRADE 2		136687						
GRADE 3		0	0					
BELOW GR		252	1225					

Press <ENTER> for more

Figure 4. Example of NE-TWIGS volume-report screen.

Each tree in the tree list will be displayed in order of increasing diameter to allow you to decide if it should be cut.

- Press: <ENTER> to leave the tree as it is.  
 C <ENTER> to cut the tree.  
 U <ENTER> to uncut the tree.  
 S <ENTER> to skip the rest of the tree list.

Remember to note tree status (STAT): (1=alive, 2=cut tree)

STAND BASAL AREA= 99.6 TREES/AC= 173.4

SEQ	USFS	SPECIES	TREE	TREE	CROWN	POT.	YEAR				
NUM	CODE	GRP NAME	DBH	CAI	TREES/AC	BA/AC	STAT	CLAS	RATIO	GRADE	CUT
14	802	WHITE OAK	11.4	.00	1.9	1.3	1	20	4.2	4	0

Type: "<ENTER>" leave tree as is, C)ut, U)ncut, S)kip the rest:

Figure 5. Example of NE-TWIGS option to cut individual trees.

The economics section of NE-TWIGS allows the user to enter unique stumpage prices for individual species. It is at this point that separate stumpage prices can be entered for each actual tree grade (Figure 6). This allows the program to calculate a more accurate estimate of the value of the stand and intermediate harvests than was possible before. An economics report

appears after each action of the management section.

### SUMMARY

NE-TWIGS has been updated to reflect tree quality in the projection of individual-tree growth, yield, and value. This improvement was made possible by the addition of equations

which assign potential tree grades to individual-tree records. These grades can be used to better simulate intermediate cuttings and provide more accurate reports of value to the user.

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CURRENT STUMPAGE RATES FOR WHITE OAK

OPTION VALUE DESCRIPTION

- A \$125.00 Per 1000 board feet of tree grade 1 sawtimber.
- B \$ 85.00 Per 1000 board feet of tree grade 2 sawtimber.
- C \$ 75.00 Per 1000 board feet of tree grade 3 sawtimber.
- D \$ 50.00 Per 1000 board feet of below grade sawtimber.
- E \$ 10.00 Per cord of poletimber.
- F \$ 7.00 Per 100 cuft of residue.

Type option letter or type Z to continue:

Figure 6. Example of NE-TWIGS screen to set stumpage rates.

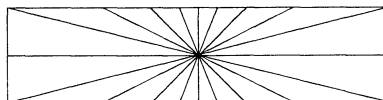
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